



Universitat Politècnica de Catalunya

DOE – Departament d'Organització d'Empreses

Doctoral Dissertation

International Project Teams as Innovation Hubs:
Power and Politics in the Knowledge Change Process

Author: Luciano Marques de Araújo

Director: Prof. Dr. José Maria Sallán Leyes

BARCELONA, 2013



Curso académico: 2004

Acta de calificación de tesis doctoral

Nombre y apellidos Luciano Marques de Araujo

DNI / NIE / Pasaporte: CY262935

Programa de doctorado Doctorado en Dirección y Organización de Empresas

Unidad estructural responsable del programa DOE - Departamento de Organización de Empresas

Resolución del Tribunal

Reunido el Tribunal designado a tal efecto, el doctorando / la doctoranda expone el tema de la su tesis doctoral titulada _____

Acabada la lectura y después de dar respuesta a las cuestiones formuladas por los miembros titulares del tribunal, éste otorga la calificación:

APTA/O NO APTA/O

<i>(Nombre, apellidos y firma)</i>		<i>(Nombre, apellidos y firma)</i>	
Presidente/a		Secretario/a	
<i>(Nombre, apellidos y firma)</i>	<i>(Nombre, apellidos y firma)</i>	<i>(Nombre, apellidos y firma)</i>	<i>(Nombre, apellidos y firma)</i>
Vocal	Vocal	Vocal	Vocal

_____, _____ de _____ de _____

El resultado del escrutinio de los votos emitidos por los miembros titulares del tribunal, efectuado por la Escuela de Doctorado, a instancia de la Comisión de Doctorado de la UPC, otorga la MENCIÓN CUM LAUDE:

SÍ NO

<i>(Nombre, apellidos y firma)</i>		<i>(Nombre, apellidos y firma)</i>	
Presidenta de la Comisión de Doctorado		Secretaria de la Comisión de Doctorado	

Barcelona a 30 de Marzo de 2013

*To Solange and Mariana,
for their support along this journey.*

*To Prof. Sallán,
for his support and trust.*

"Transparency is the new objectivity"
(David Weinberger)

SUMMARY

CONVENTIONS.....	14
TABLE LIST.....	15
FIGURE LIST.....	16
ABSTRACT/RESUM/RESUMEN.....	19
ACKNOWLEDGMENTS.....	21
INTRODUCTION.....	22

SECTION I - THEORETICAL BACKGROUND

CHAPTER I - ECONOMIC ORGANIZATION, KNOWLEDGE AND SOCIAL PROCESSES

1.1. Monopolistic Competition.....	28
1.2. Knowledge-Based Competition.....	30
1.3. The Organization in the Knowledge -Based Competition.....	31
1.4. Knowledge Change and Social Processes	33
1.4.1. Traditional Approaches to Knowledge in Organizational Studies.....	33
1.4.2. The Social Construction of Knowledge.....	34
1.4.3. Reification and Anomie: Divergent Paths Along Knowledge Change.....	36
1.4.4. Isomorphism, Path Dependence, Increasing Returns and Complementarities: Explaining Institutional Continuity.....	39
1.4.5. Non-Identical Reproduction, Institutional Layering, Endogenous Shocks and Strategic Action: Explaining Institutional Change.....	41
1.4.6. Knowledge Heterogeneity, Politics and Innovation.....	42
1.4.7. Intermediate Institutions and Quasi-Institutional Equilibrium: Towards a Dynamic Order.....	44
1.4.8. The Social Construction of Knowledge: A dynamic Perspective.....	44

CHAPTER II – MNE FOUNDATIONS

2.1. MNEs, International Diversity and Politics.....	48
2.1.1. International Diversity as MNE Determinant.....	48
2.1.2. Economic Approach to International Diversity: Arbitrage and Firm-Specific Advantages.....	48
2.1.3. Cultural Approach to International Diversity: Conflict, Acculturation and Hybridization.....	49
2.1.4. Institutional Approach to MNEs: Between Convergence and Divergence.....	51
2.1.5. Politics as MNE Resultant.....	51
2.2. Politics in Organizations.....	55
2.2.1. Politics as an Organizational Phenomena.....	55
2.2.2. Politics as a Mechanism of Change.....	57
2.2.3. Venues of Political Action.....	59
2.2.4. Limitants for Political Action.....	61

CHAPTER III – MNE DYNAMICS

3.1. The Management of MNEs.....	64
3.1.1. Types of MNEs.....	64
3.1.2. Internal Dynamics and the Evolution of MNEs.....	65
3.1.3. MNEs and the Management of Interdependences.....	67
3.1.4. Mechanisms of Coordination within MNEs.....	68
3.2. Team as a Mechanism to Enhance Coordination.....	70
3.2.1. Management by Projects.....	70
3.2.2. International Project Teams.....	72

CHAPTER IV – INVESTIGATION DESIGN & METHODOLOGY

4.1. Investigation Guidelines.....	76
4.1.1. Theoretical Summary and Investigation Question.....	76
4.1.2. Object of Investigation and Main Objectives.....	76
4.2. Methodology.....	78
4.2.1. Epistemological Paradigm: Multi-Paradigm Interplay.....	78
4.2.2. Methodological Approach: Qualitative Approach.....	79
4.2.3. Investigation Method: Longitudinal Case-Study.....	81
4.2.4. Strengths and Weaknesses in Building Theory from Case-Study Research.....	83
4.2.5. Methodological Rigor in Case Study Research.....	84
4.3. Methodological Concerns.....	85
4.3.1. Methodological Considerations in International Management Studies.....	85
4.3.2. Methodological Considerations in Organizational Politics Studies.....	86
4.4. Investigation Design.....	87
4.4.1. Theoretical Background.....	87
4.4.2. MNE as Investigation Context.....	89
4.4.3. The Choice of the Field.....	89
4.4.4. Data Collection.....	90
4.4.4.1. Researcher Standpoint.....	91
4.4.4.2. Investigation Context.....	92
4.4.4.3. Participant Observation.....	93
4.4.4.4. Field Notes.....	94
4.4.4.5. Interview.....	95
4.4.4.6. Meetings.....	96
4.4.4.7. Informal Conversations.....	97
4.4.4.8. E-mails.....	97
4.4.4.9. Archival Data.....	98
4.4.5. Data reliability.....	98
4.4.6. Data Presentation.....	99
4.4.6.1. Narrative as Case Study Protocols.....	100
4.5. Data Analysis.....	102
4.5.1. Analytic Guidelines.....	102
4.5.2. Process Analysis.....	103
4.5.3. Analytic Procedures.....	103
4.5.3.1. Longitudinal Case Analysis.....	104
4.5.3.2. Cross Case Analysis.....	105

4.5.3.3. Model Specification.....	105
4.5.3.4. Literature Comparison.....	106
4.5.3.5. Back-Checking Conclusions.....	106
4.6. Ethical Concerns.....	107
4.6.1. Identification Disclosure.....	107
4.6.2. Sensitive-Information Confidentiality.....	103
4.6.3. Participant Anonymity and Privacy	108
4.6.4. Researcher Neutrality	108
4.6.5. Secure Data Collection Storage	109

SECTION II - DATA PRESENTATION & ANALYSIS

CHAPTER V - CONTEXT OF INVESTIGATION

5.1. Economic Context.....	114
5.1.1. International Economic Context: A Turnaround in the World Economic Order.....	114
5.1.2. Local Economic Context: Brazilian Economy.....	121
5.2. Business Context: Engineering Services Sector.....	131
5.2.1. Engineering Services Background.....	131
5.2.2. International Engineering Business Context.....	131
5.2.3. Local Engineering Business Context.....	134
5.3. Investigation Context.....	137
5.3.1. Researcher Standpoint	137
5.3.2. Field Selection.....	148
5.3.3. CCC.....	149
5.3.4. WP.....	150
5.3.5. CNC.....	152
5.4. Field Entry.....	154

CHAPTER VI – PDY PROJECT

6.1. Project Object.....	160
6.2. Project Stakeholders	162
6.2.1. The Client: Petrobras.....	162
6.2.2. The Contractor: WP-Houston.....	164
6.2.3. Local Partner: CNC.....	166
6.3. Case Context	167
6.3.1. “International Workshare” Current State of Knowledge.....	167
6.3.2. Entering the Field.....	173
6.3.3. Project Organization.....	175
6.4. The Knowledge Change Process.....	178
6.4.1. Current Knowledge Weakening.....	178
6.4.2. The Innovation Moment.....	187
6.4.3. New Knowledge Expansion.....	194

6.5. Knowledge Change Outcomes.....	208
-------------------------------------	-----

CHAPTER VII – UNA3 PROJECT

7.1. Project Object.....	224
7.2. Project Stakeholders	228
7.2.1. The Client: Eletrobras Eletronuclear.....	228
7.2.2. International Partner I: WP-Reading (U.S.).....	231
7.2.3. International Partner II: WP-Sofia (Bulgaria).....	232
7.3. Case Context	233
7.3.1. CNC/WP Debut.....	233
7.3.2. “Global Pricing Contracting” Current State of Knowledge.....	236
7.3.3. Entering the field.....	240
7.4. The Knowledge Change Process.....	242
7.4.1. Current Knowledge Resilience.....	242
7.4.2. Project Organization.....	253
7.4.3. Current Knowledge Weakening.....	256
7.4.4. Sequential Knowledge Change.....	268
7.5. Knowledge Change Outcomes.....	281

CHAPTER VIII – BGB PROJECT

8.1. Project Object.....	288
8.2. Project Stakeholders	292
8.2.1. The Client: BG.....	292
8.2.2. Local Partner: LLX.....	295
8.3. Case Context	297
8.3.1. Contractor: CNC/WP.....	297
8.3.2. “Fast Track Project” Current State of Knowledge	299
8.3.3. Entering the field.....	301
8.4. The Knowledge Change Process.....	305
8.4.1. Current Knowledge Resilience.....	305
8.4.2. Project Organization.....	308
8.4.3. Current Knowledge Weakening.....	309
8.4.4. Innovation Attempt.....	321
8.4.5. Innovation Break-up.....	334
8.5. Old Knowledge Collapses.....	336

CHAPTER IX – DATA ANALYSIS

9.1. Data Interpretation.....	342
9.1.1. PDY Case.....	342
9.1.2. UNA3 Case.....	352

9.1.3. BGB Case.....	364
9.2. Case Insights.	372
9.2.1. PDY Case Insights.....	372
9.2.2. UNA3 Case Insights.....	376
9.2.3. BGB Case Insights.....	379
9.3. Cross Case Analysis.....	380
9.3.1. Cases Similarities.....	380
9.3.2. Cases Differences.....	385
9.4. Key Study Findings.....	399
9.4.1. Analytic Backdrop.....	399
9.4.2. Knowledge Change Framework.....	400
9.4.3. International Project Teams as Innovation Hubs.....	415

CHAPTER IX – DATA ANALYSIS

10.1. Conclusions.....	424
10.2. Contributions to the Field.....	426
10.3. Recommendations for Practitioners.....	428
10.4. Study Limitations.....	429
10.5. Suggestions for Further Research.....	432
 BIBLIOGRAPHIC REFERENCES.....	 435

CONVENTIONS

Palatino Linotype 11: Text in general

Palatino Linotype 11 (Black): Author Emphasis

Palatino Linotype 11 (Italic): Third-Party Concepts

“Palatino Linotype 11” (Black, Italic): Author Concepts

“Palatino Linotype 11” (brackets): Popular Sayings

“Palatino Linotype 8” (brackets): Field Diary Notes

“Palatino Linotype 8” (brackets, Italic): Third-Party Speeches

‘Palatino Linotype 11’ (apostrophe, Italic): Non-Literal Citations

Times New Roman 8: Foot-notes.

TABLE LIST

Table 1: Largest Brazilian MNEs per sales.

Table 2: Case study profile.

Table 3: PDY Project split of work

Table 4: Inflows and outflows of expatriates along data collection.

FIGURE LIST

- Fig. 01: Spiral of Organizational Knowledge Creation (SECI model).
- Fig. 02: Activities in the Knowledge Evolution Cycle.
- Fig. 03: The social construction of knowledge: a dynamic perspective.
- Fig. 04: US, EU and Japan GDP growth along 1990-2010.
- Fig. 05: GDP growth forecast 2010-2050.
- Fig. 06: GDP growth: BRICS x Advanced Economies from 2000-2011.
- Fig. 07: Current Account Balance: EM x US x EU from 1995-2010.
- Fig. 08: GDP growth per country 2010.
- Fig. 09: Brazil average annual GDP growth rate.
- Fig. 10: Brazil exports composition 1964-2010.
- Fig. 11: Brazil balance of payments 1970-2010
- Fig. 12: Foreign MNEs participation in Brazilian Economy
- Fig. 13: Brazil FDI flows 1990-2010
- Fig. 14: Work visas issued to foreign workers in Brazil 2006-2010
- Fig. 15: Largest engineering companies worldwide profile.
- Fig. 16: Engineering Sector in Brazil by annual revenues 1995-2010.
- Fig. 17: WP growth (Source: WP Presentation)
- Fig. 18: WP personnel distribution worldwide (Source: WP Presentation)
- Fig. 19: WP Corporate Structure (Source WP Presentation).
- Fig. 20: WP & CNC expected synergy.
- Fig. 21: Investigation timeline.
- Fig. 22: PDY location (Source: Google Maps)
- Fig. 23: Brazilian petrochemical sector consolidation process.
- Fig. 24: PIDD – P&G Petrobras Strategy.
- Fig. 25: Simplified interdisciplinary information workflow in oil & gas projects.
- Fig. 26: Traditional supports for engineering information.
- Fig. 27: New supports for engineering information.
- Fig. 28: 3D model transformation to 2D engineering documents.
- Fig. 29: Schematic representation of the “look at the model” approach.
- Fig. 30: Early spreadsheets used to control the information turnover process
- Fig. 31: PDY project organization as per 05th October 2009.
- Fig. 32: Schematic representation of the information flow in the traditional engineering process.
- Fig. 33: Schematic representation of the information flow found at the PDY project.
- Fig. 34: Extraction
- Fig. 35: SOW (Scope of Work)
- Fig. 36: SIC (Scan and Insertion Control) and Summary Spreadsheet
- Fig. 37: Schematic representation of the information flow with the first set of controls
- Fig. 38: Tag discrepancies
- Fig. 39: Classification discrepancies
- Fig. 40: Database discrepancies.
- Fig. 41: New workshare flow.
- Fig. 42: New SIC spreadsheet
- Fig. 43: New information workflow
- Fig. 44: PDY project organization as per 05th November 2009.
- Fig. 45: Image annex to the e-mail
- Fig. 46: Area 8000 plan and perspective.
- Fig. 47: Model progress curve.
- Fig. 48: Work gap curve.
- Fig. 49: 3D information turnover progress graphics as per 28th May 2010
- Fig. 50: UNA3 location.
- Fig. 51: UNA3 initial earthworks as per April 1986.
- Fig. 52: UNA3 imported equipment storage and conservation.
- Fig. 53: UNA3 important material and equipment storage and conservation.
- Fig. 54: UNA3 foundation works as per July 2010.
- Fig. 55: Eletrobras Holding structure.

Fig. 56: UOP consortium arrangement.

Fig. 57: Hours per PRM1 unit estimated by CNC/WP (CNC) and WP-Houston (WP).

Fig. 58: Bidding Instructions Document.

Fig. 59: UNA3 schematic bid guidelines

Fig. 60: Initial man-hour estimation spreadsheet.

Fig. 61: Eligibility requirements.

Fig. 62: Bid weighing.

Fig. 63: Execution requirements.

Fig. 64: Technical Scoring Criteria.

Fig. 65: Pricing Criteria.

Fig. 66: Standard WP estimation spreadsheet.

Fig. 67: Standard WP Workflow for 3D modeling and Piping Modeling.

Fig. 68: UNA3 compatibility matrix – Items Methodology and Organizational Structure (calendar and punch list).

Fig. 69: UNA3 Project Organization (only key participants).

Fig. 70: Spreadsheet to control the completion of the sections in UNA3 proposal technical documents (write-up's).

Fig. 71: List of Questions sent by WP-Sofia engineers on the 22nd July 2010.

Fig. 72: WP global management structure as per 13th August 2010.

Fig. 73: WP nuclear business management structure as per 13th August 2010.

Fig. 74: WP organizational chart for UNA3. Red-box for WP-Reading, blue-box CNC/WP ones.

Fig. 75: CNC/WP workflow developed according to UNA 3 bidding instructions.

Fig. 76: List of Questions sent by WP-Sofia engineers on the 22th July 2010.

Fig. 77: BGB location.

Fig. 78: Brazil Round 2.

Fig. 79: SWOT terminal schematics.

Fig. 80: Açu Superport Industrial Complex as per March 2011.

Fig. 81: BG Group history.

Fig. 82: BG geographic diversification.

Fig. 83: LLX Açu Superport strategic location and overall plan.

Fig. 84: WP Service methodology.

Fig. 85: BG investment appraisal methodology – Select Stage.

Fig. 86: BGB overall schedule.

Fig. 87: Initial indications of unusual documentation required for BGB.

Fig. 88: BGB project organization.

Fig. 89: Unusual documentation required for BGB.

Fig. 90: Contracting strategy alternatives.

Fig. 91: Statement of Owner Requirement front-page and index.

Fig. 92: Process Basis of Design front-page and index.

Fig. 93: "Shopping list" of documents example.

Fig. 94: BGB basic design alternatives.

Fig. 95: Interface and data gathering question list.

Fig. 96: Interface and data gathering responses.

Fig. 97: BGB preliminary inputs and outputs.

Fig. 98: Project team responsibility matrix.

Fig. 99: BGB fast-track project/crash schedule.

Fig. 100: Piping document list – Return to old knowledge.

Fig. 101: BGB preliminary lay-out plan view.

Fig. 102: BGB preliminary lay-out isometric view.

Fig. 103: PDY international workshare knowledge change stage 01.

Fig. 104: PDY international workshare knowledge change stage 02.

Fig. 105: PDY international workshare knowledge change stage 03.

Fig. 106: PDY international workshare knowledge change stage 04.

Fig. 107: PDY international workshare knowledge change stage 05.

Fig. 108: PDY international workshare knowledge change stage 06.

Fig. 109: PDY international workshare knowledge change stage 07.

Fig. 110: PDY international workshare knowledge change stage 08.

Fig. 111: PDY international workshare knowledge change stage 09.
 Fig. 112: PDY international workshare knowledge change stage 10.
 Fig. 113: UNA3 global price contracting knowledge change stage 01.
 Fig. 114: UNA3 global price contracting knowledge change stage 02.
 Fig. 115: UNA3 global price contracting knowledge change stage 03.
 Fig. 116: UNA3 global price contracting knowledge change stage 04.
 Fig. 117: UNA3 global price contracting knowledge change stage 05.
 Fig. 118: UNA3 global price contracting knowledge change stage 06.
 Fig. 119: UNA3 global price contracting knowledge change stage 07.
 Fig. 120: UNA3 global price contracting knowledge change stage 08.
 Fig. 121: UNA3 global price contracting knowledge change stage 09.
 Fig. 122: UNA3 global price contracting knowledge change stage 10.
 Fig. 123: UNA3 global price contracting knowledge change stage 11.
 Fig. 124: UNA3 global price contracting knowledge change stage 12.
 Fig. 125: BGB fast-track project knowledge change stage 01.
 Fig. 126: BGB fast-track project knowledge change stage 02.
 Fig. 127: BGB fast-track project knowledge change stage 03.
 Fig. 128: BGB fast-track project knowledge change stage 04.
 Fig. 129: BGB fast-track project knowledge change stage 05.
 Fig. 130: BGB fast-track project knowledge change stage 06.
 Fig. 131: Socialization length influence on upward knowledge density and power asymmetry developments.
 Fig. 132: Actor's self-confidence influence on downward knowledge density and power asymmetry developments.
 Fig. 133: PDY knowledge change window.
 Fig. 134: UNA3 knowledge change window.
 Fig. 135: BGB knowledge change window.
 Fig. 136: Process/product paradox applied to the knowledge change process.
 Fig. 137: Process/product paradox applied to PDY/BGB in comparison to UNA3.
 Fig. 138: Simplified framework of the knowledge creation process from a social-constructionist perspective.
 Fig. 139: Different forms of political action.
 Fig. 140: Objectivation as a reflexive process.
 Fig. 141: Shifting forces along objectivation.
 Fig. 142: Institutionalization as a distributive process.
 Fig. 143: Quasi-institutional knowledge and institutional knowledge decline.
 Fig. 144: Changing forces along knowledge change.
 Fig. 145: Simplified framework of the simultaneously countervailing forces acting over knowledge.
 Fig. 146: Balance of forces along knowledge change.
 Fig. 147: Moving the threshold of political action to expand new knowledge at corporate level.
 Fig. 148: A model for knowledge change within international project teams.
 Fig. 149: Comparative chart among different forms of collaborative joint work.
 Fig. 150: Investigation time-line

ABSTRACT/RESUM/RESUMEN

The aim of this investigation is to understand how international project teams enable mature multinational enterprises (MNEs) to cope with knowledge diversity and political activity, two well-known disruptive organizational phenomena, in order to leverage their innovative potential and competitive capabilities. To answer this question a longitudinal multi-case study has been designed to collect in-depth qualitative data from three large-scale international projects conducted by a focal MNE and an array of its subsidiaries. In a dialectic way, data collected has been used both to enhance the dynamic knowledge change framework provided by contemporary sociology and to explain the complex mechanisms that make international project teams an increasingly used organizational tool. As a result, knowledge change (and thus innovation) has been found to hinge on a dynamic balance between power and politics which is favored by conditions that are inherent to these organizational settings. Finally, a model describing the mechanisms that enable international project teams to drive knowledge diversity and political activity towards innovation and knowledge change within MNEs has been developed.

L'objectiu d'aquesta investigació és entendre com els equips de projectes internacionals permeten a les empreses multinacionals madures fer front a la diversitat de coneixements i l'activitat política, dues reconegudes fonts de problemes organitzacionals, amb la finalitat de potenciar les seves capacitats d'innovació i potencial competitiu. Per respondre a aquesta pregunta un estudi longitudinal embolicant casos múltiples s'ha desenvolupat per recollir dades qualitatives en profunditat des de tres grans projectes internacionals a càrrec d'una empresa multinacional focal i una gran varietat de les seves filials. D'una manera dialèctica, les dades recollides han estat utilitzats tant per millorar el marc del canvi dinàmic del coneixement proposat per la sociologia contemporània i explicar els complexos mecanismes que fan que els equips de projectes internacionals en una eina cada vegada més utilitzada per aquestes organitzacions. Com a resultat, es mostra que el canvi d'un determinat coneixement depèn d'un equilibri dinàmic entre poder i política afavorit per les condicions que són inherents a aquests formats organitzacionals. Finalment, es desenvolupa un model que detalla els mecanismes que permeten als equips de projectes internacionals impulsar la diversitat de coneixements i l'activitat política cap a la innovació i el canvi del coneixement dins de les empreses multinacionals madures.

El objetivo de esta investigación es entender cómo los equipos de proyectos internacionales permiten a las empresas multinacionales maduras hacer frente a la diversidad de conocimientos y la actividad política, dos reconocidas fuentes de problemas organizacionales, con el fin de potenciar sus capacidades de innovación y potencial competitivo. Para responder a esta pregunta un estudio longitudinal envolviendo casos múltiples se ha desarrollado para recoger datos cualitativos en profundidad desde tres grandes proyectos internacionales a cargo de una empresa multinacional focal y una gran variedad de sus filiales. De una manera dialéctica, los datos recogidos han sido utilizados tanto para mejorar el marco del cambio dinámico del conocimiento propuesto por la sociología contemporánea y explicar los

complejos mecanismos que hacen que los equipos de proyectos internacionales en una herramienta cada vez más utilizada por estas organizaciones. Como resultado, se muestra que el cambio de un determinado conocimiento depende de un equilibrio dinámico entre poder y política favorecido por las condiciones que son inherentes a estos formatos organizacionales. Por fin, se desarrolla un modelo que detalla los mecanismos que permiten a los equipos de proyectos internacionales impulsar la diversidad de conocimientos y la actividad política hacia la innovación y el cambio del conocimiento dentro de las empresas multinacionales maduras.

ACKNOWLEDGMENTS

I would like to thank the Generalitat de Catalunya and the citizens of Catalunya who made possible for me to join the Doctoral Program at UPC.

The Government of Spain for the opportunity to live and study in the country.

To the DOE-UPC board for accepting me in their Doctoral Program. To all DOE-UPC professors for their great classes who inspired me in this investigation endeavor.

To Prof. Dr. Jose Maria Sallan, my thesis director, for his support along the doctoral program, and also for his essential contributions in strategy, knowledge management and methodological subjects of this investigation.

To Prof. Glen Morgan from Warwick Business School and Prof. Javier Quintanilla from IESE Business School, who gently provided support on multinational literature.

I would like also to thank Teresa Asurmendi, who so kindly hosted me in Barcelona for the year long credit period and the many academic visits afterwards.

Finally, I would also like to thank the support and trust of the many companies and investigation participants without whom such rich investigation would be impossible.

INTRODUCTION

Emergent factors have dramatically changed the political, economic and social scenes (Czinkota & Ronkainen, 1997; Caves, 1998). Political-economic integration, widespread economic deregulation, technological advances and the growing importance of the so-called emerging markets provided the basis for a qualitative shift in the economic dynamics in play (Dunning 1998). On the way of these changes, markets that used to be portrayed as quintessentially efficient become ensnared with a level of dynamism and complexity far beyond any attempt of simplification (Ostry, 1998). Increasingly the neoclassical notion of *perfect markets* (Coase, 1937; Williamson, 1975), with their dispersed players, substitutable goods, complete information, mobile/tradable resources, seems a distant reality (Cool & Schendel, 1988; Rumelt, 1991; Hansen & Wernerfelt, 1989). Firms who have long addressed competition in monopolistic terms, dedicating time and effort to restrict the number of competitors and to build large business structures, now see their leadership vanish in face of newer and apparently less-endowed competitors (Teece et al., 1994).

In response to the challenge of explaining the mechanisms underlying such a competitive shift, scholars rendered increasing interest in the insights of the so-called "*Austrian*" economics (Schumpeter, 1934; Mises, 1949; Kirzner, 1973). According to this theoretical body, in imperfect markets, above normal returns result from rapidly dissipating opportunities originating from the entrepreneurial discovery of new products, unnoticed markets or novel processes. By gathering, processing and using increasing amounts of information firms can induce changes in the current state of knowledge that enhance their capacity of market assertion. By putting knowledge, change and profits in close causal relationship, authors in this line argue that economic forces progressively drive market participants away from a *monopolistic competition* paradigm and closer to a *knowledge-based* one, where *innovation* plays a central role in market organization and wealth generation (Jacobson, 1992).

Paradoxically, traditional organizational structures that helped firms thrive in monopolistic environments put their future at risk in knowledge-based ones (Galunic & Eisenhardt, 2001; Boisot & Child, 1998; Tushman & O'Reilly, 1996; Leonard-Barton, 1992; Hedlund, 1986). The bureaucratic legacy of conformity to rules, long command chains and adherence to codified knowledge present in most contemporary organizational structures impose strong constraints to *innovation* (McGrath, 2001). But if bureaucratic systems are the best organizational response within monopolistic markets, then how should firms, in organizational terms, shall address a knowledge-based competition? Although anecdotic evidence converge towards some key features that organizations shall pay attention, empirical evidence remains scattered and an encompassing organizational theory addressing this emerging competitive paradigm remains elusive (Grant, 1996a; Spender, 1996; Eisenhardt & Santos, 2001; Nickerson & Zenger, 2004. Martín de Castro et al., 2011).

Underlying much of the debate on the effects of knowledge in organizational structure and behavior is the notion that social processes are of huge importance (Child, 1997), and therefore, social sciences should be revisited in order to elicit the

conditions in which social organization favors *innovation*. Cumulative works not only in the field of Sociology (Berger & Luckman, 1966, 1995; Baudrillard, 1984; Habermas, 1984; Sewell, 1992; Padgett & Ansell, 1993; Ellingston, 1995) but also in the field of business (Pichaut, 1998; Clemens & Cook, 1999; Coopey & Burgoyne, 2000; Aguilera & Jackson, 2003; Deeg, 2005; Morgan, 2001, 2005) point that *innovation* can be understood as a change in the current state of institutionalized knowledge commonly associated to situations where *knowledge diversity* and *political action* are found simultaneously. Organizational literature, however, has traditionally portrayed *knowledge diversity* and *politics* as liabilities rather than assets (Parkhe, 1991; Watson et al., 1993; Kanter & Brinkerhoff, 1981; Mintzberg, 1985; Rosen et al., 2009), and as a result, organizational theories have frequently addressed how these two social phenomena should be constrained or mitigated rather than understood and explored.

The study of multinational enterprises (MNEs), however, could never rule *diversity* and *politics* out of their analysis (Béret et al., 2003), and thus, offers a unique opportunity to examine the influence of these two social phenomena over organizational systems. Having *diversity* as a defining condition and *heterarchic networks* as an outcome of their natural evolutionary process (Malnight, 1996, 2001; Birkinshaw & Hood, 1998; Taggart, 1998), MNEs offer a vivid example on how *diversity* and *politics* can co-exist within organizations. Even though, empirical evidence demonstrates that innovation capacity varies considerably among MNEs (Zander & Sölvell, 2000; Luo, 2002; Rugman & Verbeke, 2001; Edwards, 1998, Béret et al., 2003), showing that although *diversity* and *politics* are two necessary elements for *innovation* they are not sufficient ones.

Recent research (DiStefano & Maznevski, 2000; Salk & Brannen, 2000; Earley & Mozakowski, 2000; Lam, 2003; Haas, 2006; Javernick-Will & Levitt, 2010) report the increasing use of international project teams as a way by which MNEs develop unique complex tasks where innovation is either the objective or an intrinsic part of the work (Clark & Fujimoto, 1991; Ancona & Caldwell, 1992; Brown & Eisenhardt, 1995; Hoegl & Gemuenden, 2001). These observations suggest that there might be conditions involved in this mode of organizing that punctually contribute for innovation to occur amid knowledge diversity and intense political action. Authors, however, fall short to explain the circumstances and mechanisms involved in this process, and thus, fail to provide insights that can contribute to improve organizational theory towards knowledge-based competitive environments. In this sense, the main objective of this investigation is to understand **how international project teams enable MNEs to cope with knowledge diversity and political activity in order to unleash their innovative potential.**

To answer this investigative question it was necessary to describe which social mechanisms were enacted during these collaboration processes, the key variables involved and their relationships. For this, a longitudinal multi-case study has been designed to collect in-depth qualitative data through participant observation from three large-scale international projects involving a focal MNE and an array of its subsidiaries along a continued period of four years. Following a dialectic tradition,

data collected has been used to strengthen the dynamic knowledge change framework stemming from current sociological debates, which in turn served as a backdrop to approach the object of investigation and to answer the investigation question. As a result, a dynamic approach on knowledge change could be more clearly delineated and model on how international project teams can operate as innovation hubs within MNEs has been developed.

A better understanding on the mechanisms behind knowledge *diversity* and *politics* can benefit both international and strategic fields of management. For international management it can help unlock the vast potential MNEs have in changing and disseminating knowledge while integrating and bridging different cultures and institutional traditions. For strategic management in general, it can be useful in identifying mechanisms that can help domestic firms to take advantage of their inner knowledge diversity (divisional, disciplinary, functional, regional, educational and generational) to leverage their innovative capacity, and thus stand for the challenges of a knowledge-based competition.

This work is organized as follows:

SECTION I presents the theoretical background which supports this investigative work. **Chapter I** examines the economic and sociological basis that this investigation used to approach the object of investigation. **Chapter II** presents theoretical developments regarding MNE macro-dynamics (origins, development) with an emphasis on current debates which highlight the close connection between diversity and politics. **Chapter III**, regarding MNE micro-dynamics (management with an emphasis on they address the challenges posed by politics and diversity. **Chapter IV**, exposes the theoretical guidelines that supported investigation design, data collection and analytic work.

SECTION II covers data presentation and analysis. **Chapter V** provides information regarding the context of the investigation, researcher standpoint and field entry. **Chapter VI, VII and VIII** present data collection along the three cases investigated. **Chapter IX**, presents the analytical work. **Chapter X** comprises conclusions and final considerations.

SECTION I
THEORETICAL BACKGROUND

CHAPTER I
ECONOMIC ORGANIZATION, KNOWLEDGE
AND SOCIAL PROCESSES

1.1- MONOPOLISTIC COMPETITION

Much of the traditional strategic management thinking is based on the neoclassical economics concept of *efficient/perfect markets* (Jacobson, 1992). According to neoclassical authors (Coase, 1937, for example), *perfect markets* are those characterized by small and numerous players, trading perfectly substitutable goods, in possession of complete information, using mobile/tradable resources, within a foreseeable future (Ferguson, 1972). Provided such conditions, competitive forces naturally drive markets into a state of *efficient equilibrium* where prices reach a minimum and rents are just enough to maintain capital investment (*normal equilibrium rents*).

Within neoclassical economic framework, firms of an industry are nothing more than identical combinations of resources that serve the function of paying factors of production the value of their marginal product (Robins, 1992). The notion of *perfect competition* provides the foundation for the premise that to earn above normal returns firms must be able to restrict competitive forces and actively seek to create *imperfectly competitive markets*. In a general sense, this can be achieved by means of monopoly power, cartelization, dumping, entry barriers, lobby, and control over scarce resources or any other mean with potential to upset competitive forces from driving markets into a state of efficient equilibrium.

Porter (1980), a key author in this line, has long advocated that the main strategic objective of a business unit is to position itself in an industry where it can best defend against competitive forces or at least influence them in their favor. In his *competitive forces approach*, he identifies five industry level forces (entry barriers, threat of substitution, bargaining force of buyers, bargaining force of suppliers and rivalry among industry incumbents) as key determinants of a firm potential profitability. In the *competitive forces approach*, strategies are often aimed at altering the firm's position *vis-à-vis* competitors and suppliers. Furthermore, in considering that some industries and sub-sectors are more attractive because they have structural impediments to competitive forces, his approach claims that industry structure plays a central in determining and limiting the strategic action of a firm.

Closely related to the latter in its focus on product market imperfections, entry deterrence, and strategic interaction is the *strategic conflict approach* (Shapiro, 1989). This approach uses the tools of game theory to analyze the nature of competitive interaction between rival firms. The main thrust in this tradition is to reveal how a firm can influence the behavior and actions of a rival firm and thus the market environment. It implicitly views competitive outcomes as a function of the effectiveness with which firms keep their rivals off balance through strategic investments, pricing strategies, signaling, and the control of information. Underlying this approach is the belief that by manipulating the market environment, a firm may be able to increase its profits.

Although game-theoretic models view the strategic problem as one of interaction between rivals with certain expectations about how each other will behave, both approaches appear to share the view that rents flow from privileged product market positions (Teece et al., 1997). In this sense, both approaches assume that industry structure plays a central role in determining and limiting strategic action. Rents are created largely at the industry and sub-sector level rather than at firm level. For both approaches, the strategic movements follow the intrinsic objective of eliminating, weakening or controlling competitors to obtain a monopoly position. In so far, these approaches represent different perspectives of a *monopolistic competition* paradigm within strategic management.

In the last two decades, however, the *monopolistic competition* paradigm came into growing criticism because it failed to explain many inconsistencies empirically observed (see Cool & Schendel, 1988; Rumelt, 1991; Hansen & Wernerfelt, 1989). As a first attempt to break with the monopolistic tradition, another class of approaches emerged with an emphasis on the advantages stemming from fundamental firm-level advantages.

One strand of this literature (Penrose, 1959; Rumelt, 1984; Wernerfelt, 1984), often referred to as the '*resource-based perspective*', emphasizes firm-specific features and assets as the fundamental determinants of firm performance. The *resource-based approach* sees rents not as a result of strategic investments that may deter entry or raise prices above long-run costs, but as a result of a unique set of idiosyncratic and difficult to imitate resources that a certain firm might possess. The *resource-based approach* is based on two key assumptions: firms are heterogeneous with respect to their resources, and these resources are "sticky", that is, they are not readily tradable or readily movable. Even when the asset can be purchased the price paid for it in a competitive factor market will fully capitalize its potential rents (Barney, 1986). If within a monopolistic paradigm the strategic logic follows from the selection of an attractive industry to the acquisition of the necessary assets in the factor market, within a resource-based approach this logic follows backwards, that is, starts with the identification of firms' unique resources, proceed to the search of a industry where those resources are most valuable.

Despite the fact that the resource-based perspective invites consideration of managerial strategies for developing new firm-specific resources, its focus on the exploitation of existing firm-specific assets is evident. In last analysis it may be said to represents a variant of the monopolistic view in the sense that it considers the control over scarce resources as a key source of competitive advantage. As a whole, this perspective recognizes but does not attempt to explain the nature of the mechanisms that enable above normal rents and competitive advantage to be sustained. Moreover, empirical evidence shows that firms can accumulate a large stock of valuable assets (brand, capital, specialist knowledge and so on) and even though be outcompeted by apparently less endowed firms.

1.2- KNOWLEDGE-BASED COMPETITION

The persistence of theoretical blind spots and the accruing of contradictory evidence rendered increasing interest in the insights of the so-called “*Austrian school of economics*”, embodied in the works of Bain, Mises, Kirzner, Hayek and also Schumpeter. Authors in this line see above normal returns not as the result of restricted competition but rather as the consequence of discovery and innovation. Such perspective points to a complete shift in strategic thinking formulation. Instead of trying to limit competitive forces, firms should concentrate efforts in overcoming them through ‘*entrepreneurial discovery*’ of new products, unnoticed markets or novel manufacturing methods.

Schumpeter (1934), for example, not only sees *innovation* and *discovery* as the only way to outperform other firms and achieve higher profits but also highlights the role of the *entrepreneur* as the key agent of this process. For Mises (1949), *entrepreneur* is the one who discovers errors or inefficiencies in the market and tries to eliminate them. By exploiting these market imperfections, the entrepreneur receives not only the normal equilibrium rents but also the residue of the arbitrage.

Noteworthy, however, is that these *entrepreneurial profits* are short-lived. As soon as innovations reach the market and imperfections become visible to competitors, they can be easily imitated, what dissipates arbitrage returns and send profits back into the level of *normal equilibrium rents*. This process termed as “*creative destruction*” by Schumpeter, sets the markets in a state of constant disequilibria where firms have to exploit rapidly dissipating and changing opportunities.

Also in this line, Kirzner (1973) suggests that at any given time, an enormous amount of ‘ignorance’ stands in the way of the complete coordination of the actions and decisions of the many market participants. Even though some opportunities are uncovered by pure chance, certain firms have more information than others, and this knowledge gives them an advantage in ascertaining market inefficiencies. Through entrepreneurial action, firms gather, evaluate and utilize additional amounts of information that enable them to extend their capacity of market assertion.

For Jacobson (1992), these changes in the state of knowledge themselves produce disequilibrium situations and, therefore, profit opportunities. Because knowledge is continually changing, the market is also continually changing. When the competitive process eliminates one opportunity, changes in the stream of knowledge produce other opportunities. As such, an unending stream of knowledge keeps the market in perpetual motion and new profit opportunities result from ever-changing sources.

Overall, this economic view on market dynamics brings knowledge, change and profits into close causal relationship substantiating an alternative competitive paradigm known as *knowledge-based competition*. Underlying this view is the belief that by producing continuous *innovation*, that is, by constantly challenging the current state of knowledge of market participants, firms can reap above normal returns and stand out from the competition.

1.3- THE ORGANIZATION IN THE KNOWLEDGE-BASED COMPETITION

Bureaucracy is by far the most traditional way of organizing and its origins can be traced back to the ancient times. It has in Weber (1978) its greatest advocate and still represents the dominant form of economic organization. The various functions of a firm (e.g.: finance, marketing, production) focus on the efficient production of their own outputs, coordinated by a general manager who exercises a command-and-control influence over the functions. *Bureaucracies*, in the weberian sense, are organized around the following characteristics: *governance by written rules, hierarchical control and well-delimitated boundaries*.

Within a knowledge-based competition, however, the results of bureaucratic organization are awkward. Obedience and conformity to rules, expected and rewarded in bureaucratic systems, means complete submission to a sanctioned stock of knowledge and thus stands in stark contrast with the very idea of *innovation* (McGrath, 2001). Even where rule breaking is selectively allowed, the time wasted in obtaining authorization across long command chains and in re-writing the rule system allows room for imitation or for further environmental changes, which either dissipates rent generation potential or renders changes ineffective. Finally, well-delimited organizational boundaries insulate entire domains of organizational knowledge within firms precluding cross-fertilization among functions and divisions and stimulating partisanship among organizational actors.

Advocates of alternative forms of organization (Galunic & Eisenhardt, 2001; Boisot & Child, 1998; Tushman & O'Reilly, 1996; Leonard-Barton, 1992; Hedlund, 1986) argue that, in order to face the challenges of a knowledge-based competition, decisions should be pushed to where relevant knowledge and information reside or is more readily available. Instead of providing top-down direction, managers are expected to identify business opportunities, provide guidance, settle conflicts, and work for better communication. Small units should be encouraged because they are more responsive to market requirements and better able to adapt to external changes rapidly. Organizational units must concentrate on core activities for which they have developed a distinct competence. Workers in general are expected to become responsible for larger, but less well-defined roles (Child & MacGrath, 2001).

Authors, however, are not unanimous in these claims. Afuah (2001), for example, contends that making firms smaller or horizontal does not represent a definitive alternative. He found that there are contexts and time delimited situations where a vertically integrated hierarchy outperforms horizontal structures (e.g.: during industrial standard setting disputes). Other authors try to re-elaborate traditional organizational theories in the lights of a knowledge intensive competition, what usually takes the suggestive form of *enabling bureaucracies* (Adler et al., 1999). In the opposite direction is the emerging concept of *boundaryless organizations* (term popularized by Jack Welch, former General Electric CEO) where quasi-independent units contribute with complementary functions to a value chain, aided by electronic data exchange and communication.

For quite some time an intense debate hovered around the growing relevance of knowledge within firms and for the way firms are approached and managed. The idea of knowledge as critical input in production (rather than resources or capital) and primary source of value turned upside-down the traditional dichotomy markets (contract-based organization) versus hierarchies (authority-based organizations) which have long dominated the way firms were approached. Demsetz (1991), for example, pointed that firms represent a response to a fundamental asymmetry in the economics of knowledge due to the immobility of tacit knowledge and the expropriability of explicit knowledge. Hence, firms would exist because they create optimal conditions for the accumulation and deployment of knowledge.

In this line, March (1991), as well as Nelson & Winter (2002), see organizational knowledge as stored in procedures, norms, rules and routines, accumulated over time by its members through historical recollection (p.73). Firms, in this sense, are repositories of knowledge accumulated through experience. The problem with this view is that usually firms and their members know more than what is written in their procedures and know more than what is visible through their observations. Moreover, this view disregards the fact that knowledge can be harnessed through the interaction of organizational members.

Grant (1996a), in opposition, sees knowledge as a property of individuals and firms as knowledge integrating entities. As a result he argues that *coordination* (rather than cooperation) is the key organizational challenge that organizations face and point to the key role of "common knowledge" (basic knowledge evenly distributed within organizational members, p. 115) in allowing for that. In his view, the higher the need for specialized knowledge in decision making the more hierarchies are expected to fail. Moreover, this view allows for different forms of organization within firms depending on the type of knowledge predominantly manipulated by a department.

Spender (1996) goes a step further and sees the firm as a system of both knowledge production and application and places the manager at the center of internal knowledge processes. Similarly, Nickerson & Zenger (2004) use a problem-solving perspective to identify three essential forms of organization (i.e.: markets, authority-based hierarchy, consensus-based hierarchy) which address different combinations of problems and required levels of interaction for a solution. These authors also recognize that firms can change their boundaries and internal functioning according to the problems they face. Nevertheless, Eisenhardt and Santos (2001), argue that a knowledge-based theory of the firm remains elusive, but point that by advancing the static notion of "knowledge as a resource" (tacit x explicit) towards a dynamic notion of "knowing as a process" further firm's theoretical advancement can be achieved.

According to Child (1997), a common notion underlying much of the debate around emerging organizational forms is that social processes are of huge importance. Once assumed that knowledge change and social processes are at the core of the contemporary economic-organizational problematic it is key important to revisit social theories to understand the circumstances where social organization facilitates knowledge change, and thus, innovation.

1.4- KNOWLEDGE CHANGE AND SOCIAL PROCESSES

1.4.1- Traditional Approaches to Knowledge in Organizational Studies

Knowledge is broader, deeper, and richer than data or information. For Bhagat et al., (2002) *data* reflect discrete, objective facts about events in the world, *information* is organized around clusters of interrelated data and *knowledge* is created, restructured, or changed from both related and unrelated pieces of information. Davenport & Prusack (1998) define *knowledge* as a fluid mix of framed experience, important values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information.

In organizational studies, the most widely used theoretical framework on knowledge is the one proposed by Nonaka (1994) and Nonaka & Takeuchi (1995). Drawing on Polanyi (1962), these authors see knowledge along a continuum that ranges from tacit to explicit. *Explicit* refers to articulated knowledge embodied in artifacts (e.g.: manuals, softwares, tools), whereas *tacit* refers to non-articulated knowledge embodied in personal cognition or social routines. In their view, organizational knowledge is created along four sequential processes - *socialization*, *combination*, *internalization* and *externalization* – which gradually transforms knowledge from tacit into explicit and from individual into collective. This model, known as the “spiral of organizational knowledge creation” (SECI model), is represented by the following diagram:

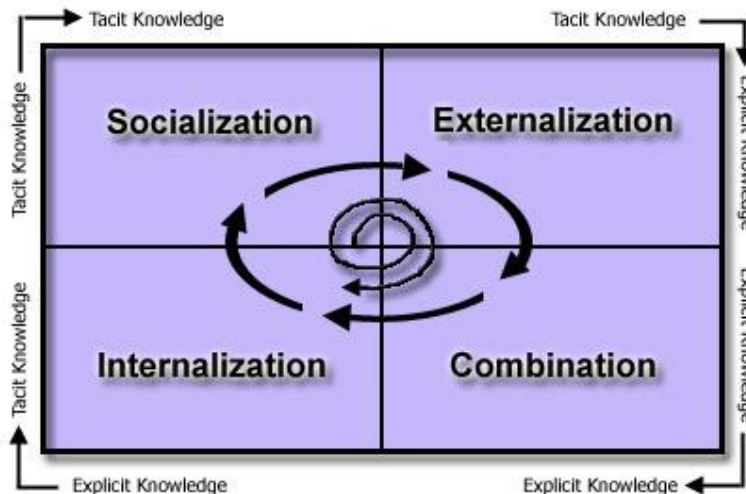


Fig. 1 – Spiral of Organizational Knowledge Creation (SECI model) - (Nonaka & Takeuchi (1995).

Several authors depart from this framework to propose their own organizational knowledge approaches. For Crossant et al. (1999), organizational knowledge creation also follows from individual to collective and to organizational, with a difference on the processes, which are: intuiting, interpreting, integrating and institutionalizing. For Smith et al. (2005) the focus of knowledge creation process falls upon the exchange and combination aspects of SECI model. Zollo & Winter (2002), as much as

Levitt & March (1988), depart from the variation-selection-retention paradigm (Hannan & Freeman, 1989; Campbell, 1969) to arrive at a circular mechanism that extends the SECI model by adding external stimuli and positive feedback as dynamic forces within the process of knowledge creation, and by distinguishing exploration and exploitation phases.

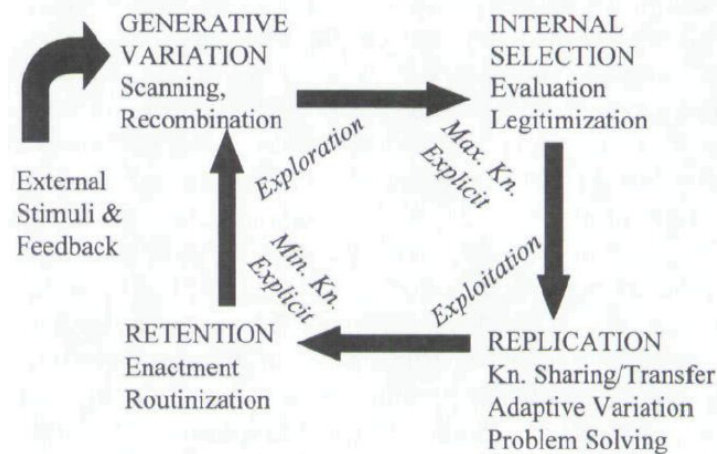


Fig. 2 – Activities in the Knowledge Evolution Cycle (Zollo & Winter, 2002, p. 343)

Although SECI model (and their variants) offers a theory about how organizational knowledge can be created as a cyclical process it says little from where does knowledge creation start and where it ends. Neither there is a reflection on the effects of pre-existing knowledge over emergent ones (Levitt & March, 1988; Smith et al., 2005) nor on how some piece of knowledge might emerge anew from scratch. The social processes and forces involved in the bi-directional conversion of tacit and explicit knowledge are also not clearly described. Moreover, the relative strength and persistence of a determined body of knowledge reflected in its power to induce and constrain action is not well addressed by the tacit – explicit continuum. Finally, the notion of time compression inherent to a knowledge-based competitive paradigm fits awkwardly into the cyclical timeframe assumed in the SECI model as less time would invariably lead to less knowledge.

The *sociology of knowledge* has long examined how kinds of social organization make whole orderings of knowledge possible, offering deep examinations on the very forms, processes and practices of knowing. As such, this approach will be used as a theoretical background on what knowledge is and how it is created and evolve overtime.

1.4.2- The Social Construction of Knowledge

The *sociology of knowledge* first appeared in Mannheim’s works on how the social location of individuals shaped their knowledge about the world. According to Mannheim (1936), the principal tenet of the *sociology of knowledge* is that there are *modes of thought* which cannot be adequately understood as long as their social origins are obscured. In his opinion, individuals find themselves in inherited

'already-defined' situations with patterns of *thought* which are appropriated to this situation. Although representing a turnaround on the approaches to knowledge this initial tradition has come under growing criticism as the relationship of knowledge and social position has been viewed as reductionist (Geertz, 1973).

In the late 60s, the expansion of cultural studies has greatly enriched data for sociologists of knowledge to work with. This shift to cultural elements that are more conscious equipped the discipline with new models of how social organization influences the creation and dissemination of knowledge and brings the *sociology of knowledge* back into evidence (Swidler & Ardit, 1994). Among the many direct and indirect contributions it has received, the works of Peter L. Berger and Thomas Luckmann (especially *The Social Construction of Reality*, 1966 and the more recent *Modernität, Pluralismus und Sinnkrise*, 1995) deserve special attention as they provide important insights on how knowledge is socially constructed and disseminated. According to these authors, knowledge is created as a result of four processes: typification, objectivation, socialization, and institutionalization, which take place sequentially along a linear timeframe.

As long as two individuals interact, in whatever manner, *typifications* will be produced quite quickly. The typificatory schemes of interacting actors enter into an ongoing *negotiation* as long as the direct interaction lasts. In the course of this negotiation individual typifications evolve into a mutually specific pattern of conduct, and so, a collection of reciprocally typified actions is expected to emerge. In general terms, all actions repeated once or more tend to be habitualized to some degree, just as actions taken by one actor naturally develop some typification on the part of an observer. However, for typification to occur there must be a continuing social situation in which the habitualized actions of two more individuals interlock. Which actions are likely to be reciprocally typified will depend on which actions are relevant within their common situation.

For Berger & Luckmann (op. cit), the most important gain individuals accrue from *typification* is that their actions will be mutually predictable and can be continually built on a common ground. In their opinion, *typification* relieves individuals of a considerable amount of tension. Time and effort are saved not only in external tasks they might be engaged in separately or jointly, but also in terms of their respective psychological economies, as many joint actions will be possible on a low-level of attention. Overall, as the process of *typification* proceeds, individuals will be constructing a background which will serve to stabilize both their separate actions and their interactions.

The *typifications* undertaken during the interactions of the initial set of actors, formations that until this point still had the quality of *ad hoc conceptions*, gradually gain historicity. With the acquisitions of historicity, these formations perfect a quality that was incipient when interaction began and this quality is *objectivity*. The process by which the externalized products of human activity attain the character of objectivity is called *objectivation*. Language and symbols are two particularly important cases of *objectivation* as they clearly delimitate *typifications* and enable them

to transcend time and space. For the time that this incipient knowledge is kept at the interaction level of the initial set of individuals and they are able to reconstitute the whole creation process and reassess the objectivations made, objectivity remains tenuous and knowledge easily changeable.

The process of transmission of objectivated typifications, either for newcomers or across generations, known as *socialization*, changes the character of knowledge among individuals. In the process of transmission, knowledge “hardens” and thus gains “density”, not only to those who receive it but also for those who transmit it. *Institutionalization* takes place as actors come to accept shared definitions of reality. Knowledge at this point assumes an institutional character and henceforth cannot be changed so readily. *Institutional knowledge* is experienced as existing over and beyond the individuals, which confronts them as an external coercive fact. The validity of *institutional knowledge* is taken-for-granted and people are unlikely to lift doubts about it under the threat of severing the knowledge ties that bind them to population at large.

Deviance from the institutionally programmed courses of action, however, becomes more likely as *institutional knowledge* becomes distanced from its origins. Newcomers also posit a problem of compliance because, different from knowledge creators who can revive objectivations by recollection, they receive it as a given fact. In order to contain deviations, it is necessary to develop underlying explanations that bring together disparate realms of *institutional knowledge*. The constitution of *symbolic universes* makes up for a special case of *legitimization* where different pieces of *institutional knowledge* are manipulated to become complementary, further reinforcing their rigidity and density. This task is performed by concrete subjects who tanks to a privileged position operate as *reality definers*. *Legitimation*, thus, is this process by which these *reality definers* or *legitimators* “explain” and “justify” *institutional knowledge*.

1.4.3- Reification and Anomie: Divergent paths along knowledge development

The specialization of knowledge and the consequent emergence of competing legitimation bodies also bring occasions for social dissension. As diverse and more complex forms of knowledge emerge many alternative versions of a determined reality may arise without making for an overarching system. As long as some of these alternatives can be conceptually and socially segregated as appropriate to “strangers”, it is possible to have fairly friendly relations with them. The trouble begins when events make this “strangeness” breakthrough and the knowledge it embodies appears as real option. Although dissenting definitions of reality may coexist over a period of time or through the spatial segregation of dissenters, attempts of *elimination* or *integration* are always expected to follow as a result of their rivalry.

In principle, the question can be decided with relative ease by seeing which theory is most conducive to success in practice. However, due to the complexification of knowledge the proof of practice many times reveals itself impractical, or ensnared

with a great deal of chance and argumentation, which by their very nature does not carry the inherent conviction of pragmatic success. What might be convincing in one tradition may not be in another. In this vacuum of certainty, *power* is frequently employed as a way to enforce one argument against its competitors. In short, definitions of reality may be enforced by the coercive use of *power*.

Power in society includes the prerogative to legitimate *institutional knowledge* and to determine decisive socialization processes, that is, to produce reality and to make one self to internalize it. To eliminate dissent and ensure knowledge *identical reproduction* subjects need to be *over-socialized* what requires additional socialization methods like physical segregation, ritualization, and mythification. The coercive use of *power* inevitably strengthens *institutional knowledge* tendency to persist even when it has completely lost their original functionality or practicality. One does certain things not because they work, but because they are “right”, that is, right in terms of the *ultimate definitions* of powerful *reality definers*. When a logic of appropriateness and legitimacy completely supersedes practical reasons, reality, and thus the knowledge it embodies, becomes reified.

Drawing on Lukács, Berger & Luckmann (1966) see *reification* as the apprehension of human phenomena as if they were things, that is, in non-human or possibly in supra-human terms (e.g., cosmic laws, facts of nature, or manifestations divine of will). *Reification* implies that social actors have forgotten their own authorship of knowledge and thus consider themselves unable to change it. The reified world is, by definition, a dehumanized world. It is experienced by individuals as a strange facticity over which they have no control. Radical faith and dictatorships are two extreme examples of how knowledge can be completely abstracted from its initial practical roots to control realities and turn into far-reaching systems of control over entire populations.

Apart from the situations where *over-socialization* is imposed, it can be expected to exist a social-structural base for competition between rival definitions of reality. Thanks to the frequent detachment of knowledge from the precise scrutiny of practice, it is largely expected that non-practical *interests* will decide the outcomes of this rivalry. Different social groups will have different affinities with the dissenting theories and will consequently become carriers of the definitions that please them most. Whatever result prevails in theoretical terms will intrinsically depend on the outcome of the conflicts involving these *rival groups*. Side by side with this struggle between interest groups for imposing their definitions of reality, the contemporary phenomenon of *modernization* contributed to further complicate this scenario by dramatically weakening the strength of *institutional knowledge*.

Modernization emerged as a result of the consolidation of democratic-capitalist societies and implies in a radical transformation of most objective conditions of human existence. In material terms, this development translates into a huge expansion on the range of possibilities to what individuals are confronted within these societies. *Modernization* means the change from an existence largely based on fate to one consisting on a series of possible choices. The technological-economical

foundations of this change are material, however, its social dimensions are intensified, above all, by *pluralism*. *Pluralism* not only permits one to make choices but it forces one to do so. One can no longer choose not to choose.

Two central institutions of modern society promote this transition from the possibility of choice to the compulsion for choosing: the *market economy* and *democracy*. Both institutions are founded on the aggregation of individual choice, and themselves encourage continuous choice and selection (Berger & Luckmann, 1995). As previously discussed, institutions emerge to alleviate individuals of the necessity to reinventing the world and reorienting themselves on a daily basis. Institutions retain their power as long as the validity of their knowledge is not effectively placed in doubt. However, they are endangered as soon as people begin to place themselves at a distance and viewing the world as options rather than givens. For Baudrillard (1984), fixed meaning is being replaced by a 'network of floating signifiers' that allows for one-off communication rather than the ability to store and transmit knowledge.

In this sense, modern *pluralism* undermines the "density" of *institutional knowledge* as the world, life, society and personal identity are called ever more into question. They may be subject to multiple interpretations and each interpretation defines its own perspectives of possible action. No interpretation, no body of knowledge, no range of possible actions can be accepted any longer as the only true and unquestionably right one. Where *pluralism* has achieved its full development, meanings are not equally shared by all members of a population. In these places, *tolerance* is reckoned as the virtue *par excellence*, because only through *tolerance* can individuals interact guided by partially distinct bodies of knowledge.

Overall, *modernization* can be experienced as a great liberation, as an opening of new horizons and possibilities of life, leading out of the institutionalized modes of existence and patterns of action. However, it may be also experienced oppressively, as it pushes the individual to repeatedly make sense of an ever-changing unfamiliar reality. At a certain extent, there are some people who withstand this pressure while others may even seem to appreciate it. Increasingly, however, people feel insecure and lost in a confusing world full of possibilities, some of which are linked to alternative ways of life.

Within an uncertain body of knowledge to be shared, individuals are under-socialized, that is, receive nothing but the toolkit of knowledge necessary to make just enough interactions as necessary. Along time, these processes increasingly retreat individuals from the psychically extenuating task of relating to the others what further contribute to weaken the existing body of knowledge, as well as social roles and identities. At limit, shared knowledge may become so rarefied that it can barely sustain any meaningful social interaction, leading to a state of social paralysis and disaggregation identified by Durkheim (1897) as *anomie*.

As depicted above, *reification* and *anomie* represent two limit cases in the development of knowledge within a social group. At one extreme, social processes

produce a sort of knowledge so dense that changes can only be achieved through exogenous shocks which not rarely leads to the breakup of social order. At the other extreme, social processes produce a sort of knowledge so tenuous that there is no common referential structuring social interaction anymore. A conjecture that may arise at this time is that as both these extreme paths of knowledge development ultimately leads into social disintegration then the existence of relatively stable social settings along time implies that there must be additional social processes responsible for a certain level of dynamism and equilibrium in the development of knowledge.

1.4.4- Isomorphism, Path Dependence, Increasing Returns and Complementarity: Explaining Institutional Continuity

As previously seen, legitimacy is a key mechanism of *institutional knowledge* self-preservation. Legitimacy is achieved by the skillful action of actors that claim validity of one body of knowledge based in the validity of similar ones. As such, *institutional isomorphism* drives social groups towards forms of knowledge that are socially legitimate, that is, isomorphic or consistent with the institutional environment (Meyer & Rowan, 1977; Powell & DiMaggio, 1983). According to these authors, *isomorphism* can take three forms: *coercive*, *mimetic*, and *normative*. *Coercive isomorphism* happens when a group receives pressures to conform to the beliefs of a more powerful group or from society as a whole. *Mimetic isomorphism* happens when uncertainty forces a group to follow the knowledge of another group perceived as successful. *Normative isomorphism* is rooted in closed circles of socialization and communication which along time eliminate divergent views.

The concept of *path-dependency* is also widely invoked in the social sciences to explain institutional continuity and, to a much lesser extent, *institutional knowledge* resistance to change. Morgan (2005b) highlights that the range of experimentation and differentiation in any society is institutionally determined, and while individuals can do things differently, that can have a wider impact if it brings advantages to other actors to follow that practice rather than the existing rules of the game. In other words, is important to know whether there is *complementarity* and consequently *increasing returns*.

Some authors (Pierson, 2000; Mahoney, 2000) argue that a *path-dependent* process is one characterized by a self-reinforcing sequence of events. Each event or choice points in the sequence sets the direction of subsequent events. Events early in the sequence matter more in determining overall path trajectory because their effects are exaggerated downstream. As events move down the path, changes become more bounded, that is, previously viable options are increasingly costlier to adopt. A *path* starts with a *critical juncture*, after which following moves would be reinforced through a positive feedback mechanism.

Deeg (2005) conceptualizes *institutional path* as a logic, a distinct pattern of institutionally rooted constraints and incentives that limits *institutional knowledge* change. Changes that do not defy such logic are considered '*on-path*' and can be approached as institutional improvements, in a sense that something has to change

so that the overall order can be reinforced. He suggests that four mechanisms act in a self-reinforcing way to tie actors into a determined path: *initial costs*, *learning effects*, *coordination effects*, *adaptive expectations* and *coherence/complementarity*.

Initial costs keep changes on-path because after making investments in a given path actors have an incentive to sustain that path in order to recover their investments. *Learning effects* strengthen the path as actors learn how to explore on their favor the existing arrangement enhancing its value and utility. *Coordination effects* make that the greater the number of actors along a determined path, the greater the returns for all of them. Along *adaptive expectations*, actors adopt a particular path because they expect others to do so. Finally, through *coherence/complementarity*, additional arrangements are encouraged by previous ones to adopt similar or complementary roles on the promise of social legitimation or mutually reinforcing (*synergistic*) gains.

Complementarity is commonly used to explicate the links that are considered to bind such ensembles. Two things are complementary when one makes up for the deficiencies of the other. Complementary set of knowledge differ from each other but they are not just different, they are linked in the specific way defined, that makes each one more plausible due to the existence of the other. The *logic of complementarity* also works on the side that certain efficiencies are achieved when balancing or contrasting characteristics are found alongside each other (Crouch, 2005).

According to Deeg (2005), as complementarities loosen between particular institutions, actors may look for ways of acting that sustain the parts of the system that survive. Accordingly, other institutions may be brought into action to take the place of the old ones, the roles of the remaining ones may also change in order to reaccommodate the existing balance. For Morgan (2005), institutional *complementarity* needs to be understood in terms of how institutions and the knowledge they carry can create powerful and effective balances in social systems. Any particular form of *institutional knowledge* can be characterized by divergent principles that exist in creative tension and reflect a broader sociopolitical compromise between key actors.

Strong versions of *path-dependency* advocate that only *exogenous shocks* can radically alter the incentives/constraints that tight actors to a path and demand radical and socially painful changes. Short of this, changes are incremental and '*on-path*'. As such, the *theory of path-dependence* suggests that the longer an institution has been in place, the more resilient to change it will be and the more likely that change will be incremental and limited. As a consequence, given enough time and enough self-reinforcing mechanisms, a path will develop a '*deep equilibrium*', and thus, become highly resistant to change and likely to endure for a long period.

It is important to highlight, though, that *institutional path-dependence* does not directly translate into stability, as it clearly begins within a dynamic framework marked by incremental changes and adjustments. What calls attention, however, is the unidirectional and decreasing character of these changes that at limit ($t \rightarrow \infty$) become imperceptible. This means that even in the absence of a direct form of coercive power, natural mechanisms of institutional development like *isomorphism*, *increasing*

returns and *complementarity*, if let alone, can direct *institutional knowledge* into a state of *static-equilibrium*, and therefore towards *reification*.

If efforts made to keep *institutional knowledge* unchanged under a *static equilibrium* state inexorably contribute to its *reification*, it thus can be expected that *institutional knowledge* equilibrium, if exists, shall be a dynamic one. A state of *dynamic equilibrium* therefore shall imply constant change around a certain gravitating point, a move restricted by the limits imposed by the attraction zones of anomic chaos and reification. As such, one might expect to exist mechanisms along knowledge development that constantly upset and restructure knowledge within the limits of meaningful interaction and knowledge reasonability.

1.4.5- Non-Identical Reproduction, Institutional Layering, Endogenous Shocks and Strategic Action: Explaining Institutional Change

Clemens & Cook (1999), devise venues of change for institutions. First, where rules and models of action are not homogeneously enforced, there is opportunity for agency (Sewell, 1992). By weakening the institutional determination of social action, agency fosters *mutation* and innovation. Second, even within a determined institutional domain, models or scripts of behavior appropriate in one situation may prove strongly dysfunctional elsewhere. To the extent that institutional arrangements embody *internal contradictions*, reliable reproduction is less likely. Third, overlapping institutional fields expose actors to alternative frames, allowing them discretionary action. Therefore, action becomes less predictable where multiple institutions compete or no institution is firmly established.

The capacity of human beings to learn means that, where there is knowledge of the past, even if inaccurate, there is no pure repetition of an action. According to Sorge (2005), no matter the effort made in reproducing *institutional knowledge*, and the institutions that happen to embody them, the socialization process is never perfect and the result is somewhat different from what has previously existed. Although these differences may eventually come to be marginalized and segregated, the *non-identical reproduction* character of socialization contributes to minimally diversify the stock of institutionally knowledge available within a social group.

Djelic & Quack (2005) argue that the idea of *path dependence* implies a focus on the past constraining the present and the future. As such they put forth the concept of *path generation*, in which a redirection of the path comes not from a single critical juncture but is rather constructed through a historical sequence of multiple junctures that cannot be fully anticipated. As a result of the accumulation of changing pressures, the path is a *crooked* one and reflects long periods of struggle between countervailing forces interrupted by sudden change. This *crooked-path* shows the historical interplay between pressures for change and continuity, as long as the accumulation of external and internal change claims challenge *institutional knowledge* development mechanisms.

Thelen (2000) advances this argument proposing that mechanisms of change can operate at the same time as mechanisms of reproduction of given path. Over time, however, the mechanisms of change may outweigh those of reproduction, leading to a major change in path trajectory. *Institutional layering*, thus, must be understood as the process by which actors recombine legitimate elements of existing *institutional knowledge* in alternative arrangements that lead to more suitable outcomes. She also recognizes the role of *politically marginalized actors* who may use such mechanisms to turn a path more favorable to their interests.

Another probably source of change concerns the fact that interests of actors on the path may change such that they seek radically alter the path they are on. Such shift of interests may result not only from *exogenous shocks* but also from unanticipated effects or developments of the path that may lead actors to reassess their interests in face of the current path outcomes. In that sense, *endogenous shock* would include actions, events, or processes that result directly from the key mechanisms of path reproduction and that at certain point make increasing returns level off or turn into decreasing returns.

In the same way that *institutional complementarities* may empower certain institutions to the point that their influences are transmitted across unrelated institutional domains, unexpected tensions generated by conflicting principles of rationality within certain institutional domains may yield a fertile ground for *strategic action* (Aguilera & Jackson, 2003). In this case, actors may use entrepreneurial skills, power, or access to other social networks or institutional ideas in an effort to alter the path. Therefore, *endogenous shocks* may result both from unexpected institutional developments and from unexpected outcomes from this development.

Due to *institutional layering* the effects of these forces may pass unnoticed and accumulate over long periods of time, until unpredicted *events* come to unsettle long existing bodies of *institutional knowledge* (Morgan, 2005b). Although to a badly informed observer change has occurred under a critical juncture due to a onetime event, in fact it has silently developed along time as a result of the struggle of several actors for their interests in face of the changing effects of many small scale events and from unpredictable development and outcomes of the institutional path they are in.

1.4.6- Knowledge Heterogeneity, Politics and Innovation

For Clemens & Cook (1999), institutional change rests on an appreciation of the heterogeneity of institutional arrangements and the resulting patterns of conflict or prospects for agency. In their opinion, knowledge change is more likely when models of action are understood to be discretionary, *institutional knowledge heterogeneity* is high and social networks are fragmented and extend across significant social distances. In their opinion, knowledge diversity constitutes the loci of structural indeterminacy that may be exploited by political entrepreneurs. All this argument drives to the conclusion that changing high-order institutional rules, and thus, moving social orders or even subsystems into '*off-path*' change is a process

strongly mediated by political activity. Knowledge change requires the coordination and exercise of political action by pro-reform groups.

Underlying this argument there is a distinctive kind of political action called *institutional entrepreneurship*. The essence of *institutional entrepreneurship* is to skillfully contrast, align or transpose organizational institutional forms with those from the outset. Political entrepreneurship presumes a degree of knowledge fragmentation or the availability of alternative models for mobilization and intervention. Institutional entrepreneurs seek to transpose models of collective action from one social setting to another in order to enhance the available set of alternatives and therefore shape the political space. According to this view, the presence of alternatives creates the space for *political action* and innovation.

Political challengers may mobilize change by deploying familiar models of social organization in unfamiliar ways. They can also go around highly controlled institutional systems by using its complexity and segmentation to craft alternative paths to problem solving. Political entrepreneurship, however, is complicated when there are multiple audiences for whom new political events and arrangements must be interpreted and legitimated (Stryker, 1999). As Padgett & Ansell (1993) noted, political action is grounded in *multivocality*, that is, single actions being interpreted coherently from multiple perspectives simultaneously. Insofar, the disruption of institutional systems creates space in which political actors struggle to reestablish interpretive frames for multiple audiences (Ellingston, 1995).

The content of institutions can also change over time as a result of diffusion and experimentation. Diffusion processes may also spur innovation as actors seek to accommodate newly adopted institutional rules to existing practices, resources and competing schematas (Stryker, 1999). The greater the heterogeneity of institutional arrangements, the more likely that the effort to transpose models and embed them in different social settings will disrupt reliable reproduction and lead to innovation. While experimentation may be an important source of institutional change, not all actors are equally likely to experiment. Marginalized groups, for example, are more likely to experiment because denied the benefits of current configurations they have fewer costs associated with deviating behavior.

For Clemens & Cook (1999), success in articulating, passing and implementing knowledge change often depends on embedding a proposed program in an array of supportive constituencies. In this sense, effective politicians may enhance the attractiveness of a particular body of knowledge by building deep analogies to already institutionalized models or widely held norms. Therefore, the institutional effects attributable to normative legitimacy and socialization are reinforced by the mobilization of a set of stakeholders and alignment of incentives.

Pichaut (1998) suggests that concentration and asymmetry of power elicit different kinds of political activity. He argues that concentrated and asymmetric power systems have a tendency towards perpetuation and thus elicit resistance and exit, whereas dispersed and symmetric systems elicit negotiation and compromising in

order to satisfy multiple stakeholders. Overall, he proposes that power concentration stimulates regressive political processes while power dispersion elicits more progressive political processes. Their proposition has two fold implications. First, it supports the argument that 'unbounded' social systems are more prone to political processes than more 'bounded' and formalized ones. Second, that the way power is distributed along social settings allow for dissidence and contestation on the part of disadvantaged actors¹.

Drawing on Habermas (1984), Coopey & Burgoyne (2000) argue that an open political space is key to create *ideal speech conditions* which in turn foster learning and knowledge exchange. In their view, free and open political activity encourage people to share ideas while free speech enhances mutual understanding what help actors to move from entrenched positions and accept that no view is authoritative or represent absolute truth. In their view, political activity is both seen as a means to create psychic space in which people are able to speak out and engage with others in knowledge change and also to promote a space for innovation to be disseminated.

1.4.7- Intermediate Institutions and Quasi-Institutional Equilibrium: Towards a Dynamic Order

According to Morgan (2005b), as individuals learn both across and within generations, change rather than stasis characterizes human societies and their organizations. Actors in contemporary society often regard the institutional context as provisional and as capable of amendment. *Institutional knowledge* is therefore caught in an almost permanent process of redefinition and search for equilibrium, a dynamic situation more likely to result in a '*quasi-institutional order*' where actors are free to explore and negotiate meanings and interpretations that can be very different from the ones that were initially intended.

Berger & Luckmann (1995) argue that *overarching institutions* and their taken-for-granted, almost indisputable knowledge have been dislodged from the center of modern societies. In their place has emerged a distinct class of "*intermediary institutions*", which account for a state of *quasi-institutional equilibrium* that makes

¹ As noted by Lawrence et al. (2005), organizational research and theory has traditionally seen **power** and **politics** as intrinsically linked constructs. Pfeffer (1981; 1992) define **power** as "the potential ability to influence behavior, to change the course of events, to overcome resistance, and to get people to do things that they would not do otherwise", and **politics** and influence as "the processes, the actions, the behaviors through which this potential power is utilized and realized" (p.30). In the same line, Buchanan & Badham (1999) define **power** as "the capacity of individuals to exert their will over others" and **politics** as "the practical domain of power in action" (p. 611). Authors like Lawrence et al. (2005, p.182), however, clearly differentiate **power** as "force" (systemic) and as "influence" (episodic), a view also shared by Pichault (1998) which sees **power** either "concentrated/asymmetric" or "dispersed/symmetric". This conceptual divide is an important one because it allows for a different concept of **politics** (more akin to political sciences) which equates politics with *persuasion* (direct/open/interactive) rather than *influence* (indirect/covered/unidirectional). In this line, March (1962, p. 671) advocates for a *process-oriented political theory* which sees **politics** from a conflict-resolution perspective. According to his view, social systems are composed by various interest groups where brokers - the politicians - try to organize viable coalitions around interest maximizing outcomes by means of bargaining, compromise, and negotiation. **Politics**, thus, is a process by which system welfare takes precedence upon individual ones and therefore must be enacted collectively. Similarly, view is shared by Cardoso (2012, p. 146), which sees **politics** as an art in which *persuasion* has a key role in "creating the conditions for the achievement of an objective which are not given at first-hand". In line with Habermas (1975), he argues that even though such conditions can be created by the coercive use of **power**, in the absence of the consensual character or *persuasion*, the cost and consequences of unilateral decisions tends to wear off the legitimation that is the very source of **power**. Following these authors and in line with Pichault (1995; 1998) the present work assumes that **power** and **politics** (understood as *persuasion*) though intrinsically linked, are mutually excluding. The more **power** is used the less space there is for **politics** (consensus) and system welfare.

society to experience a sort of *dynamic order*. In consequence of the mediating role of such institutions, the knowledge they embody is not experienced as authoritatively given but as a repertoire of possibilities, which is sufficiently flexible to be open to further change. Consequently, *intermediary institutions* make up for a social space where individuals have the chance to participate in knowledge reexamination and in the authorship of their realities.

Similarly, for Coopey & Burgoyne (2000) it is possible to strike a dynamic balance between unity and disunity so that continuous learning is facilitated without destabilizing the organization. In this state, which they call “dynamic balance”, social life is regulated by a minimum amount of tradition and the friction between competing ideas sparks a stream of innovation. In their framework, learning, unlearning, rationalization and re-framing are key moments in knowledge change and innovation.

1.4.8- The Social Construction of Knowledge: A Dynamic Perspective.

The theoretical body previously presented suggests that *institutional knowledge* and social organization are intrinsically linked and overtime develops a sort of dynamic order (red arrow in the picture below). On the one side, we have environmental changes and the strategic action of social actors bringing into question the validity and legitimacy of *institutional knowledge*. At the other hand, we have political action continually renewing the stock of knowledge to fit environmental needs and accommodate the interests of a broader set of social actors. All this dynamism is surrounded by zones of attraction (grey arrows) composed by socially undesirable states of both stasis (reification) and disruption (anomie) elicited by power imbalances.

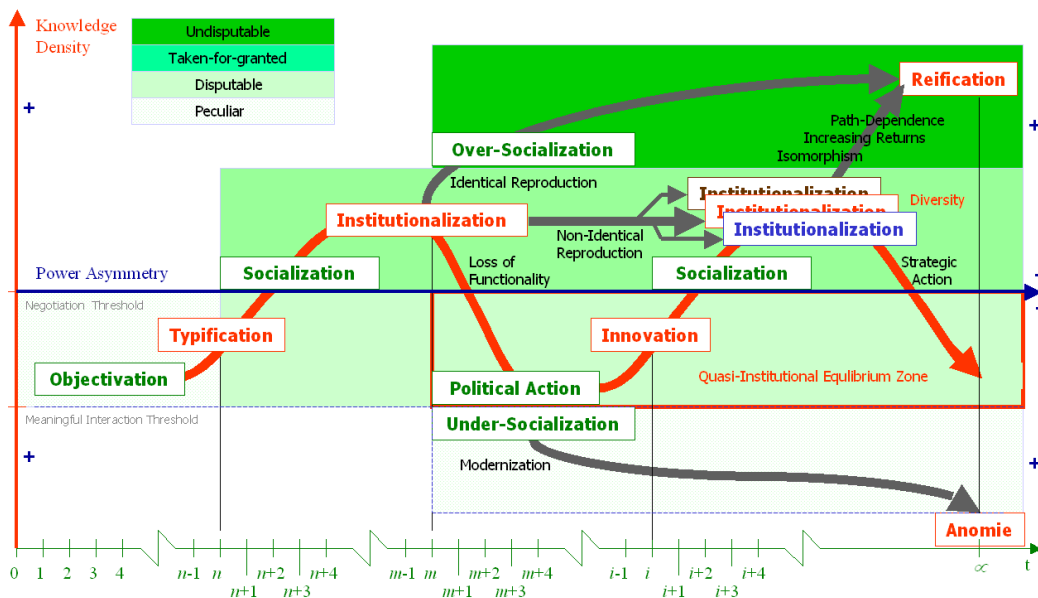


Fig. 3 – The social construction of knowledge: a dynamic perspective.

CHAPTER II
MNE FOUNDATIONS

2.1- MNEs, INTERNATIONAL DIVERSITY AND POLITICS

2.1.1- International Diversity as MNE determinant

For Dunning (1998), intellectual capital, technological trade, and stakeholder collaboration are key forces driving the world towards increasing economic integration. This phenomenon, roughly known as *globalization*, can be viewed as the gradual establishment of linkages at the level of national and regional economies, such that decisions, activities, and competitive strategies taken in one part of the world have clear implications in other parts.

By coordinating and controlling operations across borders, MNEs stimulate the establishment of such links and thus are central agents in this process (Whitley, 2001). In opposition, individual countries continue to exhibit distinctive cultural, institutional and legal modes of operation which directly affect the nature and the behavior of these firms (Ferner & Quintanilla, 1998). As a result of this duality, MNEs are expected to confront decision-making problems that exceed in complexity those of single-nation businesses.

As noted by Béret et al. (2003), diversity is a key aspect to understand the kind of tension experienced by MNEs. On the one side, authors claim that diversity in cultural backgrounds, organizational characteristics and management practices can severely hamper the ability of organizational units to work jointly and effectively (Parkhe, 1991; Watson et al., 1993). On the other, diversity is acknowledged to provide firms with abilities to cope with complex and changing scenarios (Boyacigiller & Adler, 1991; Maznevski, 1994), enhance their capacity to learn (March, 1991) and lower operational risk.

The way international diversity affects MNEs dynamics and evolution has been addressed by many different approaches. Next, a critic review of the last three decades of academic debates is exposed in order to review assumptions and weaknesses of traditional approaches (economic, cultural and institutional) as well as to single out elements that point to the reassessment of political processes within MNE studies.

2.1.2- Economic Approach to International Diversity: Arbitrage and Firm-Specific Advantages

Guillén (2002) indicates that the study of firms' international expansion has been traditionally approached from an economic perspective. One of the first authors to show interest for the thematic, Hymer (1960) proposed to treat *foreign direct investment* (FDI) not as the simple move of capital beyond borders but as the result of a firm's decision to go abroad due to market/industry-related advantages in the home country. As such, economic analysis of MNEs have traditionally focused at differences at the country, industry, and firm level, including among others, labor costs, currency exchange rates, trade protectionism, industry concentration and growth, as well as firm size and technological assets. According to the basic

'*transaction-cost model of the MNE*', FDI is launched to exploit the differential quality of firm's proprietary assets (Buckley & Casson, 1998a).

Adopters of this approach see diversity not only as an opportunity for economic arbitrage but also as enhancing operational flexibility through global sourcing, facilitating access to international markets and way to diversify or reduce bulk risks (Dunning, 1993). Foreignness can be considered an asset as well, for example when it is associated with desirable product characteristics, or when local companies lack legitimacy (Kostova & Zaheer, 1999; Mezas, 2001).

Scholars, however, recognize that diversity also confront MNEs with challenges. Zaheer (1995) coined the term *liability of foreignness* to specify the kind of costs that MNEs face that domestic companies face to a much lesser extent, such as: transportation costs, coordination costs, lack of knowledge about the market, nationalism and contested legitimacy. Furthermore, qualitative studies recognize that knowledge accumulated in the home country context are of limited usefulness abroad (Lam, 2003; Morgan et al., 2003). Brannen (2004), for example, draw a compelling case on how *cultural recontextualization* can change the meaning of a determined strategic asset (i.e.: practice, a brand or a product) to the extent that it completely loses its character of competitive advantage as believed at home market.

Overall, the economic approach of MNEs sees international diversity as an absolute measure to be stripped and explored. According to this view, differences must be assessed within an eye on differential economic properties which shall be arbitrated to generate rents. The absolute and straightforward character of this approach makes the balance between opportunities and challenges to be poorly addressed at the organizational level. As such, the simplified picture of diversity provided by the economic approach explains why its use has prevailed only in macroeconomics and at industry-level analysis.

2.1.3- Cultural Approach to International Diversity: Conflict, Acculturation and Hybridization.

In the early years of international management studies, Swedish researchers (Johanson & Wiedersheim-Paul, 1975; Johanson & Vahlne, 1977) developed the concept of *psychic distance* to describe the "*factors preventing or disturbing firms learning about and understanding a foreign environment*" (O'Grady & Lane, 1996, p.313). Later, authors recognized the strong cultural content of this concept then *cultural distance* became a key proxy for international diversity (Barkema et al., 1996; Gomez-Mejia & Palich, 1997).

Dissimilarities in national cultures are considered one of the most important causes of conflict and misalignments within MNEs. Studies exemplifying how differences frustrated cooperative efforts and business negotiations between people of different national cultures abound (Adler, 1986; Graham, 1985). A key tenet among culturalists is that entering psychically/culturally close countries is easier for companies than distant ones (Johanson & Vahlne, 1992; Kogut & Singh, 1988).

Authors in this line assume that individuals enact in their work their particular cultural background and that processing frameworks acquired in one culture are persistent and influence behavior even though contextual circumstances change (Erez & Earley, 1993). Another assumption in this approach is that people within a given country share common values, and these values can be used to distinguish one country's culture from another. Finally, they assume that similarity is easier for firms to manage than dissimilarity, thereby making it more likely that they will succeed.

A considerable body of literature in this tradition follows Hofstede's (1980) framework, which conceive organizations in each country as situated within a given cultural framework, from which they are a manifestation and a consequence. His four *cultural dimensions* are frequently used to describe a 'typical' national behavior. Their potential to make inferences and formulate hypothesis about organizational phenomena in cross-cultural analysis, as well as their potential to generalize findings across cultures explains a great deal of its wide use among scholars.

Many authors, however, argue that culture is a problematic determinant of variations in organizational functioning and structuring (Clark et al., 1999; Smith, 1992; Chapman, 1996). They point that, at the conceptual level, the most fundamental problem is the lack of any agreement as to how define culture. The distinction between 'culture' and 'nation' is a further problem. Even though 'nation' is a much broader construct encompassing social, political and economical institutions, within cultural studies, this concept has been indiscriminately used as proxy for 'culture' (Ferner & Quintanilla, 1998).

In this matter, Smith et al. (1996) cast doubts on the reliability of using cultural indexes as a reference frame to explain cross-country organizational differences. His findings show that despite of the different cultural backgrounds, a great deal of similarities marked the way managers tackle firm problems. For Shenkar (2001), the inconsistent results reported from *cultural distance's* impact on FDI mode and performance show that it may be too narrow a construct to capture the decisions of firm-level actors. Au (1997) demonstrates how cultural measures can be misleading when taken as discrete variables and not as population distributions. For Schein (1985), measuring cultural distance at the national level overlook differences that may exist within countries, industry, groups or individuals.

The culturalist approach has been also criticized in other fronts. Salk & Brannen (2000) provide evidence that poor performance does not emerge out of cultural differences but rather on how organizational contexts and individual members' orientations channel these differences. O'Grady & Lane (1996) shows that entering a psychically close country may paradoxically result in poor performance or even failure. Brannen (2004) shows that entering psychically close countries does not necessarily reduce the level of uncertainty, and in fact, might represent a persistent shortcoming once attempts to single out differences are often misleading.

Another point of attention is that much of the cultural debate on MNEs has been focused on dyadic contexts (home x host), with an emphasis on the adaptation of exiting competencies and capacities to new environments. A key assumption in this approach is that different cultures can be appropriated by interacting partners. *Acculturation* and *hybridization* are frequently quoted as means by which diversity in international settings can be resolved. Lam (1995), however, argues that such approach neglects the multidimensional nature of inter/intra-firm diversity and that cross-cultural blending may not be always feasible or indeed desirable. While the concepts of *adaptation* and *hybridization* aid in the specification of different practices in local sites, it can be argued that they do so at the expense of ignoring the dynamics of change associated with multinationals in these broader contexts.

Overall, cultural studies see diversity as a nuisance to be overcome or contained within MNEs. Although diversity is seen as a variable measure and subject to change, the focus on conflict and tension make their analysis limited and piecemeal. The term 'cultural diversity' when applied to organizational studies is either defined in psychological or behavioral terms and used as an 'omnibus variable' that account for various dimensions and levels of diversity without specifying how they are interconnected, and in what ways each dimension reduces or enrich collaborative organizational efforts.

2.1.4. Institutional Approach to MNEs: Between Convergence and Divergence.

Within an *institutional approach*, studies share an interest in structures rather than content and take into account firms' ability to produce both of them. In the study of MNEs two streams of research prevail. The traditional *phenomenological institutionalism* (DiMaggio and Powell, 1983; Scott & Meyer, 1994), is rooted in the idea that institutions are sets of cultural rules and norms. The more contemporary *historical institutionalism* (Whitley, 1992) argues that institutions are sets of structural arrangements stabilized at the level of the nations which serve as a context for different logics of action and multiple rationalities (Djelic & Bensedrine, 2001). Although departing from a common framework, these two streams arrive at quite different views of MNEs.

For *phenomenological institutionalists*, institutions are responsible for providing a coherent set of rules upon which structured interaction among actors is made possible (Aoki, 2001). Institutionalization operates at various levels, from the interpersonal to the supranational, such that the wider social and cultural world is infused with long-term processes of rationalization. Social actors feel compelled to adopt positions that are consistent with rationalized beliefs held at large in society (Scott & Meyer, 1994). In this sense, institutional frameworks powerfully shape the reaction space of actors both by defining the scope and nature of new problems, as they operate as filters for environmental stimuli on how actors perceive changes, and by limiting the set of available alternatives. By structuring both preferences and power, the institutional framework constitute a matrix of incentives and constrains that militates toward some kind of behavior and away from other.

Authors in this line, argue that global pressures are leading to the increasing convergence of both governance structures and business practices (Alvarez 1998; Chandler, 1990; Ohmae 1995, Scott & Meyer, 1994). Benchmarking, mergers and acquisitions, international management consultant firms, specialized press, and business schools are among the main sources of external *isomorphic pull* (Moen & Lilja, 2001). Tainio et al. (2001) add that institutional investors play a central role in disseminating the so-called *shareholder value orientation* (i.e.: liquidity, short-term returns, and risk diversification) which drives corporate restructuring worldwide. Internally, as MNEs expand their reach, they feel compelled to closely integrate their activities and make the best use of its resources and competences, differences are formalized and made available for use in other parts of the company. The enforcement of '*best practices*' represents a move away from diversity and is manifested in the standardization of management tools and modes of organization.

If *phenomenological institutionalists* take institutional fields at large, *historical institutionalists* (or neo-institutionalists) have traditionally described MNEs as social constructions shaped by their home contexts. They assume that the home context shape the strategies and structures of these firms as well as the way they internationalize and behave in foreign contexts. Overall, authors in this line advocate that the behavior of a MNE is significantly influenced by its home-country institutional framework.

The concept of *national business system* (NBS) (Whitley, 1992) is a central construct for this stream. For NBS theorists, institutional arrangements reflect key phases and formative events in the evolution of the nation-state, such as the manner and timing of industrialization, the process of class formation, the development of political representation, as well as the role of the State itself. These State-level institutional fields influence market structures, financial system, collective bargaining, skill formation, corporate governance, intra-firm labor division, and control systems, which are key elements to understand firms' business behavior. Therefore, NBSs can be seen as 'clusters' of interlocking institutional and business-related cultural elements that shape the behavior of firms rooted in them.

Although evidence shows that MNEs indeed display characteristics from their *home-country* NBSs (Egelhoff, 1984; Erramilli, 1996), many authors demonstrate that MNEs may be prevented from moving them abroad due to countervailing *host-country* NBS influences (Bélanger et al., 2003). Hayden & Edwards (2001) show that the diffusion of employment practices within MNEs is severely hampered by local labor laws, and trade union organizations. Béret et al. (2003) argue that the influence of local practices persist in HRM despite attempts to establish global guidelines. Rosenzweig & Singh (1991) suggest that HQ influence over different aspects of subsidiary management depends on the strength of countervailing local isomorphic pressures arising on the subsidiary side. According to Sharpe (2005) the fact that MNEs selectively transfer practices due to local constrains, reinforce diversity rather than reduce it.

At the convergent front, Westney's (1993) argues that the institutional framework fails to explain how firms deal with competing isomorphic pulls arising from the many different environments they participate. Morgan (2005) claims that competitive pressures stimulate firms into more differentiation and not to less. Béret et al. (2003) suggests that even when companies adopt foreign guidelines, they do that in manners that retain a considerable number of elements characteristics of the local NBS, a process identified as *hybridization*.

At the divergent front, many authors argue that examining MNEs in terms of national business systems leads to an incomplete picture of the phenomenon. Bélanger et al. (2003) claims that multilevel interactions and increasingly interconnected stakeholders across the globe challenge the notion of closed system that permeate most of NBS theory. For Morgan (2005), national institutional contexts are not as monolithic and internally homogeneous as supposed because their systemic linkages are neither tight nor entirely complementary. Ferner & Quintanilla (1998) suggest that institutional analysis appears at times to be rather vague in specifying the precise mechanisms whereby conflicting isomorphic pulls become translated into particular outcomes within MNEs.

As debates over the role of diversity in MNE organization seemed to have stuck between convergence and divergence of institutional paths, some authors call for an emphasis on *strategic action*. Within an '*actor-centered*' view (Herrigel & Wittke, 2005; Hancké & Goyer, 2005), MNEs are viewed as populated by *strategic actors*, who, although constrained by national business systems, simultaneously possess some capacity of independent action. *Institutional frameworks*, they argue, have the capacity to offer alternative adjustment paths that cannot simply be read-off following the conventional views. The creative use and the re-articulation of existing elements of the *institutional frameworks* by *strategic actors* allow them to adopt unpredictable paths. Therefore, institutions are seen as influencing the range of effects but not determining the outcomes (Sorge, 2001).

According to Ferner & Quintanilla (1998), research on such complex conjunction of forces calls for a greater attention to the power relations of organizational and institutional actors, as long as actors within subsidiaries may find in local institutional constrains a power resource in negotiating their relationship with the parent company. In that sense, it is useful to view MNEs as firms with complex internal processes of contradiction and conflict which are the outcome of political negotiation between actors in and around the company.

2.1.5. Politics as MNE Resultant

Botti (1995) argues that subsidiaries may be considered as places where organizational knowledge can be translated and negotiated. Sharpe (2001) suggests that multinationals are sites of negotiation and conflict in which the underlying mechanisms of different business systems and actors come into confrontation and contest. For Morgan et al. (2003), once firms go abroad, they create new social spaces (*transnational social space*) where well-accepted practices and routines are confronted

in the light of alternative ones. What was taken for granted at home-country need once again to be made explicit, communicated, negotiated and implemented in the new context. In this process, actors try to make sense of these changes not by drawing on old models or repertoires but by developing new understandings. Once the experience of internationalization has been absorbed into the firm, the internal organizational space no longer remains the same.

Bélanger et al. (2003) see MNEs as complex political organizations where the 'management by facts' discourse does not always prevail in corporate decision making. Local subsidiaries are monitored and constrained in a variety of ways and must necessarily engage in the internal political process. In their view, innovation emerges as a result of a two-way political process in which the interpretation of market trends and opportunities developed both at corporate and subsidiary level are tested and mediated. For Ferner (2000), the notion of *interpretation of market signals* brings into evidence the political dimension in the relationship between MNEs and subsidiaries.

Also, there is strong evidence that over time a rather large fraction of subsidiaries develop strategies for expanding their mandates (Birkinshaw & Hood, 1998). An unintended consequence of this process is that subsidiaries are more able to grow and survive by pursuing subversive strategies than by sticking to their original mandates. Empirical evidence shows that subsidiaries are more prone to engage in technological innovation (and gain independence of HQ) by communicating with external actors in their local context than by getting along with their sister units (Tregaskis, 2003). Another unintended consequence of subsidiary evolution is that as they increasingly become insiders in their local business systems, they tend to appear outsiders to their parent companies (Sölvell and Zander, 1998).

In this sense, Kristensen & Zeitlin (2001) suggest that beyond the initial phase, it becomes highly unclear what type of logic will dominate MNE's development. The more subsidiaries enter into MNEs composition, the more MNEs become ground for mutual competition among a variety of aspirations and goals and home for ambiguity and heterogeneity. Conflicts and alliances that may go on within individual persons, professional groups, and across subsidiaries make it very unclear which strategic lines are dominant and which principles shall guide control, coordination and the division of labor within MNEs.

Although terms like *heterarchy* do capture this situation, these multilayered networks are more probably the result of an unintended process where MNEs structures are caught in games of strategic interaction among many agents each following distinct *logics of action*. Indeed, the evolution of a MNE depends on whether this interaction converges towards a virtuous or vicious pattern of interaction. Key in this debate is the notion that the continuous success of MNEs depends on how well subsidiaries interact, compete and cooperate despite their differences (Kristensen & Zeitlin, 2001).

For Djelic & Bensedrine (2001), *political action* is the processes by which common understandings and logics of action, reflecting the multiplicity of actors, the diversity

of interests, and the balance of their resources, can emerge. Even in business, interests are far from driven only by an economic logic, being predominantly political elements framed by an institutional framework in which debates take place.

Pierson (2000) briefly addresses how troublesome it is to exchange economics for politics in the organizational debates. The metric for good performance in economic terms is relatively simple and observable while politics is a far murkier environment. It is often very hard to observe or measure important aspects of political performance as there may be long lags and complex causal chains connecting political actions and their outcomes. While we may assume that economic actors are concerned primarily with profits, political actors are likely to pursue multiple simultaneously untenable goals (Deeg, 2005).

In this line, Ferris & Judge (1991) question the ability of a rational strategic approach, focused on structures to control activities and ensure trust and bring the interests of both individual and organizations across borders into a strategic 'organizational fit'. They argue that the supplementary issues of competing interests, power and politics should be taken into account to explain the subjective evaluative reality that pervades coordination in complex settings. Authors in this line, argue that political influence, promoted by competing influential actors, exerts deep influence over information flows and decision criteria used across all strategic decisions.

2.2- POLITICS IN ORGANIZATIONS

2.2.1. Politics as an Organizational Phenomenon

Authors have traditionally addressed politics within organizations in negative terms. Kanter & Brinkerhoff (1981) characterize organizations as "battlegrounds" where stakeholders with different interests compete to influence critical decision criteria on their benefit. For Rosen et al. (2009), organizational politics represent illegitimate self-serving behavior which happens at expense of the welfare of the organization and co-workers, and is perceived as harmful, and divisive. Mintzberg (1985) sees political activity within organizations as intrinsically conflictive as organizational actors mobilize their resources to turn the balance of power on their favor.

Despite his negative bias, Mintzberg (op.cit) recognizes situations under which politics display a functional role within organizations. Among them, he highlights:

- Politics help to correct dysfunctional allocations of power;
- Politics encourage necessary organizational change blocked by the *status quo*;
- Politics allow room for different sides of an issue to be explored;
- Politics provide alternate channels of information and promotion;
- Politics help build legitimacy around decisions to be made.

Authors like March (1962), go further by addressing firms as being intrinsically political entities driven by "political coalitions" (p.672). Others like Milgrom & Roberts (1988) consider politics a key variable within firm's economic behaviour.

For Buchanan & Badham (1999), political behavior can be simultaneously deployed in the defense of organizational goals and for personal purposes. Therefore, dichotomies such as *legitimate x illegitimate*, *sanctioned x unsanctioned* and *self-serving x altruistic* are frequently inappropriate. In the same line, Ferris and Judge (1991) see power and politics as facts of the organizational life and political activity as a value-neutral process, which is neither good nor inherently bad.

Hickson et al. (1986) stress the important role political process display in *decision making*. Schwenk (1989) suggests that political activity affects the way group level alternatives reach top management level for discussion and how consensus is reached among top managers. Butler et al. (1991) view decision making as composed by a technical side (find the best solution) and a political one (resolving divergent interests). Under conditions of complexity and uncertainty, technical problems may impose a degree of subjectivity which extends the relative weight of political processes in decision-making. Besides, other personal level features also affect political influence in decision-making, such as the extent to which decision makers are held accountable for subordinates' decisions, the extent to which they are prepared for the decision task, and thus not susceptible to political influence, and characteristics of their personal agenda, which drives his pursuit of allegiance.

For Ferris & Judge (1991), the ambiguous nature of work performance provides opportunity for the political management of meaning. Ouchi (1977) shows that performance evaluation frequently incorporates subjective attributes like cooperation, teamwork and attitude, which easily extrapolate into more subtle and personal ones such as liking, similarity and fit. In these circumstances, individuals monitor the environment to discover cues regarding superior's preferences and social approval to boast their perceived performance. Even organizational goals can have their meanings politically managed. Thompson (1967) notes that in condition of uncertainty, preferred measures of firm effectiveness shift to satisfaction of external constituencies, that is, towards external legitimacy. According to Ferris & King (1991) the reestablishment of legitimacy during crisis is often accomplished through active efforts to manage collective meaning.

A number of authors suggest that promotion systems and management succession are highly political in nature. On the one hand, the outcomes of succession are informative of the dominant coalitions or most influencing interests at the time. Dominant interests attempt perpetuation in power through promotion of supportive individuals (Cohen & Pfeffer, 1986). On the other hand, managers actively use *reward allocation* to increase their influence in organizations (Barton & Martin, 1990). As managers mediate the contact of subordinates and top management, they are in position to manipulate available information about their ability, reputation and fit, to favor those they are supportive. Once a candidate is labeled "successful", decision-makers are influenced towards providing more resources to these "winners" and making favorable future evaluations. Therefore, luck tends to favor initial winners, while losers are stigmatized and if allowed to compete again it is at a different level with reduced status and rewards (Ferris & Judge, 1991).

For Brass (1984), network centrality in work-related communication network is a key predictor of power. For Pfeffer (1992), the power that derives from information control derives largely from one's position in both the formal and informal communication networks. According to Krackhardt (1990), however, power accrues not only to those who occupy central network positions in organizations but also to those who have an accurate perception of the information network in which they are embedded. Deep knowledge of the power landscape allows individuals to spot powerful actors, map coalitions and assess their weakness. Accurate assessment of the network gives an edge in anticipating resistance and in mobilizing support for action and change. It can also reveal weaknesses in political groups by exposing holes, gaps, and locations of lack of support. Therefore, one way to address political landscapes is by mapping the information flow in organizations.

2.2.2. Politics as a Mechanism of Change

McLoughlin & Badham (2005) point that many organizational dynamics and their consequences are the products of choice and negotiation by powerful individuals and groups within organizations. As such, the choices made during the process of change should be recognized as both temporal and hierarchical in nature, as involving a wide range of actors and as being shaped at each stage by the social dynamics produced by the prevailing distribution of power and the differing world view of actors.

For Lucas (1987), organizations are constructed out of processes of conflict involving interest groups. These groups engage into political processes in order to accommodate their interests into a structured equilibrium, which closely approaches the notion of *negotiated order* as proposed by Strauss (1978). A *negotiated order* comprises a set of rules operating in the organization at any given moment. In this sense, each organization is seen as an experiment in struggle, composed by diverse groups trying to overcome the unintelligibility of their own diversity into a common situation

Similarly, Ferris and Judge (1991) assume that organizations are composed of varied actors with diverse interests that can act deliberately to influence *shared meanings* in order to produce the outcomes desired. This frame assumes that the complexity and ambiguity inherent in organizations is acted upon by individuals who create and manipulate meanings. According to their view, *shared meanings* are collective responses to social events and the subsequent interpretations people make about them, and thus, provide guidelines for organizational behavior.

Rodrigues (2006) suggests that politics play a key role in organizational culture change. She argues that as it is difficult to attain cultural consensus beyond the scope of particular groups. As these groups vary in their capacity to mobilize material and symbolic resources, one of them may become dominant, either by accommodating a wider range of interests or by addressing specific situations better than others. This *subculture* thus becomes "the" *organizational culture*, and its dominance lasts while it fulfills the symbolic needs of the organization or holds necessary resources or

external legitimacy. At this point opposing groups engage into political action to replace the dominant group and to elicit a new organizational culture.

The literature of organizational change is fragmented and deals with political behavior from a range of stances. For Buchanan & Badham (1999), the *contextual/processual approach* to change is the one that better addresses the role of political factors in implementing organizational change, as it recognizes the non-linear dynamics involved as well as the enabling and constraining characteristics of the context. In their view, the more widespread the implications of organizational change, the greater the political involvement required by the change agent.

Thompson & Purdy (2009) see organizational politics as a multi-layered process involving increasingly abstract levels of power within organizations. At surface, they see power stemming from direct leverage over resources, with actors acquiring or expanding their power from tactics such as sponsoring, lording, and rule citing. Below surface, power is shaped by indirect influence through communication manipulation, resource/outcome control, and managing/resisting change, with actors employing tactics to frame decisions or control who participates in the decision making. At the lowest and most invisible level, power emerges from the *deep structures* of the organization, which reflect social and historical roots, and shape what actors view as possible or not (i.e.: *institutional knowledge*). At this level some actors employ tactics to favor one social reality over other possible alternatives, thus advantaging some interest groups at expense of others.

Similarly, Lawrence et al. (2005) suggest a connection between politics and learning and argue that this link is able to explain why some organizations are better able to learn and why only few innovations are embraced by organizations. They propose a framework that extends Crossan et al. (1999) learning process by adding the role of power and politics. As a result they propose a cyclical organizational learning model primarily moved by political processes, where each of the four stages - intuition, interpretation, integration and institutionalization – are set in motion (or blocked) by a particular form of power and its associated political strategies. Overall, they argue that influence helps overcoming ambiguity and uncertainty associated with *interpretation*, force facilitates collective action during *integration*, domination overcomes resistance to change and supports *institutionalization*, and discipline enables the development of expertise necessary for *intuition*.

Frost & Egri (1991) build further upon the notion that power exists at numerous levels arguing that similar process can occur between organizations as well as within organizations. Drawing on this argument, Elg & Johansson (1997) suggest that firms within a network not only make moves to pursue their interests, but also develop more subtle activities that prevent issues from being discussed and actions from being taken. They also highlight that a certain degree of stability is a precondition for change to occur, otherwise uncertainty would jeopardize investment made in current relationships as well as strategic advantages of belonging to the network.

Based on these assumptions, Thompson & Purdy (2009) propose a model that establishes a relationship among innovation, organizational context and political action. Drawing on Frost & Egri (1991), they assert that the more innovation is congruent with “*deep structures*”, the smaller the range and intensity of political action, and therefore, the higher the probability of an innovation being successfully implemented. Political action, thus, is the direct result of actors’ conscious or subconscious reactions to the fit between “*deep structure*” and *innovation*.

Nevertheless, they recognize that far from being a unified construct, “*deep structures*” can embody substantial amount of conflict (i.e.: heterogeneity). In their view, the more “*deep structured*” is the conflict, the less likely perceptions of congruence will converge because actors are assessing innovation against different elements and interpretations of the deep structure. Therefore, they call upon an alternative construct identified as “*agreement about congruence*” which refers to actors’ perceptions of the degree to each innovation fits the deep structure.

Similarly, Clemens & Cook (1999), argue that institutional change rests on an appreciation of the heterogeneity of institutional arrangements and the resulting patterns of conflict or prospects for agency. In their opinion, institutional change is more likely when models of action are understood to be discretionary, institutional heterogeneity is high and social networks are fragmented and extend across significant social distances. In their view, innovation is generated by networks that crosscut institutional boundaries while societal heterogeneity constitutes loci of structural indeterminacy that may be exploited by political entrepreneurs.

2.2.3. Venues of Political Action

Ralston (1985) suggests that political activity is likely to occur in environments or situations characterized by a high degree of ambiguity or at low-density knowledge. In the absence of clear collective evaluation criteria reliance is often placed on a more personal subjective one.

Underlying this argument there is a distinctive kind of political action called institutional entrepreneurship. The essence of institutional entrepreneurship is to skillfully contrast, align or transpose organizational institutional forms with those from the outset. Political entrepreneurship presumes a degree of fragmentation or the availability of alternative models for mobilization and intervention. Institutional entrepreneurs seek to transpose models of collective action from one social setting to another in order to enhance the available set of alternatives and therefore shape the political space. The presence of alternatives creates the space for political action and policy innovation.

For Clemens & Cook (1999), success in articulating, passing and implementing policy often depends on embedding a proposed program in an array of supportive constituencies. In this sense, effective politicians may enhance the attractiveness of a particular policy by building deep analogies to already institutionalized models or widely held norms. Therefore, the institutional effects attributable to normative

legitimacy and socialization are reinforced by the mobilization of a set of stakeholders and alignment of incentives. Institutional arrangements, however, have great capacity for eliminating alternatives. They may suppress alternatives either by decoupling the components necessary to enact a particular policy or by reinterpreting experience (Ellingson, 1995).

Perhaps the best known influence tactic is *ingratiation*, which can take a number of forms such as favor doing, flattery, opinion conformity, and subservient behavior. Kipnis & Van der Veer (1971) provide evidence that a subordinate who engage in ingratiation receive above average positive performance ratings. Other type of influence tactics is *self-promotion* which involves verbal claim of responsibility for positive events or outcomes that have occurred even when one cannot rightfully be credited with such outcomes (*entitlement*), and attempts to exaggerate or make more of one's accomplishments than is justified (*enhancements*). Some studies have also examined *goal setting* as a potential political influence tactic. Dosset & Greenberg (1981), for example, found that managers give higher performance ratings to workers who set higher goals, regardless of their actual performance.

Dawson & Buchanan (2005) call attention to the role of *organizational narratives* and the political processes involved in creating *compelling stories*. In their view, *narratives* are significant carriers of knowledge and understanding within organizations and provide a powerful tool not only for communicating *meaning*, but also for establishing the hegemony of a particular interpretation of organizational events. In their view, history may be rewritten to service current political aims and to shape perceptions of future outcomes. As such, a *compelling story* can be viewed as a venue of influence and *story-telling skills* as a power resource akin to expertise and personal influence.

Drawing on Emerson's (1962) notion of power as a function of available alternatives, Gargiulo (1993) shows that actors build ties of interpersonal obligation with people directly affecting their performance in the organization, but whenever divergences emerge within ties, their focus turn to building new ties with people able to constrain the performance of the diverging party. Therefore, individuals try to enhance their power positions not only by building direct alliances to tap into resources but also by building indirect alliances to block the access of others to key resources.

Graen et al. (1982) suggest that perhaps the most important characteristic bosses look for in subordinates, which leads to these subordinates being evaluated more positively and achieving in-group status, is the extent to which the subordinates think like them, mimic decisions, and provide support on matters of importance to bosses. Behind this assumption is the principle that *similarity* leads to attraction because it increases one's confidence that his or her opinions are correct. Ambiguity contributes to conformity and consensus in beliefs because individuals actively seek support and legitimacy for their own ideas. Ferris & Judge (1991) remind that once evaluations of *fit* and *similarity* are highly subjective, they represent a substantive object of meaning management through political influence.

Kanter (1993) coined term *homosocial reproduction* as the characterization of promotion systems in which decision makers favorably evaluate and promote people just like themselves. Similarly, March (1984) observes that most evaluation and mobility systems are essentially filters that screen people on the basis of similar attributes, thus serving to reduce variation and increase homogeneity among managers in the firm.

Some authors go further by acknowledging that *similarity* is able to exert influence downstream into recruitment. Beehr & Gilmore (1982) demonstrate that physical attractiveness (including grooming and attire) can be considered a channel of influence over recruiters by conveying a sense of *similarity*. Gilmore & Ferris (1989) indicate that managers prefer recruiting individuals similar to themselves because it would allow them to extend more easily their coalition and build up their power base. Although this does not imply managers will actually use influence tactics in the selection process, it does suggest that political motives may underlie selection decisions. Cohen & Pfeffer (1986) argue that hiring standards are a visible outcome of competing interests trying to gain control over personnel selection decision criteria.

Pfeffer & Fong (2005) argue that the principle of *self-enhancement*, or the tendency of individuals to see their actions in positive light, is at the origin of many organizational phenomena underlying the misuse of power and influence processes, such as escalating commitment, similarity attraction, avoidance of self-evaluation, overestimation of self-efficacy, perseverance of hierarchy and autonomy suppression and disinhibition.

2.2.4. Limitants for Political Influence

The situations shown above elaborate the argument that the intentional management of shared meaning can be played out quite effectively in organizations through personnel selection, performance evaluation and intra-organizational mobility (Ferris & Judge, 1991). Parker et al. (1995) argue that whether political behavior proves beneficial or harmful to the organization depends more on how that behavior is perceived rather than reality. As such, they suggest managerial action to help reduce perceptions of organizational politics, like instilling a sense of organizational purpose, give minority groups a voice in decisions and reducing employee ambiguity.

Political behaviors are neither equally effective nor similarly perceived. Baron et al. (1986) highlight that political influence attempts can backfire if taken to extreme. If the target interprets the attempt as a conscious effort to manipulate, they likely will react negatively. Ferris & Judge (1991) point that more research is needed to better establish the effectiveness of different tactics in different contexts. Strategic-assertive tactics such as prestige, status, credibility and reputation are in need of more longitudinal research in order to be more fully understood.

CHAPTER III

MNE DYNAMICS

3.1- THE MANAGEMENT OF MNEs

3.1.1- Types of MNEs

A considerable number of authors (Forsgren, 1989; Hedlund & Ridderstrale, 1997; Harzing, 2000), regard MNEs generically as territorially and functionally differentiated inter-organizational networks characterized by a complex structure in terms of resources, loci of decisions and influence. Nevertheless, a vast literature in international management recognizes the existence of different types of MNEs and many are the terms used to distinguish them. Polycentric, Geocentric, Ethnocentric, Multidomestic, International, Global and Transnational are among the commonest expressions used to designate these different forms of acting internationally (Harzing, 2000).

Among current typologies, the most extensively used is certainly the one proposed by Bartlett & Ghosal (1989). In their view, companies with international operations could be arranged according to *strategy* and *structure* into four types: *Global*, *Multinational*, *International* and *Transnational*. Other alternatives have attracted attention as well, such as the one proposed by Prahalad & Doz (1987) in terms of *integration* and *responsiveness* as *multidomestic* (low integration/high responsiveness), *Global* (high integration/low responsiveness), *transnational* (high integration/high responsiveness), and *international* (low integration/low responsiveness), or the role-based typology proposed by Birkinshaw & Morrison (1995) which divide subsidiaries into *local implementers*, *specialized contributors* or *world mandate*.

Building on Prahalad & Doz (1987), Harzing (2000) noted that despite great convergence of terms meanings were not consensual. Her analysis also indicated that convergence of meaning often took place along a continuum of circumstances where *integration/coordination/globalization* advantages were weighted against *differentiation/responsiveness/localization* ones. However, the notion that not every subsidiary played the same role within MNEs (Martinez & Jarillo, 1991) remained quite annoying and raised several questions against the accuracy of the strategy/structure approach. Exploring this perception, she proposes to classify MNEs not only in terms of *strategy* and *structure* but also in terms of *responsiveness* (extent to which subsidiaries respond to local differences in customer preferences) and *interdependence* (extent to which various unit of a MNE are dependent on each other). As a consequence, three concepts of MNE emerged from her analysis: *Multidomestic*, *Global*, and *Transnational*.

Multidomestic companies usually operate in industries submitted to strong local demands, mostly determined by cultural, social and political factors. High responsiveness to these demands is usually obtained through local production, considerable proportion of local R&D and careful marketing attention. This intermittent adaptation require loose structures of control, generally in form of a decentralized network, what explain the relative independence that subsidiaries presents in relation to headquarters and the reduced flow of products and ideas in circulation.

Global companies operate in industries with relatively standardized consumer needs, where cost-efficiency based competition requires a remarkable level of rationalization and integration of production. Subsidiaries typically fulfilled roles as “pipelines” for headquarters, with sales and purchases depending heavily on its decisions. They are not supposed to respond to local market demands and when they do so odds are that it is limited to marketing adaptation and cosmetic changes in the product.

Transnational companies, on their turn, are those who have to respond simultaneously to the sometimes-conflicting strategic needs of global efficiency and national responsiveness (Kamoche, 1996). MNEs of this kind pursue a general strategy based on realizing synergistic linkages between sites across borders. In this sense, these companies can be characterized as interdependent networks built from an intensive flow of people, products and knowledge stretching all over the organization. A combination of specialization and local market sensitivity pervades most of subsidiaries and the interrelations among subsidiaries outweigh those with headquarters. HQ in transnational firms is expected to dedicate less effort to constraining and directing subsidiary action, and more to evaluating and arbitrating such action (Edwards, 1998).

Lane (2001) draws a clear line between *multinationals*, in a general sense, and *transnationals*. Whereas *multinationals* had their features linked to their home country institutional environment, *transnationals* are influenced by several countries. Their subsidiaries enjoy greater autonomy and a high level of discretion over local resources. Freed to become more embedded into their host countries, transnational subsidiaries are able to engage into learning processes that may lead to new organizational structures, practices and competences. As long as they remain integrated with other subsidiaries and to headquarters, their organizational and technological innovations can be channeled back and change the company as whole.

3.1.2- Internal Dynamics and the Evolution of MNEs

Edwards et al. (1996) call attention to the fact that MNEs may occupy more than one cell of a typology. Bélanger et al. (2003) provide evidence that even within a particular host-country, the pattern of HQ-subsidiary relations may vary from one subsidiary to another, and in relation to the same subsidiary along time. Relationships with some subsidiaries may reflect dependence whereas others may be more integrated due to the different roles they are in charge. Such *intra-company variation* is thought to reflect not only the relevance of subsidiary behavior, as is stressed in the contingent models, but also the accidents of history and the outcomes of organizational politics.

Although researchers have traditionally assumed that ownership-specific advantages are developed at HQ and leveraged overseas (Dunning, 1981), as subsidiaries grew in size and developed their own set of unique capabilities, it became apparent to many researchers that headquarters was no longer the sole source of competitive advantage to the MNE. According to Birkinshaw & Hood (1998), *subsidiary evolution*

can be interpreted as the change in subsidiary mandate, as result of accumulation or depletion of capabilities over time. These authors emphasize the importance of understanding how these roles change, especially in terms of driving-circumstances and managerial processes. In general terms, they propose that *track record*, or the extent to which subsidiary has consistently delivered results, is one of the critical factors affecting subsidiary evolution.

Internal competition for charters is another fundamental force behind subsidiary evolution. *Competitive internal resource allocation* can be felt through corporate-wide systems that are built to foment internal competition, either by allowing bids for new investments or by creating a system through which existing charters can be challenged by other units (Galunic & Eisenhardt, 1996). The concept of *internal markets* (Rugman, 1981; Caves, 1998; Buckley & Casson, 1998a) expands this view regarding the competition for charters to encompass the role set of exchanges within MNEs. The existence of *internal markets*, they argue, provides divisional managers with an opportunity to bypass weak or incompetent sections of the company, and provide units with competitive discipline on internal transfer prices, preventing their manipulation for political ends. As such, *internal competition* is deemed critical to the capability enhancement process and is thought to act as buffer to the sometimes destructive effects of erratic external competitive forces.

Forsgren (1990) argues that one of the consequences of subsidiary evolution is that the hierarchical power of the corporate HQ can be counter-balanced by the resources gained by subsidiaries as a result of their participation in local networks. In his opinion, MNEs can be devised as '*loosely coupled political systems rather than tightly bonded, homogeneous, hierarchically controlled systems*' (p.294). Doz & Prahalad (1991) also advocate that the study of resource-based power and dependence relationships in MNEs can complement the analysis of structural sources of power (i.e., stemming from position in the formal organizational hierarchy). Similarly, Ghoshal & Bartlett (1990) view MNEs as inter-organizational networks where power at subsidiary level emerges not from the role assigned by HQ, but from the position it occupies in the local network of stakeholders. The concepts of *heterarchy* (Hedlund, 1986) and *transnational* (Harzing, 2000) are attempts to explain the role played by subsidiaries in corporate competitiveness.

In this line, Bartlett & Ghoshal (1989) advocate for an *evolutionary model* of the MNE. Such evolution would start from the *multidomestic* form, with their dispersed and loosely coordinated subsidiaries, proceed to the *global* form, more coordinated and centralized, then follow to the *international* form and their federated structure, until finally reach the top of the evolution as a *transnational*. As such, the transnational status would reflect the inability of other structures to handle the inherent complexity of deeper modes of internationalization. *Transnationality* would be marked by different contributions stemming from various national branches, with knowledge being shared multidirectionally and organizational structures resembling more of a matrix, and less of a hierarchy. The transnational solution is an attempt to blend hierarchies and networks in order to retain value creation largely within the range of a given MNE.

Additionally, Malnight (1996) argues that dramatic changes in the competitive environment are impelling many MNEs to move from decentralized to network-based approaches. In his opinion, two fundamental adjustments have been responsible for the gradual linking and integration of previously autonomous affiliates. First, the rationalization of duplicated resources across national markets towards specialized centers performing activities that meet global requirements. Second, the improvement of control mechanisms, beyond financial-based ones, prompted subsidiaries to exchange resources and capabilities further enhancing their level of interdependence.

3.1.3- MNEs and the Management of Interdependences

Traditionally, the extent to which an organization can be operated interdependently with other organizations was assumed to be constrained by limits imposed by information-processing capacity and physical distance. As information and communication technologies have advanced, interdependent operations become much more attainable, and in fact, desirable (Child & McGrath, 2001). Majumdar & Venkataraman (1998) highlight that a key aspect of interdependent systems is that the outcome for any party to a transaction is fundamentally entwined with the actions of and the outcomes for other players. This meshing makes the management of interdependent systems particularly complex. A change in one component of an interdependent system produces unpredictable changes in others, thus leading to coordination problems.

According to Harzing (2000), all MNEs are characterized by some level of interdependence. *Interdependence* indicates the extent to which units of a MNE are dependent on each other. As Caves (1992) argues, there must be some transactional advantage in placing geographically dispersed operations under common administrative control. In his view, it is through the *management of interdependences* that MNEs accrue the necessary rents to cover the transactional costs associated with geographic dispersion and to reward the required investments. In this sense, *interdependence* within a MNE is not only a given condition but also a key element to achieve competitive advantage.

Bartlett & Ghoshal (1989) suggest that the level of interdependence varies across the different models of MNE. Kostova & Roth (2003) credit this variability to the nature of the resource flows between headquarters and subsidiaries. According to these authors, the level of interdependence ranges from *low* in the multidomestic to *high* in the transnational model. The type of interdependence goes from *simple* to *complex*. *Simple interdependence* occurs when the resource flows between entities occur at few points and are easily specified. *Complex interdependence* reflects a situation where resource flows and exchanges are indeterminate owing to high levels of change, ambiguity and unpredictability. There is uncertainty as to what resources should be exchanged, and where and when the supporting interactions should occur.

While *simple interdependence* can be managed through structural arrangements (e.g., formal reporting, policies and procedures), *complex interdependence* limits the possibility for a complete a priori specification and design of formal arrangements. Such conditions place an increased emphasis on informal means of coordination and control (Bartlett & Ghoshal, 1989). They also require supplementing the simple written and verbal means of interaction with more intensive and rich forms (e.g., face-to-face, nonverbal, shared cognitive structures), which have the capacity to support complex relationships (Daft & Lengel, 1986).

Edward et al. (1996) devise two routes for managing the kind of interdependences that arise in international operations: *synergetic interlocks* and *financial control*. *Synergetic interlocks* result from the development of vertical and horizontal integration between operating units, together with a frequent use of meetings, the regular transfer of staff and a team or matrix approach to decision making. *Financially controlled* firms manage their subsidiaries through financial rewards and penalties (Hill & Hoskisson, 1987). However, empirical evidence demonstrates that firms do not fit neatly into these *ideal-types*, which would rather be seen as diverging tendencies that interplay at many different levels.

3.1.4- Mechanisms of Coordination within MNEs

According to Béret et al. (2003), coordination may be maintained by mechanisms that are formal (budgeting, auditing, committees), informal (e.g.: international mobility, quasi-mobility of key personnel, culture), or hybrid (e.g.: projects). These mechanisms are not mutually exclusive, and they interact to a considerable extent (Ferner, 2000). Such coordination is supposed to give the firm enhanced competitiveness, flexibility and, above all, capacity for learning.

MNEs typically design appropriate mechanisms of formalization and centralization to mitigate uncertainty generated by internal and external sources and thus increases the efficiency of corporate governance. *Formalization* provides explicit norms (i.e., rules and procedures) of desirable behavior whereas *centralization* establishes legitimacy of the decision-making authority through a hierarchical design of governance (Roth & Morrison, 1990). However, formal mechanisms are generally not sufficient to achieve the necessary level of coordination a globally oriented organization requires. In this line, Grant (1996a) reminds that the more firms resemble "*institutions for integrating knowledge*" the more hierarchical/formal coordination is expected to fail. Similarly, Whitley (2005) points that international coordination through planning and regular communication may be quite straightforward when problem solving activities follow relatively predictable trajectories, however it becomes more difficult as the importance of tacit knowledge increases and uncertainty grows.

The prototypical form of collaboration enacted by most MNEs is interface collaboration (Lam, 1995). *Interface collaboration* typically involves a clear division of labor across the interacting organizational units. That is, each side pursue an independent goal in developing one part of the collaborative effort and join forces at

the end to link the separate development into a final work. Overall coordination between the partners takes place via a small number of interface managers or senior specialists who occasionally meet to exchange information and make critical decisions. Necessary communication and information exchange at the operational level is conducted, as far as possible, via video or telephonic conference and through electronic mail. *Interface collaboration* allows firms to manage the boundary relationship with caution while maintaining tight control over the flow of information and sensitive knowledge, and thus, happens to be the preferred method for cross-border collaboration.

According to Lam (1995), however, *interface collaboration* is a potentially unstable form of interaction in organizational settings and presents many limitations. In her opinion, *interface collaboration* confines the flow of information and coordination to a small number of interface points at the senior level while, in practice, the span of issues involved in complex joint works tends to defy such few contact points. Additionally, *interface collaboration* constrains the rapid multidirectional exchange of information and makes a joint work difficult also by restricting the scope of collaboration between interacting parties. Finally, she argues that *interface collaboration* can also impede the development of trust and open communication as it restricts opportunities for actors to form close working relationships and a common language to address their exchange needs.

Some authors (Tung, 1993; Napier, 1989) assume that mutual adaptation and organizational learning will bring about a '*hybrid organization*' based on blending and mixing of diverse policies and practices. According to Novicevic & Harvey (2001), integrating personnel mechanisms such as strategic global staffing, global task forces, and oversight committees are mechanisms that lead to *mutual adjustment*. Dowling et al. (1999) argue that the process of lateral integration enable corporate and subsidiary managers to share the same strategic logic in their operating philosophies and orientations. The relationships derived from these mechanisms are expected to delve into 'soft' structures which function both as informal control devices. Harvey and Buckley (1997) also note a trend towards the use of *inpatriates* for coordinating roles in lateral integration mechanisms. They define *inpatriates* as local or third-country nationals that are carefully selected within organizations network and intensively developed at the regional and/or corporate level.

Lam (1995) argues that differences between organizational units within MNEs are so ingrained with their national institutions and societal contexts (notably in terms historical heritage, labor market structures and education/training systems) that they cannot be easily reconciled through organizational learning. Organizational learning will only enhance understanding but not integration and firms engaged in cross-national collaboration will have to actively deal with the persistent tension between different and sometimes contrasting systems of work. She also calls attention to the fact that integration might not necessarily be desirable as long as intra-organizational diversity, though tension-inducing, may contribute positively to engender multidimensional perspectives that are essential to help firms to cope with the complex and fast moving demands of global product markets. Moreover, diversity of

perspectives and specializations may represent an important source of hedge that firms can count on moments of intense product market fluctuation.

In her opinion, the real challenge facing cross-national collaboration is not about the trade-offs between arm's length relationships and close integration. It is about how to manage the boundary relationship in such way that it permits a high degree of permeability and reciprocal knowledge exchange in critical areas, and yet preserves the distinctive identity and core strengths of the different systems. A way to address this need is through the gradual creation of what she calls "*integrated pockets of collaboration*", which generally assume the form of complex large-scale projects.

These "*integrated pockets*" involve more intense exchange of personnel at the operational level and formation of cross-national teams. They constitute the bases for the development of personal networks and become important information and knowledge exchange networks within and across organizations. Such cross-national teams are not free of the problems and tensions already discussed, and they may be costly, time-consuming, and limited to certain types of collaborative work as well. However, they are supposed to provide 'off-line' micro-structural mechanisms where new practices can be tried without threatening established systems. In her opinion, what remains to be seen is how far these '*integrated pockets*' will remain insulated micro-structures on their own, and the extent to which they might create hybrid practices that extrapolates the edges of the overlapping units.

3.2- TEAMS AS MECHANISMS TO ENHANCE COORDINATION

3.2.1- Management by Projects

It is well known in the business literature that multidisciplinary teams gathered around a onetime goal or project are increasingly been used as a way by which highly complex tasks can be accomplished (Clark & Fujimoto, 1991; Ancona & Caldwell, 1992; Brown & Eisenhardt, 1995; Hoegl & Gemuenden, 2001). Management by projects has been part of a prodigious movement towards the sophistication of administrative science in which organizations achieve things more rapidly, at less cost, with greater order and coherence.

Cohen & Bailey (1997) define *project teams* as time-limited, non-repetitive groups charged with producing a one-time output. According to Clegg & Courpasson (2004), by definition, projects involve well-delimited settings outside the formal structuring of organizations, involving the coordination of complex tasks and inter-organizational relations. For Béret et al. (2003), the project form of management imposes constrains on teams, notably in terms of costs and deadlines. Management by projects is intended to formalize work networks and impose constrains on them.

Recently, organizational theorists have increasingly endorsed management by projects as the definitive post-bureaucratic organizational arrangement. By combining elements of organic structures (Burns & Stalker, 1962) and empowerment and self-reliance, management by projects became a prefigurative image of future

modes of work, where highly complex tasks would be held by a network of highly-skilled just-in-time workers on a contingent basis. Clegg & Courpasson (2004), however, are critical on this approach and argue that despite the postmodern appeal, project teams are strongly institutionalized arrangements. In their field observations, project teams displayed a strong hierarchical dimension, which vertically defines objectives and responsibilities, guided by a strong code of practice (Project Management Body of Knowledge - PMBOK) designed by an overarching legitimization body (Project Management Institute – PMI).

The tension between the personal and the hierarchical means that project authority becomes based more on interdependence than on the organizational position. A substantial part of project leaders' power arises from his ability to communicate, persuade and align interests. Moreover, as projects are usually run in segregated spaces, away from corporate bureaucracies from which hierarchical power arises, project managers are in position to substitute the adherence to the rules to the accomplishment of objectives. In this process, they have space to use creativity and explore innovation to rewrite processes and negotiate a number of exceptionalities.

Ferner (2000) argue that lean structures meant to react more quickly and more strategically to market trends and opportunities by having fewer people to consult do not diminish political influences but actually increases them. The concentration of resources in the hands of few actors, endowed to act relatively unconstrained, creates mutual dependences that enhance the need for instances of political mediation. Therefore, project teams are expected to be highly political in nature with actors struggling to influence the interpretation of events and decisions in order to obtain resources and status.

Pfeffer (1981) reminds that when power is highly concentrated, system participants have disincentives to engage in contest for control which provokes the visible conflict and political activity observed when power is more equally distributed. In this line, formalization can be viewed as a characteristic of centralized power systems while dispersed power systems can be identified as lying in interpersonal relations or on the possession of specific skills.

Pichault (1998) agrees with this point and adds that innovation is the result of such loosely coupled organizational system pursuing simultaneously conflicting interests. In these arrangements, he sees more chance that new and unforeseeable evolution may arise to satisfy, simultaneously various stakeholders. As managers can be confronted by experts they will be inclined to accept negotiations and compromise between them. Informal change agents may emerge out of the professional core, escaping the initial objectives assigned to the project, with the implicit agreement of hierarchy, and contribute to improving the current structural arrangement and their processes. In this case, conflicts are able to contribute to renewing the current way of working.

Clegg & Courpasson (2004), however, claim that several more subtle forms of control exert great influence over project teams. *Reputational control*, for example, refers to the

extent that daily tests on the skill of experts and communication abilities of project managers are brought into permanent tensions resulting in legitimation or delegitimation of their project positions. *Calculative control*, refers to the extent that performance monitoring elements can be used to reassert central control by making reporting essential to the project objectives and an indication of the successful operation of the project. Finally, *professional control*, regards the extent to which a project managers are influenced in his action by the actions of their peers in their struggle to win the benefits provided by central management.

In their view, project management can be viewed as a system for controlling costs and achieve objectives. Project managers are intermediaries between a rule-governed organizational body and local rationalities. Rather than abolishing hierarchic control project management entails the recomposition of certain aspects of it and the reinforcement of others Overall, project management is seen as a form of “soft-despotism” based on the appearance of equality in the project team and the reality of a pervasive system of governance.

3.2.2- International Project Teams

For Beret et al. (2003) international project teams allow individuals who are geographically, professionally and culturally remote to be brought together around clearly identified common objectives using short-term and relatively low-cost forms of mobility such as exchanges and visits. In order to build project teams, managers and project leaders need to single out employees with strategic competences and to identify the contributions of the different project members.

Edstrom & Galbraight (1977) have long acknowledged that both integration and decentralization were achievable through a policy of worldwide transfers and socialization, which would foster commitment to the firm and the creation of information networks. Such policies facilitated information flow and learning across the firm in addition to achieving integrative organizational control. Nonaka (1990) describes the use of multi-national and multi-cultural teams as a way to achieve a subtle balance between central and unit-level initiative.

International project teams can also be seen as arrangements that contribute to the creation and dissemination of knowledge. For Thompson (1967), the use of teams in the workplace may be thought of lying on a continuum. At one end, teams with a low degree of interdependence would consist of employees who rarely see each other and perform their tasks without exchanging information and materials. At the other end, teams with a high degree of task interdependence would consist of employees who frequently interact and exchange materials and information to complete their tasks.

Authors are unanimous in asserting that successful task accomplishment on highly interdependent teams depends directly on the quality of members’ interaction. In their study of international research teams, Teagarden and colleagues (1995) emphasize that trust and effective communication between team members are *sine*

qua non conditions for cross-cultural collaboration. Iles & Hayers (1997) identify some competency dimensions for effective multicultural team working: cultural awareness, communicative competence, cognitive competence, valuing difference, and gaining synergy from difference. Ledwith & Seymour's (2001) suggest that willingness to engage with the difficulties and tensions of multicultural group-work is key to achieve positive results in the use of such arrangements.

Many authors (Mendehall & Oddou, 1985; Ledwith & Seymour, 2001) recognize that although many education and training in management cover activities such as conducting appraisals, teamwork, leadership, performance management, and recruitment & selection, fewer combine these areas with an equal effort to provide *intercultural competence*, understood as the ability to work productively with those from different cultural backgrounds. Takeuchi et al. (2005) recognize that although specific knowledge of (or experience in) a different culture may be useful, it does not itself guarantee intercultural competence. Nevertheless, Barkema et al. (1997) reminds that the capacity to work within diverse settings can be learned not only from previous international experiences, but also from previous domestic experiences in handling diversity.

Easterby-Smith & Malina (1999) highlight some aspects that might affect cross-national collaborative work. First, each national group tends to form independent assumptions about other group's intentions (often in negative terms) that do not correspond to exact ones. Second, age, gender and nationality of interacting partners may be compounded by international differences, and external attributions of status may conflict with internal assumptions about role definition and competence area. Third, interacting actors are not likely to become aware of differences in their approaches to a determined task until they engage joint fieldwork. Differences become apparent only *in locus* and rarely can be anticipated or managed in advance. Overall, flexibility is essential to accommodate the unexpected and to dissipate misunderstandings what bring us back to the quality of the relationships. Fourth, the exchange of mutual perceptions can lead to reflexive insights about each group own assumptions and rationalities. By clarifying differences it is possible to find some overlapping ground between different perspectives, opening the prospects for a working consensus.

In a similar line, Salk & Brannen (2000) provide evidence that over time nationally distinct groups develop a common set of precedents and experiences that become the foundation for a context specific, or local, *working culture*. In assessing this *working culture* it is important to take into account how individual team members perceived and reacted to emergent norms. In their opinion, the degree to which individual members came to accept locally negotiated norms and the investment they had made in adaptation can be gauged in terms of comfort and self-efficacy.

A considerable number of authors (Hambrick et al., 1998; Earley & Mosakowski, 2000; Salk & Brannen, 2000) advocate that successful heterogeneous teams create *hybrid team cultures* over time. For Earley & Mosakowski (2000), in highly heterogeneous groups, because few commonalities exist and the notion of primary

traits is not shared, members will attempt to create and establish new shared understandings, team process, role expectations, communication methods and so forth. As a result, a team culture is expected to develop after members had sufficient time and opportunity to form common basis of exchange and interaction. These authors highlight that these characteristics need not be completely shared among team members, but there must be significant overlap among them for these *hybrid team cultures* to come into existence.

Gibson & Zellmer-Bruhn (2001) note that there are important differences in the concept of teamwork across different cultures, and they affect their effective implementation and acceptance. In their view, the metaphors used to describe teamwork are representative on the members' expectations on how teams should be managed and how team process should unfold. Lau & Murnighan (1998) highlight that demographic traits of individuals should not be disregarded in the analysis of team cultures. In their view, a number of demographic elements (age, race, gender, social class, educational and functional background) can create '*faultlines*' and operate as a source of identification between team members, allowing for the creation of potentially disruptive subgroups. Which characteristics members perceive as primary depends upon their societal, cultural, and personal backgrounds.

For Montoya-Weiss et al. (2001), another key aspect of international project teams is the challenge of temporal coordination. New communication technologies are providing the means for work that are dispersed (carried out in different places) and asynchronous (carried out at different times). The dispersed and asynchronous communication context renders inoperable many of usual forms of social control, such as direct supervision, physical proximity, shared experience, and social trust. In their opinion, in the absence of the multiple cues that characterize human communication, consensus building becomes difficult and collaboration potentially conflictive. Consequently, it is necessary to establish some mechanisms of temporal coordination in order to replace that cues that would be naturally be available through direct interaction.

CHAPTER IV
INVESTIGATION DESIGN & METHODOLOGY

4.1- INVESTIGATION GUIDELINES

4.1.1- Theoretical Summary and Investigation Question

The theoretical body presented suggests that knowledge and social organization are intrinsically linked and overtime develops a sort of *dynamic equilibrium* (red arrow in Fig.3). On the one side, we have environmental changes and the strategic action of social actors bringing into question the validity and legitimacy of *institutional knowledge*². At the other hand, we have *political action* continually renewing the stock of knowledge to fit environmental needs and accommodate the interests of a broader set of social actors. All this dynamism is surrounded by zones of attraction (grey arrows in Fig. 3) composed by socially undesirable states of both stasis (reification) and disruption (anomie) elicited by power imbalances or lack of political action.

In this framework, **diversity**, **politics** and **innovation** are intrinsically linked elements in a process of knowledge renewal that is essential to social adaptation and maintenance. Understand how these elements can be brought together in a functional way is key important for contemporary organizations. Therefore, the examination of a real instance where these elements are bind together to promote substantial changes in the state of a determined sort of knowledge is utmost important to the advancement of contemporary organizational studies.

Mature MNEs, particularly those close to the *transnational* type, are very complex organizations which embody at the same time a high level of *knowledge diversity* and great room for *political activity*. Although empirical evidence shows that they increasingly respond to the challenge of managing complex settings and meet innovation needs through the use of international project teams, a clear theoretical approach explaining how these work arrangements are capable to turn two problematic organizational phenomena into key organizational resources remain elusive. Therefore, the question that drives this investigation is **how international project teams enable MNEs to cope with knowledge diversity and political activity in order to unleash their innovative potential?** Which social mechanisms are enacted during this process? Which are the key variables and how they interrelate?

4.1.2- Object of Investigation and Main Objectives

The *object of study* in the present investigation is the *knowledge change process* that takes place within international project teams. By observing how knowledge on a determined subject is appropriated and eventually goes into change within these arrangements it is possible not only to understand the elements that triggered the change need but also the process by which a new compromise is reached and change

² Drawing on Berger & Luckmann and other authors previously mentioned, *institutional knowledge* herein shall be understood as "taken-for-granted courses of action experienced as existing over and beyond individuals, which confront them as a coercive fact". This stance breaks with the analytical divisions traditionally used to conceptualize knowledge along different dimensions (tacit x explicit) or different levels (individual, collective, social) as suggested by authors like Polanyi (1962), Nonaka (1994) and Nissen (2007). This concept also contrast with other uses of the expression "institutional knowledge" such as "knowledge of the local institutions" (Chetty et al., 2006; Erickson et al., 2007; Javernick-Will & Levitt, 2010) or "institutional memory" (Weick, 1988; Walsh & Ungson, 1991).

becomes effective. The focus on the *knowledge change process* aims to open up the sequence of events that take place in these situations and cast light on the exact role that diversity, politics and the project team context had in the process.

Insofar, the main objective of this investigation is to arrive at a model that describes the mechanisms elicited by the international project team context that allow diversity and politics to be channeled into knowledge change, and thus innovation, in organizational settings. The accomplishment of the main objective depends on the following *related objectives*:

- a) Describe the surrounding environment and the investigative setting. Emphasis on the socio-historic conditions and on the economic, political and institutional forces in play.
- b) Outline the *institutional knowledge* subject in focus. Its origins, its supporters, its legitimacy mechanisms and the outcomes of its use in the investigated setting.
- c) Describe the factors that brought the *institutional knowledge* subject into question. The reaction of supporters, and pro-reform groups and the legitimacy claims and contestations;
- d) Describe how disputes were settled and a compromise has been reached around a new understanding with an emphasis on the arbitrating process and on the consequences of this processes to the dynamics of interaction;
- e) Describe how the changed knowledge becomes effective within project team limits with an emphasis on the resistance and acceptance movements involved and the reasons and actions underlying them;
- f) Describe how changed knowledge is received beyond project team limits by the organization setting at large and how it becomes institutionalized. If it does not, explain why that happened and which forces were in play;
- g) Identify if the assumptions described in the theoretical discussion hold in the empirical setting;
- h) Describe the power relations initially established in the investigative setting and how they evolve over time;

4.2- METHODOLOGY

4.2.1- Epistemological Paradigm: Multi-Paradigm Interplay

Considering methodology as an ensemble of procedures to approach a determined object of study, it is important to notice that underlying any methodological choice there is the worldview of a determined social group, what makes it hard to lay claims of *scientific neutrality* (Minayo, 1985). With this notion in mind, it is important first to unveil the epistemological stance used in this investigation which will support not only the methodological approach but also the selection of data collection instruments and the analytical focus to be applied.

Within organizational studies, *positivism-functionalism* and *interpretivism* are the prevalent epistemological paradigms and differ in the extent to which they define an analytical framework prior to entering the investigation field. *Post-modernism* is a less known but increasingly important paradigm to be considered in social research.

Positivism-functionalism adopts the stance of realism and relies on the assumptions of an objective world that can be unequivocally portrayed by scientific data and theories. Positivists adopt the stance of realism, that is, the existence of a tangible truth, and analysis is conducted by gauging the causal relations between predefined variables to confirm or refute hypothesis. Post-positivism slightly differs from positivism by holding that reality can be known only in a probabilistic way, and hence verification is not possible. Once verification is not attainable, the aim of post-positivist research is to falsify prior hypotheses. *Positivist-functionalist analysis* operates primarily in a causal mode and is predominantly convergent. They move from a relatively unpatterned appreciation of phenomena to a more ordered and less bulky one. A current critic to the use of positivism in organizational studies is that it falsely portrait the object of study by reifying social reality as existing objectively and independently of the labor that actually produced those conditions.

Interpretivism adopts a relativist stance, therefore multiple situated truths are assumed to exist. Rather than evaluating hypotheses, interpretive research seeks to establish how naturally occurring factors and events, at different levels of analysis, interact to influence observed outcomes over time in particular contexts (Dawson & Buchanan, 2005). Interpretivists express a strong interest in the ongoing processes of sense making and meaning creation, however, they rarely explore ruptures, discontinuity, and fragmentation of sense making. Studies in this line generally follow a divergent analytical process, in that the primary goal is to expand and enrich the analysis by constantly seeking more interpretations and associations.

Postmodernism has a short story within organizational theory. It adopts the stance of historical realism and involves the belief that apparent realities are only social constructs, as they are subject to change inherent to time and place. Because they believe that there is no pattern of sense to be found, general theories are not attainable (Lyotard, 1984). Postmodernists focus on contradictions, critical incidents, signs, and symbols to develop structural and historical insights that portrait the

temporary and fragile characters of an organizational life marked by flux and discontinuity. For Cooper & Burrell (1988), postmodernists are more interested on the processual, as opposed to structural character of human institutions. The aim of postmodern analysis is to uncover hidden interests and contradictions in order to display the power implications of meanings and encourage critical reflexivity.

Quinn & Cameron (1998), acknowledge that both contrasts and connections between paradigms create an intellectual tension that might prove beneficial to the approach of complex and multifaceted phenomena. In this line, Schultz & Hatch (1996) suggest an *interplay strategy* to take advantage of the connections between paradigms and enable richer frameworks of analysis. In order to analyze organizational social phenomena, researchers have to conceive generality and contextuality, continuity and discontinuity, in term of each another. In their view, the application of the interplay strategy would involve two steps: first, the recognition of the contrasts and connections; second, the generation and application of interdependence and tension between the contrasts and connections by moving between paradigms.

Management, as a positive science that search practical solutions to objective problems, exerts an institutional pressure over this investigation towards the use of a *positivist-functional* stance. The processual character of the object of investigation, however, demands an *interpretivist* stance in order to explore the full range of interpretations and associations possible. However, the coercive character of *institutional knowledge*, a key construct in this investigation, invites the use of a post-modern stance in order to unveil the power and vested interests behind its existence. Therefore, in considering the particular conditions of this investigation, which is subject to multiple disparate influences at once, a paradigm interplay approach seems to be the most appropriate one.

In this sense, despite being predominantly guided by the object of study towards an interpretivist stance, following a paradigm interplay approach, the present investigation will lean towards a post-modern glance in its reflections regarding power relations in the events surrounding the knowledge change process as whole, as well as veer towards a more positivist stance in the overall analysis of the outcomes of the knowledge change process in order to provide answers and general guidance for practical organizational problems as required by the management science tradition.

4.2.2- Methodological Approach: Qualitative Approach

The relationship between theory and methodology is an important one. Researchers need to use methodologies that are consistent with the assumptions and aims of the theoretical view being expressed. According to Pratt (2008), it is key to explain what motivates the study and why the chosen method is appropriate. In this sense, the reasons ahead exposed explain to a large extent why a *qualitative approach* is the most suitable one for this investigation.

Qualitative research is multi-method research that uses an interpretative, naturalistic approach to achieve its goals. A number of researchers (Mintzberg, 1979; Van Mannen, 1983) argue that qualitative methods are well-suited for building theory and writing rich descriptions. Qualitative research is often designed at the same time it is being done. It requires highly contextualized individual judgments to progress and is open for unanticipated events. It allows more flexibility in what variables and processes are encountered and examined, and this flexibility means that qualitative methods provide more chances to learn information that is independent of or in contrast to existing theory.

In contrast to the quantitative researcher eager to discover the world “outside” him, the qualitative researcher is an integral part of the methodology process of socially creating understanding. It often studies phenomena in the environments where they occur and uses social actors' meanings to understand the phenomena. It is highly descriptive and often recounts who said what to whom as well as how, when and why. An emphasis on situational details unfolding overtime allows qualitative research to describe processes. Thus, an important value of qualitative research is description and understanding of the actual human interactions, meanings, and processes that constitute real-life organizational settings. In this sense, a qualitative approach provides insights that are difficult to produce with quantitative one (Gephart, 2004).

Qualitative methods not rarely are portrayed as primitive tools compared to traditional quantitative methods like survey, research, analyses of archival data and experiments. Some researchers indeed dismiss the use of qualitative methods as “unscientific”. A common consequence of this prejudice against qualitative research involves the attempt to make qualitative research resemble quantitative and thus more palatable for a non-qualitative audience. In fact, quantifying the data does not serve most small-sample quantitative studies.

Not uncommon are the situations where inductive and deductive reasoning are combined inappropriately, for example when some researchers engage in random sampling rather than theoretical or purposeful sampling or attempts to control sample variance. Though induction and deduction work well together on a macro-field level, on a micro-research level they represent opposite strategies. Deductive reasoning arrives at a specific conclusion based on generalizations. Making deductions is important when we cannot directly observe a cause, and can only observe its consequences. Inductive reasoning progresses from observations of individual cases towards the development of a generality. Induction is usually described as moving from the specific to the general, while deduction begins with the general and ends with the specific.

In response, Dachler (1997) argues that if for quantitative methods eliminating errors is all that counts, within a qualitative approach the knowledge of the process itself is all that counts. In this regard, he assumes that the degree to which the researcher influences or obscures the actual behavior of the researched and the many other issues related to the subjectivity and involvement with investigated subjects is crucial

for bringing about interesting problems and alternative explanations. Moreover, qualitative research critics disregard the fact that quantitative research itself possesses sampling and measurement error of their own kind and in many ways a far less more scientific than good qualitative research.

For Sutton (1997), when the goal of qualitative research is theory development, the significance test for assessing its quality should be restricted on - whether or not - new, interesting and logical insights were developed. In his opinion, the intended product of qualitative research is new insights, not a test of those insights. One could argue that the open-ended nature of qualitative research is one of its key strengths, however, all this openness comes at a price, that is, it makes extremely difficult to both write and evaluate qualitative research. What is really expected in terms of good qualitative research is to achieve a delicate balance of writing a compelling and focused account that honors all possible sides regarding the investigated object, provides sufficient evidence for claims, and significantly contributes to extant theory.

4.2.3- Investigation Method: Longitudinal Case-Study

A number of researchers argue that longitudinal studies have advantages over cross-sectional ones when the variables change over time and when the causal relationship between the variables needs to be determined. According to Lane (2001), an in-depth examination of a small number of case studies is well suited to the exploration of the complex company-internal dynamic of this process. Such approach is able to capture the tension between strategic intent and institutional constrain making evident the unresolved tensions between conflicting strategic goals and the sometimes unstable compromise between innovative strategies and institutional inertia/resistance. For Ferris & Judge (1991), the way politics can influence organizational life can be better understood through longitudinal studies which provide a better picture on how these processes unfold overtime.

Following these advices and considering both the *exploratory* character of this investigation and the singular features of the object of investigation, a *longitudinal case study* was selected as investigation method, supported by the criteria put forth by Yin (1989). According to this author, a *case study methodology* is the most appropriated method when the phenomenon to be investigated constitutes a process involving many variables whose relationship is intrinsically complex.

The case study is a research strategy which focuses on understanding the dynamic present within single settings (Eisenhardt, 1989). Case studies can involve either single or multiple cases, and numerous levels of analysis (Yin, 1989). Case studies typically combine data collection methods such as archives, interviews, questionnaires, and observations. The evidence may be qualitative, quantitative or both. A case study describes a single event or unit of analysis determined by the researcher, with the use archival or documentary data along with other sources as it changes over time.

A great concern involving the use of case studies refers to the number of cases necessary to generate theoretical insights. Authors like Eisenhardt (1989) argue that this number should be situated between four and ten, with fewer likely to yield feeble and unconvincing theory and more being excessively complex. However, for Dyer & Wilkins (1991), this prescription violates the essence of case study research, that is, to provide a rich account of the social scene and reveal the deep structures of social behavior. In their view, investing in multiple cases invariably lead thinner descriptions, limiting the investigation to the more readily observable aspects of the setting and neglecting the more tacit and less obvious ones.

In a reply, Eisenhardt (1991) argues that by multiple cases researchers allow for patterns and generalizations to be more readily observed, thus eliminating chance association. Multiple cases also emphasize complementary aspects of phenomena that pieced together allow for a wider theoretical picture. Finally, *stories* represent a source of cognitive bias and thus shall not displace the search for better *constructs*. Pentland (1999), however, puts aside this standoff and claims that there is no trade-off between better *stories* and *constructs*. Similar to DiMaggio (1995), he argues that in the domain of *process theory*, *stories* are key elements to explain relationships between events in a process or in a narrative, and thus functional equivalents to *constructs*.

Overall, the central issue is not the number of cases approached but whether the researcher is able to understand and describe the context of the social dynamics in question to such a degree as to make the context intelligible to the reader and to generate theory in relationship to that context. More, the appropriate number of cases depends upon how much is known and how much new information is likely to be learned from incremental cases. Many researchers suggest stopping adding cases when *theoretical saturation* is reached. *Theoretical saturation* is simply the point which incremental learning is minimal because the researchers are observing phenomena seen before. Another practical point is that *theoretical saturation* often combines pragmatic considerations such as time and money to dictate when research ends.

In this investigation, the chosen *unit of analysis* to be taken as single case is the *project*, understood as a “*temporary endeavor undertaken to create a unique product, service, or result*” (PMBOK Guide, 2004 p.5). The balance between doctoral program time limitations and the necessary immersion to approach the object of study restricted the number of cases/projects analyzed to three (3), with data being collected over a continuous period of approximately 24 months.

Another time-related problem affecting the number of cases was the sensitive character of the data collection (i.e.: firm knowledge, power conflicts, political influence and intercultural relationships). If access to rich data turned into a lengthy process it could further restrict the number of cases/projects to be analyzed. This has been addressed by restricting all three cases/projects to the same organizational setting (WP) and national locus (Brazil).

The threat of a feeble investigation with an unconvincing theory typical for same setting investigations (Eisenhardt, 1989) has been more than compensated by the

turbulent transitional period experienced by the organizational setting investigated, which has been particularly useful making more readily observable relevant elements to this investigation that would otherwise remain latent or imperceptible. Changing moments in a company life, thus, represent a privileged research opportunity in which subtle motivations and logics of action become apparent.

Furthermore, restricting the investigation to one organizational setting allowed for a more precise map of the organizational power relations what would result in an overly exhaustive task for a single researcher (or poorer maps) if different companies were approached. It would also be harder to follow changes to the organizational power relations as a result of project outcomes or external events once cases were finished and the research left the different organizations.

Although possible, *statistical sampling* of cases from the chosen population (to control for some variability) is unusual when building theory from case studies. In the more usual *theoretical sampling*, cases are chosen by theoretical reasons (and not statistical) to replicate previous cases, extend emergent theory, fill theoretical categories and provide extreme situations or polar types for analysis. In this sense, cases/projects were selected on the basis of different clients, goals, personnel and context in order to explore “*all possible sides regarding the investigated object*”, as suggested by Sutton (1997, p.98).

4.2.4- Strengths and Weaknesses in Building Theory from Case Study Research

Although theories can be built out of observations, literature analysis, common sense and related experience, Eisenhardt (1989) argues that it is the intimate connection with empirical reality that permits the development of a testable, relevant, and valid theory. The likelihood of valid theory is high because the theory building process is so intimately tied with evidence that it is very likely that the resultant theory will be consistent with empirical evidence. This intimate interaction often produces theory which closely mirrors the observed reality.

The process of building theory from case study research is a strikingly iterative one. While an investigator may focus on one part of the process at a time, the process itself involves constant iteration backward and forward between steps. Also, the process is alive with tensions between divergence, into new ways of understanding the data arising from a multitude of collection methods and searching tactics, and convergence, onto a single theoretical framework. Each piece of evidence is submitted to diverse perspectives before converging into construct definitions and a framework for structuring findings.

The use of a case-study methodology to build theory is not free of weaknesses. At one extreme, intensive use of empirical evidence can lead to theory that is overly complex. Theorists working from case data can lose their sense of proportion as they confront vivid, voluminous data and be tempted to reach for an all encompassing theory. At the other one, cases may result in narrow and idiosyncratic theory. If the researcher is unable to raise the level of generalizability of the results it is posed to

make only a modest contribution to the field. Therefore, building theory from case study research is most appropriately in the early stages of research on a topic or to provide freshness in perspective to an already researched topic.

4.2.5- Methodological Rigor in Case Study Research

A critical challenge in organizational theory is how to move from surface structure to deep structure, or how to recover a single, objective account from multiple, partial, subjective, and even conflicting accounts (Pentland, 1999). As a researcher moves from surface observations towards the underlying structure, he moves from description to explanation and so to better theory (Sutton & Staw, 1995).

Gibbert et al. (2008) acknowledge that, despite its contribution to generating and testing theory, case study method has been prone to concerns regarding methodological rigor in terms of validity and reliability. While deficiencies in any methodology are problematic, lack of rigor in case study deserves special attention because initial research fragilities tend to have their effect exaggerated downstream with any doubts concerning research's reliability may dim its conclusions into irrelevance. According to these authors, four criteria are commonly used to assess the rigor of field research: *internal validity*, *construct validity*, *external validity* and *reliability*.

Internal validity refers to the causal relationships between variables and results. The issue here is to verify whether the research provides a plausible causal argument, logical reasoning that is powerful and compelling enough to defend the research conclusion. In order to enhance internal validity researchers must develop a clear research framework, demonstrating the causal relationships involved and explain why they are ruling out alternative explanations (Yin, 1989). It is also important to empirically compare observed patterns with those predicted by related theory or found in different contexts (Eisenhardt, 1989).

Construct validity refers to the quality of the conceptualization or operationalization of the relevant concepts and to the extent that research procedures lead to an accurate observation of the reality. In this line researchers are encouraged to establish a clear chain of evidence to allow readers to reconstruct how the research went from the initial questions to the conclusions. Furthermore, researchers are expected to triangulate data, that is, use different data collection strategies and different data sources in order to appreciate the phenomenon from as many different angles as possible.

External validity relates to 'generalizability', that is, the degree to which a theory can explain phenomena beyond the studied setting. Although case studies indeed do not allow for statistical generalization they do provide the means for analytical generalization, that is, generalize from empirical observations to theory rather than to a population (Yin, 1989). A way to enhance external validity is to conduct cross-case analysis involving not only cases from different settings but also conducting different case studies within the same setting.

In this line, Eisenhardt (1989) emphasizes that qualitative research should be systematic rather than impressionistic, and propose guidelines about the amount and kind of qualitative data to gather, how to code such information, and how it should be analyzed to provide grounding and credibility for theory. Sutton (1997), however, suggests that there is no relationship between the amount of data gathered and the rigor to which qualitative research is done. In his opinion, though cases becomes more convincing as evidence grown in number, it's their diversity in kind that enhance the internal validity of the proposed constructs and the strength of ongoing conclusions. The conclusiveness which comes from the convergence of several kinds of evidence reflects the fact that separate varieties of evidence can be reconceptualized as deductions from a basic proposition which have now been verified on the field (Whyte, 1999).

Weick (1989) argues that rigor on qualitative research depends more on the features of the thinking process itself than on the properties and the quantity of the data collected. For Dyer & Wilkins (1991) what matters is to focus on the context and describe the phenomena richly. Such descriptions act as clear examples of new relationships, new orientations, or phenomena not yet registered. Overall, authors point that a strong theory-building study is grounded in compelling evidence and yields theory that is parsimonious, testable and logically coherent. It must yield new, groundbreaking insights.

4.3- METHODOLOGICAL CONCERNS

4.3.1- Methodological Considerations for International Management Studies

O'Grady & Lane (1996) argue that business people seldom reflect on and articulate their values, although they feel uncomfortable when these values are violated. Also, they are often not aware of the assumptions that underlie and guide their actions. As a result of different mental programming, people from various cultures, ascendances and educational backgrounds have different approaches and solutions to problems. Each tends to believe that his/her way makes the most sense and is best. Therefore, it is utmost important to be aware that one's cultures can act as a barrier to accurately understand the environment that one is facing. This may be even more crucial when differences are not obvious or noticed.

Easterby-Smith & Malina (1999) remind that the problem for researchers from one culture or context wishing to conduct qualitative research on another culture is that outsiders' past experiences will not have equipped them to make sense of events in the same way that insiders would. As Teagarden and colleagues comment, "*no one research can be insider in multiple cultures*" (1995, p.1283). In their view, a way to equate this problem is through the exercise of *reflexivity*, that is, the researcher has to use information given by studied subjects to gain understand about itself and this way become aware of its own cultural bias.

According to Pierson (2003), beneath the surface of any apparently stable institutional setting, cumulative processes are occurring in direction of change, what

Thelen (2000) previously conceptualized as *institutional layering*. Actors in disadvantage do not simply embrace the position assigned to them, on the contrary, they often bind to it until conditions shift and they feel free to act strategically or even in a subversively way to revert their situation, building new institutions that systematically test the limits of the current institutional order. Thus, analysts have to pay special attention not just to the surface level of activities but also to the underlying patterns of tension and conflict.

4.3.2. Methodological Considerations in Organizational Politics Studies

There are clear difficulties in bringing empirical data regarding organizational political activity given the potentially damaging outcomes involved in the disclosure of such information. Political activity normally involves stimulating debate, gaining support from key people, and even covert manipulation, actions that what in many organizations may be regarded as subversive or ethically objectionable. Therefore, most organizations and their members do not regard disclosure of these actions as a valuable corporate or personal publicity. Attempts to disguise political actions can separate accounts from their history and context, making adequate interpretation problematic (Buchanan & Badham, 1999).

In this sense, a number of methodological problems need to be considered and addressed in organizational politics studies. One is the potential social desirability bias inherent to questions concerning sensitive topics. Because most people perceive politics in the pejorative sense, a powerful social bias is likely to result when people is questioned about their political behavior. As a result, alternative sources of information must be considered beyond actor's self-report (Ferris & Judge, 1991).

Because political behaviors are not readily observable and are subject to interpretation, some techniques should be used to enhance data credibility. Prolonged engagement is a vital element of credibility (Thompson & Purdy, 2009). Being a participant observer for the length of the study helps to support the legitimacy of researcher's interpretations. This make possible to follow discussions between participants with different views about the process and to uncover arguments and intentions not necessarily expressed in interviews. Similarly, McLoughlin & Badham (2005, p. 839) point that any interesting methodological approach to political processes need to go beyond methods which enable "to get close to the action" into more effectively ones that "tell it like it is".

For Dawson and Buchanan (2005), *narratives* provide a particularly powerful tool not for establishing the hegemony of a particular interpretation of organizational events. In their view, narratives have the potential to become political resources that serve to maintain and advance the positions of individuals and groups, while delegitimizing the accounts and positions of others. As such, story-telling skills associated with constructing compelling and convincing accounts can be viewed as an effective political instrument for influencing others. Compelling stories can enable groups to influence decision-making and steer organizations in certain preferred directions. A powerful and influential story will be coherent, engaging, and robust in the sense

that it is resistant to subversion, and at the same time, flexible enough to be revised without threat to the author's credibility.

Research into process of change is enriched theoretically and practically through explicit attempts to identify, expose, and analyze *competing narratives*. Instead of being swept away through triangulation, deviant versions must be viewed as competing attempts to make sense of events and their consequences. By shedding light over competing narratives, researchers expose the socio-political process through which they were constructed and particular positions and versions of events corroborated. Like Dawson & Buchanan (2005), this work is interested in competing versions of reality and in uncovering stories that remain locked beyond public view through the power play of key actors, and that the embedded constraints of hierarchy and function. Not to forget that researchers are also authors of change narratives. Although the use of the narrative approach allows the author to capture some of the complexity and ambiguity of the change process, the researcher has nevertheless sifted, selected, and interpreted data in a way that is likely to reflect its particular interests.

Another methodological issue of considerable importance for the understanding of political processes is level of analysis. The interpersonal dynamics of political influence take place within a context that is shaped by competing interests and influences taking place at group and organizational levels of analysis. As such, to neglect these levels would render a deficient and incomplete view of the process. Thompson & Purdy (2009) highlight that process theories often recognize the recursive relationship between human agency and context overtime. In their view, a process approach yields a rich view of both context and agency and recognizes the complexity of the organizational context in which innovation and political activity occur, offering the means by which the full range of political actions can be characterized.

4.4- INVESTIGATION DESIGN

4.4.1- Theoretical Background

Despite some claims within methodological literature that inductive research should be purely emergent, it is in fact not recommendable to enter the investigation field without at least some orienting ideas and investigative focus. Inductive and loosely designed studies make sense only when researchers have plenty of time and are exploring exotic cultures or very complex social phenomena. The looser the initial design, the less selective the collection of data and once the researcher awash in data need a lot of time to sort it out. Moreover, waiting for key constructs or regularities to emerge can take a long time. Therefore, it is important to provide extant literature review that notes the contents and limits of prior research in the field that point to gaps in theory that the study can address.

Similarly is not uncommon for qualitative research to understate explicit goals, objectives or research questions behind data analysis and research outcomes. It is

important for qualitative research to have a clear focus on which to proceed in order to make a stand for the contributions being made. Where questions are clearly stated, the concepts underlying them may be not, and as a result, the meaning of the question remains elusive. Theoretical background to key concepts needs to be disclosed in ways that create consistency among theories, concepts research questions and methodologies (Gephart, 2004).

Most of qualitative research lives on this delicate balance: something is known conceptually about the phenomenon, but not enough to house a theory. Researcher knows parts of the phenomenon that are not well understood, and know where to look for what is missing where, from who and when. He/she has a rudimentary conceptual framework, a set of general research questions, sampling notions and initial data-gathering devices.

A conceptual framework explains, either graphically or in a narrative form, the main dimensions to be studied and the presumed relationship among them. Theoretical frameworks have a focusing and bounding function that helps researchers to see where to get information and what should be done once it has been collected. As qualitative researchers collected their data they revise their frameworks, making them more precise and adjusting relationships. Although not common in theory-building studies to the date, a priori specification of constructs is valuable because it permits researchers to measure constructs more accurately. If these constructs prove important as the study progresses, then researchers have a firmer empirical grounding for the emergent theory (Eisenhardt, 1989).

The formulation of research questions can precede or follow the development of a conceptual framework, but in either case they make theoretical assumptions more explicit and delimitate what the researcher wants to explore, focusing attention towards determined variables and relationships and away from others. Research questions facilitate the transition from conceptual framework to consideration about sampling, instrumentation and analysis. In fact, sampling and instrumentation decisions actually work delimiting settings, actors, processes and events to be studied, thus constraining the range of analysis possible. In short, framework informs the choice of research question. The research question, in turn, informs the sampling frame: where one goes to get answers, to whom he talks, and to what he observes.

The conceptual framework and research questions determine the focus and boundaries within which samples are selected. Qualitative research usually works with small samples which tend to be more purposive than random. Sampling in qualitative research involves not only decisions about which people to observe or interview, but also about settings, and processes. Sampling issues are often linked with '*generalizability*' issues. While sampling, it is always important to consider why a determined informant is important. Settings, events and processes that initially look interesting with time may prove not to be the most pertinent or rich ones, and thus should be systematically reviewed. Although most information is obtained from core actors, it is also important to work a bit at the peripheries and talk to people that are

not central, dissidents, renegades or no longer involved, to get contrasting and comparative information.

4.4.2- MNE as Investigation Context

According to Pratt (2008), the choice of the investigation context must be clearly explained. Authors should justify their context from a sampling perspective, stating if it represents a prototypical or an extreme case. Authors should disclose their sampling strategies as well as its expected changes along the study in order to make explicit to readers the underlying assumptions behind the conclusions.

Roth & Kostova (2003) point that MNEs have been extensively used for theory-building and research propositions by a number of research agendas. However, the potential for MNE contributions for organizational research can only be fully realized if its conceptual distinctiveness is clearly delineated, what depends on more rigorous and systematic approaches strongly linked with underlying theory. Otherwise, the use of MNE may appear incidental or considered distinctive without any supporting articulation.

In this sense, they point that MNE context may be used for the examination of MNE-specific phenomena, that is, phenomena that do not exist in the purely domestic context, or have been modified as a result of the introduction of cross-border conditions (i.e.: Zaheer, 1995). In some studies, the MNE context highlights the limitations of the basic explanatory mechanism of existing theory and invite alternative explanations (i.e.: Earley and Mosakowski, 2000). Within this investigation, however, the MNE context is used as a proxy for intraorganizational heterogeneity and complexity and make the case for extreme competing pressures, choices and tradeoffs. In this case, the MNE context is either important for increasing variance in data, and thereby allowing for a rigorous test of existing theory and suggest new theorizing.

4.4.3- The Choice of the Field

Over the last decades, the service sector has become increasingly internationalized. As well as exporting services to other countries, firms have established a variety of organizational forms and networks in order to enable themselves to deliver their products across national borders. Whereas some consideration has been given to understand strategic issues, very little is known about the internationalization of service sector firms at the level of organization, management, and work processes. This is particularly true for *professional service firms*, which are characterized by the knowledge intensity, dependence on highly skilled employees and intangibility and customization of solutions delivered (Grosse, 1996; Morgan & Quack, 2005).

Professional service firms primarily deliver problem solving to their customers, what involves not only the application of standardized solutions but also the development of new customized ones. Knowledge processes are central to these firms as they operate in highly context-specific environments and need to coordinate work

processes in which people possessing the relevant knowledge must cooperate to meet clients' demands. As problems become both more extensive and complex, a key issue affecting these firms is how to deliver the necessary coordination in the presence of diverse knowledge. Even though, the way such firms deal with knowledge is by no means fully understood or theorized. This is even more the case where such firms become involved in international business.

Due to their nature, such firms often suffer from two main sources of difficulties when going international. First, internationalization usually requires an increase in the number of interfaces between business actors and in the course of this process. Second, perceptions of what constitutes relevant knowledge and appropriate processes for knowledge are likely to differ considerably between countries, so they can no longer rely on the same degree of common understanding of rules, norms, and behaviors among business actors that they have been used in their home base.

Extant studies highlight that professional services firms need to reconfigure existing structures and develop new mechanisms of organizational coordination as they expand across national borders, a process that involves considerable amount of experimentation given the complexity and velocity of change in international business environment. Most of these studies have developed from debates of professional service firms rather than the analysis of internationalization and MNEs and therefore provided limited explanation to how such firms develop internationally based competences (Morgan & Quack, 2005).

Maybe even more important is that differently than other economic sectors that can almost insulate themselves from foreign environment when going international, service firms cannot choose not to interact with their context. On the contrary, deep interaction with the context and extensive exposition to diverse knowledge is what better identify *international service firms*.

Among such firms, *international engineering companies* have been at the forefront of internationalization process since the beginning of the last century and, due to the strategic content of its activity, spared from the protectionism that limited the international expansion of other types of service firms. Due to their deep involvement with the many contexts they operate simultaneously, the knowledge intensive character of its activity and the mature state of the existing MNEs, *international engineering companies* provide the perfect field for the present investigation.

4.4.4- Data Collection

Many authors (Pratt, 2009; Gephart, 2004; Van Mannen, 1983) agree that there is no widely accepted template for writing up qualitative research. There is no minimum number of interviews and observations that should be conducted in a qualitative investigation. What is enough depends on what questions a researcher seeks to answer.

A huge part of the fieldwork in qualitative investigations consists of taking notes, recording conversations and picking up documents, products and artifacts. In this sense, talk about instrumentation may seem out of place. However, it is always useful for a qualitative researcher to have at hand orienting questions, headings for observations and a few forms for document qualification. For Eisenhardt (1989), a clear definition of the research question helps researchers to specify the kind of data to be gathered. Without a research focus, it is easy to become overwhelmed by the volume of data.

It is difficult to determine how deep a researcher must go to generate good theory, however classic case study researchers usually spend a long time, building relationships from whom they could obtain information on a regular basis, make formal or informal interviews, participate in activities of the organization as a member and develop extensive work diaries. Field researchers must engage in a long-term contact with their subjects, so that the understanding of the actors can gain sufficient weight compared to theoretical prejudices of the scholar.

As such, a multi-method data collection is the ideal choice for a complex investigation like this one as it enables the *integration* and *triangulation* of findings and helps to extend the levels of internal validity of the data collected and provide stronger substantiation for constructs and theory. In agreement with Kristensen & Zeitlin (2001), what matters is to get the details right and to find coherent ways of recounting them in a way that do not violate actors' own effort to make sense of what is going on.

Following the work of Javernick-Will & Levitt (2010) on the key methods that international project firms use to transfer and mobilize knowledge internally, data collection paid attention to both *formal processes* (i.e.: manuals, templates, procedures, check-lists, available through information systems) and *social processes* (i.e.: meetings, personal discussions, on-line communications, e-mails, personnel transfers, "lessons-learned", and "peer-reviews"). In this sense, the data collection instruments detailed ahead have been fundamental to the accomplishment of the objectives of this investigation.

4.4.4.1- Researcher Standpoint

Several authors argue that a more personal disclosure of author's biases and involvement in particular is welcome in qualitative studies. For Miles & Huberman (1984), it is good for the researcher to make their preferences clear instead of letting the reader to intuit from which standpoint the author is operating from. According to Pratt (2008), the author must be very clear about his position in the field. In his opinion, the relationship between researcher and researched must be clearly stated. These details are important, as they inform readers about researcher's approach to the study.

As recommended by the above authors, prior to the data collection presentation, this researcher provides a short review of his personal, professional and academic

trajectory in order to make explicit to readers the worldview and societal perspective that guided the investigative work. Authors like Minayo (1986) suggest that bringing bias or prejudices into light help readers to evaluate the impersonality of the claims made and the reliability of the data collected, thus improving overall research quality.

4.4.4.2- Investigation Context

First, a clear and systematic view of world's recent economic developments is key to understand a great deal of the macro forces that set the stage for the phenomenon under study. The *international economic context* and the *local economic context* have been examined with the help of key historians, governmental and multilateral economic reports, business press and the Internet. In this part, a non-citation strategy has been adopted within this section to avoid repetitiveness, allow for a more fluid construction of the text and better amalgamation of the multiple sources. In this endeavor I acknowledge the help of the summarizing power of the Wikipedia (en.wikipedia.org), the works of historians like Rondo & Neal (2002), Furtado (2007), and Prado (2006), newspapers like the Financial Times, NYTimes, La Vanguardia, Folha de São Paulo and Estado de Sao Paulo, business magazines like Exame and The Economist and public databases like EUROSTAT, IMF and IPEA.

The engineering business context has been described both at international and local level in order to provide readers with an overview of external forces to which the investigated setting was submitted, with a special emphasis on economic and institutional ones. The *international engineering business context* has been reconstructed from specialized business magazines and Internet accounts extracted from engineering firms websites. The *local engineering business context* has been richly described by Brazilian authors, particularly work sociologists, which exhaustively debated the role of engineering in Brazilian economic development and society.

Prior to the investigation context description, the *field entry* process is described so as to inform readers about the sequence of events that led to the selection the investigation setting, as well as to clarify the preliminary relationships established with it.

Though the investigation has been restricted to a single locational setting, a large engineering office in the city of São Paulo (Brazil), it took place at a turbulent time where this office went through several different ownerships. In the relatively short period of four years this office went from a minor company in a large Brazilian conglomerate, to an independent company and finally to a key branch of large transnational company. Though challenging, the turbulent period involving the investigated setting proved a rich time for data collection as subtle processes became more apparent and their outcomes rapidly observable. This unique investigation setting made possible to explore how increasing diversity and power shifts affected firm knowledge process in a relatively short period of time.

As such, the *investigation context* description involved the examination of the historical contribution of these several companies to the particular features of the investigation context. The use of secondary data from *sociological studies* and *public company documents*, as suggested by Lane (2001), helped to reconstruct the socio-historic conditions and internal forces (economic, political and institutional) affecting the investigation setting prior to the investigative period.

For Luger et al. (2005), limiting the research on influence activities to direct face-to-face interactions provide a too narrow focus. As the meaning of influence is also socially constructed, it is important to bring to light the construction process itself. McLoughlin & Badham (2005) highlights the importance of taking a historical perspective in order that the broader context of change can be understood. As such, information about the physical setting, the psychological state of the participants, demographic characteristics, or any other element capable of enriching the context available for examinations are also of great value. Data concerning the identities and relationships of the participants of a process are required, if one is to understand role structure and social networks in which the process is embedded.

In this sense, a current account concerning the contextual state of the investigated setting at the time of each case/project is presented to introduce the specific circumstances in which they have developed. *Case context* not only involved the internal affairs of the investigated setting but also their relationships with clients and partners that could influence the internal knowledge change outcomes. For this, *archival documentation* including speeches, internal memoranda, strategic plan reports and internal communication has been used to provide a precise account of the contextual background on each knowledge change process has developed.

4.4.4.3- Participant Observation

Through *participant observation* researchers gain access to members of a group or organization to observe behavior as it occurs, and also build relations of personal trust needed to elicit full and reasonably frank interview material. Ideally the researcher blends into the social scene in such way as to minimize the impact of his presence on the behavior of those observed. In that model, one hopes to accomplish what is not entirely possible: to describe and analyze the behavior of those studied as it would occur without the presence of the observer (Whyte, 1989). Yet, the very notion of "participant observer" must be understood through a spectrum of possibilities such as: complete participation, the participant doubling as observer, the observer doubling as a participant and the complete observer. Each observation strategy, however, bring its own peculiar positional problem: the participating observer of being a traitor, the observer participant of being a spy and the complete participant of concealing his character in order to preserve the observed process.

Jarvie (1969) casts doubt on the assumption that to observe a social phenomenon at best, involves living that phenomenon. First, he questions "the inside" as privileged observation point by reminding that the vantage point is a matter of what the researcher wants to observe and why. Second, he points that by "going native" it

may become impossible for researchers to objectify their experiences towards scientific knowledge. Another problem arises when researchers confront situations in which these roles violently clash. The research may come into situations where his system of values strongly put him at odds with the facts he is observing (i.e.: crime, injustice, prejudice, betrayal, physical integrity) however for the sake of the precise observation he must conceal his position and by doing so neglect his moral duties. Overall, he argues that science is better served when the observer engages into a full and equal relationship with the subjects of study and do not exclude from those relationships the tensions and clashes which enrich the living experience.

Due to the complex and sensitive nature of the object of study, data collection involved direct and covered *participant observation* over a period of 24 months. Along this time it was possible to constantly collect data about the investigation setting context and the cases approached. Through this full embeddedness strategy it was possible to observe in detail the processes of knowledge change triggered by international project teams both along time and across levels (i.e.: individual, team, office, corporate). Key events, interactions, observations and personal feelings have been captured by notes in a field diary following the ethnographic tradition. Remarks, commentaries and observations were also noted on the field diaries for further reference during data presentation protocol and analysis.

Nevertheless, it is important to distinguish the selected data collection method from a class on their own of participative investigation such as *action research* (Thiollent, 1997; Coghlan, 2011). Differently from this strain of research, where the research engages into open and direct interaction with investigated subjects with aims to solve organizational problems, *participant observation* as data collection toll aims only collect rich data from a privileged insider point of view.

4.4.4.4- Field Notes

A striking feature in theory building research is the frequent overlap of data analysis with data collection. Field notes, for example, are an important means of accomplishing this overlap. Field notes are an ongoing stream-of-consciousness commentary about what is happening in the research, involving both observation and analysis (Van Mannen, 1983). These notes can be cross-case comparison, hunches about relationships, anecdotes and informal observations. One key to useful field notes is to write down whatever impression occurs, that is, to react rather than to sift out what may seem important, because it is often difficult to know what will and what will not be useful in the future. A second key to successful field notes is to push thinking in these notes by asking questions to itself (Eisenhardt, 1989).

Overlapping data analysis with data collection not only gives the researcher a head start but, more importantly, allows researcher to take advantage of flexible data collection. This freedom to make adjustments in data sources and collection instruments enables the researcher to probe emergent themes, move focus of interest and take advantage of special opportunities. This flexibility is not a license to be unsystematic, but rather controlled opportunism in which researchers take

advantage of the uniqueness of a specific case and the emergence of new themes to improve resultant theory.

4.4.4.5- Interviews

Interviews are situated face-to-face interactions in which researchers typically pose questions that a respondent answer. Interviews amount to a condition where private speech can be externalized and captured by the research in order to reveal the subject's interpretation on the events that they experience (Gephart, 2004). During the initial investigation design work and along the early investigative moments, interviews were supposed to be an important part of data collection as it was expected that subject's perspective would contribute to understand the object of investigation.

Reality however proved far trickier as initial interviews, though helped understand the investigation context and capture subject-level conflicts, yielded few if any specific relevant information regarding the knowledge change process itself. *Non-structured interviews* with international team members predominantly displayed a cultural comparative focus (i.e.: here is this way, there it is this way). Where a more structured approach was tried to invite subject's into deeper reflexivity, researcher has been inherently forced out of his covered position resulting in subject's feeling observed and changing their public behavior in his presence. Due to this unacceptable observer bias, *structured interviews* were ruled out of the investigation as they would expose the covered character of the researcher and undermine his capacity to collect rich unbiased data.

Another problem affecting interviews is that they systematically silenced or concealed details regarding power conflicts and political influence activities, which were vividly captured in public situations. As such, there has been either unawareness on the part of subjects about their role in knowledge change process or a disguised interest in it to be hidden. This polar sort of behavior made private speech either of little relevance to data collection or substantially different from public speech. The data collection problem faced then is that although *private speech* is conducive to the understanding of social phenomena in subject's terms, it is *public speech* that is actionable in social interaction situations, and thus, relevant to understanding social rationalization processes (Habermas, 1984). Therefore, although differences in private and public speech revealed an underlying conflict regarding what subjects think and do, the objective of this investigation closely linked with the latter and thus better served by public speech.

With these limitations in mind, this investigation restricted interviews to situations where subjects wanted to openly speak of events and made their opinions widely known, that is, under conditions that made private speech equal public speech. They were predominantly open-ended *informal interviews*, with an average of 1 hour and conducted on random basis with several subjects per team. They stopped being collected when *saturation* was reached, that is, when further interviews did not contribute to deepening the understanding of the object of investigation. Both

electronic recording and written notes have been used depending on written permission of the interviewees or strategic interest of the researcher to compare recorded and non-recorded interviews.

To overcome the limitations imposed by private speech conditions, data collection focus turned to situations where public speech could be vividly observed and collected. Particularly important situations of public speech were meetings, informal conversations and e-mails.

4.4.4.6- Meetings

Meetings mounted to situations where project members were officially gathered to receive/retrieve information, discuss problems, expose their views and settle agreements. Meetings were usually invoked by project top ranks around specific topics and lasted from 30 minutes to several hours. They involved not only team members but also corporate wide personnel, members of other project teams in the company, project partners, client personnel and suppliers. Some meetings were carried on face-to-face situation, others through videoconference technologies, and others through phone-conference. Most often meetings took place in the company facilities. At their end usually a “minutes of minutes” (MOM) was issued in order to make official compromises settled and actions to be taken. Where not, an e-mail was prepared and sent to all interested parties in order to provide a means for decision recollection and to induce action.

On the course of the investigation meetings provided a rich media for data collection as they presented the author with a social situation where knowledge processes could be dynamically observed. Meetings are structured arenas of discussion in which participants are selected not only on the basis of their potential contribution to the debates but also based on their rank and potential role as legitimators. Meeting composition/selection represented itself a materialization of power forces in play along knowledge change processes. During meetings lower ranks are given voice towards higher ones what mounted to a unique opportunity to exert influence beyond its peers and immediate superiors.

The real-time interaction between project members during meetings exposed not only the discourses, behaviors, cultural patterns and underlying rationalities of the participants but also the silences, the prejudices, subtle allegiances, legitimation/delegitimation strategies, the timing of proposition introduction or withdrawal, the risk taking pattern of change agents as well as the resistance strategies of defendants of the status quo. Meetings were also privileged situations where knowledge roles (i.e.: legitimators, change agents, and status quo) became evident. Overall, meetings make up for the bulk of political action in the knowledge change processes examined.

Meetings were electronically recorded using a cell-phone and saved as audio files (*.MP4). Approximately 130 meetings along the three study cases were captured through this process and had their audio files subsequently examined through a

fluctuant attention technique and had points of interest marked on a timetable for later appreciation. Key meetings and points of discussions were entirely transcribed to digital media format (WORD files) for in depth examination. Meeting recording also stopped when *saturation* was reached, that is, when further data collection did not contribute to deepening the understanding of the object investigated.

4.4.4.7- Informal Conversations

According to Miles & Huberman (1984), informal talks can yield valuable backstage information. It has been no different for this investigation as informal or “corridor” conversations proved a rich source of information regarding the phenomena under investigation particularly from the standpoint a more challenging, and thus less public, speech and of concealed actions towards less sanctioned venues of influence. They provided a contrasting stance against the sanctioned and legitimate character of meetings in which particular and partisan views became more salient and underlying discourse strategies and focus of influence could be more vividly captured.

Informal conversations made explicit information and positions strategically concealed in order to enlist additional partisans and gain further support before/after meeting debates or in order to preserve personal positions from status quo potential retaliation. Informal conversations happened all the time but were particularly relevant right before/after meetings, during lunchtime, coffee breaks or were brought about by chance as a cathartic impulse. Informal conversations most likely involved non-aligned peers, closer colleagues, and sympathetic audience. Overall, informal conversations made up for the bulk of strategic action in the knowledge change processes examined.

Informal conversations have been noted on a booklet and lately incorporated to the field diary notes together with conversation impressions, setting details and subsequent observed actions. Two booklets with a sum of almost 200 pages of notes have been taken out of this process along data collection period.

4.4.4.8- E-mails

E-mails extended the public speech character of meetings beyond the range of the initial participants and the locational setting. E-mails had also the feature of public positions and official statements and thus were highly actionable. Message tone (harsh x polite), response time (long x short), impact (answered x ignored) and outcomes were significant indicators of a wider audience recognition and knowledge effective change. In this sense, e-mails mounted to instruments of quasi-institutionalization in the knowledge change processes examined.

Just as meeting composition/selection represented a materialization of power forces in play, mail listings were also representative of audiences to be influenced and allegiances to be met. E-mails also helped to organize data collection on a temporal

sequence of events, and thus helped to establish a clear causal chain among events along knowledge change processes.

Along data collection period more than 1000 thousand electronic messages have been stored through MS Outlook tool and on later stage printed and examined using a *fluctuant attention* technique. Key remarks, commentaries and constructs were marked down for further reference, quotation and incorporation to the data presentation protocol and analysis.

4.4.4.9- Archival Data

Archival data has been extensively used to reconstruct the context of investigation and to support or contrast field evidences during data collection period and along the analysis process. Archival data collected involved public company documents, press releases, speeches, internal memoranda, strategic plan reports and internal communication.

4.4.5- **Data Reliability**

A recurrent question in qualitative research, which can be naturally directed towards this investigation, is how are the readers to know if the facts were as they were reported? Away from the increasing concerns involving fraud, the real problem rests with the honest research whose eventual mistakes during data gathering may undermine his conclusions (Whyte, 1989). In this regard, several considerations shown below have helped this investigation to avoid interpretive traps during qualitative data collection.

Many items of evidence in qualitative studies consist of statements by members of the group under study about the observed events. However, individual's statements and descriptions of events are made from a perspective which is function of his position in the group, and thus, must be carefully examined against a critical backdrop concerning his veiled interests. Nevertheless, it is important to notice that even when statements prove to be seriously biased, they are still conveying useful evidence towards unexpected relationships and conclusions.

Another problem concerns the evidential value of statements whether they have been made independently or have directed by a question from the observer. Although volunteered statements seem less driven by observer's interference than one which is made in response to a direct question, the observer's very question may direct the informant into self-elaborating the problem and give an answer which might never occur to him otherwise.

Statements and actions made in the presence of the sole observer may differ greatly from those made to an audience. More important than judging which situation is more reliable, it is important to view each datum as valuable itself towards a thoroughly understanding of the phenomenon.

In assessing the value of evidence one must also taken into account the observer's relative role in the observed group. How subjects define researcher's role affects what they tell him or let him see. If the observer carries on his research incognito, participating as a full-fledged member of the group, he/she will have access to knowledge that would normally be hidden from an outsider. He/she could properly interpret his experience as that of a hypothetical "typical" group member. On the other hand, the "strangeness" may help the observer to learn how group members define him and their reaction to his conditions may also be a valuable source of information to interpret evidence.

Although a myth surrounding theory building from case studies is that the process is limited by researchers' preconceptions, in fact, the constant comparison of conflicting realities tends to unfreeze thinking and lead to less biased research than incremental studies or axiomatic deduction. For Whyte (1989), the possibility of closely studying important changes that would not be possible from the outset far outweighs the potential disadvantages of researcher bias through personal involvement in the investigated process.

For Lee (2001), the methodological context must provide enough information to allow a reader to understand the decision-making process that the qualitative research has followed. The reader may agree or disagree with the researchers choices, nonetheless, he is to be provided with sufficient information to hypothetically replicate the study's underlying logic, comprising a sort of "replication standard" (p.215).

Overall, *reliability* can be considered the measure of transparency and replicability used in the study that allow for subsequent researchers to hypothetically arrive at the same insights if they conduct the study along the same steps again. *Transparency* can be enhanced by elaborating *case study protocols*, that is, reports that specifies how the entire case has been conducted. *Replicability* may be accomplished by assembling a *case study database*, which should include the notes, documents and narratives collected during the study, organized in such a way as to facilitate retrieval or inspection by further researchers.

4.4.6- Data Presentation

Showing data is critical for accessing whether successful theorizing is plausible. One key mistake in writing qualitative research happens when an author rather than showing any raw data, give only their interpretation of the data. This analytic excess is problematic because no clear chain of evidence shows how the researcher moved from their data to their interpretations. Crafting elaborated tables and relegating all data to these tables is a variation of the problem. Ideally, authors should place at least some data within the body of the paper, what not only makes the text more interesting to read but also facilitates the task of establishing the necessary chain of events and conclusions.

The opposite also represents a problem. Although “thick description” may ultimately contribute to theory, limiting an analysis to just describe what one found is not likely to make it significant. Indirectly, several analytic strategies can lead to descriptive excesses. Organizing findings around research questions often leads to the use of quotes and other data to answer them, however the answers focus frequently supersedes the discussion focus hindering the elaboration of theoretical contributions. Crafting typologies may also lead to being overly descriptive in some circumstances. Simply sorting themes out of the data without explaining how this classification schemes leads to new theory or new theoretical insights makes the text too descriptive.

For Pratt (2009), key data should be placed in the body of the text and only in exceptional cases in tables. These data may be in the form of “power quotes” and “proof-quotes”. Generally “power quotes” are the most compelling bits of data a qualitative research may use, once they effectively illustrate and bolster points that have been priority developed along the analysis. Many quotes may be provided for each argumentation point in order to strengthen the evidence backing author’s statements.

Figures may also be used to help in the presentation of how the methodological process unfolds and for depicting more complex analyses. They are also helpful in capturing the chain of evidence towards one conclusion. The use of figures is particularly of great help for depicting process and for representing how the author moved from raw data to the theoretical labels or constructs used in the analysis.

Within-case analysis typically involves detailed case study write-ups for each site. These write-ups are often simply pure descriptions, but they are central to the generation of insight once they allow for the investigators to become deeply familiar with each case before start making generalizations. In this investigation, study-case protocols have been organized in the format of narratives describing the process of knowledge change with an emphasis on context, actors and knowledge processes (Eisenhardt, 1989).

4.4.6.1- Narratives as Case Study Protocols

Process theories attempt to understand ill-defined flows and patterns of action in specific organizational contexts, characterized by untidy, politicized and iterative change process driven by a range of actors, using a combination of multi-level, longitudinal, qualitative data from multiple sources. It thus adopts a less tightly defined relationship of causality which can be equated with the contextualized and temporally sensitive expressions of causality conveyed by *narratives* (Dawson & Buchanan, 2005).

According to Putnam et al. (1996), *narratives* are accounts of events, usually developed chronologically and sequentially to indicate causality. They are vehicles through which organizational values and beliefs are produced, reproduced and transformed. They shape organizational meanings through functioning as

retrospective sensemaking, serving as premises of arguments and persuasive appeals, acting as implicit mechanisms of social control, and constituting frames of reference for interpreting organizational actions. Similarly, Weick (1995) argues that accounts help people to connect events in a plausible and coherent way, contributing to the interpretation and evaluation of actions in general.

Pentland (1999) argues that narratives can be a valuable source of insights about organizations, and thus, can provide the means for better process theories and explanations in case-study research. Once any narrative contains a description of a process or a sequence of events, so they are able to confirm the existence of a sequential pattern, as well as expose its antecedents and consequences. However, describing patterns, antecedents and consequences does not by itself explain the underlying process. A single process can generate many different performances, with many different points of views, narrated in great variety of ways. Explanations require researchers to go beyond the surface level of events, where accounts can be rather fragmented, situated, strategic and conflicting, and systematically triangulate and confront data from different sources towards the deepest levels where the generating mechanisms enable and constrain the process under examination.

In using narratives to describe processes it is important not only the contents of texts but also their trajectories: where they emanate from, how they are used by organizational actors and what connections are established among texts. Such approach provide focus for an intensive qualitative investigation to examine the link between particular actions carried out in an organization that relates to legitimacy or sensemaking and the texts that are produced, as well as the subsequent impact of those texts.

In creating a coherent story, it is important not only to describe themes and events, but how they fit together. Just as a literary story has a focal character, so too should a qualitative story have a focus on around which the rest of the contents gravitates. A narrative must provide a clear time sequence (beginning, middle and end) which works as a central organizing device for presenting actions and events. Excessive emphasis on time sequence, however, tends to enhance descriptive generalization at expense of meaningful explanations, once a focus on events encourages readers to abstract away from actors and their relations.

Narratives can take many forms, however, they usually unfold around the following key elements: time sequence, focal actors, narrative voice, evaluative frame of reference, context and events. In this way they link antecedents, action and consequences. As noted by Dawson & Buchanan (2005), narratives are theory-laden because they systematically link antecedents and consequences in a relationship of causality. However, the theoretical background and the selection of key developments may not be always transparent allowing room for all sorts of political manipulation aimed at furthering a determined point of view.

Every story is told from a particular point of view, with a particular narrative voice, which is not regarded as part of deep structures. The way a story is told can provide

additional insight into the social world under investigation as well as tellers' point of view and their relationship to their audience. Stories also vary depending on who is doing the telling, and the details of how a story is told are worth great attention. Objectivity is created and sustained when researchers tell stories in their own scholarly voice, rather than letting their research subject do the talking. Selective silencing is also an unavoidable feature of narrative, as well as finding the silent voices and revealing the sources of power enhances its deconstructive role.

Evaluative context can drive processes, enabling and constraining certain choices and key events. Careful attention to evaluative context also can be used to show how unstated assumptions influence actions and opinions and how pervasive structural tensions form and are handled in the setting. In this sense, researchers do not just observe events, they focalize them and create stories to explain them. (Dawson & Buchanan, 2005).

4.5- DATA ANALYSIS

4.5.1- Analytic Guidelines

More than just presenting data, it is also important to analyze, interpret, compare and contrast cases to reveal conceptual similarities and differences within it. Moreover, authors need to revisit research questions or goals in their discussions to explain how their questions were answered and how their goals were achieved in the report research. The broader implications and importance of the findings need to be explained and related in terms of key management and/or social science issue.

For Gephart (2004), it is important to show what was done in the research process and to articulate how research practices transformed observations into data, results, findings and insights. Researchers need to report their sources and types of data as well as their analysis practices. In moving from data to findings, the goal is to be clear about what has been done, so that readers can evaluate the veracity of the methods. In doing this, it's important to explain how and in what way data were used during analysis and make sure the chain of evidence is clear and compelling.

Similarly, this author suggests that the operation of data into concepts needs to be made in a clear and explicit way if the findings are to be comprehensive and credible. A well-developed analytical procedure ensures that data has been systematically, comprehensively and exhaustively reviewed. In his opinion, making these links explicit avoids the problem of "exemplifying" where a researcher addresses a few cases but fails to explain how these cases represent a broader data set or explain how they were chosen.

In qualitative research, frequently thoughtful ideas and interesting ideas derive from unplanned questions and non-recorded observations. Given the common scientific norms that most researchers are socialized to, ideas resulting of these unplanned/unrecorded actions are usually dropped out of analysis, or concealed from readers view, undermining his assessment of the analytic process and on what

basis conclusions were reached. In this investigation, fine grained and apparently unconnected pieces of data have been extensively collected through the use of field notes which helped in the data aggregation process and in some cases to provide complementary support for theoretical claims.

Though part of the analysis carried in this investigation display similarities with *grounded theory* (Glaser & Strauss, 1967; Strauss & Corbin, 1990) it extends this traditional approach by using a multi-method strategy, which give great emphasis to time and level dynamics. Moreover, in agreement with Sminia (2009), although the whole purpose of grounded theory is to construct theory from raw data in a systematic and traceable manner, the actual process of emergence of the codes and categories and how they link together in the mind of researcher remains on the verge of obscurity. In this sense, the object of this investigation is better served by a collection of methods more akin to a *process theory* building method.

4.5.2- Process Analysis

Overall, this investigation follows the guidance provided by process researchers such as Van de Ven & Poole (1995), Langley (1999), Dawson & Buchanan (2005), Dooley & Van de Ven (1999). For these authors, *process research* is about finding answers to 'how' questions regarding the outcomes of a process or a specific phenomena. In general terms, these authors assume processes as an organized family of occurrences that are systematically linked to one another, either causally or functionally.

According to Van de Ven & Huber (1990), process research is concerned with understanding how things evolve overtime and why they evolve in a determined way. Process data consist of events, actions and choices ordered overtime. Differently from variance theories that provide explanation for phenomena in terms of relationships between variables (i.e.: $+A \rightarrow +B$), process theories provide explanations in terms of sequence of events leading to an outcome (i.e: $A \rightarrow B \rightarrow C$). Therefore, understanding patterns in events is key in developing "process" theories.

Process data, however, display characteristics that make them difficult to manipulate and analyze. First, events and actions are far more subtle and difficult to measure than variables. Second, process phenomena display a fluid character that spreads out over both time and space, turning different examination levels into a continuum where it becomes difficult to establish analytical boundaries. Finally, although processes are usually treated in a linear fashion way, it is not uncommon to find situations where they display recycling between phases and parallel tracks, as well as multilayered and changing contexts (Langley, 1999).

4.5.3- Analytic Procedures

The most serious and central difficulty in the use of qualitative data is that there is no prototypical method of analysis. Usually most of the attention is dedicated to issues like gaining access and avoiding bias during data collection. For qualitative investigations, analytic methods are rarely reported in detail and even when

researchers try to be explicit about their methods, the lack of common language and the labor-intensiveness of the analytic process give room for great ambiguity.

In this sense, it is important to describe the successive procedures used for within-site and cross-site analyses, all the way from the initial coding of site-level notes to the more explanatory cross-site analyses. It is also important to detail the analytic steps taken, the decision rules used, the bases for drawing conclusions, the confidence held in the conclusions, and the strengths and weaknesses of the analysis.

4.5.3.1- Longitudinal Case Analysis

Following Miles & Huberman (1984) qualitative data analyses consisted of three concurrent flows of activities: data reduction, data display and conclusion drawing/verification. These three streams of activities made up for an interactive, cyclical process, making qualitative data analysis a continuous and iterative process. As such, qualitative analysis has been documented as fully as possible for purpose of auditing but also for purpose of learning.

Data reduction refers to the process of selecting, focusing, and transforming collected data. Researcher's choices on how to gather and handle have analytic nature. Following Weick (1989), data reduction aimed to be as simple as possible, and applicable, however, preserving its intrinsic complexity. As such, data reduction involved a careful examination of data collection using a technique of *fluctuant attention* which consisted of successively reading and listening data collection several times taking associative notes until key actors, events and actions arise and made up for a clear causal link in the knowledge change process examined. Along this process, unrelated elements were progressively filtered, and thus, ruled out from main analysis. Another cognitive process that helped in data reduction was *reflexivity*, that is, the causal links preliminarily established have been back checked several times in situations detached from direct source data examination in order to eliminate chance association, and first impression bias, helping to consolidate the causal links discovered.

Data display refers to an organized assembly of information and is a major venue to valid qualitative analysis. The most frequent form of display for qualitative data is the narrative text, although matrices, graphs, flowcharts are also useful. First, following Langley (1999) and Dawson & Buchanan (2005), data has been preliminarily displayed in the form of temporal narratives (see data presentation section) describing in detail the events that took place in the knowledge change processes examined with an emphasis in the direct and indirect actions that concurred to the outcomes observed. Second, following Dooley & Van de Ven (1999), the two main dimensions *knowledge density* and *power asymmetry* have been examined (plotted) along time series and had their points of inflection associated to knowledge processes theoretically expected and explained in terms of the key actions and events highlighted by the narrative work (see data analysis section).

Conclusion drawing/verification refers to the process of deciding what things means, of ruling out regularities, and lifting explanations, causal relations and propositions. Researchers should hold these conclusions lightly, maintaining openness and skepticism until data collection is over. The meanings emerging from a single case nonetheless have to be contrasted with other cases in order to gain plausibility and robustness, and thus achieve *construct validity*. As such, in the beginning of the analysis, a summary with preliminary observations is presented in order to highlight the particular contribution and specific circumstances circumscribed to this specific case.

4.5.3.2- Cross Case Analysis

According to Eisenhardt (1989), cross-case analyses consist in selecting categories or dimensions and look for similarities and differences across different situations. Cross-case analysis force investigators to go beyond initial impressions, through the use of structured and diverse lenses on the data. These tactics improve the likelihood of accurate and reliable theory and enhance the probability that the investigators will capture the novel findings which may exist in the data.

As themes, concepts, and possibly even relationships between constructs begin to emerge, the next step is to compare the emergent frame with the evidence from each case in order to assess how well they fit along the data gathered. Sharpening constructs is a two-way iterative process involving construct redefinition and evidence building. Through constant comparison between data and causal links, accumulating evidence from diverse sources converges upon a single, well-defined causal link.

Cases that confirm emergent relationships enhance confidence in their validity. Cases which disconfirm the relationships often can provide an opportunity to refine and extend theory. When a relationship is supported, qualitative data often provides a good understanding of the dynamics underlying that relationship. It is important to discover the underlying theoretical reasons for why the relationships exist because it helps to establish the internal validity of the findings.

4.5.3.3- Model Specification

One important thing about qualitative research is that analysis is carried on sequentially, with important parts of the analysis being made while the researcher is still gathering his data. This brings two consequences: First, further gathering data takes its direction from provisional analysis. Second, final comprehensive analyses may not be possible until fieldwork is complete. In this investigation, the entire data examination and analysis took place AFTER fieldwork has been completed. Though this strategy can potentially hurt analysis by denying research from additional confirmatory data, this has been necessary due to doctoral program time constrains.

Becker (1958) identifies four phases unfolding from qualitative research analysis. In the first stage, the observer selects significant events where the phenomenon under

study become salient and set focus for further investigation. Second, he/she checks the relative frequency of these events among categories of subjects and proposes relationships which may turn into provisional models. While provisional models may be charged imprecise, the observer is in position to infer what kind of evidence would most likely to support or refute them and go for it. Third, he/she constructs models of parts of the organization and seeks greater accuracy by successively refining the model to take account of evidence that does not fit previous formulation. After accumulating several models of this kind, he seeks connections between them towards an overall model of the organization.

During model specification, some of the strategies promoted by Langley (1999) were followed, such as visual mapping where findings were graphically represented to make key construct and relationships emerge out of researcher's analytical process and the proposed model amenable to readers in general. This work also follows his *alternating templates strategy* in that initial causal links are constantly contrasted with alternative ones developed after direct data examination. Competing explanations were "tested" in a hypothetico-deductive fashion way, which gradually refuted weaker theorizations and consolidated the main ones.

The final systematic analysis, carried on after the fieldwork is complete, consists of rechecking and rebuilding models as carefully and with as many safeguards as data will allow. At this stage, the observer carries on the model building operation more systematically and arrives at the final model specification.

4.5.3.4- Literature Comparison

Comparison with the emergent concepts with theory and extant literature is important for two reasons. First, if researchers ignore conflicting findings the confidence in them will be reduced either by incorrectness (challenge to internal validity) or by idiosyncrasy (challenge to generalizability). Second, the juxtaposition of conflicting resulting forces researchers into a more creative, groundbreaking mode of thinking in order to extend theory to accommodated the findings or to definitively challenge it. Literature discussing similar findings is important as well because it ties together underlying similarities in phenomena normally not associated with each other.

Overall, tying the emergent theory to existing literature enhances the internal validity, generalizability, and theoretical level of theory building from case study research. While linking results to the literature is important in most research, it is particularly crucial in theory-building research because findings often rest on very limited number of cases so any further corroboration of internal validity and generalizability is an important improvement (Eisenhardt, 1989).

4.5.3.5- Back-Checking Conclusions

A controversial issue in participatory research is to allow the studied subjects to check facts and offer alternative explanations. For Whyte (1989), researchers have

traditionally reacted against criticism on the interpretations of the facts and conclusions by telling that subjects are just being defensive. In his opinion, to safeguard against researcher's self-delusion, facts must be checked by those with firsthand knowledge before any written reports.

In this investigation, however, back checking conclusions has been limited by the covered character of the investigation and also by the furtive or unconscious character of the processes involved in the knowledge change process. First, submit subjects to "theory checking" to convey their opinions would expose the covered character of the investigation and jeopardize future researcher relations with the subjects investigated. Second, even if deemed possible, subjects would rather deny proposed theorization than admit being caught on the course of their political influence processes and strategic actions. Therefore, only informal back-checkings have been proposed to some key informants and the results were displayed at the final of the analytical section.

4.6- ETHICAL CONCERNS

4.6.1- Identification Disclosure

Under the investigation permission agreement the identification of the investigated companies has not been disclosed as it could potentially open up mismanagement claims from minority shareholders as well as easily convey insider information for competitors. As such focal companies investigated were identified by initials like WP, CCC, CNC (prior purchase), CNC/WP (after purchase) and their location offices when required.

Differently from investigated companies, client names are an important source of contextual information as long as it says much about the type of business relations that the investigated companies try to build and how different they treat a diverse client based. As such, Petrobras, Eletrobras/Eletronuclear, LLX and BG (former British Gas) are identified as such.

Investigated subjects, were also identified by a letter code (i.e.: X.Y.Z.) which do not have directly relationships with their names initials, though it may look. This procedure had the aim to preserve actor's reputation from wider social or professional scrutiny, which could be harmed by inadvertently or selective use the information contained in this investigation.

4.6.2.- Sensitive-Information Confidentiality

Companies strategy and business information have been collected exclusively by means of public records, such as business press, investors relation reports, and particularly important through their corporate institutional websites. Acting this way the researcher was able to prevent that by any means sensitive data could be inadvertently disclosed alongside the investigative work.

Even when sensitive information were incidentally captured along data collection it has been kept off data presentation and analysis, unless its disclosure represented little risk for the investigated company and high impact in terms of explaining or contextualizing the investigated phenomena. Situation like these were limited to no more than two or three potential occurrences all over data presentation.

Nevertheless, the latest data collection dates 2 years back from this doctoral dissertation been made public. Insofar, researcher and investigated companies agreed that any piece of sensitive information that may have passed through these filter hardly will be useful for any economic or legal concern on due date.

4.6.3- Participant Anonymity and Privacy

Under investigation permission agreement, investigation was not submitted to companies for prior appreciation before being open to the public in order to preserve the privacy and reputation of investigated actors. Given the hierarchical position of each actor on the projects investigated, firms could easily name them and use this information for a selective performance appraisal. Researcher understands that it is up to human resources department to apply official appraisals upon companies' employees, using legal and egalitarian methods it has at disposal, what by no means can be mixed with the objectives of the present investigation.

Additionally, participant behaviors not directly linked to the object of investigation (knowledge change process) whenever possible were not recorded and if incidentally recorded were kept off data presentation. Researcher understands that the individual conducts of the investigated subjects that do not interfere in the investigated object are of the sole concern of the subject and the entity that he works for. Moreover, moral and professional judgments run in a diametrically opposed direction to the impersonal scientific objectives of this investigation.

In retribution for allowing this investigation and respecting participant anonymity, the corporate entity (WP) received a separate report suggesting points of improvement for both HR policies and leadership training and selection.

4.6.4- Researcher Neutrality

Although data presentation and analysis adopted a free discursive strategy, on a permanent basis, researcher neutrality has been reflexively checked, and whenever an element of information or piece of analysis has been considered biased towards researcher ethical or moral judgment the entire topic has been withdraw from investigation report.

This procedure aimed to minimize potential biases that might have been introduced to the data collection or analytical work as a result of the intense exposure to the investigated setting the researcher was submitted to. As personal conflicts, broken expectations and unfair treatment may have contributed to unleash potentially emotional responses on the part of the research, whenever these events could

potentially affect its impartiality and clear judgment of the investigated facts, this procedure has been applied.

4.6.5- Secure Data Collection Storage

Full data collection (i.e.: e-mails, recorded meetings, field diaries, and documental evidence) is securely stored on hard-drive media away from non-authorized access and safeguarded from internet leakage.

Copies also exist in paper and are properly archived for auditing and further consultation.

SECTION II
DATA PRESENTATION & ANALYSIS

CHAPTER V
CONTEXT OF INVESTIGATION

5.1- ECONOMIC CONTEXT

5.1.1- International Economic Context: A Turnaround in the World Economic Order

Even to those used to the concept of dynamic environments (Schumpeter, 1934; Grant, 1996b; Teece et al., 1997; Eisenhardt & Martin, 2000), the last decade has been breathtaking. Unforeseen political and economic events literally turned upside-down long standing economic balances. According to Anderson (2011), two intertwined economic events radically changed the world economic landscape in recent years: China ascension and emerging markets (EM) economic decoupling from the developed world.

EM economies entered the 90's with an extraordinary set of economic imbalances (i.e.: high foreign debt, high deficits, dependence on foreign inflows, inflation). The increasingly interconnected nature of the financial system unleashed extremely strong market forces and an unprecedented wave of international financial crisis swept one by one battered EM economies like Mexico (1994), Thailand (1997), Indonesia (1997), South Korea (1997), Philippines (1998), Malaysia (1998), Russia (1998), Brazil (1998), Turkey (2000), and Argentina (2001). EM economies along this process were forced to float their currencies, restructure their debt, adopt fiscal tightening measures and run fiscal surpluses to service their foreign debt.

Unlike its neighbors, most of China's foreign investment in the 90's took the form of factories rather than securities. China took advantage of the economic disorganization that hit its Southeast Asian neighbors and took their place as reliable source of manufactured goods and became a prime foreign investment destination. In order to attract productive investment and know-how, Chinese government opened its huge state-owned enterprises (SOEs) to associations with MNEs, offering market access, attractive tax code, export facilities, full profit reintegration, cheap and obedient labor. Chinese local manufacturers also received strong governmental incentives like cheap land, low-interest loans, subsidized energy, and devaluated currency. As a result, China not only attracted manufacturers from its neighbors but also from developed countries whose MNEs quickly moved labor-intensive and low added-value activities to the country in order to reap productive gains and increase profitability (Fishman, 2004). Productive relocation has been particularly strong in the U.S. due to the market pressure of large-scale retailers (i.e.: Wal-Mart, JC Penney).

Parallel to those events, US economy experienced an unprecedented period of growth and wealth. Contributed to such economic dynamism the transition from an industrial-based to a service-based economy steered by the introduction of information technologies (IT), booming exports resulting from aggressive free-trade agreements (inclusive with China), and improved fiscal management. During the 1990s, GDP grew eight years in a row, real output increased, inflation was manageable and unemployment dropped to below 5% (full employment), conditions

only interrupted by the so-called “dot-com bubble” (2000-2001) and the terrorist attacks of 9th September 2001.

On the opposite side, the 90’s marked the beginning of a troublesome period for the Japanese economy. In the period of 1990-1992, an asset price bubble developed during the 80’s come to an abrupt end, dragging the whole economy into a deflationary trap. Growth in Japan throughout the 90’s was slower than in other major developed economies, giving rise to the term “lost decade”. In the end of the 90’s, the Southeast Asia crisis again hit hard the Japanese economy bringing the export –led growth model to a end, as some its main markets suddenly become fierce competitors. Japanese companies which for a long time were reluctant to internationalize were forced either to relocate or shift production into higher added-value, if not both. This has been a particularly rich period of business research as the crossborder implementation of Japanese management model (i.e.: Just-in-Time, Kaizen, Kanban, Quality Circles) called attention to the cultural/institutional roots of management practices.

Europe, on its turn, went through the 90’s with a relative balance of challenges and opportunities. On the challenges side, Germany struggled as the reunification in 1991 proved costlier than expected, while UK experimented the exhaustion of Thatcher’s liberal policies and the 1992 currency crisis. France and Italy faced problems with public spending and budget deficits. On the opportunities side, the formalization of the Europe Union (EU) in 1993 stimulated trade and investment within the block boosting the economies of poorer countries like Spain, Portugal, Ireland and Greece and reactivating the economies of the richer partners. It was a time of economic stability for the EU, as it could relocate production not only through its long established network of MNEs but also within its borders in order to respond competitive pressures.

In the beginning of the 2000’s, the productive distortion the Chinese government promoted in manufacturing was so intense that in some cases the net cost of exported goods barely covered the cost of the raw material used. This phenomenon generated downward inflationary pressures in developed countries, particularly the U.S., while expanded the consumption base and multinational profitability worldwide. A virtuous circle established as China flooded the market with cheap manufactures and imported specialized services and high added-value goods from the developed world.

In the aftermath of the events of 2000-2001, the concentration of white-collar activities in developed countries pushed productivity upwards, particularly in the U.S. The consequent downward inflation tendency contributed to easy credit conditions, which fuelled another round of consumption and economic growth in the developed world. The U.S., closely followed by Europe, consolidated his position as the economic “engine of the world”. Significant amounts of investment flowed among developed countries, curbing investment and consumption in EM markets, still recovering from the recent financial crisis.

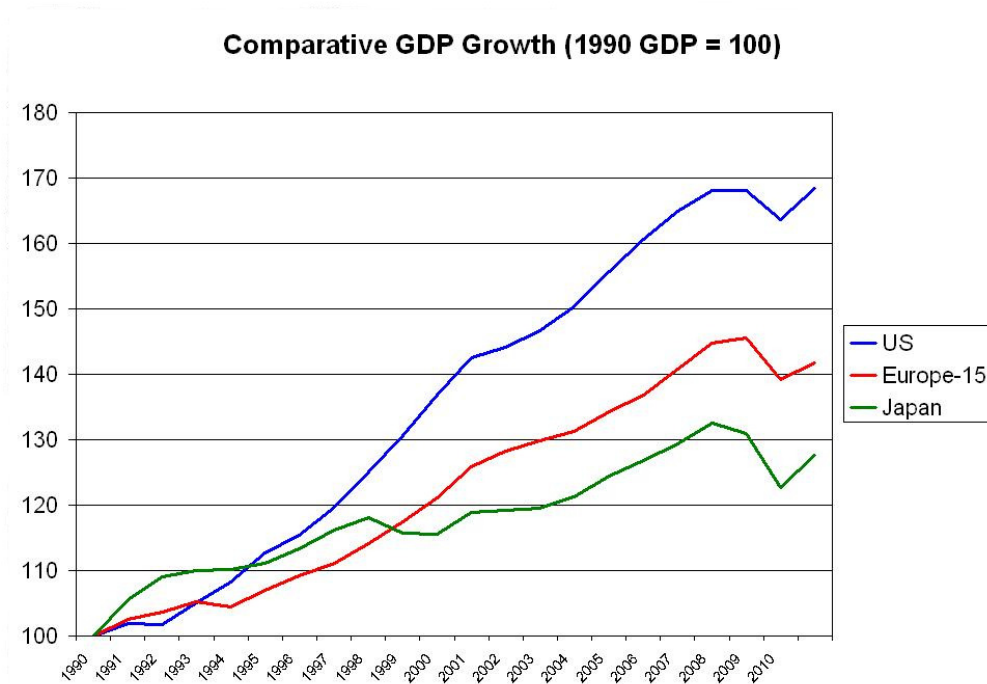


Fig. 04– US, EU and Japan GDP growth between 1990-2010 (Source: EUROSTAT - <http://epp.eurostat.ec.europa.eu>).

The year 2002 consolidated China as “the factory of the world” and the beginning of its decade-long explosion in commodity and primary resources imports. Major commodity exporters like the Gulf States, Brazil, Australia, Russia, Nigeria, and Argentina benefited enormously from Chinese growth. Aided by commodity revenues and productive relocation, key EM economies suddenly found themselves with a favorable set of macro-economic conditions (i.e.: weakened currencies, lower foreign debt, better banking systems, fiscal surplus), which provided a strong underpinning for foreign capital attraction and growth.

At the same time falling interest rates and intense competition in the developed world made capital markets look for riskier assets and higher yields in the EM, what started by Asia who had recently given signs of intense economic dynamism. By 2004, however, China was no longer an emerging market to be conquered. Decades of trade surplus and heavy State intervention in the economy created an awesome international competitor (Fishman, 2004). To keep profiting from exports, Chinese companies moved upwards in the productive chain manufacturing goods with higher added value and technological content, again with the help of technology and management brought by worldwide MNEs. For smaller companies it was too late to invest in China, as many sectors had already developed its national champions, which were about to go global (Perez & Robinson, 2004a/b).

The quest for the next great place to invest spurred many analysis and studies, none as appealing as the one developed in 2001 by Jim O’Neill, chief economist for the investment bank Goldman Sachs. He created the acronym BRICs to refer to Brazil, Russia, India and China, a group of very different but rapidly growing large and populous countries with potential to lead world economy in a few decades.

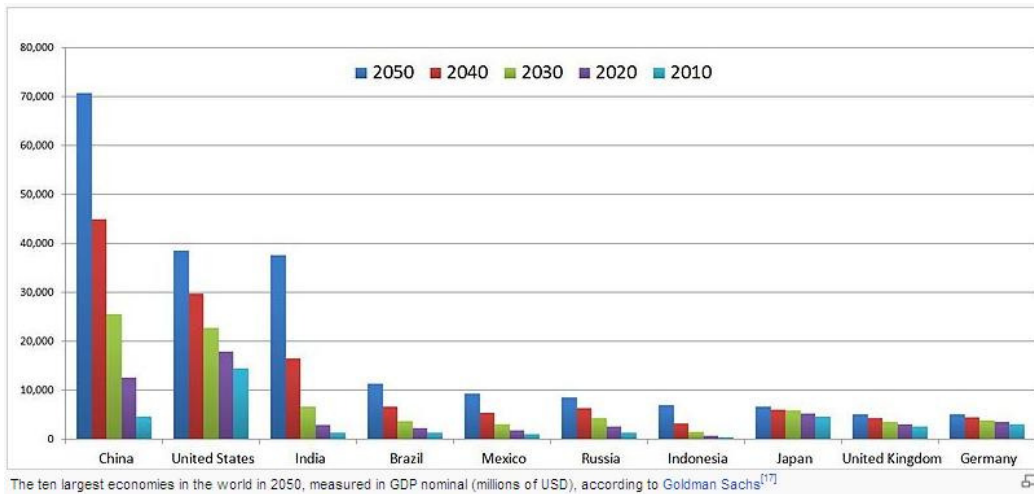


Fig. 05– GDP growth forecast 2010-2050 (Source: Goldman Sachs BRIC Report)

Like a self-fulfilling prophecy, BRIC countries quickly dominated the stage for international investment and started to receive large capital inflows after 2004. Foreign investment helped their economies grow much faster than developed world, proving O’Neill had a point. Nevertheless, an intense debate emerged about the BRIC dependence on the developed world demand to keep on growing.

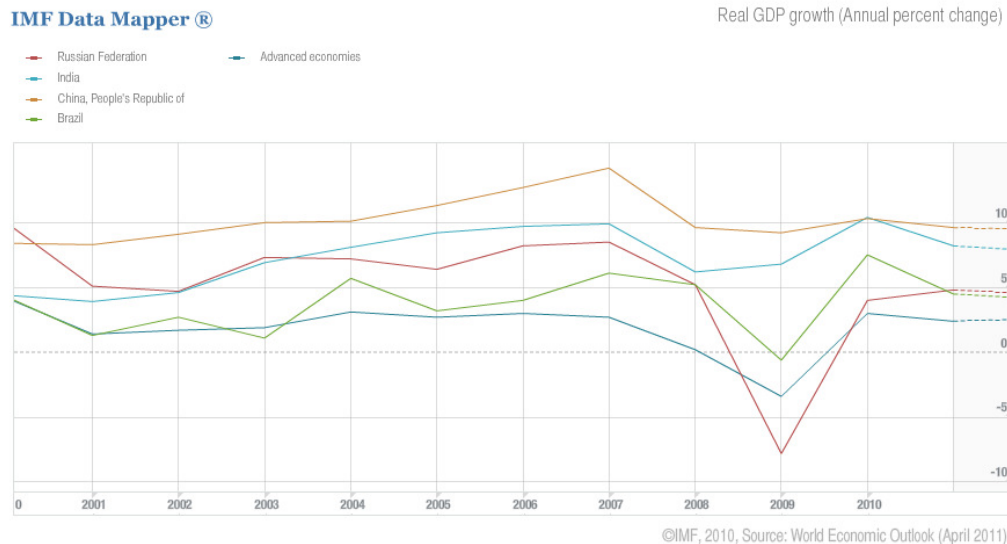


Fig. 06–GDP growth: BRICS x Advanced Economies from 2000-2011. (Source: IMF Data Mapper)

From 2004 to 2007, almost all economies around the world enjoyed some level of growth. China took advantage of the surging demand for manufactured goods in both developed and developing world and grew an astonishing 13.5% this year. As EM markets fuelled developed world appetite for commodities and basic goods, they started to run large trade surpluses and accumulate extensive amounts of foreign reserves. EM economies fearing that currency valuation would damage exports, feedback this money into the global economic system through the purchase of U.S. debt, issued to cover public deficit and the military campaigns in Iraq and

Afghanistan. These inflows were high enough to keep U.S. interest rates at extremely low levels, what stimulated steady consumption and kept the world growing.

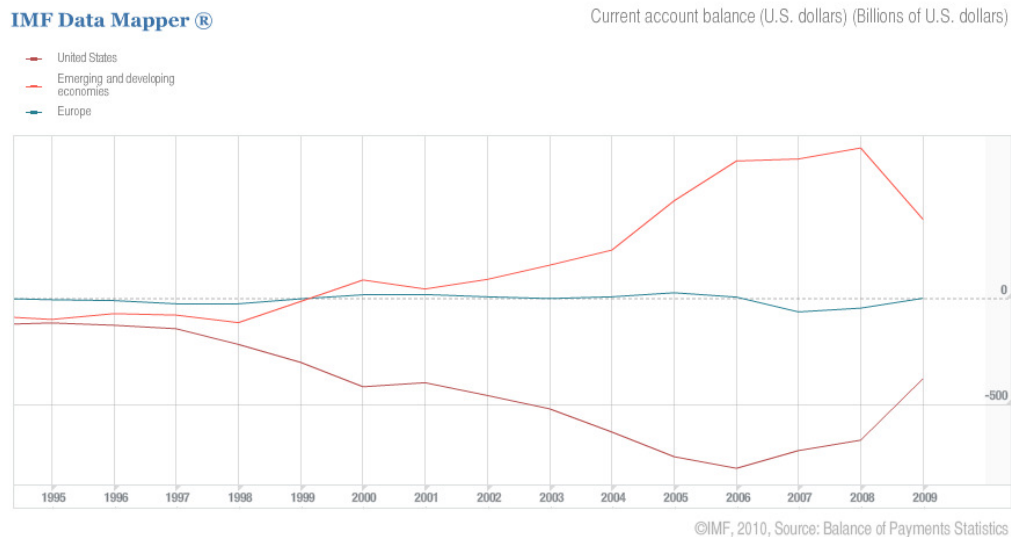


Fig. 07- Current Account Balance: EM x US x EU from 1995-2010 (Source: IMF Data Mapper).

At the same time, low interest rates promoted a boom in the U.S. real estate market. Price appreciation enabled families to refinance their homes and use the additional money to invest or expand consumption. Lenders start to push credit further into higher-risk borrowers (sub-prime) using even riskier loan options and borrowing incentives. By 2006, a building boom led to an oversupply, which caused prices slightly decline in mid-2006. In an over-leveraged economy this slightly decline blocked the refinancing strategy and led to several non-performing sub-prime loans. As foreclosures increased the supply of homes, prices continue a downward spiral that dragged down the whole mortgage system. Defaults on other loan types also increased significantly as the crisis expanded from the housing market to other parts of the economy, imposing heavy losses to the U.S financial system. The bankruptcy of Lehman Brother investment banking marks a critical point in the crisis process.

Through a process called securitization, home loans were packed and sold to foreign investors as highly secure and profitable investment options. With housing prices declining, major global financial institutions started to report significant losses. The complex mechanisms used to distribute risk and benefits in the securitization process led to a great uncertainty in the financial world. As the crisis spread worldwide, credit markets froze, risking paralyzing even the most usual short-time productive credit operations. Central banks around the world acted quickly to support market liquidity while the Federal Reserve lowered interest rates to near-zero, bought unwanted securities and bail-out banks and insurance companies.

The credit-crunch also exposed the fragility of several EU economies. With international creditors much more selective, countries like Greece, Portugal, Ireland and Spain found it increasingly difficult to finance their huge domestic deficits at discount rates. Unable to expand governmental spending these countries suffered

heavily from the 2008 recession and saw tax revenues dwindle further aggravating public debt situation. In different moments of 2010-2011, Greece had to be bailed-out by the International Monetary Fund (IMF), Ireland and Portugal received rescue packages and Spain had to commit to aggressive cuts in public spending to meet EU fiscal targets. Overall this crisis known as European Sovereign Credit Crisis, is still on course with Portugal about to receive a IMF bail-out and a growing dissent over the future course of the European currency, the Euro.

In the aftermath of the sub-prime and sovereign debt crisis, economists worldwide start fearing that the following recession would unleash a round of protectionist measures that could cause a retrenchment in globalization with disastrous consequences for the world economy. (The big question: Is globalization on the retreat in 2011. *Financial Times*, 18th July 2010). Fearing the worst, leaders on the main economies resisted protectionism and committed to keep borders and trade open.

In the early developments of the crises, EM world remained relatively untouched as "toxic" securities did not penetrate their unsophisticated or heavily regulated financial markets. With their financial markets unscathed, commentators start wondering that EM depended increasingly less on developed world for financing and trade. However, as crises intensified and the risk of a global downturn and uncontrollable deflation promoted intense resource outflows from EMs, the safety of these markets became questionable. Under this threat, key EM economies followed the example of developed markets and used their comfortable fiscal situations to launch stimulus measures aiming to offset the effects of the recession and restore steady growth. In 2009 third quarter, the numbers of Chinese economy showed that US\$500 billion stimuli package had worked and the country had taken a different course than U.S. and Europe. Other EM countries also reacted favorably to these and other packages avoiding recession and keeping a moderate growth.

In 2010, EM economies quickly recovered from the downturn of 2009 (India, 10.4%; China, 10.3%; Brazil, 7.5%; Turkey: 8.3%; Argentina, 9.2%) in response to the stimulus packages. With the decoupling thesis gaining ground, the BRIC acronym has come into widespread use as a symbol of the shift in global economic power away from the developed economies towards the EM. Development and economic dynamism went south and east as the picture next shows.

The 2007-2011 economic events confronted traditional MNEs with a number of new challenges. On the one side, with developed world in retrenchment mode the trend in talent flow reversed. Long time expatriates began to find their way back in the booming business of their home countries carrying with them global experience and a vast business networking. This reversal of talent posed a dual threat to established MNEs: first, they lost human capital when it was most needed. Second they saw competition strengthen in a moment of fragility. On the other side, MNEs with consolidated operations in EM did quite well during the crises as revenues from its EM subsidiaries compensated for the stagnant business in developed markets. A side effect of this financial reversal, however, was the increasing power of EM subsidiaries particularly those in BRIC countries.

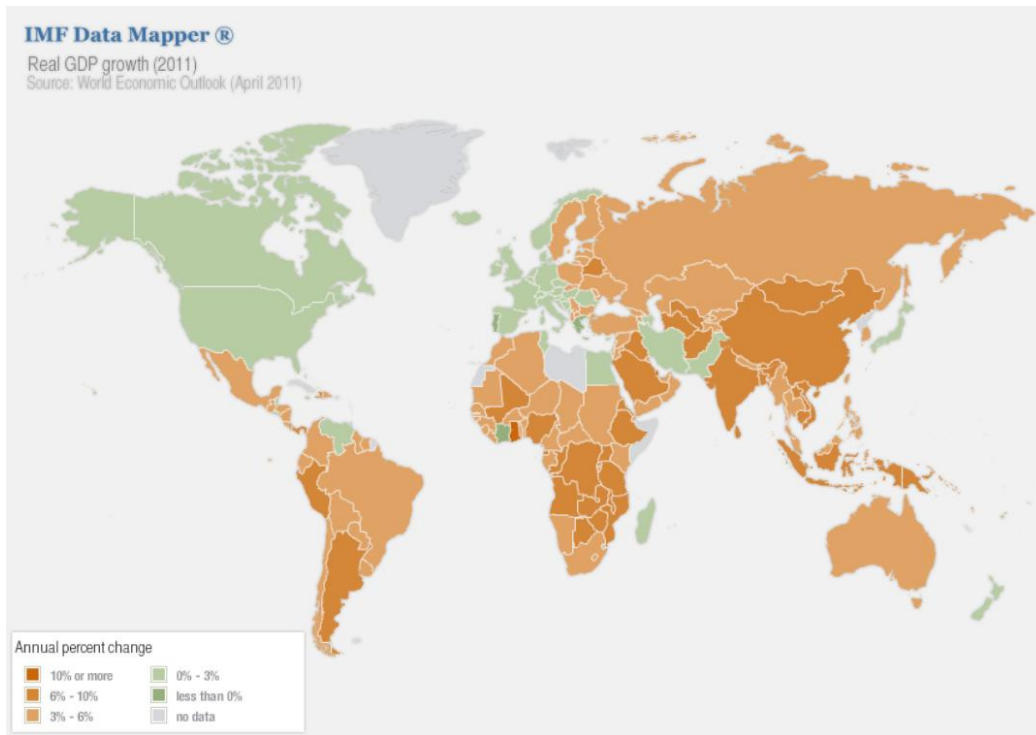


Fig. 08– GDP growth per country 2010 (Source: IMF Data Mapper).

In a series of articles the Financial Times describes the outcomes of this decade long shift in the international business landscape:

“As chief executives emerge from recession they are seeing some unfamiliar names scurrying around the global landscape. (...) These groups are climbing up the value chain with new products, services and brands, ranging from high-technology Chinese electronics to Indian cars and Brazilian financial services.(...) Once investing in EM markets mainly meant backing a particular economy’s growth potential or its capacity to export commodities, now it means investing in new technologies, brands and ways of doing business.” (Business: A Change in Gear. Financial Times, 11th May 2011)

“Once, global innovation was a one-way street with multinationals developing ideas in rich countries and pushing them out into the rest of the world. Not anymore. In the past 20 years, emerging economies have become a growing source of commercial innovation in products, services and business processes. (...) Innovation doesn’t happen in black boxes, it happen in markets.” (Innovation: The Road to New Markets. Financial Times, 5th January 2011).

“Not only do China, India, Brazil and other countries offer companies fast growing prospects but they also generate opportunities for developing new products, services, manufacturing techniques and business processes. (...) These innovations do not yet involve transformational technological shifts, but is spawning product improvements with commercial implications that are game-changing. (...) Skeptics dismiss many emerging market innovations as incremental improvements. But for business, that is beside the point, when such improvements lead to better products, services and processes. (...) The innovations may be incremental, but their effects are not.” (Innovation: Replicators no More. Financial Times, 5th January 2011).

However, great challenges remain ahead of BRICs and their EM counterparts. China despite being an economic powerhouse has a totalitarian State, deep environmental and populational problems, unresolved border conflicts, and uncontrolled underground financial market. Russia is a questionable democracy, has deep external political conflicts, an economy too dependent on oil exports, and lacks a credible institutional landmark that could attract foreign productive capital. India although a democratic State, suffers from insurgency, ethnic and religious internal

conflicts, an open external conflict with Pakistan, deep populational problems aggravated by tradition. Almost on the opposite side, Brazil is a fully fledged democracy, developed a solid institutional and legal landmark, and has no potential internal or external conflicts, however it displays a different class of problems like latent social inequality, low educational level, endemic crime and corruption, creeping infra-structure and State interventionism which threaten long-term sustainable growth.

Recently, BRICs and other EM countries have been victims of their own success. Their growth prospects attracted most of the liquidity employed to reactivate developed world economies. Now currency valuation threatens both their internal production and exports. With EM economies under increasing pressure and developed world beginning to recover, food and oil prices soared, sparking inflation and social unrest in poorer countries. Urbanization and abundant credit are fuelling asset bubbles in the EM markets that might repeat the fate of developed world disrupting the current economic order once again.

5.1.2. Local Economic Context: Brazilian Economy

Brazil emergence has been (still is) the result of a long and painful process of economic learning. The foundations of its recent development can be traced back into the 90's when a set of political-economic measures gradually institutionalized instruments to balance historical economic distortions which began on the 30's.

By 1930, Brazilian industry was incipient and concentrated in textiles, non-durable goods and food processing. Overall, economy depended heavily on agriculture, particularly on coffee exports. With the Great Depression (1929), the coffee export business collapsed and the government realized that could no longer rely on exports of primary goods. Consensus emerged that it was necessary to promote economic diversification.

The shortage of industrial products during World War II (1939-1945) and abundant work fleeing coffee farms to urban centers like Sao Paulo, set the basis for import-substitution industrialization. During the dictatorship of the Estado Novo (1937-1945), President Getulio Vargas initiated this process by establishing the first large government enterprise, an integrated steel mill, Companhia Siderúrgica Nacional (CSN), inaugurated in 1941, and to supply iron ore to CSN he also created Vale, in 1942. In 1953, during his second term, Getulio Vargas created another large state-owned enterprise, Petrobras, to explore recently discovered oil fields in Bahia state. In 1954, he proposed Eletrobras, to command power generation and distribution.

In the second half of the 50s, under the presidency of Juscelino Kubitschek, the government invested in infrastructure (roads, ports and power) and gave strong industrial incentives, notably to the base industry (automotive, cement, steel, aluminum, cellulose, heavy machinery, and chemical industries). This period saw the emergence of large Brazilian groups like Gerdau (steel), Votorantim (cement), Camargo Correa (construction), WEG (electrical), Suzano (Paper), Romi (machinery)

and the arrival of key international players like Volkswagen (automotive); Mercedes-Benz (automotive), Scania (automotive), IBM (automation), General Electric (electrical equipment and home appliances), and Shell (oil retailer).

Until early 60's Brazil experienced rapid growth and attained considerable economic diversification. Such rapid growth, however, generated inflation, and substantial trade deficit, as inputs and machinery imports were not offset by the exports of low cost primary goods. During this period two problems added to the long-standing current account problem: international debt, used to finance infrastructure, and MNE profit remittances. With problems mounting, a time of intense political turmoil paralyzed the country and curbed growth. In 1964, the military took power and imposed financial and structural reforms with the objective to fight inflation and current account deficit. The wages have been frozen to cut consumption, currency devaluated to promote exports and state-owned companies were freed to profit from their monopoly position in order to generate revenues for the central government. After a deep but short recession, inflation lowered, exports grew, particularly in manufactured goods, and public finances improved allowing for state-led investment.

From 1968 to 1973, years of the "Brazilian miracle", economy grew annually 11% on average. The industrial sector experienced not only rapid growth but also considerable sophistication. More State-owned enterprises were created like Petroquisa (petrochemical), Embraer (aviation), Telebras (telecommunications) or empowered like Eletrobras (power generation and distribution). New Brazilian conglomerates emerged like Itau (banking), Coteminas (textiles), Metalfrío (industrial machinery) and new multinationals arrived like Fiat (automotive), Ford (automotive), Dow (chemicals), and Voith (industrial machinery). However, once again the economy overheated and the currency overvalued, putting pressure on the account balance.

The oil shock of 1973, cut exports at the same time that amplified oil import expenses generating strong account deficit. Higher oil prices also sparked inflation and strong social unrest. The military government decided to borrow internationally to keep on investing in the base industry (steel, energy and petrochemical) and in the infrastructure in order stimulate growth. Abundant international credit also fostered ambitious mega-projects (i.e.: Itaipu hydropower, Angra nuclearpower, Transamazon highway, Rio-Niteroi bridge) aimed at boosting the international image of Brazil as an emergent power, however, with questionable economic results. Along the late 70's, growth was kept steady but international debt soared. When the second oil crisis hit in 1979, it also brought higher interest rates.

Despite the intense economic growth, the economic policies implemented during the "Brazilian miracle" strongly aggravated income inequality in Brazil. To support industrialization and curb consumption, government let inflation erode wages, which gradually lost their purchase power. Inflation also hit harder lower than higher social strata because of the latter access to interest accounts in banks, which protected their savings. Public education focused on elite universities rather than on

basic and technical schools, created a large educational gap between classes. Moreover, thanks to better infrastructure and supply of skilled workers, economic expansion took place more vigorously in the Center-South region, while a combination of a harsh climate, concentrated land, and elite resistance prevented the North-Northeast from developing.

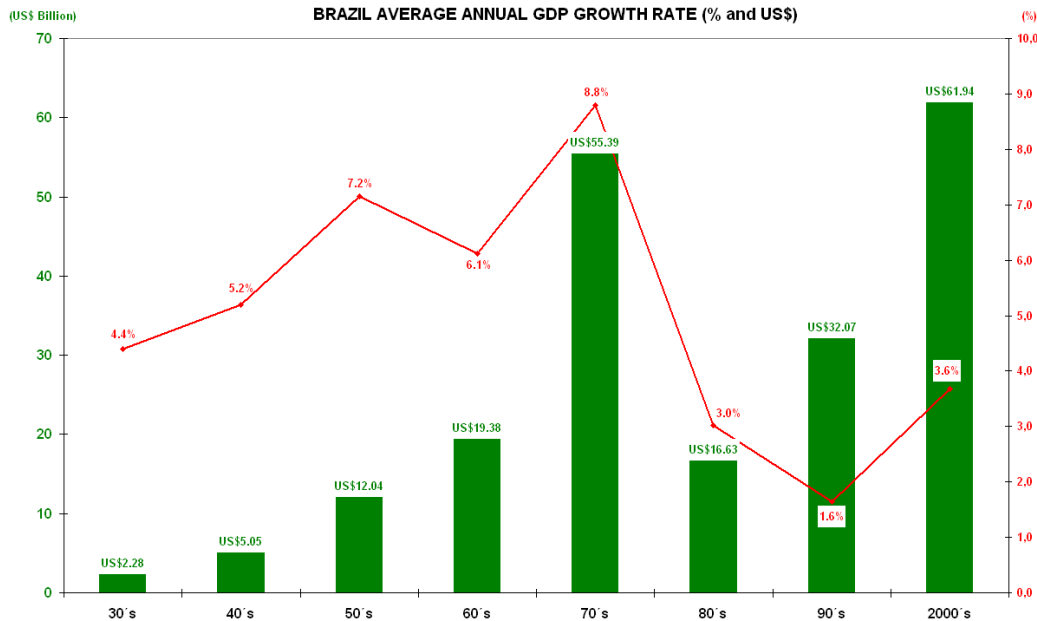


Fig. 09– Brazil average annual GDP growth rate (Source: IPEA - <http://www.ipeadata.gov.br/Default.aspx>)

In the 80's, Brazilian industrialization already provided the economy with a large, diversified and integrated productive base. However, its import reduction effects arrived too late to avoid the international debt crisis that hit the country. When Mexico defaulted in 1982, international markets closed for Brazil, foreign reserves ran out quickly, and the current account balance became unsustainable. Brazil was bailed-out by the IMF and forced to follow an austerity program. To generate large trade surpluses and service foreign debt, government closed the economy to imports and constantly devaluated the currency, measures that brought long time inflationary and recessive effects. In 1985, under increasing social unrest caused by the economic measures, the military allowed elections and left the power.

During the rest of the 80's, both Brazilian companies and MNEs operating in the country were prompted to look for business opportunities overseas in order to offset the effects of the internal financial problems and to obtain valuable foreign revenues. In this first internationalization push, construction companies as well as automotive, steel, food processing and electrical industries become successful exporters and Brazilian trade balance boomed for sometime alleviating the chronicle current account problems. The quality of international trade also enhanced and for the first time industrialized items dominated the list of exports. Internally, however, automatic price adjustment mechanisms made inflation extremely resilient and economic growth felt gradually.

All along the 80's and early 90's, several "heterodox" economic plans tried unsuccessfully tackle inflation. With increasing foreign debt, uncontrolled public deficit and low internal savings nothing seemed to work. With each plan came a boom and bust and the population realized that there would be no easy way out.

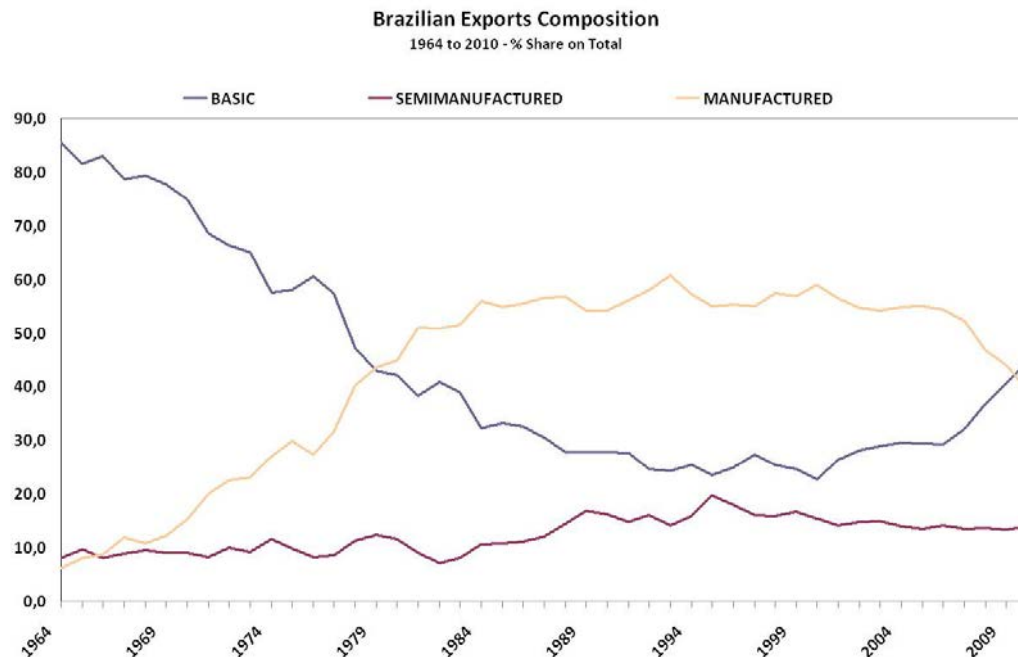


Fig. 10 – Brazil exports composition 1964-2010 (Source: SECEX - <http://www.desenvolvimento.gov.br>).

In 1994, during the presidency of President Fernando Henrique Cardoso, economic orthodoxy finally prevailed. Foreign debt was renegotiated into longer and softer terms. Then came the "Real plan", which created a new currency pegged to the U.S. dollar (the current value reference), and eliminated most automatic price adjustment mechanisms. Central government assumed the debt of states and public entities but prohibited them by law to further contract debt to expand expenses and investments.

Government also restructured and privatized state-owned companies to reduce public debt, attract foreign inflows and dynamize the economy. In private hands, former state companies like Vale, Embraer, and CSN, quickly became key economic agents in the country and first mover Brazilian international investors. Communication companies, like Telebras and Embratel, and public banks, like Banespa, were purchased by international groups, particularly Spanish and Portuguese ones, which invested heavy in infrastructure and governance. With the help of the BNDES (national development bank), petrochemicals and power distributors were kept in Brazilian private hands. Petrobras, Eletrobras, Banco do Brasil, due to their size and economic implications, had their capital opened in stock exchanges, keeping government as controlling shareholder.

With the currency stabilized, the Central Bank gained autonomy to lift interest rates and fight inflation through a mechanism known as "inflation target". Repressed

demand and price pressures were met by opening the economy to imports with foreign reserves obtained during privatization providing a buffer against resulting current account deficit. Without inflation, however, many private banks faced financial problems as they heavily depended on inflation for revenues. Government helped troubled banks to restructure and merge with healthier institutions assuming part of their debt.

Large inflows attracted by privatization overvalued the currency and helped fight inflation, however, the consequent falling trade balance together with debt concentration in the central government put the current account under mounting pressure. The international crisis of late 90's caught the country in the middle of the process of currency and current account adjustment. When the public pensions system reform failed to get Congress approval, international markets perceived that government would have to choose between internal debt and currency control, and bet heavily against the Real. As the Central Bank tried to protect the currency, foreign reserves dried up leading to a currency crisis. Government was forced to let the currency free float and to ask for an IMF emergency loan.

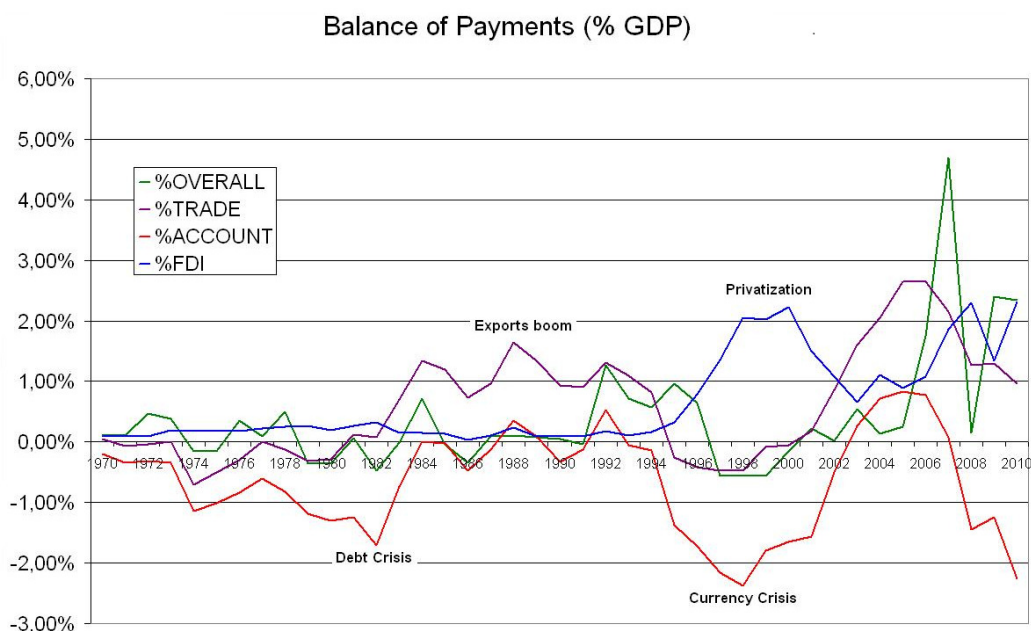


Fig. 11 – Brazil balance of payments 1970-2010 (Source: Banco Central- <http://www.bcb.gov.br/?SERIEBALPAG>)

The IMF urged government to cut public debt to generate surpluses of at least 2.5% GDP. To end the currency crisis, regain market support and shield against new international crisis Brazilian government offered 3,5% GDP. The strong fiscal adjustment forced government to cut public service wages, raise taxes, interest rates and lift utility prices (electricity, gas, oil) above inflation so that profit in remaining public companies like Petrobras, Eletrobras helped the public surplus. These measures curbed economic growth raised unemployment and generated great popular dissatisfaction which, kept alive by the power shortage in 2001, opened room for opposition victory in 2002 elections.

The election of Lula, a former metalworker and union leader, was seen with skepticism by international finance markets which withdrew large amounts of capital months before the elections. Unexpectedly, Lula reinforced the orthodox economic policies from his predecessor by hiking interest rates and further lifting public surplus to 4.5% GDP. The steep devaluation of the Real, together with the increasing Chinese demand for commodities, made trade surplus surge from 2002 to 2008. With inflation low and public savings up, the abundant foreign currency was rapidly incorporated into national reserves shielding the country from further current account crisis. As the foreign reserves grew, risk premiums fall and government renegotiated most of its debt in far better conditions. With the public finance in good shape Lula was able to boost direct income transfer programs of his predecessor, correct minimum national wage above inflation and expand credit and regular employment into lower social strata.

In clear opposition to the policies of the “Brazilian miracle”, these measures stimulated and broadened consumption in the base of the economy, bringing millions out of poverty, building up internal market and further enhancing public finance. After more than 75 years of economic development, the problematic balance between low internal savings and the need for high investment rates reached equilibrium under an institutionalized mechanism of price and investment adjustment. Since then free-floating exchange rate, inflation target and fiscal surplus turn out to be known as “macro-economic stability pillars”. Not even the U.S. property bubble of 2008 unsettled this balance once the constant public surplus obtained through internal market growth can be used either to cool (i.e.: interest rate hike) or heat (i.e.: public investment) the economy.

The decades of turmoil left the country with a legacy of strong popular economic awareness and enterprise creativity as common citizens and businessmen had to make sense and quickly adapt to the almost daily economic and political changes. It also developed an intensive negotiation capacity, as ordinary Brazilians were encouraged to skip the complex institutional system and solve their problems directly at personal level. Personalism also became a way to overcome the highly hierarchical economic relations, where “good relationship” is used to tap into opportunities. Parallel, entrepreneurship has largely developed as a way to set free from the same asymmetrical economical relations prevalent in Brazilian society (Brazil Great Expectations: Financial Times, 28th September 2009).

Nevertheless, the ancient relation between business and politics has been exacerbated by decades of State intervention and by the youth of democratic institutions. With annual budget of almost US\$100 billion (25% of 2009 annual Brazilian projected investment), BNDES (Brazilian Economic and Development Bank) is the very visible handle of government in Brazilian investment market. Through its private equity arm, BNDESpAr, the bank has chairs in the boards of almost all largest Brazilian companies traded in stocks. So forth, a strong legacy of ties interlocking the interests of businessmen and politicians pervades Brazilian business environment, blurring the division between public and private and creating

distortions that affect the competitiveness of newcomers in face of incumbent interests (Lanzarinni, 2010).

Along this period, although Brazilian economy attained a considerable level of international participation, hosting subsidiaries from almost all major MNEs, it produced far fewer international companies than would be expected. By 2003, only 6 of the 20 major Brazilian companies displayed any level of internationalization and outward FDI averaged US\$ 1billion a year (Lima, 2001). Several reasons accounted for this lack of interest. Historically, the inward orientation of Brazilian companies due to the decades of import-substitution industrialization, protectionism and economic instability; structurally, investment capacity largely subdued by high internal capital cost; and culturally, local management features like centralization, short-term vision, and State dependency precluded international expansion.

However, the few companies that took advantage from the export boom in the 80's, and from the economy opening in the 90's to set international operations benefited greatly from cheaper capital and market diversification (Exame, 08th August 2003). Among the main drivers for internationalization we find: internal market saturation, need to overcome trade barriers, better credit conditions abroad, and productive limitations related to exchange rate and poor infrastructure. (Múltis Brasileiras investem mais no exterior: Folha de São Paulo, 18th February 2003).

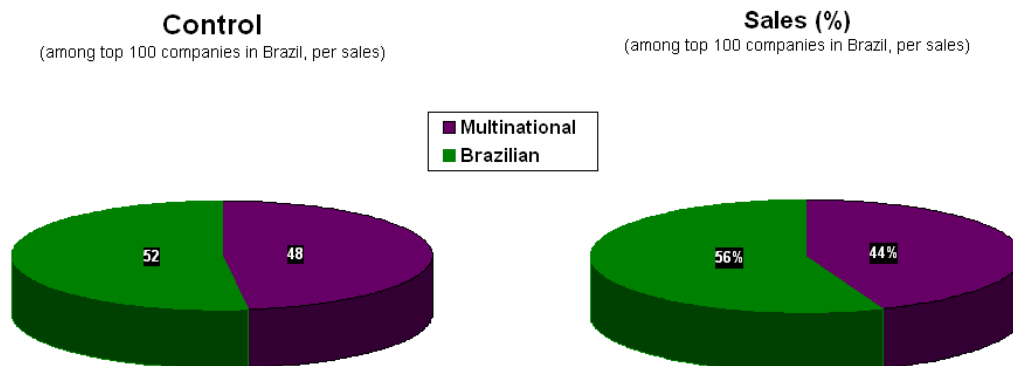


Fig. 12– Foreign MNEs participation in Brazilian Economy (Source: Exame Maiores e Melhores 2009).

During early 2000's, almost all international economies enjoyed high growth based on the opening of new markets and the return of cheap capital. In Brazil, however, growth barely reached half of world average. Harsh business conditions with elevated taxes, high interests rates, poor infrastructure, and excessive bureaucracy, stringent work legislation, together with the imports opening of the late 90's and early 2000's, pushed companies into a survival rush. For local companies options were to use the economic opening to gain efficiency or to go abroad and enjoy better business conditions. For subsidiaries the option was to go deeper into the local market or sell its distinctive competences in company's internal markets.

From 2004 to 2008, several Brazilian companies breached internal resistances and took advantage of the growth differential between Brazil and the rest of the world to

expand abroad. The average outward FDI reached US\$14billion a year during the period. Gerdau (steel) and Votoratim (cement) purchased troubled companies in the U.S. to turn over management and profit from the housing boom. Odebrecht, Andrade Gutierrez, and Camargo Correa, used their political abilities to gain support of governments in Latin American, Middle-East and Africa to breach their heavy construction markets. Vale, a former state-owned company, gained scale and diversified its mineral production buying several mining companies around the world. Clifford Krauss in an article to the NYTimes describes this process:

“The new “multi-latinas” are aggressive, resourceful enterprises that are a byproduct of the market liberalization that swept Latin American economies in the 1990’s. (...) After the Argentine economy collapse in 2001, many multinationals pulled out of the region. That left the field opened to private Latin American companies, which knew the terrain and went bargain hunting. Many first invested around the region, and then looked to the United States and beyond.” (Latin American Companies Make Big U.S. Gains: NYTimes, 2nd May 2007)

The process that began with capital-intensive sectors, soon reached more marketing-sensitive ones. WEG (electrical equipment), Sadia (food processor), and Marcopolo (transportation), quickly expanded abroad and by 2008 had almost half of their revenues coming from foreign operations. Another measure of dynamism, after the merger and acquisition boom of the 90’s, Brazilian executives protagonized several examples of *reverse takeovers* (where purchased company executives end by controlling the purchaser) like the case of ABInbev (Exame 26th October 2005; Financial Times, 16th June 2008) and Coteminas (Exame, 26th October 2005).

After the global crisis in 2008, internationalization of Brazilian companies developed through massive governmental investments to create “national champions” in sectors where Brazilian participation is considered strategic. Central government used BNDES to provide money for mergers and international acquisitions. Almost US\$10 billion were directed to consolidate “national champions” in sectors like petrochemical, paper, telecommunications and food processing. Examples of this process were the emergence of Votorantim, JBS Friboi and Brasil Foods to the top of Brazilian multinational ranking (BNDES gasta R\$8bi em um ano para criar ‘campeãs nacionais’: Estado de São Paulo, 27th September 2009).

RANK	2006	2009
1	Vale	Vale
2	Petrobras	Petrobras
3	Gerdau	Gerdau
4	Embraer	Votorantim
5	Votorantim	JBS-Friboi
6	CSN	CCC*
7	CCC*	Marfrig
8	Odebrecht	Ultrapar
9	Aracruz	Embraer
10	WEG	WEG
11	Marcopolo	Brasil Foods

Table 1: Largest Brazilian MNEs per sales. (Source: Lima (2001). SOBEET – Sociedade Brasileira de Estudos de Empresas Transnacionais e da Globalização Econômica. *Name changed due to company privacy requirements.)

In 2008, outward FDI reached US\$20 billion, and the Brazilian stock of outward investment reached US\$158 billion, with U.S., Spain, Argentina and Uruguay as the

main destinations (Lima, 2010). The top 20 multinationals had 25% of their sales and almost 27% of total employees abroad.

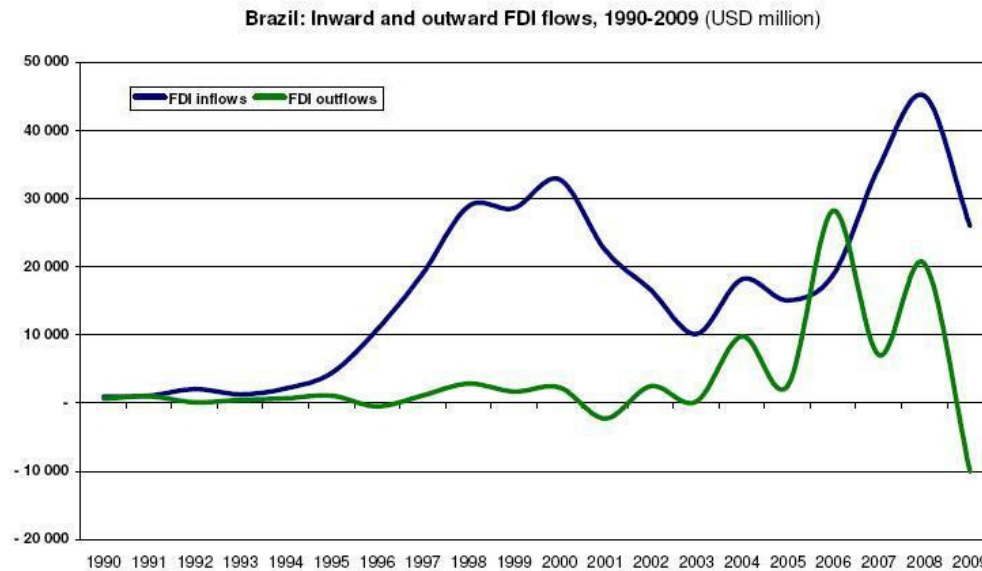


Fig. 13 – Brazil FDI flows 1990-2010 (Source: UNCTAD, Annex Tables of World Investment Report. In Lima (2010), SOBEEET – Sociedade Brasileira de Estudos de Empresas Transnacionais e da Globalização Econômica.)

On the other side, Brazilian subsidiaries have been traditionally set as exploration units and as implementers of strategies developed at headquarters. In the 90's however, subsidiaries start to be seen as extensions that could improve global multinational productivity as whole. Only recently, however, the evolutionary process accelerate as many of Brazilian subsidiaries gradually moved from the position of local adaptators and start to develop their own line of products, and in some cases, products for other subsidiaries or to the company as a whole. In his work with Brazilian subsidiaries, Boehe (2007) already indicate a change in this profile as he quantifies in 50% of Brazilian subsidiaries are local adaptators, 37% are local innovators, while only 13% can be considered as international innovators, with 6% falling in the category of *emergent market innovator*, showing that the role of a determined subsidiary not only vary hierarchically but also geographically.

Parallel, authors like Amatucci & Bernardes (2007) recognize that some sectors of Brazilian economy display some features like such as scale, segmentation, severity, trained workforce, and governmental incentives, that provide a consistent backdrop for the development of locally rooted competences and the evolution of subsidiary role into more innovative activities. Oliveira et al. (2009) highlight the fact that organizational factors play an important role in determining subsidiaries strategic position. Among them they ask for especial attention to interface management competences, integration and entrepreneurial orientation. This implies that for Brazilian subsidiaries the key challenge is not decision-making autonomy, but persuading headquarters about the value of its innovations, process that is complicated by internal competition among subsidiaries and the complex network of relations with multinational structure.

Brazilian subsidiaries also saw their influence grow after the global crisis. As headquarters saw themselves into financial trouble, revenues from key subsidiaries, particularly in BRIC countries, managed to keep them afloat. Moreover, many subsidiaries saw themselves as more independent as their financial healthy and accumulated competence enabled them to keep planning ahead of the crisis. In Brazil, automotive subsidiaries like General Motors, and Fiat were vital for headquarters survival. Headquarters also developed larger respect for subsidiaries' local competences as a way to offset weaknesses in traditional markets and to tap into new opportunities of EM which recognizedly depends on subsidiary capacities.

Another recent development taking place in the Brazilian context is that despite the stringent laws that apply to foreign work in Brazil, from 2006 to 2010 the number of visa requests doubled during the period. The phenomenon is partly explained by the ongoing opening of Brazilian economy which require specialized professionals to install imported machinery and equipment, operate subcontracted oil rigs, as well as artists and athletes (Mão de obra estrangeira no Brasil cresce 19% no 1º semestre: Folha de São Paulo, 23th August, 2009). However, there is also the increasing interest on Brazilian business and employment opportunities. With the currency overvalued, executive salaries also became attractive (End the Party before Brazil's bubble bursts: Financial Times, 1st June 2011)

Work visas issued to foreign workers in Brazil (per year)

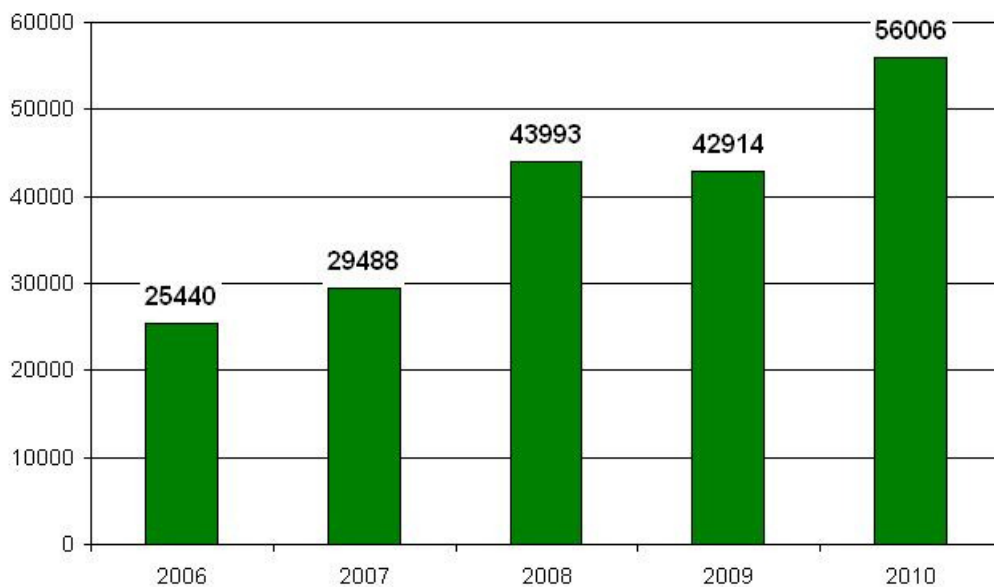


Fig. 14 – Work visas issued to foreign workers in Brazil 2006-2010 (Source: Ministério do Trabalho e Emprego-http://www.mte.gov.br/trab_estrang/est_origem.pdf)

The laws under which foreign citizens can apply to work in Brazil are very tough and their main motivation is the offset the “social dumping” of bringing workers from countries with lower salaries and rights to compete with Brazilian ones (Carelli, 2007). Examples of the requirements follow:

- 1) Brazilian companies must comply at least 2/3 of Brazilian workers (Decreto-Lei 5452/43 art. 354);
- 2) Brazilian workers at equivalent hierarchical level cannot be paid less than foreign counterparts (Decreto-Lei 5452/43 art. 358);
- 3) Scarcity of Brazilian worker with equivalent knowledge (Lei 5194/66 art.2).
- 4) Foreign Specialists shall be followed by a Brazilian apprentice (Lei 5194/66 art.85).
- 5) Authorization shall be approved by the competent authorities, Ministry of Foreign Relations and Ministry of Work and Employment upon documentation reception and after due diligence.

5.2- BUSINESS CONTEXT: ENGINEERING SERVICES SECTOR

5.2.1- Engineering Services Background

The concept of engineering has existed since ancient times as humans devised fundamental inventions such as the pulley, lever, and wheel. Each of these inventions is consistent with the modern definition of engineering, exploiting basic mechanical principles to develop useful tools and objects. In general, engineers use their knowledge of science, mathematics, logic, economics, and appropriate experience or tacit knowledge to find suitable solutions to a problem. Usually multiple reasonable solutions exist, so engineers must evaluate the different design choices on their merits and choose the solution that best meets their requirements.

Engineering, much like other sciences, is a broad discipline which is often broken down into several sub-disciplines. These disciplines concern themselves with differing areas of engineering work. Although initially an engineer will usually be trained in a specific discipline, throughout an engineer's career the engineer may become multi-disciplined, having worked in several of the outlined areas. Engineering is often characterized as having four main branches: Civil, Mechanical, Chemical and Electrical.

Regulation of the engineering profession is established by various jurisdictions around the world to protect the safety, well-being and other interests of the general public, and to define the licensure process through which an engineer becomes authorized to provide professional services to the public. In the U.S., ABET (Accreditation Board for Engineering and Technology) is the official professional regulator, in the U.K., it is the ECUK (Engineering Council), and in Brazil, CREA (Conselho Regional de Engenharia e Arquitetura). Additionally, in Brazil, engineering activity is regulated by law (Lei 5194/66).

5.2.2- International Engineering Business Context

In international terms, engineering business evolved on the backdrop of almost uninterrupted technological and economic changes in the recent history of humanity.

The first phase of modern engineering emerged as a result of the scientific revolution. The adoption of a systematic approach to practical problems made engineering scientific rather than intuitive. Technical training shifted from apprenticeship to university education. In 1747, the first engineering school, *École des Pontes et Chaussées*, opens in France, with Karlsruhe (1825), Viena (1815) and Zurich (1824) schools opening little later. In the U.S., the Rensselaer Polytechnic Institute opened in 1824. Information flowed more quickly in organized meetings and journal publications as professional societies emerged. This phase lasted through the Industrial Revolution (1760-1830), with engineering embedding into bigger business and also developing small, specialized firms to building machines, and to develop transportation means and constructive methods (Telles, 1994).

During the second industrial revolution (1860-1914) technological and economic progress gained momentum with the development of steam-powered ships, railways, the internal combustion engine and electrical power generation. Chemical and electrical engineering played vital roles in the rise of chemical, electrical, and telecommunication industries. Industrial engineers designed and managed mass production and distribution systems. Companies like U.S. Steel, Bayer, Standard Oil, Daimler-Benz, Ford, Siemens, General Electric emerged out of technological and managerial advances of the time.

This period also set the stage for the first large scale engineering companies, which took advantage of the recent developments and historical circumstance to expand and diversify, providing technical support to many different industries. Bechtel began in 1889 taking advantage of the U.S. westward construction effort. Foster Wheeler resulted from the merger of two steam-machine makers in 1891. Fluor began in 1890 with Swiss migrants building a paper mill. Kvaerner, in 1853, as a shipbuilder in Norway. Amec Plc. began in 1883 with a construction business in UK. SNC-Lavalin began in 1911 as a small civil engineering office in Montreal. UHDE in Germany began 1921 as a fertilizer maker. U.S engineering companies engaged west expansion and military efforts during the first-half of XX century and strongly build up their operations.

Research and development boomed in all fields of science and technology after World War II. Microelectronics, telecommunications, and computer joined forces to precipitate the information revolution in which intellectual tasks were increasingly alleviated by information processing machines. After the war many U.S engineering firms expanded towards Europe to take advantage of the reconstruction effort. The construction of nuclear power plants in U.S. also generated big contracts. This period also marked a strong international expansion for U.S. engineering companies with clients ranging from Iran to South Korea. In the 1960s, many engineering companies start to use computers throughout its offices for both engineering projects and managing operations.

In the late 1970s and early 1980s, international engineering companies benefited greatly from the boom oil and utility power industries, achieving excellent profit margins and contracts. U.S. companies focused in the Middle-East and European companies into Africa, South America as well as the exploration of North Sea oil

reserves. During this period, Fluor developed the concept of *task force management*, under which individual projects receive all tools, personnel, and resources to get jobs done, and the project director had full authority and responsibility for the entire project. The involvement of engineering companies in national and international politics to tap into government sponsored business opportunities and gain political influence upon major clients and competitors also became increasingly visible.

In mid-1980s, industry's heavy overbuilding resulted in a reversal for engineering companies. Even in the Middle-East, big construction projects were no longer the norm, thanks largely to significant lower oil prices. The lack of big projects, led international engineering firms into projects previously regarded as too small, including unfinished competitors jobs, modernization of existing plants, and finally with the creation of operating services divisions to keep skilled experts at work in their fields, mostly in ongoing maintenance facilities. Traditional U.S. firms also saw faced increasing competition from European, South Korean, and Japanese companies and saw their share of large scale projects fall substantially. In order to face the crisis, international engineering firms reorganized into more decentralized structures to more closely serve their different markets (i.e.: process, power, hydrocarbons, mineral, infrastructure, and defense).

In the 90's, with the necessary modernization of the countries of the old communist block and the reconstruction process after the Gulf War, engineering demand rebounded. U.S and E.U. cleaner energy requirements also lifted demand for engineering services. International engineering companies were also boosted by emerging markets, first during the Southeast Asia boom and then by China rising. Large engineering firms recovered from the 80s crisis, and strongly diversified both in industry markets and geographic regions, mainly through acquisitions.

A fourth phase of engineering companies development can be identified after 2000s with the emergence of the global information networks such as the Internet. The increasing use of fixed-price contracts and worldwide competition made engineering a very risky business, with even large contracts yielding little if any profits. Now highly specialized firms located close to scientific clusters or pools of specialized work developed a worldwide network of engineering solution suppliers, which have to be assembled together in optimal conditions to deliver the necessary engineering services. In this scenario, international engineering companies were forced into becoming consulting and contract management firms, away from their traditional technical role. Alternatively, many international engineering companies decided to go into the opposite direction focusing on smaller, high-tech, higher margin contracts, migrating from business such as minerals, fertilizers and petrochemicals into pharmaceuticals, biotechnology and environmental services.

In 2009, total revenue of world top 100 engineering firms reached US\$105.7 Billion, with at least US\$46.7 Billion (44%) originating from overseas operations, evidencing the remarkable internationalization of the sector. The financial woes of the past two years hit hard the global engineering market with sales down 4.2% from 2008-2009. The U.S. recession and the EU debt troubles made engineering firms struggle. In

opposition to the fall in developed markets (-0.5% in U.S. and -7.1% in Europe), EM provided some relief, with North Africa revenues jumping 34.7% and Latin America up 21.7%, taking from Asia (+1.3%) its traditional hotspot title. (The Top 200 International Design Firms: Engineering News-Record, 26th July 2010, <http://enr.construction.com>).

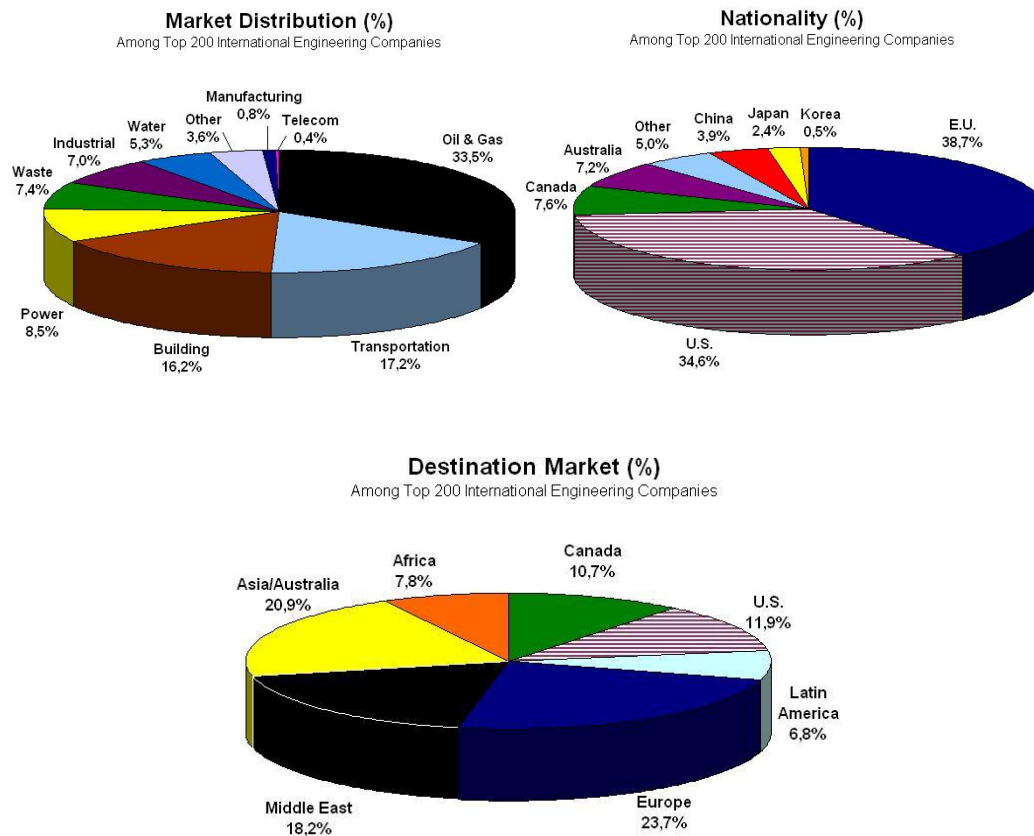


Fig. 15 – Largest engineering companies worldwide profile (Source: The Top 200 International Design Firms: Engineering News-Record, 26th July 2010, <http://enr.construction.com>)

5.2.3- Local Engineering Business Context

The history of engineering in Brazil began in 1810, when the first engineering school in Brazil was founded, the Academia Real Militar in Rio de Janeiro. Despite the early opening, it was mainly a military school dedicated to the design of fortresses and mapping. In 1874, the Academia Real Militar opened places to civil students and became Escola Politécnica do Rio de Janeiro. From 1890-1900, several other engineering schools opened in Brazil, among them the traditional Escola Politécnica de São Paulo and the Mackenzie College both in São Paulo. (Telles, 1994)

According to Prado (2006), by the end of the XIX century, growing coffee business fostered an incipient industrialization in order to process and pack the product as well as to build the infrastructure necessary for its transportation. Engineering business opportunities first appeared in the railway, power, building and public services. Brazilian engineering schools adopted the French pragmatic orientation of first providing generalist and theoretical knowledge to only then allow for

specialization in later courses. Such orientation, however, conflicted with the knowledge limitations of the country and was not able to provide the highly specialized skills necessary for further specialization or industrial applications. To bridge this knowledge gap, technically specialized engineers were frequently hired abroad and brought to Brazil to help in the more complex tasks. Brazilian engineers were left with the task of organizing and managing the work processes in compliance to imported technology (Laudares & Ribeiro, 2000).

The creation of large industrial State companies in the 40's (CSN, Vale, Petrobras and Eletrobras), redirected Brazilian engineering from infrastructure to industry, and from imports implementation to local supply development. This movement has been further reinforced during the 50's through the "import substitution industrialization" effort. Many multinationals arrived during this period and promoted the exchange of engineering professionals between Brazil, U.S., France and Germany. Such in-company exchange programs helped to provide specialist skills to the generalist formation available in Brazil.

In the 60's and 70's, under military government new technologically advanced State companies (i.e.: Petroquisa, Embraer, Telebras, Embratel) required even more specialized engineers. Government created two of its most important technical universities ITA (Aeronautical Technological Institute) to support the development of aerospace industry and UNICAMP to further enhance the telecommunications and petrochemical industry. With a surge in infrastructure and industrialization, Brazilian engineering experienced a boom and engineers start to occupy not only important technical positions but also increasingly important executive ones. This movement reached its maximum during the "Brazilian miracle", with the establishment of a powerful 'technocracy' formed by engineers firmly occupying key business positions in Brazilian dominant State-companies (Suarez, 1986).

The sequence of crises during the 80's and 90's, hit hard engineering companies in Brazil. National companies either diversified (i.e.: Promon, Jaakko-Poyry), merged with construction companies (i.e.: TENENGE) or simple bankrupt (i.e.: Araujo, Natron). Almost all international companies left Brazil during this period (i.e.: UHDE, KBR, Lummus, Foster Wheeler, Fluor Daniel). Technicians laid-off during this process (i.e.: Natron, Promon, Jaakko-Poyry) reagruped into smaller engineering companies and retrenched into the main refineries and petrochemical complexes to award maintenance contracts or small improvement projects. As companies shrank, split, and closed, much of what has been technically developed by Brazilian engineering has been lost and forgotten. Engineers with years of experience have been forced to look for management jobs or into retirement.

During this period, the rationalization of work processes and the implementation of computational tools split the engineer role in Brazil into two: one technical supervisory, with direct involvement in production, implementing new technological tools and production methods, managing sub-contracts and responding for investments under his supervision; and other, predominant managerial, with almost no contact with production, where engineers generalist

knowledge and mathematical skills were used by non-engineering sectors such as banks and management consulting firms to implement rationalization in non-technical environments (Laudares & Ribeiro, 2000).

From 2004 to 2009, heavy investments planned by the government, Petrobras, and Eletrobras, tied to minimum national content, reactivated the internal engineering market and improved substantially the revenues of project and consulting companies, which grew 274% in five years. In 2009, even depressed by the global crises, overall engineering and construction market in Brazil grew 11.8%. Private companies, like Vale and Votorantim, which do not abide by minimum national content rules, awarded engineering contracts abroad searching for the best price among specialist firms.

During this period several new companies emerged (i.e.: Mana, CH2M Hill, Projectus, Genpro, Progen, EPC, Alusa, Chemtech, Minerconsult) challenging the few survivors of the lost decades (i.e.: IESA, Promon, CNC, Poyry, Engevix, Techinp, UTC). On the one side, new firms positioned themselves to provide engineering at lower cost, high flexibility, however, with a backdrop of extended schedule and low quality due to their lack of structure and consolidated methods. On the other side, traditional companies positioned themselves to benefit from their structures and experience to provide high quality engineering and on schedule execution at a comparatively higher price.

Although traditional companies were the first ones to benefit from the engineering surge in 2004, thanks to its better structural conditions, quickly the new ones catch up to the governmental bidding requirements and start to compete head to head with traditional companies. Further changes in governmental bidding criteria involving higher liabilities for cost and schedule overrun dragged the engineering business under influence of the much larger construction companies, which were able to face such costs. As the price of traditional more structured companies raised to incorporate the additional risk, they increasingly were shun off bidding consortia by larger construction companies in favor of smaller companies. Therefore, by 2009 most of the new contracts awarded by the government and the largest State companies fell in the hands of non-traditional players in the engineering business.

In 2010, total revenue of Brazil top 40 engineering firms reached US\$ 4.16 billion (4.4% world engineering business). Among them, only six companies are foreign controlled, with US\$ 1.1 billion revenues and 24% market share, what segregating recent foreign acquisitions of important local companies, indicates the predominance of local players in Brazilian engineering business. This year, also marked an intense period of sector consolidation with several merger and acquisitions concluded involving local and international players. Odebrecht, the largest construction company in Brazil, partially acquired Genpro, a mid-sized engineering company. SNC Lavalin, world 10th largest engineering company, acquired Minerconsult, a local mining specialist company, and Marte Engenharia, a local nuclear engineering company. WP, world 6th largest engineering company, acquired CNC, Brazilian 4th largest. Progen, a mid-sized engineering company acquired several smaller

specialized companies. Techint, the largest Argentinean construction company, spun off and created its own engineering company to multiply its bidding consortia alternatives.

**Brazilian Top 40 Engineering Companies
Annual Revenues (US\$ billion)**

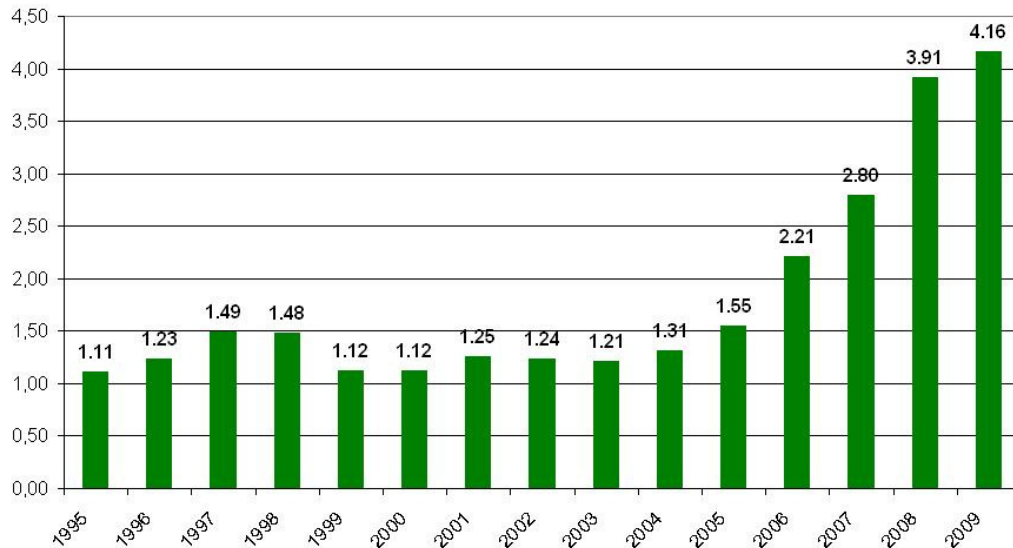


Fig. 16 – Engineering Sector in Brazil by annual revenues 1995-2010 (Source: Revista “O Empreiteiro”. 500 Grandes da Construção, July 2010 - <http://www.revistaempreiteiro.com.br/>)

5.3- INVESTIGATION CONTEXT

5.3.1- Researcher Standpoint

The aim of this section is to disclose the personal bias and social cues through which the researcher approached the object of his investigation.

I was born in 1975, on an affluent mid-sized hub city in the state of Minas Gerais, Brazil. Rose by a low-middle class family in a place dominated by landowners, lawyers and doctors, very early in my life I was encouraged to embrace study and work as tools for social mobility and recognition. This ideology has been reinforced by examples of social and economic failure within family and facilitate by the considerable educational infrastructure available due to the hub character of my hometown. During my childhood I gravitated between the flair of local elite colleges and the hardships of working on a mechanic shop with my father. I assume that this participation in contrasting social contexts create a urge for upward mobility which drove me away from the expected cultural bias of a Brazilian family of Portuguese ascendance (collectivism, conformity, uncertainty avoidance and low assertiveness in Hofstede terms) and closer to a more of individualist, challenging, and assertive ethos. One thing a get used to hear from my father was that he would never save on the education, and I remember that at some point he spent about half of his income in private schools for his kids.

This educational push finally paid off in 1993 when right from the secondary school I succeeded in two of the most competitive undergraduate selection tests in Brazil: UNICAMP and FUVEST (for UFSCAR). I decided to move to Campinas (400km) and join the Chemical Engineering course at UNICAMP, the best in field in Brazil until today. The reasoning behind this choice was that by living in Campinas (1 million hab.) I would both enjoy a more exciting life and improve my chances of getting a good job after graduation. Unexpected though was a singular and determinant character of UNICAMP. Differently from most Brazilian public universities, which selected locally, UNICAMP selected nationally. As a result, UNICAMP comprised a melting pot of different national accents, slangs, tastes, habits, behaviors and approaches. Away from their home, family and friends, the great majority of students had no other choice than to “manage these differences” not only to share housing and transportation but also to create new social ties and to overcome the heavy academic routine, which frequently involved collective work and evaluation. Overall, the immensely rich experience of living away from home with people from some different places and social backgrounds marked those times and I could certainly say that by absorbing the unique experiences provided by all that national diversity I truly became a Brazilian.

Eventually students from overseas added to it, but in considerably smaller number. Although Brazilian public universities reserve places for international students and provide fairly good mobility conditions, admission processes attracted only few applicants from countries like Cabo Verde, Angola, Mozambique, Peru and Colombia. Intriguing to me, at that time, was how fast those foreigners were engulfed by this process of “managing differences” and how fast they integrated themselves into that diverse Brazilian set. Segregation and clique formation rather than a characteristic of foreigners was much more common among local affluent students who privileged their local social ties in face of those at university.

By 1996, declining airline fares and undergraduate exchanging programs like IAESTE (International Association for the Exchange of Students for Technical Experience) made possible for Brazilian middle-class students (particularly for those enrolled at public universities, who enjoyed full tuition weave), to legally go abroad in search of international academic or professional experience. In 1997 around 30% of my classmates went abroad for periods larger than three months. By 1998, more than 70% of the bachelors in the last year of Chemical Engineering had enrolled into an international exchange programs. At this point, extending the course for one additional year to go abroad become standard for engineering students at UNICAMP.

Unfortunately, that was not my case. Not only I didn't have the means but I desperately needed to focus at finishing graduation and start working in order to get by. An internship on a large Brazilian corporation helped in the expenses for some time, however when I realized I wasn't learning anything useful for my career I decided to quit and focus in the final exams and selection processes. At the date of my graduation, beyond almost bankrupting my family, I owed at the bank, an

amount of R\$1000 (US\$ 750), almost one month's engineer salary at the time. Money spent on language schools, extracurricular courses and living expenses away from home.

I clearly remember my closest friends telling me on their return from the US or Europe how nice was to live abroad, compared to the hardships of living in Brazil (i.e.: disorganization, low salaries, job insecurity, crime). Most of them expressed their wish to go back to live in the "first world" permanently. Many of them did not adapt on their return and moved overseas after graduation or for a second internship. The 90's, maybe even more than the 80's, certainly were a time of low national self-esteem. Inflation control in 1994, squeezed national income and retracted both private and public investment, bringing a shortage of opportunities. Many times this middle-class delusion with the country violently clashed with my excitement about all the diversity and possibilities I saw. I clearly had not bought into the story that Brazil was a lost case. This impression was reinforced by conversations with foreign students who shared the same optimistic view about Brazil.

Thus, beyond the prospect of a good time abroad and enhancing language skills, students were also moved by a dwindling economy and tightening competition for better jobs, usually at large multinational corporations, like Shell, Unilever, Rhone-Poulenc, Nestle, Phillip Morris, Citibank, McKinsey, Booz-Allen & Hamilton and Accenture, who annually came at UNICAMP to hire last year engineering students. Large private Brazilian companies at the time like, like Banco Itau, Embraer, Unibanco also took part on this hiring spree however with much less appeal. Common place among undergraduates at the time (I included) was to join a trainee program in a multinational company, to become manager in three years, go for a company-sponsored MBA program in the US or Europe to join an international career program where "the sky was the limit". All this, they believed, would be paved by an international exchanging program.

Reality though proved more complex. Differently from the previous years when the local branches of large industrial multinationals like Unilever and Rhone-Poulenc (now Aventis) were capable of hiring all 42 UNICAMP graduating chemical engineers at once, 1997 offered a very different story. Though all my classmates (except for one who decided to go abroad exactly in the beginning of the recruitment season) left university with a job position, this has been a long and extenuating process. I remember to have submitted more than 50 job applications and joined many recruitment process unsuccessfully just like my colleagues. With almost no investment, rampant rationalization programs, and declining import tariffs to combat inflation, it was a hard time for engineers in Brazil.

Nevertheless, an unexpected way out emerged when the financial companies in order to survive the end of their inflationary revenues decide to hire engineers to carry on radical modernization programs. I remember to hear on a presentation of an important Brazilian investment bank to say that banking industry preferred engineers over business graduates because they were good at numbers and mastered technology. International consulting firms also flourished at this time on the trail of

intensive rationalization of Brazilian companies and a round of industry consolidation through merger and acquisitions started. As a result, from a class of 42 engineers maybe fewer than 5 followed the technical career. I myself started working for a small marketing consultancy in Sao Paulo.

The data processing and analytic skills I received at university certainly helped me to overcome the lack of experience in the field of marketing. In less than 3 months, I had conducted important studies at this consultancy and attracted manager's attention. However my professional immaturity, the low wage, the extenuating work schedule (14 hours a day), the precarious living conditions I could afford, the personal disillusion for not being able to get a good "multinational job" weighted on me to the point that I decided to quit and go back to my hometown and start to look for a technical job.

Particularly strange to me nowadays is to recover the reasoning behind the decision of searching for a technical job. I never questioned the importance of a technical education, or regretted to have joined an engineering school, however, all the time at university I mentally prepared myself to be a manager rather than an engineer. Part of this apparent paradox probably came from the internalization of a common discourse in Brazil that engineers come up to be better managers. Such discourse has its roots in the military dictatorship (1964 – 1985) when fast government-led investment was conducted by an elite of "*technocrats*". Although strongly opposing the dictatorship, UNICAMP provided a firm ground to this discourse because, lacking a business school, technical staff occupied its key management posts. More important maybe was my personal inclination for "doing" instead of "selling". At the time, it was repulsive to me the idea of going out selling something. In a certain sense, becoming an "engineer", or "the one who people look for solutions", has been a way to distance myself from the figure of the "salesman", or "the one who bother people offering things". But as a junior marketing analyst in a small consultancy, it was virtually impossible to avoid public exposition and services sale pressure. This strong sales pressure pushed me towards a radical reaction of abandoning the incipient business career and retrenching back to my technical profile, where - I thought - no one could make me work on something I radically opposed.

After three months at home, jobs were increasingly scarce as private investments were discouraged by government's strategy to use an overvalued currency to fight inflation, flooding the market with cheap imports. Just when my savings were about to run out, I found a job in the local representation (SIG, henceforth) of a large U.S. multinational software house (INGR, henceforth). Back in Sao Paulo, I have been located in the unit responsible for selling and supporting clients in the process, oil & gas industry. Few days past, my excitement in getting back to work on a more technical field, within a multinational corporation faded away together with my hope of an international carrier. SIG was no more than an ordinary Brazilian company with minor sales ties with INGR. Once again I had to face the same problems that made me quit the previous job: low wage, no carrier opportunity, unaffordable living conditions in Sao Paulo and so on. This time however, I decided not to quit and stay put while looking for alternatives. However, disappointed with

the possibilities that have been presented to me after graduation, this time I was not so sure where to go. I thought about returning to university for a master degree in organizational studies and put things back on line, however with a poor business curriculum and with no savings to afford the 2 additional years with no revenue, this option looked unreachable. While I wondered what to do, an exchange rate crisis hit the country and companies simply stopped hiring.

During this recessive period SIG survived basically upon orders from state-run companies. They have a particularly profitable relationship with Petrobras and its local service suppliers, who were contractually forced to work on a specific engineering application supplied by INGR. Despite the fact that I have studied chemical engineering and Petrobras dominated Brazilian process industry, at that time, it was a much closed institution, and paradoxically it was my first professional contact with the company. The relationship between SIG and Petrobras was a turbulent one and I was in the middle of that. Under license agreement, SIG supplied top INGR hardware, software and training to Petrobras but commanded premium prices. As a state-run company and with minor shareholder pressures, Petrobras invested heavily (and sometimes carelessly) to be in the forefront of technology but frequently complained of the disproportionately high prices practiced by INGR and SIG in Brazil. Even though, Petrobras offered year long contracts to acquire software, hardware and training from SIG which were delivered on demand. For one year and a half I traveled across Brazil to give private classes for Petrobras employees on the latest 3D engineering design systems. Many times to people that only were sent to fill in the classes and would never use the software again. Service suppliers, on their turn, resisted paying for SIG training as they considered it expensive, time consuming, and detached from practice. This relationship come to a halt when SIG, to take advantage of a contract about to past due, decided to sold a single INGR workstation by US\$1.000.000 which did not work at all. Worst, after years buying expensive INGR workstations on the belief that they were the only ones with processing capacity to run INGR software, costumers increasingly realized that commercial desktops could well replaced them by a tiny fraction of the price. Crisis came for SIG and I was at risk of being laid off. My reactions were mixed. I did not want to stay, but without a job and any savings I would not be able

A surge in exports a month later, boosted by a currency devaluation of approximately 50%, reactivated Brazilian economy and investment. Not only the risk of being laid off disappeared but job prospects at SIG enhanced and it was signaled to me that I would be sent to the US to receive training at headquarters to lead a new line of products. Too late. Tired of being overlooked and with my finances struggling, I decided to take advantage of the favorable moment and sent my résumé to clients that I knew were hiring. Few weeks later I received two job offers that tripled my salary. When I left SIG, a hard phase of my life, marked by financial strain and social inertia, had finally ended.

Out of this period I took several lessons. First, I should never quit a job without an alternative at hand. Second, I should not bet my future on a single profession, particularly a seasonal one like engineering. This made me decided to invest all the

money and effort necessary to be accepted on a graduate business program. This way I could reconcile with my past aspirations while grabbing a new professional specialization. Third, I could never escape becoming a “salesmen”, because in the essence any work involves “selling” something, an idea at least.

After a turmoil of events I moved to the south of Brazil to work as factory engineer in a large company of the South Petrochemical Complex. What initially sounded as a great professional and personal opportunity, once southern state capitals were leading Brazilian development and life standards at the time, proved an adaptation challenge. Cultural values, social cues, identity traits, and personal habits of the “Gauchos” not only were different from my southeastern-average Brazilian ones but were defined in opposition to them. In a certain sense, to live in Porto Alegre (Rio Grande do Sul state capital) was almost like living abroad. During four years there a barely made six friends, none of them from the capital.

Until that, wherever I had gone in Brazil I had always been “welcomed” and “invited” to join the local culture, in a relation between equals. At Rio Grande do Sul state, in some situations I felt like “tolerated”, while in others “compelled” to embrace the local culture, always presented as superior and more praiseworthy. According to the “Gauchos”, their food were the best, their women the most beautiful, their man the bravest and even their sunset the most beautiful. Not few times I had even heard that they should separate from the rest of the country, something they never did a single step to. Whoever questioned their “superiority” would face strong debate and collective distrust. Since I had just moved from a metropolis Sao Paulo and knew quite well the rest of the country, this collective imaginary sounded particularly naïve and hard to be accepted. Striking to me was that most of this fierce defense of the “gaucho superiority” has held by people who never had never left the state or, at best, had been to the neighboring state of Santa Catarina. In the beginning, I was frequently caught into comparative discussions that Gauchos used to reinforce their superiority, particularly in the presence of outsiders. With time, I learnt how to avoid such provocation and to distance myself from any form of cultural controversy.

In my mind, anyway, I was there temporarily just to earn some money and go back to Sao Paulo to join a master’s degree. Indeed, the better job conditions and the relative solitude allowed me to dedicate more time and resources to apply for the graduate program of the Faculty of Economy and Business at USP (University of Sao Paulo). After six months preparing myself and having succeeded in the preliminary tests, I was told during an 15-minute interview, which cost me a trip to Sao Paulo, that I should be aware that “there were other candidates which were well known by the faculty and thus were in advantage during the selection process”.

Back to Porto Alegre I was resolute in reacting to such a blow and decided, in the last minute, to apply for the Master of Science in Business Administration program in the also traditional UFRGS (Universidade Federal do Rio Grande do Sul). A desperate measure I thought, because if in the meritocratic USP I had been defeated by personal linkages, what could I expect from a university embedded in such a closed

culture? Against all odds, however, I was accepted in the program. It was also an opportune moment to find another activity. The company I worked for started to feel confident to implement a series of measures designed to reduce the salary of contract professionals like me. As I threatened to quit and dedicate to my studies, they gave up implementing any change.

This way I finally settled down and started to make a living at Porto Alegre. I rented an apartment in a fancy and traditional neighborhood and accept the fait of a long stay in the south. Despite the hardships of working and studying at the same time, it was a delightful time to me. For the first time I was studying something I really enjoyed. I avidly participated in the classes and devoured the papers and books teachers recommended, particularly those involving the subjects that fascinated me at the time: organizational forms, practices and work performance.

My chosen field of specialization was Human Resources and soon a distinctive characteristic of the Master of Business at UFRGS became increasingly salient and clashed with my engineering background: the strong humanistic bias of the course. Far beyond Taylor, Porter, Mintzberg and Schein, traditional business writers that permeate graduate business courses, during organizational behavior seminars we discussed Derrida, Baumann, Deleuze and Foucault, in anthropology we read Malinowski, Pritchard, Levi-Strauss and Geertz, in organizational sociology we debated over Weber, Marx, Bourdieu, Castells, Sahlins. Even Freud, Lacan and Jung frequented my classes since two of my professors and a classmate were psychoanalysts. This immersion into the human sciences classics melted down any engineering positivist bias I could ever had and definitively changed my way to see people and their organizations. From practices and organizational forms my interests moved first to organizational culture and then to culture in organizations. From work performance I moved to study competence.

In my master's dissertation I presented a longitudinal study covering three distinct phases in the twenty-five year history of one of the largest petrochemical companies in Brazil. This work shows how multiple levels of culture (local, regional, national) dynamically interact with organization's history to inform the actions and identities of organizational members. It also displays how a determined cultural set reacts to different management models and the multifaceted character of this relation. Finally, It demonstrates how cultural manipulation may adversely affect organizational functioning. It has received the maximum qualification from its evaluators and was recommended to receive a "cum laude" mention. Curiously, this investigative work had a therapeutical side effect as it helped me to cope with the incoherent and sometimes unfair behaviors I observed. In a certain sense, the master's degree made organizations and other social settings more transparent as it gave me conceptual tools to appreciate and understand its inner works.

By this time, the investigative bug had definitively caught me. As soon I received my master's degree I decided to apply to a doctoral program. My investigation interests expanded towards a more encompassing notion of cultural interaction (international) and change (innovation). Differently from most Brazilian doctoral students that go

abroad on the mid-term of the course for one-year government sponsored stay, I decided to go on my own and enroll on a full time doctoral program. One year later, I quit my job and moved to Barcelona to begin my doctoral studies at the Universitat Politècnica de Catalunya (UPC) and have my long wanted international experience.

By 2004, Spain was the brightest star in the European Union constellation. It reverted decades of poverty and closure into a wealthy, multicultural and vibrant society. From the outset, it was especially noteworthy how fast its companies internationalized, ranking Spain among the key international investors, particularly in Latin America. Moreover, Spain was increasingly recognized as an innovation hub in many areas of knowledge. It was certainly the place to be at the time. In my view, cultural similarities made Spain a proxy for Brazil's future. Studying in Spain represented an opportunity to learn about this development process and to find elements to challenge the hegemonic anglo-saxon business thought. Furthermore, it was also an opportunity to enhance my language skills, and acquire an international experience in a hot, interesting and friendly country.

Indeed, Spain did not let me down, except to the fact that I was not exactly in Spain but in Catalunya, as I was frequently reminded by the local language, the Catalan. I arrived at Barcelona in a very special moment. It had just hosted the Summer Olympic Games and the Universal Forum of Cultures (www.barcelona2004.org) with grandiosity and innovation. The world was fascinated with Spain as a whole and with Barcelona and Catalunya in special, and so were the Spanish (and Catalan) companies with the idea of conquering the world with their aggressive and challenging businesses. For anyone interested in studying multiculturalism and innovation Barcelona was certainly the hotspot.

In the spring of 2004, 12 students enrolled the full time doctoral program. We were 2 Catalans, 2 Spaniards (Madrid and Basque Country), 2 Colombians, 2 Mexicans, 1 Peruvian, 1 Chilean, 1 Venezuelan and 1 Brazilian (me). Most of us shared the same ethos of having an international experience and embedding ourselves into all that dynamism to become agents of change in our countries. Despite the linguistic differences and the long held position of Brazil to give its back to the continent, I could feel a genuine sense common identity and proximity with my Latin classmates. It was interesting to see how well we get together and shared the same worries and aspirations. Just as the university experience made me feel more Brazilian, doctoral classes made me feel more Latin American.

The academic environment reflected the intense governmental effort to make Catalan universities worldwide recognized, and their research, internationally relevant. Such drive involved investments in infrastructure (facilities and interconnected libraries), publication incentives, research training and strengthening ties with other European universities and attracting foreign students. However, all this effort was undermined by the research focus on local affairs and the timid academic production in English. This situation produced a relative disconnection from the main international research networks, which more dramatically weakened the field of organizational research, an alien agenda in a technical university.

In response, UPC business doctoral program promoted the same tools and research philosophy students at top universities were used to. As such, parallel to more traditional seminars and business subjects, we were introduced to academic databases, key scientific publications, bibliographic metrics, reference managers, cross citation strategies, and all the sort of tools to track investigation hotspots and to build cohesive theory. Additionally, we went deep into the bases of epistemology, methodology, and techniques of investigation to bring about rich and relevant data. This critic and instrumental formation has unequivocally contributed to my academic formation in general and to this work in special.

Outside university, I adapted very fast to Barcelona. Even faster than I had adapted to some places I lived in Brazil. I have never felt an outsider during conversations as Catalans automatically switched to Castellán in the presence of a non-Catalan speaker. Though I did not made many friends I still believe my integration was satisfactory observed the conditions involved. I hardly experienced any form of cultural shock in daily situations, thanks maybe to the cultural similarities, the partial domain of the Castellán, and my respectfulness, which most Catalans praised. In a certain sense, I strongly identified myself with Spanish (and Catalan) cultural features like the rush for innovation, respect for tradition, boldness, temper and passion. I was capable of understanding their local affairs and even capture the subtle humor in their phrases. After a few months I actually forgot I lived in a country that wasn't mine and start to feel the unusual sensation of being home whenever I get back from my short trips (even from Portugal, my ancestors land). Specially interesting, in this multicultural venture, was the experience of sharing housing with three French undergraduates, which made experience diversity in culture, class, age, gender, and educational level all at once. Against all odds, we get on quite well. I credit the success in this challenge to the many housing arrangements I have experienced in Brazil, whose knowledge help me to overcome many situations.

Overall, some observations surprised me at the time. First, how different the Catalans saw themselves from other Spaniards while, despite of the language, they had far more in common than Paulistas and Cariocas (São Paulo and Rio de Janeiro dwellers, respectively). Second, how Catalans were able to care so much for their identities and at the same time being such an open society. Also attracted my attention how Catalans were tolerant with foreigners taking over their public spaces, sometimes in ways that most Brazilians despite all their world famous receptivity would never accept.

However, at some point I could feel a sense of exhaustion in all that openness and tolerance. As a massive numbers of foreigners arrived Spain every day, they stop making part of the landscape and started to compete with locals for employment, housing and public services. This situation was especially disturbing in Barcelona a city that attracted most of the foreigners. Increasingly, news published cases of crime among Eastern Europeans, Chinese competition closing traditional businesses, insecurity with Islamic extremists among Pakistanis, and Latin Americans overstressing the public service infrastructure. This incipient sense of upheaval has

invaded even the university. I clearly remember a classmate contesting a professor during a seminar that as UPC was a Catalan university, seminars should all be in Catalan, and Catalans should be majority in class, just to hear the professor saying that UPC selection was public, international and meritocratic, and the language that pleased students most would be the chosen one.

By mid-2005, the surging living costs in Barcelona and the completion of all seminars make me realize that it was time to move on. At this time the United Kingdom was in a rush to attract skilled professionals worldwide to supply their booming business particularly in the prime service sectors (financial, engineering, and consulting), the intended focus of my investigation. My initial plan was to obtain a high-skilled migrant visa, to get an engineering job and to set a foothold there in order to start my investigation and obtain credits for the EUDOKMA (European Doctor) title with the help of a British business school. The first part was easy. Spending about US\$2000 and being patient to collect and translate all the documentation required, it took me less than two months to get the visa. The second part, to find a job, proved much harder as British companies preferred Asian nationals to fill in their placements as much of the world economy was leaning to that part of the world. At this time Brazil and Latin America attracted little attention and seen with skepticism.

Even though, the hard fiscal adjustment implemented in the first two years of Lula's government in Brazil start showing results. As the confidence of the markets returned and the capital inflows to Brazil resumed, companies in the country started planning investments and hiring once again. In this scenario, while looking for a job in UK, I received a job offer to go to Salvador, the 2 million habitants capital of Bahia state, a traditional summer destination in northeast Brazil. Though determined to go to the UK, the financial depletion I was starting to suffer and the seduction of a beachfront job offer weighted and I decided to accept the offer. Initially, I planned just to enjoy a sunny 4-6 months "remunerated vacation" in Salvador to once again resume my UK plans, particularly because of the doctoral work that would certainly gain from an exposure to the British environment.

What happened, however, was quite different. Thanks to tourism revenues economic dynamism in northeast Brazil anticipated that of other places in the country. By August 2005, when I arrived Salvador, a Miami-like metropolis had already replaced the colonial city I used to know. Living conditions in the new middle-class neighborhoods of Salvador far exceed those I would find in equivalent zones of Barcelona and London.

In this wakening of the Brazilian economy, developed economies start to show clear signs of overheating. Surging living costs gradually forced production and services into lower cost locations. Six months later, I could hardly find a job in the UK that compensate for my return. Discounted taxes and living costs, I would earn more in the emerging Salvador than in booming London. As such, what started just as an affair became a sort of marriage. In the end, I spent one year and a half living in Salvador and completely dropped the plans to go to the UK.

During this period I worked for an ambitious emerging engineering company whose focus was to expand its operations by means of technological innovation. Thanks to my experience in project automation, I was hired to be number two in the recently created "Nucleo de Desenvolvimento de Tecnologias" (technology development department), or simply NDT. In a few weeks the company moved from a tiny and improvised space, to occupy three entire floors in a fancy building near the main business hub of the city. The NDT itself occupied a special area of this new office and has been designed to be a world-class working space, equipped with planned furniture, special illumination, top hardware and even a 3D virtual reality auditorium.

The head and architect of NDT was a systems engineer, who gained the trust of the company's owner and went from desktop supplier to Engineering Automation Manager in just two years. He developed an operational strategy (and efficiently sold it to the board of directors) which basically saw innovation as a top-down process to be developed within his NDT to only then gain production. This way, he was able to concentrate in his hands all engineering technological resources of the company, and control what would be done, when and who would participate. In a business environment where knowledge differentials were determinant for the mobility, wage and status of a professional, this meant a lot of power. This top-down strategy, however, yielded poor results as technological resources were developed disconnected from production needs and their return in terms of quality, efficiency and revenue was disastrous.

In this scenario, he took my presence as a threat to his position and established an intense rivalry with me. While I worked together with production trying to fix this flawed strategy, he constantly confronted my opinions and suggestions during technical forums, removed any resource from my control, and blocked my contact with clients and directors. He controlled so many resources, had such a sharp mind and developed such a discourse that he was able to influence anyone in his favor. He was so convincing that sometimes I even questioned myself if I was really right. This tension kept for a long time as we developed a symbiotic relationship where he depended on me to have things done (and keep playing top manager), and I depended on him to keep accessing valuable knowledge in order to enhance my prospects of a way out. During this period the relation between power, politics and innovation, became evident to me as I realized how politicized could be a technical working environment and saw the role of political influence in determining winning ideas, the meaning of key events and agenda setting.

In February 2007, I left this company and moved to São Paulo to provide engineering consulting services for a couple of companies, among them an engineering branch (CNC) of a giant Brazilian construction conglomerate (CCC). As CCC operated in many countries and was one of the first Brazilian MNEs, I believed that at some point it would offer great investigation opportunities and in fact I was right.

5.3.2- Field Selection

By June 2007, I concluded my doctoral research project and clearly set my object of investigation; the relation between knowledge diversity political processes and innovation. A choice that reflects the many influences and points of interest I have been through the doctoral period.

According to my theoretical developments, in order to vividly capture this relationship I should look for workspaces where dynamic power relations and knowledge diversity coexisted. Hardly I could find a better place to investigate this relation than in international project teams. The temporal and relational character of these work settings create situations that make power relations change along time and space involving project and company hierarchic levels as well as clients, suppliers, and regulation agencies, all of them interacting to influence project outcomes. Knowledge diversity, on its turn, is inherent to project teams, which can be devised as working arrangements where specialized knowledge from different areas is put together to the accomplishment of a unique task. In engineering projects, however, knowledge diversity frequently involves crossborder exchanges with actors from other nationalities, taking knowledge diversity to an extreme.

My initial plan was to use my participation at CNC as a platform to access people, at CCC and related companies, enrolled in international engineering projects to obtain the necessary data for my investigation. However, a unexpected chain of events put me at the forefront of this process as CNC itself took part in several international projects and end up being purchased by one of its foreign partners (WP), becoming in this process an important subsidiary (CNC/WP, henceforth) of the largest engineering company in the world (WP).

I confronted this situation both as challenge and opportunity. The challenge was to add to the project complexity the influence of the corporate changes involving the company as a whole. In return, the same corporate changes brought the opportunity to watch not only how innovations emerged within projects but also how they survived and evolved within company structure after project conclusion. To cope with this challenge I decided to work in two different levels of analysis; the company at macro-level, and selected projects at micro-level.

As such, the investigation setting is CNC, a Brazilian company that along the 2 years of data collection left the legacy of being a satellite company within a large local conglomerate (CCC), to gain operational independence and then became a subsidiary of a large transnational engineering company (WP).

If company selection was result of chance and opportunity, at micro level project sampling aimed to maximize variability in order to test emergent theory across different project circumstances. Therefore, although all projects in the investigation timeline contribute to understand the investigation setting as a whole, the three selected projects contribute to the understanding of the object of investigation. The cases are:

	Project	Industry	CNC/WP Activity	Nationalities Involved	Case Length	Management Innovation	Project Size (US\$ million)
Case I	PDY	Petrochemical	FEED	United States Brazil	8 months	International Workshare	US\$8,400
Case II	UNA3	Energy	Bidder	United States Brazil Bulgaria	4 Months	Global Price Contracting	US\$6,000
Case III	BGB	Oil & Gas	Conceptual Project	United Kingdom United States Brazil	3 Months	Fast Track Schedule	US\$1,100

Table 2: Case study profile.

Following an *interplay strategy* (Schultz & Hatch, 1996), the investigation moved its focus along the different levels of analysis (i.e.: project, company, corporate) whenever necessary to gain wider understanding of the knowledge change process in question and to follow unfolding consequences.

5.3.3- CCC

The company began in 1936 as an association of two Brazilian entrepreneurs already carrying the name CCC. By 1939, CCC got its first major contract from São Paulo State Highway Department: the earthmoving work of 12kms stretching two small cities in the countryside. For this it acquires its first tractor. In 1942, the second large contract the excavation of a carbon mine in the neighboring state of Parana. From 1943 to 1945, CCC undertake earthmoving and paving in two airports under Air Force requirement. In 1948 it diversifies into railways and manufacturing construction.

During the 50's and 60's, CCC consolidated its position in the highway and airport sector while strongly expanding into the construction of hydropowers. In 1955 it is hired by the government to execute earthmoving to the construction of Brasilia. In 1968, CCC enters the cement industry. In 1969, it is awarded with earthmoving and tank farms for a Petrobras oil refinery in Campinas and acquires CNC to form its engineering arm. Also 1964, one of the initial entrepreneurs left the company, consolidating the familiar control of CCC.

Along the 70's, CCC intensively participated in the "Brazilian miracle", undertaking several governmental mega-projects such as Itaipu and Tucuruí Hydropowers, Transamazon highway, Rio-Niteroi bridge, São Paulo subway. In 1978, CCC undertakes its first international contract, a mid-sized hydropower in Venezuela. In the 80's, the company acquires stakes in industrial companies like Alpargatas, a traditional Brazilian footwear, and Alcoa, the largest aluminum producers in the world, and further diversifies into energy transmission and distribution systems.

In early 2000's, CCC group reaches 15 companies, 32,000 direct employees and reports gross operating revenues of US\$3.9 Billion. In 2005, CCC set up an international subsidiary to undertake several projects in Peru, Venezuela, Colombia and Bolivia. In the following year it extended its activities into Africa. In 2006, CCC enters housing construction building with an entire neighborhood in south side São

Paulo and in naval construction building a shipyard in northeast Brazil and being awarded by Petrobras with 10 Suezmax ships. It also participates in the concession of São Paulo state highways (Brazil's best) and begins in the concession management business. All over 2000's, CCC controlled companies increasingly acquire foreign competitors to expand industrial foreign operations particularly in cement, and textiles industries, and form joint ventures with international companies to explore local opportunities. In 2010, CCC made its most expensive foreign acquisition, EUR\$1.4billion, for 33% stake in Cimpor, the largest cement maker in Portugal and one of the largest in the world, becoming its controlling shareholder.

In 2010, CCC group reached 30 companies, 62,000 direct employees and reports gross operating revenues of US\$12.2 Billion. Its operations now are consolidated around construction (heavy, naval and housing), industry (steel, textiles, cement) and concessions (roads, airports and power distribution). The board is composed by four members: one market professional (CEO) and three family representatives, one for each of founders three sisters (the remaining founder died in 1994).

5.3.4- WP

The history of the company is woven around the vision and efforts of the man who is currently its Chief Executive Officer. He started his career in 1968 in Exxon Australia, until 1971 when he left the company to join a society of engineers and help establish a small Australian engineering consultancy by 1976. This small company grew steadily throughout the 1970's and '80's and in 1987 acquired the Australian interests of W, an American based engineering firm with a strong reputation in the offshore gas and oil arena. The company, then, changed its name to W and from this point began expanding steadily, securing long term contracts in Brunei, Malaysia, Thailand and Singapore, and creating local joint ventures. By 2000, W was well poised to continue its industry sector and geographic expansion with 30 offices and 3,000 personnel globally. Such intense growth enabled W to diversify further through additional partnerships and acquisitions. Through a policy of diversification W grew from the hydrocarbons sector into the power, infrastructure and environment, and minerals and metals sectors.

In 2002, W became a publicly listed company on the Australian Stock Exchange leading to a period of acquisitions of increasing magnitude around the globe, including companies in Canada, Oman, and China. In 2004, W acquired P, a Californian engineering and construction company, global leader in downstream hydrocarbons with a widely recognized reputation for its high quality project services to the Power, Oil and Gas, Refining, Petrochemicals and Chemicals sectors. As P had its own impressive history stemming back to 1944, W merged operations with P and changed his name to WP.

Further acquisitions in environment, gas, power, infrastructure and mineral & metals sector, continued to deepen and broaden WP capability and geographic presence. In 2006, WP entered the Latin American market through a joint venture with a Chilean leading base metals and infrastructure engineering firm. In 2007, Canada's largest

engineering and project services firm also became part of the WP. In November 2007, WP complemented its capability in the nuclear consulting and analysis with the acquisition of two U.S.-based nuclear engineering companies. Further, the acquisition of a leading international deepwater engineering company, in April 2008 positioned the company to provide solutions for large-scale offshore facilities, subsea and marine systems projects alike. Later, the acquisition of a leading Canadian based marine and port facility, bulk material handling and transportation specialist, further extended its infrastructure and minerals & metals capabilities.

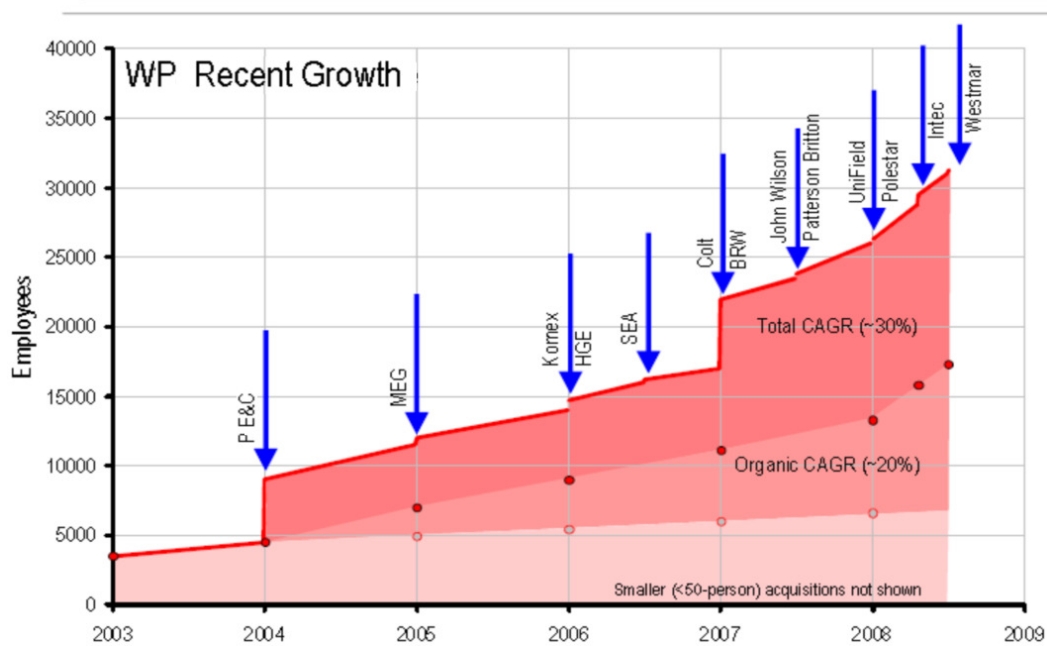


Fig.17: WP growth (Source: WP Presentation)

In 2008, after almost 10 years without working in Brazil, WP is awarded a US\$ 110 million contract with Petrobras, to provide basic engineering services for the off-site installations of Rio de Janeiro Petrochemical Complex (PDY). Two years later, in early 2010, WP acquired CNC in Brazil for US\$ 104.9 million. This acquisition complemented the existing capabilities of WP in resource and energy businesses, providing a strategic base for growth across South America. Almost at the same time WP extended its stake in BM-WP, a joint engineering company in China, to 80%, a business worth US\$ 38 million.

Nowadays, with sales worth US\$ 3.31 Billion, WP is the 1st engineering company in the oil & gas and power generation sectors, the world 2nd most internationalized (78% of revenues from overseas operations) and the 6th largest engineering & construction company (E&C) overall. Today the global enterprise has 140 operating offices in 40 countries with around 30,000 personnel. (The Top 200 International Design Firms: Engineering News-Record, 26th July 2010, <http://enr.construction.com>).

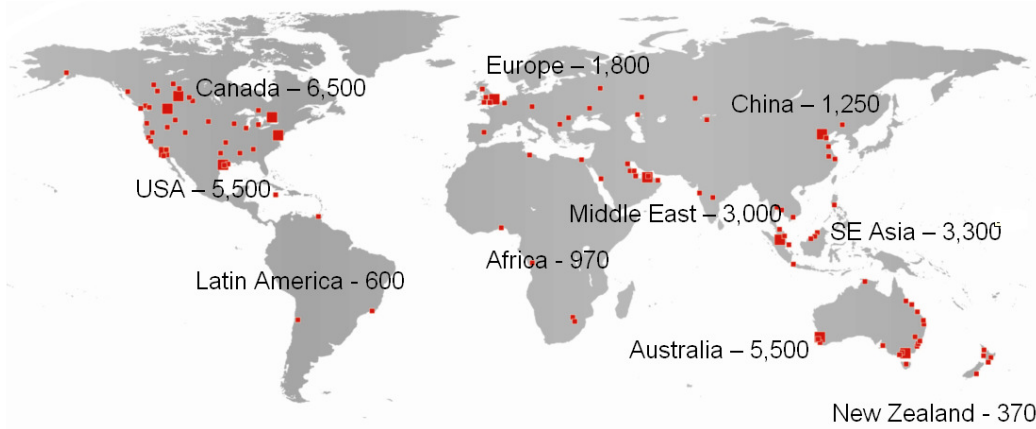


Fig.18: WP personnel distribution worldwide (Source: WP Presentation)

WP main shareholders are international banks HSBC (14.2%), JP Morgan (12.7%) although its founder and CEO still retains around 10%. The board comprises 11 directors with seven, including the Chairman, as independent, non-executive directors. The board composition is determined in accordance with the principle of independence, and each non-executive member is audited periodically to consider whether there are any circumstances that could materially interfere with the director's ability to act in the Company's best interests.

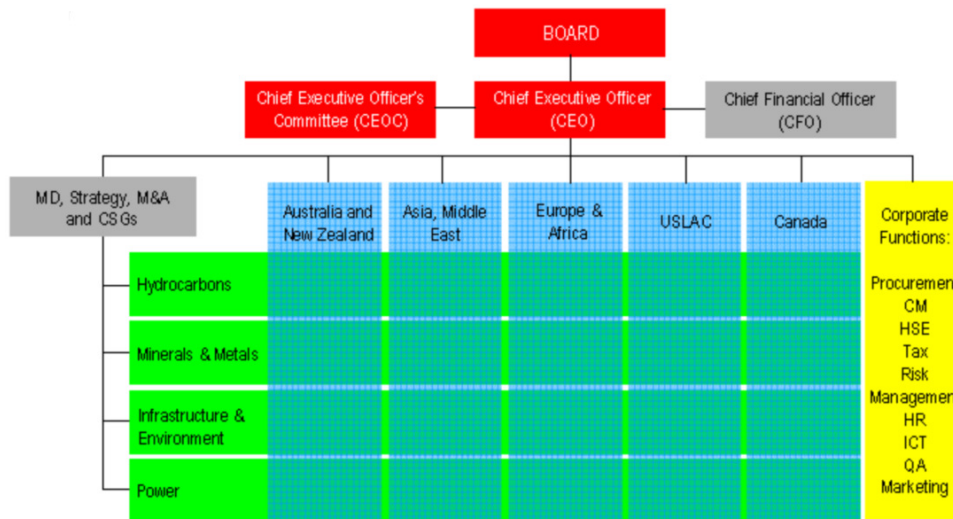


Fig.19: WP Corporate Structure (Source WP Presentation).

5.3.5- CNC

The company began in 1959, founded by teachers and graduates of the traditional Escola Politécnica (University of São Paulo's Engineering School). In 1969, CNC was incorporated by CCC as its founder believed construction should be closely supported by engineering. Since then, CNC has built a regional and international reputation in hydroelectric and thermoelectric plants, wastewater, urban development, environmental services, and lately industrial plants, refining and distributing of oil, gas, and petrochemicals throughout Brazil, Latin America, and Africa.

Thanks to large scale governmental hydroelectric investments, the hydraulic engineering area dominated the company for a long time. Along two decades, CNC provided projects for more than 40 GW (60% Brazilian power consumption) of power generation, including some of the largest hydropowers in the world. As these investments dwindle during the 80's, the company diversified into smaller hydroelectric units for private clients, which sequentially moved the company into its first thermoelectric units. Later complementary activities to the power generation business such as environmental studies, and urban development grew enough to become separate business units within company.

The relationship of CCC, its parent company, and a giant aluminum multinational, ALCOA, brought its first large scale industrial project, a aluminum processor in the north of the country. The project in association with a Canadian engineering firm credentiated the company into the industrial engineering area, an important diversification move at the time.

Surging investments from Petrobras in early 2000's stretched even further this diversification move into the oil & gas industry. Several projects involving refining and gas processing dominated the company during the period 2002-2010 and revenues from the oil sector overcame those of power projects which remained stagnant at 30% level. During the period revenues grew steadily to US\$233 million, a three-fold increase within a decade.

CNC sale came just after its first international move, an office in Buenos Aires, opened as internationalization plan encouraged by CCC. The company was purchased in cash by almost US\$ 104 million, seven times its 2010 net profits (US\$ 15 million), a price considered high by specialists. Defending the business the following official declarations were offered:

"Quando iniciamos a estratégia de internacionalização, sentimos a necessidade de nos capacitar para a área de refino de petróleo, onde ainda não tínhamos conhecimento suficiente, apesar da experiência que havíamos adquirido com a elaboração de projetos de petróleo e gás. (...) nos deparamos com duas alternativas: comprar ou ser comprados. Acabamos ficando com a segunda opção. Daqui para frente a CCC vai se focar em construção e nas outras áreas nas quais já atua" (CNC president, to Brasil Economico, 5th Jan 2010).

(When we started the internationalization strategy, we felt the need to build capabilities in the area of petroleum refining, where we had not enough knowledge, despite the experience we had gained from development of oil and gas projects. (...) then we were confronted with two alternatives: buy or be bought. We ended up with the second option. Henceforth, CCC will focus on construction and other areas where it already works – author translation).

"A CNEC é fundamental para a nossa estratégia de expansão na América Latina e para a ampliação da nossa presença nas áreas de óleo, gás e energia hidrelétrica, dois mercados que têm grande potencial. (...)A união da nossa experiência com a CNEC vai trazer sinergias que podem criar muitas oportunidades". (WP regional vice-president, to Brasil Economico, 5th Jan 2010).

(CNC is key to our expansion strategy in Latin America and to expand our presence in the oil, gas and hydroelectric power, two markets with great potential. (...) The combination of our experience with the CNC ones will bring synergies and create many opportunities – author translation)

Later, in another public interview, CNC president complemented that the link with CNC made it hard for CCC to make deals with other companies, since they fear the

leak of classified information. He also pointed that Brazilian law (Lei 8666/93, art 9º) prevented government to hire construction and engineering services within the same group. As engineering bid happened before the construction one, he explained, many times CNC declined bid participation to avoid blocking CCC from major construction contracts³. Moreover, he argues, CNC never enjoyed engineering exclusivity in CCC construction projects, and although the CCC founder believed it was better to have engineering closer to construction, group vision now was to focus on its core businesses. Nevertheless, as he tells: “*Relationship between CNC and CCC will not disappear but will happen on a case basis, project to project*” (“CNC é adquirida pelo grupo australiano WP”, Revista Grandes Construções, 12th January, 2010).

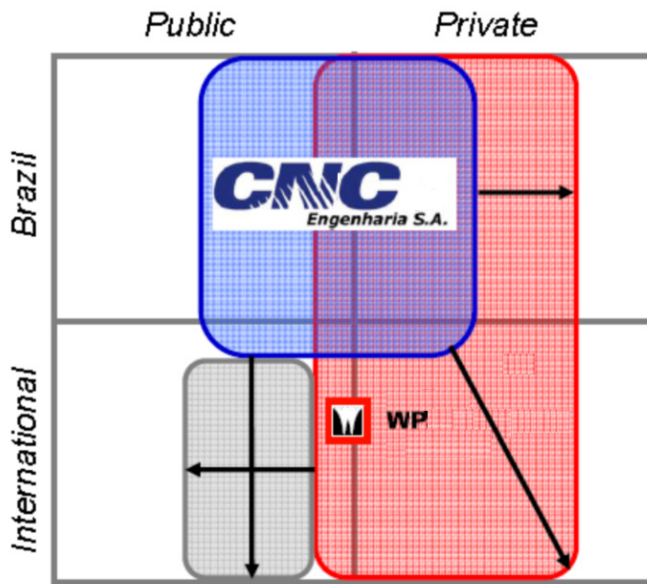


Fig.20: WP & CNC expected synergy (Source: WP Presentation).

5.4- FIELD ENTRY

In February 2002, I have been contracted to provide engineering consulting services for CNC as a plan to reinforce company’s expertise before it joining a winning consortium of a US\$260 million Petrobras onshore gas project (UTGCA) located in the north shore of São Paulo state. The winning consortium was composed by CCC (42,5%), Queiroz Galvão (42,5%), another large Brazilian construction company, and IESA (15%), a traditional off-shore Brazilian engineering company. As long as CNC was responsible for the previous FEED⁴ phase of the project, and IESA was about to be awarded a larger offshore project, CCC start to negotiate the replacement of IESA by CNC in the consortium. After two months, negotiations collapsed as IESA decided to exercise its share in the consortium and CNC was left out of the job.

³ Usually construction and procurement contracts represent 95% of entire entrepreneurship cost, with remaining 5% corresponding to engineering services.

⁴ FEED (Front End Engineering & Design): Pre-detailing phase of a project used to further cost and design definitions in order to obtain final project sanction, to require permits and to define contractual basis. Usually, is an intermediate phase coming after **conceptual engineering** and before **detailed engineering and construction**.

Little time later, and in very similar conditions, CNC overtook another engineering company in the winning consortium of a US\$480 million Petrobras RPBC refinery expansion, where it also developed the previous FEED phase of the project. The head of the winning consortium was TCT, the largest Argentinean construction company and a fierce CCC competitor. TCT decided to subcontract CNC on the assumption that its previous knowledge on the project and quick start-up capability what could help saving money on Petrobras tight margin contracts.

A conflict emerged when CCC commanded CNC to lend some of its key engineers to his UTGCA consortium, however, CNC needed these professionals to develop the RPBC project for the TCT consortium. Although unable to officially rebuff the request, CNC made no effort in that direction, leaving each professional to opt in or out. UTGCA consortium managers played hard to attract CNC professionals proposing cash, benefits and, in the end all sort of professional threats. Most engineers knew that those promises would not last much once they break-up with CNC, a well-established company, to join the CCC consortium whose existence would last as long as the project. As a result only one professional in almost twenty chose to go to CCC consortium.

BY this time, I was eager to join the RPBC project and start collecting data for my first case stud, however, other professional duties delayed the transfer for almost 4 months. When I first approached RPBC project it was too late to collect any relevant data and build a case study, since most agreements and procedures between the two companies had already being settled and Argentineans start being replaced by Brazilian professionals locally hired by TCT. During the few time I spent there with some of the Argentinean expatriates I felt like despite the friendly and encouraging relation they developed with Brazilians most of them presented adaptation problems to São Paulo, a city far less friendly than Buenos Aires, and were stressed by the constant trips to visit relatives and friends. In different occasions I testified telephonic discussions between an Argentinean engineer and his fiancée and perceived many unexplained absences among them. One month later, only one Argentinean manager was left behind, one who was already living in Brazil for decades.

The substitution of the Argentinean supervisors by Brazilian ones unleashed tensions previously concealed by the poor communication and “cultural uncertainty”⁵. Small project problems, prompted by Petrobras engineering interference quickly escalate into an open war between CNC and TCT. In its most acute phase, TCT start to sabotage CNC schedule to force a project delay in order to hide its procurement problems and transfer contract penalties to CNC. The constant stand-offs and mutual accusations intoxicated so much the project atmosphere that many professionals had to be internally transferred to other projects.

⁵ In this work I define “cultural uncertainty” as the difficulty an actor has in anticipating the effects of his actions when interacting with another actor from a different cultural background.

CNC also had problems with other two other joint projects: the USM thermoelectric (with CCC) and UTE thermoelectric (with the Argentinean branch of SKANSKA, a Swedish construction company). Delays in both projects resulted in harsh measures on the part of the leading construction partners. In USM case, entire project team had to move to the construction site until project conclusion. In UTE case, SKANSKA project director demanded the withdrawal of CNC project manager alleging his incompetence in fulfilling the task.

When current RPBC project manager moved to a competitor, this project manager gained support to move into the open place. His arrival at the RPBC project marked a period of excruciating politicking. Instead of defending CNC terms against TCT, he did the opposite as he directly vented and amplified to CNC board of directors all internal project problems, usually defending TCT side. Astonishingly, the board responded by putting pressure on technical managers to force their subordinates to cope with TCT demands. This move was interpreted by many as a way to escape the heavy organizational duties of a project manager and to please the client in order to be hired after project conclusion, what indeed happened.

As a result, TCT demands surged to the point of halting CNC work progress. Confronted with the board urge to demonstrate strength and fire whoever necessary, S.P.H a key technical manager, literally moved to the project and did not take long to understand what was happening within RPBC project. However, as he began to oppose A.F., he noticed the heavy politicking game on play, and chose to retreat. Instead of facing A.F. in the board meetings he decided to make his subordinates work almost 24x7 in order to cope with all TCT demands and to keep the project going. This action preserved jobs but ruined relationships within the project team. As I admonished him on these measures, our roles went on collision course. This stalemate caused a shift in our professional relationship from full confidence to almost complete disregard tainted with a dose of rivalry.

Along this process, relationship difficulties between CNC and CCC start to emerge. Since mid-2007, CNC had been increasingly stimulated by CCC to become more independent. Not much later, a president has been appointed to CNC (until then the company where managed by a CCC body of executives) that henceforth became a business unit apart from CCC. As a measure of isolation, in the end of 2007, the almost 350 CNC's employees were not allowed to join the traditional CCC group year-end party, a huge event involving more than 2000 people only in São Paulo.

In the beginning of 2008, with the sub-prime crisis ramping up, demand for engineering services in Brazil came to a halt and CNC saw its service backlog dwindle below the 12-months safe limit. Along the year, professionals no longer required in RPBC project were "lent" to CCC to take part in a consortium with PROMON, CNC's strongest competitor. Frequently, PROMON "cherry-picked" CNC professionals through CCC intervention, usually asking for highly specialized professionals. This process also allowed PROMON to try professionals without having to pay premium fees in order to attract them. Upon this observation, some

people who I talked to, admitted that “to be lend” to CCC meant that a professional is not part of CNC plans and this was equivalent to be “fired on the middle-term”.

With the end of the RPBC project approaching and no new large projects on the go my relationship with CNC was at risk. S.P.H. offered me two harsh options: to join a unfeasible 3-month project (RNM) in the far north Amazon state under his direct command or to be “lent” to TCT in order to provide engineering assistance in the construction field. I questioned him if there weren’t other options like PDY and RNE projects that were running on the neighboring building, or any of the many needed procedures or technical developments that were much needed within the company. He argued that the PDY and RNE projects were not requiring people at that time and that the company no longer worked with “overhead⁶”. I understood the options as a message that I was no longer “core” in his assessments. Nevertheless, this idea seemed quite personalistic and I decided to start lobbying people within company to keep my relationship with the company afloat.

At the very same day, I went for a coffee break with a close colleague, A.R.A., who had worked with me in the beginning of RPBC project but now was assigned to the PDY project. As I explained to him the oddity of my situation I noticed that he was also in distress due to work overload. As he further explained the problem I realized that I could help him, provided that I went to the PDY project. I long wished to go to the PDY project because I believed that the international joint character of this project would yield a great investigation opportunity, however my duties in the current project again prevented me from the move. Then I asked him to vent to his coordinator, D.D.C, and even to his project manager, K.G., that I was about to leave the PRBC project and could be of much help to solve the problem they faced in PDY project for almost a year and a half.

Next, I talked to a close colleague in the RPBC project and as he said to me he was very interested in going to the construction field provide support for TCT, I realized that I had an additional argument to weaken S.P.H. stance. When I met him little later I explained that I did not want to follow TCT specially because there were people in the team that were more willing to do so. Again, he looked clearly dissatisfied with my position but reaffirmed that he would never force a professional into an unwilling assignment and we should wait to see if other opportunities came by. In the very next day, K.G. called S.P.H and required my immediate displacement to PDY project in order to help A.R.A to overcome the serious problems they were facing. Down beaten by my intervention, S.P.H had no other option than let me go.

⁶ In this context, the word “overhead” is used to denote work without a specific project assignment.

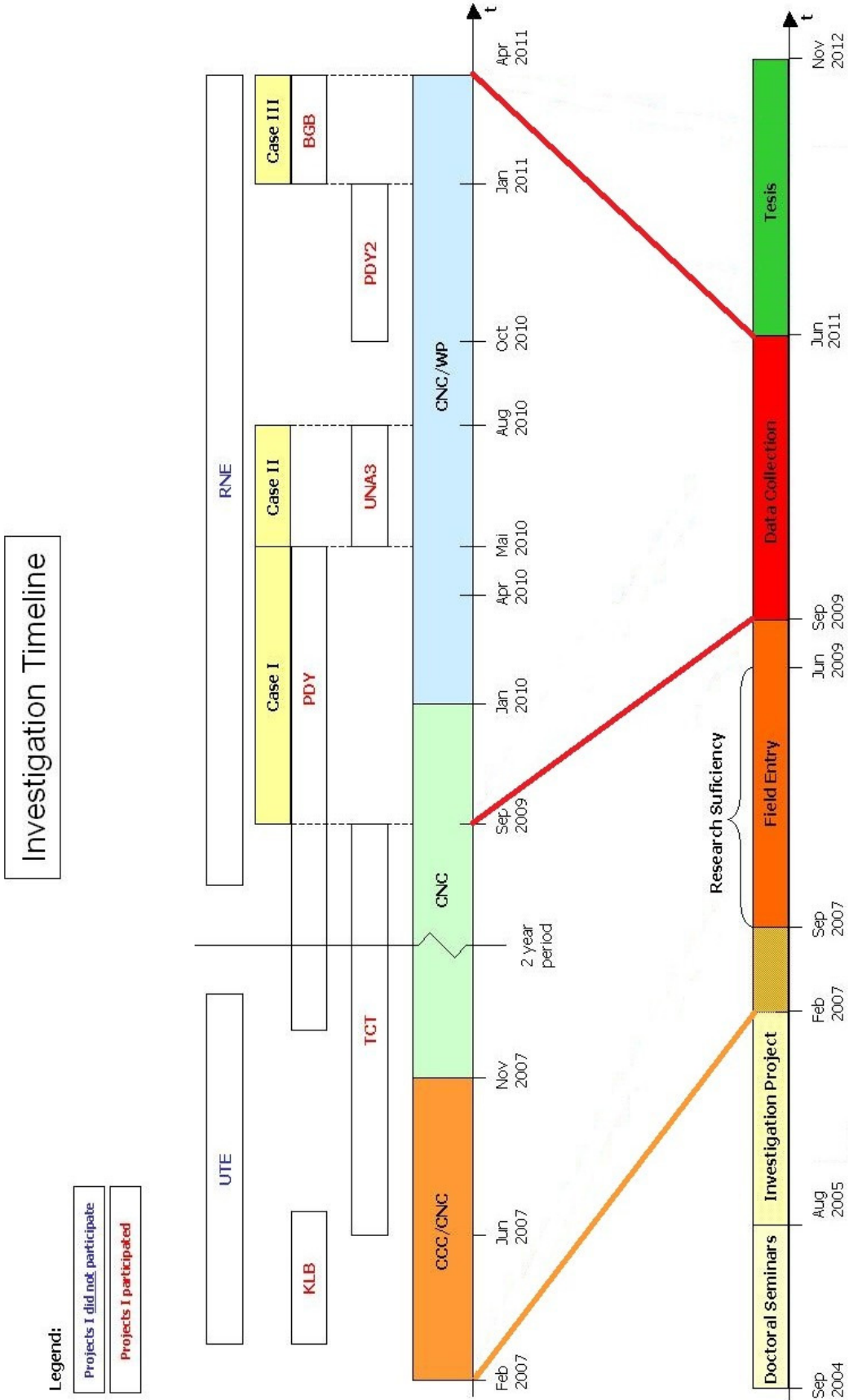


Fig. 21: Investigation timeline.

CHAPTER VI
PDY PROJECT

6.1- PROJECT OBJECT

PDY is nowadays the largest independent investment program within Petrobras, and one of the world's largest in the oil sector, mounting up to US\$8,4 billion, 108 million man-hours and 17,000 workers at peak (Petrobras presentation, Nov 2007). It was initially conceived as an integrated petrochemical complex capable of processing the 165.000 barrels per day of heavy-crude from the nearby Campos basin into fuel (30%) and 1st and 2nd generation basic petrochemicals (70%). PDY also marks the full return of the giant oil state company to the petrochemical sector after the privatization programs during which Petrobras had to sell his petrochemical assets to other large Brazilian groups to become only a minority shareholder in the business.

PDY complex would be built in partnership with Group Ultra (3rd largest Brazilian petrochemical group at the time) with two main objectives: balance future supply of 1st and 2nd generation basic petrochemicals and use low-value heavy-crude to save US\$ 2 billion/year in petrochemical imports. During the initial feasibility and conceptual studies Petrobras selected the municipality of Itaboraí, 50km away from Rio de Janeiro city, to be the construction site of PDY (Petrobras Presentation - ABEMI Meeting, Aug. 2008).



Fig.22: PDY location (Source: Google Maps)

An initial change in course of PDY initiated in 2005 when BNDES, in a market report, set the landmark for a complex process of national petrochemical sector consolidation:

"In considering that the sustained economic growth will require additional productive investments in the order of US\$12 billion, to match the petrochemical products demand until 2013, it is key to equate financial sources to enable the achievement of many scheduled projects (...) The definitive solution to the issue of raw material can be the construction of new integrated complexes, from the refinery until the second generation, using domestic oil (heavy) as raw material. (...) The contribution of BNDES for the petrochemical industry should be established by supporting the implementation of new projects and funding for capacity expansion and modernization of current. Additionally, investments in R & D and restructuring movements should be encouraged so that the sector will increase the capacity for technological innovation and is consolidated in the most competitive companies." (author translation from GOMES et. al., 2005 - Industria Petroquímica Brasileira, situação atual e perspectivas. BNDES report).

The seven-year consolidation of the Brazilian petrochemical business ended with the three smaller players, Suzano, Ipiranga and Ultrapar, being purchased by Braskem and Petrobras, with the help of BNDES. As a result, Petrobras concentrated its entire petrochemical assets, previously held by Petroquisa (Petrobras petrochemical investment operator), into Braskem a giant private company (US\$20 billion) fully national owned with a 40% Petrobras stake.

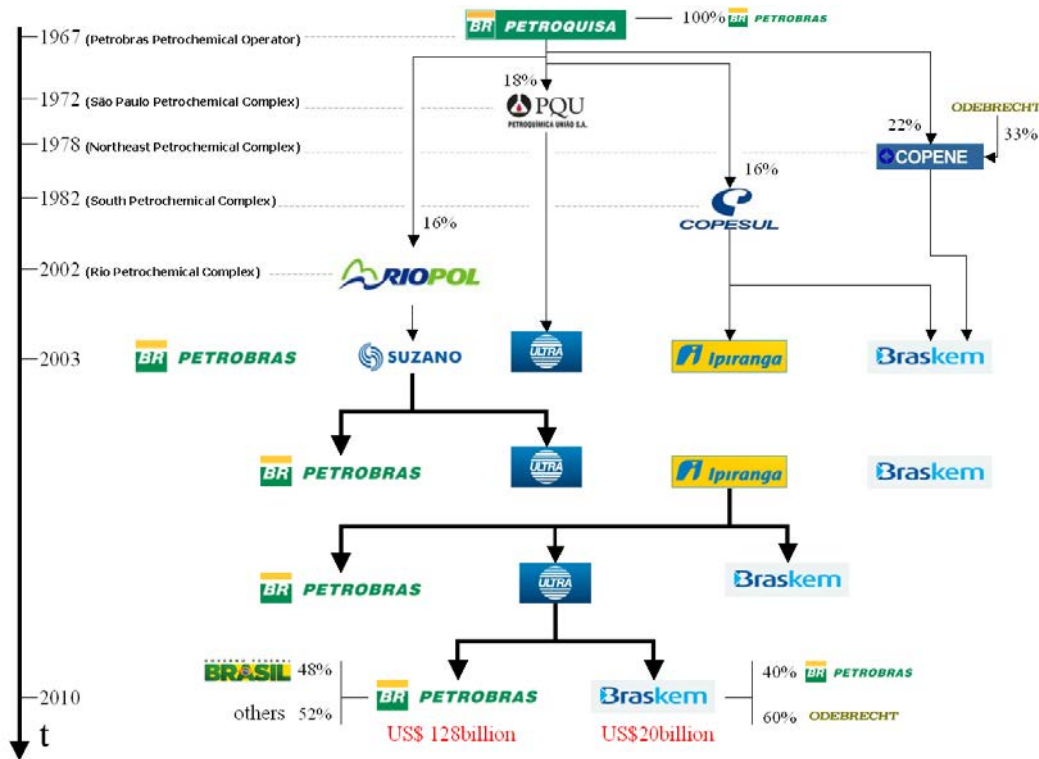


Fig.23: Brazilian petrochemical sector consolidation process.

In end of 2009, the confirmation of large light-crude oil deposits in the so-called "pre-salt" fields and the end of long round of petrochemical sector consolidation sponsored by the government completely changed the initial plans. The large quantity of light-crude and gas in the new fields required Petrobras to quickly build up its oil refining and gas processing capacity. By early 2010, in the end of the case study, Petrobras decided to concentrate PDY activities into oil refining and let Braskem responsible for all petrochemical activities within the complex what marginally affected the result of the project and its relation with WP the engineering company in charge of PDY basic engineering assessment.

6.2- PROJECT STAKEHOLDERS

6.2.1- The Client: Petrobras

Petrobras was established in 1953, during the second term of the developmentalist government of President Getulio Vargas, to undertake the monopoly in the oil sector activities in Brazil on behalf of the state. The campaign for Petrobras creation, however, started in 1946 under the slogan: *“The oil is ours”*. In his inaugural speech Getulio reinforced the nationalist discourse behind the company creation saying: *“It is, therefore, with great satisfaction and patriotic pride that I sanctioned the bill approved by the legislative which is a milestone in our economic independence”*. The new company, assumed responsibility above all oil exploratory activities and two small refineries privately owned.

The dream of oil independence was challenged in 1960 when a senior American geologist Walter K. Link, reported the impossibility of producing relevant amounts of oil from Brazilian on-shore basins (the so-called Link Report). The document questioned the rationality of wasting resources on daring exploratory programs and set a pessimistic view about Brazilian oil potential. Additionally, the report stated that further geological information could change this scenario for the off-shore exploration, however, he was also pessimistic about Petrobras capability of overcoming the challenges of off-shore exploration.

In the urge to refute the Link Report and legitimate its existence, Petrobras technicians set an aggressive path for oil exploration in Brazil. Although some significant results were obtained in on-shore fields, it was the off-shore fields that surprised. With the construction of its first large scale oil refinery (REDUC) in 1961 and the beginning of off-shore exploration with the Brasilia oil rig, Petrobras set an important foothold for its existence and legitimacy. To meet the technological demands necessary to further extend oil exploration, in 1968 Petrobras created CENPES, a research and development center, today largest Latin America research center and patent holder.

Despite the investments, in 1997 Brazil was still producing less than 60% of the oil consumed domestically. In that year, president Fernando Henrique Cardoso signed a law 9.478/97 ending Petrobras' monopoly in oil exploration and created the National Petroleum Agency (ANP), to mediate conflicts among business, government and consumers. The law also established the concession system where ANP goes public to offer oil prospecting areas. In this system, the highest bidder, be it a national or international companies, pays the federal government to win full exploration rights under certain conditions (i.e.: local content, investment targets, production schedules), that if not met, result in concession revoking and re-auctioning. The less the risk the higher the bonus paid for a determined area.

The aim behind the end of state oil monopoly was to produce an investment shock in the Brazilian oil sector upon the arrival of new competitors and enhance state revenues limited by Petrobras exploration capacity. It also aimed to submit

Petrobras, seen at time as large and inefficient company, into competitive pressure to modernize their operations. Overall, the concession system was successful as it stimulated the national oil production from 900.000 barrels/day in 1997 into more than 2.000.000 barrels/day by 2010, attracted almost 35 large international oil companies and generated around US\$ 4,5 billion in government revenues (ANP website: www.brasil-rounds.gov.br). Nevertheless, Petrobras remained a dominant player in the internal oil market as it deeply knew the Brazilian geology and had the financial and political means to keep control over the most interesting exploration areas. In the riskier or higher investment areas Petrobras established joint ventures with mid-sized foreign oil companies like Repsol (Spain), BG (UK), Statoil (Norway) and Galp (Portugal).

Nowadays, Petrobras is the largest company in Latin America by market capitalization and revenue, and the largest company headquartered in the Southern Hemisphere by market value (8th worldwide in market value). Petrobras has up to 132 production platforms, 16 refineries, 16 thermoelectric plants, 30,000 kilometers of pipelines and more than 6,000 service stations in Brazil. Petrobras controls significant oil and energy assets in 29 countries in Africa, North America, South America, Europe and Asia. These holdings as well as properties in Brazil give it total assets of \$133.5 billion. Petrobras is a world leader in development of advanced technology from deep-water water oil production (company website: www.petrobras.com.br).

Beyond its roles as an oil company and State revenue generator, Petrobras also behaves as an economic development agency. Through its PIDD-P&G policy, acronym for "*Política Industrial Dirigida por Demanda*" (Demand-Driven Industrial Policy), Petrobras uses its purchase power to enhance organization and growth of local suppliers as well as the entry of international players. As show in the chart ahead, the program has the following objectives:

- (1) Expand productive capacity in sectors considered highly competitive (i.e.: steel, piping, pumping equipment, subsea equipment, steam turbines, generators and electric engines; substations and heavy electrical equipment);
- (2) Expand productive capacity and technologically develop sectors considered intermediately competitive (i.e.: piping connections, heavy equipment, alternative compressors, gas and diesel engines, cranes and lifting equipment, industrial valves, engineering services, construction services.
- (3) Stimulate entry of new local and foreign suppliers, as well as foster associations between them, in sectors without local production (i.e.: centrifugal compressors, large engines, turbines, instrumentation.

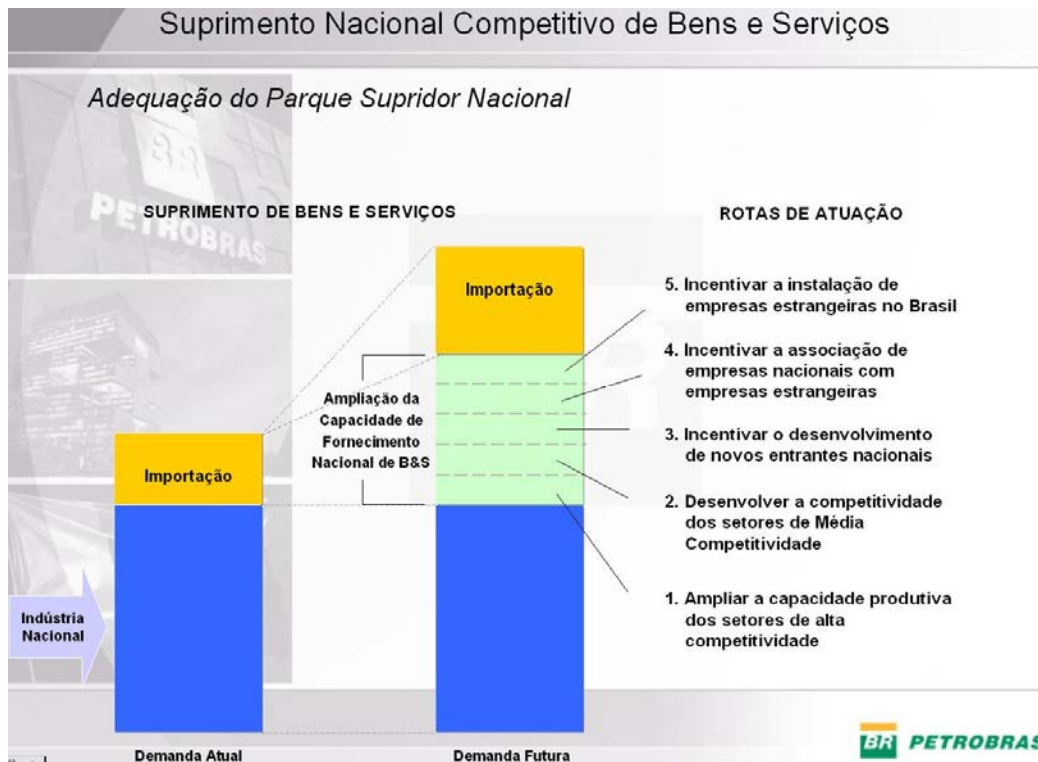


Fig.24: PIDD – P&G Petrobras Strategy. (Source: Lenart, 2011. Cadeia Produtiva de Petróleo, Gás e Energia Petrobras presentation - Encontro de Negócios da Cadeia de Fornecedores de Petróleo, Gás e Energia, Bacabeira –MA, Brazil)

With an investment budget of US\$ 58.5 Billion and a resulting “national content policy” hovering 70%, it exerts a considerable impact in the Brazilian economy, by providing strong demand to the national industry in the sectors of transport, steel, shipbuilding and heavy equipment. It also provides a considerable stimulus for services like engineering, construction and maintenance where national content reach almost 100%.

Beyond the internal demand drive and the building of a closer supplier network, the PIDD-P&G policy also aim to offset the risks of Dutch disease⁷ due to a surge in primary products exports, a current problem in Brazilian economy. Another side effect of PIDD-P&G is that Petrobras requirements exerts a considerable institutional pressure over a considerable part of Brazilian industrial sector, shaping their operational modes and technological choices on its own terms and limitations.

6.2.2-The Contractor: WP-Houston

Due to the complexity of the PDY project, Petrobras had to submit the project to an international bidding process, involving direct invitation to companies with proven expertise in taking large scale petrochemical projects. Such bidding processes involve a far different approach to what Petrobras usually does at national level, and beyond

⁷ **Dutch disease** is a concept that explains the apparent relationship between the increase in exploitation of natural resources and a decline in the manufacturing sector. Its underlying assumption is that an increase in revenues from natural resources makes a given currency stronger compared to the ones from trading partners, resulting in exports becoming more expensive and the manufacturing sector less competitive.

best price, it also perform technical evaluations upon the type of technology to be developed during the basic project phase, with energetic and raw material consumption, product yield and ownership costs also taken into consideration in the final offer.

In November 2007, WP announced that it had been selected by Petrobras to perform integration and project management services, execute front-end engineering design (FEED) for utilities and offsite in the largest industrial undertaking in the history of Petrobras in Brazil, the PDY complex. The contract valued at approximately US\$ 110 million covered the integration of the overall project, preparation of planning for the implementation phase, cost estimation, documentation for bidding process of detailed design, procurement, and construction of the facilities. Contract management and project execution was left in the hands of the WP-Houston office, which have elaborated the winning proposal.

The many years supplying engineering services to key oil companies around the world specially in the Gulf of Mexico, Middle East (i.e.: Saudi Arabia, Kuwait, Bahrain, Qatar, Iraq) and Asia (i.e.: China, Kazakhstan) turned WP-Houston into a very confident subsidiary of WP deeply specialized in oil & gas projects. The "excellence center" status granted by the HQ further extended this over-confidence and WP-Houston operated almost like an independent company. WP-Houston knew the job, had proven methods, qualified professionals and the necessary technological skills to successfully fulfill the task.

WP-Houston embraced considerable diverse people (i.e.: women, Afro-descendent, Latin-descendent, young, elder), not only U.S. citizens but also from many different origins (i.e.: Mexico, Colombia, Philippines, Egypt, China), which eventually required U.S. citizenship during the economic boom years. WP-Houston members were ultimate examples of business globetrotters, holding several short and long-term international assignments along their careers. Technical education and, above all, long time experience in doing the same job provided a high level of expertise and fast response from WP-Houston members. All of them official employees from WP enjoying considerable benefits (i.e.: Medical care, parking lot, 4 days work week) and in being hourly remunerated developed a sort of financial relation with the company (*"I work as much as I get paid"*, E.R.K).

Nevertheless, WP-Houston members knew little if something about Petrobras and Brazil. The decades of political and economic turmoil in Brazil limited the interest of average North Americans about the country and in this vacuum of knowledge stereotypes proliferated, reducing Brazil to the Amazon, samba, soccer and poverty. Along year 2007, however, a dramatic shift started taking place. With the sub-prime crisis building up and several service orders being suspended, the PDY project became a lifeline to WP-Houston.

This situation somehow represented an unusual power reversal on the traditional "package" approach that international engineering companies apply to EM clients. In the "package" approach, the overall engineering service is offered at a discount rate

provided that clients accept the technological “package” with only minor adaptations. Each individual plant operator, however, has a different set of economic, raw material, and energetic limitations which require plant adaptations to realize the tight margins that such large investments involve. As long as accepting a “package” means either a dysfunctional operation or future high adaptation costs, clients are induced to anticipate all package changes prior to contracting, an impractical task as most of the limitations come out on the course of basic engineering development. Although “package” contracts allow for a certain amount of adaptation, these limits are usually poorly defined and debatable leaving space for international engineering companies charge additional hourly fees which make up for the bulk of their profits. Petrobras was aware of that and despite the turbulent history it had with international engineering companies, took advantage of the situation and exerted intense schedule and project adaptation pressures upon WP.

The international bidding processes of PDY also required the foreign winning company to hire a local partner in order to share part of the contract. WP saw a local partner as a nuisance, and delayed it as much as possible. However, with communication problems mounting, and Petrobras increasingly upset due to WP literal stance on contract management, this requirement could no longer be postponed. For WP, hiring a local partner became an essential move in order to create a mediating stance, despite the cost of managing an interface with a local, and probably less experienced company. After several months of negotiation, in early 2008, WP decided to hire CNC as its local partner, following Petrobras advice.

6.2.3-Local partner: CNC

Though new to the game and coming from a very different engineering tradition, CNC has been able to find a place for itself in the oil & gas sector. Its deep relations with CCC enabled CNC to keep its lean and professional structure relatively untouched along the economic crisis period, providing the company with an edge over its competitors when Petrobras unleashed the first phase of its recent investment program. From 2004 to 2008, CNC was awarded increasingly complex projects from Petrobras:

- 2004: UTGCA (FEED) – US\$ 10 million* * Overall contract value
- 2005: RPBC (FEED) – US\$ 15 million*
- 2006: UTE-RN (Detailing Engineering) – US\$ 160 million*
- 2006: UTE-RPBC (Detailing Engineering) – US\$ 180 million*
- 2007: RPBC (Detailing Engineering) – US\$ 460 million*
- 2008: RNEST (Detailing Engineering) – US\$ 1,1 billion*

Along this period CNC built, through its São Paulo office, a considerable reputation within Petrobras and the loyalty of some of the best professionals in Brazilian engineering market. At the time of the partnership, CNC held several large projects mounting to a backlog of more than two years. Market for engineering professionals where red hot and the company feared not to have enough people and office space to handle all that projects at once.

Relations with Petrobras although tense were manageable particularly due to skillful operation of CNC project managers and coordinators. CNC knew that Petrobras was a demanding and erratic client to be sometimes confronted and sometimes pleased. Beyond financial gains, the partnership with WP was considered strategic. Not only in terms of the expected transfer of knowledge, and international projection but also because it would allow CNC to replicated its successful model of taking part in basic engineering have a edge in the detailing phase in a multibillion undertaking.

Differently from WP-Houston, CNC personnel presented a far less diverse setting, being predominantly male, white and Brazilian. The few highly experienced technicians where outnumbered by colleagues with university degrees, what conferred a more multifunctional profile to CNC personnel. While lower ranks stood as officially registered employee (with benefits and taxes), the majority of higher rank professionals preferred contract employment (no benefits and lower taxes). Nevertheless, CNC members saw themselves as equals and enjoying for a relatively stable employment relationship developed a sense of company belonging and partnership, extending working hours without payment of additional benefits. International assignments where uncommon among CNC employees and when in contact with foreigners they invariably reacted with embarrassment or overexposure. Language skills, where existing, lacked fluency.

Even tough, Brazilians were far more used to U.S. than North Americans to Brazil. Most of Brazilians grew up looking at the U.S. as an example of developed society and even as cultural reference. From the 80's to mid 2000's, any form of relationship with the U.S., be it educational stays, vacations, relatives, a car or a cloth from an American brand, even learning and speaking English in public, was keenly seen as symbol of status among Brazilians. Attention to the U.S. used to be so intense that U.S. related news received a lot of coverage on TV. This relation increased and became more asymmetric when Brazilians begin to move to the U.S. to live "the American dream", and became anomalous characters within the "Latino" stereotype.

Overall, CNC members assigned to PDY project saw the partnership with WP in very positive terms. An opportunity to get in contact with foreign professionals and learn new methods and skills, emulating somehow what would be expected from an international experience.

6.3- CASE CONTEXT

6.3.1- "International Workshare" Current State of Knowledge.

Established the partnership between WP and CNC, they had to decide how to share the work. The split of work between partners was set as forth:

	BASIC ENGINEERING		FEED	
	WP	CNC	WP	CNC
PROCESS	X		X	
PIPING	X		X	
MECHANICAL	X		X	
INSTRUMENTATION	X		X	
ELECTRICAL	X			X
HVAC		X		X
ARCHITECTURE		X		X
CIVIL/METALIC		X		X

Table 3: PDY Project split of work

Such division of work, concentrating CNC role in Civil and Electrical design, probably reflected the WP vision over CNC capabilities, at the time, as profoundly linked to its past as an hydropower engineering company. It also embedded a privileged position for WP which reserved an independent upstream position in the engineering process for itself whereas CNC had to fit into a downstream position, and thus, become fully dependent on WP information to work. It also cannot be ruled out that WP had further subcontracted parts or entire sections of his job to any other office or third-party company around the world, once its internal operating processes were opaque to external viewers.

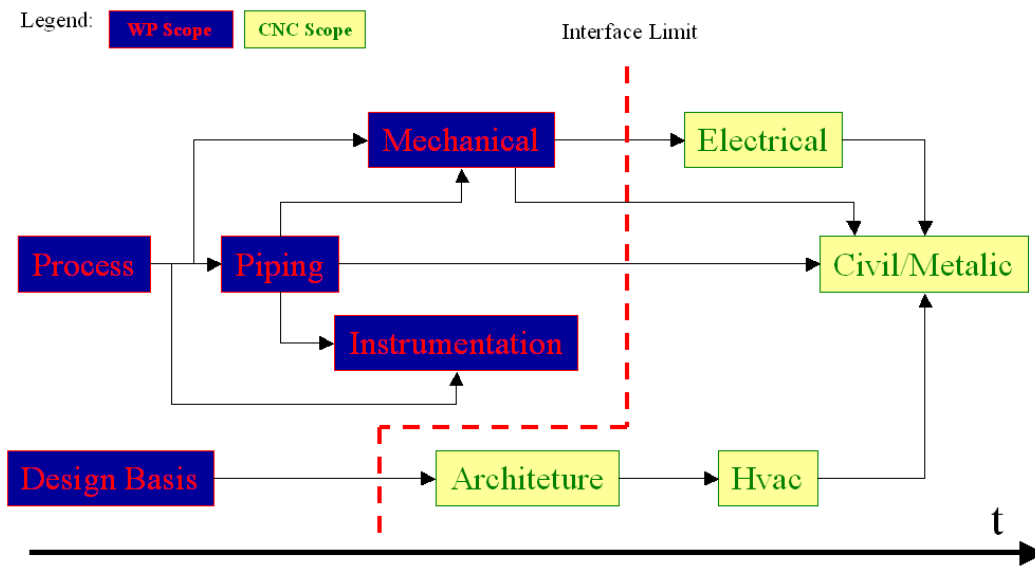


Fig 25: Simplified interdisciplinary information workflow in oil & gas projects.

In the first half of the project, CNC enjoyed a comfortable position as the project balance concentrated activities in the WP-Houston office. A small but highly specialized task force has been mobilized in CNC but remained almost idle for a several months. Along this time only one project coordinator (P.D.J.) has been assigned to WP-Houston in order to follow project execution and if possible anticipate information for CNC work. Project manager, coordinators and discipline

supervisors also participated in videoconferences between Petrobras and WP-Houston on a weekly basis.

As the project execution advanced in the WP-Houston office, more and more information was available to be released to CNC. With a growing amount of information considered released by WP, P.D.J. returned to CNC and a WP project coordinator (V.S.) was sent to Brazil to provide support to CNC work. Depending on the nature of the information it was nested into different media formats.

Property data and logical information, which were textually and symbolic represented, went directly to the “digital paper” format to be assembled into “engineering documents” (i.e.: design basis, specifications, spreadsheets, and diagrams). Such “engineering documents” then were formalized and made accessible⁸ for project members through electronic document management systems. Once they were electronically “issued”, CNC was able to use the embedded information as reference for its downstream work.

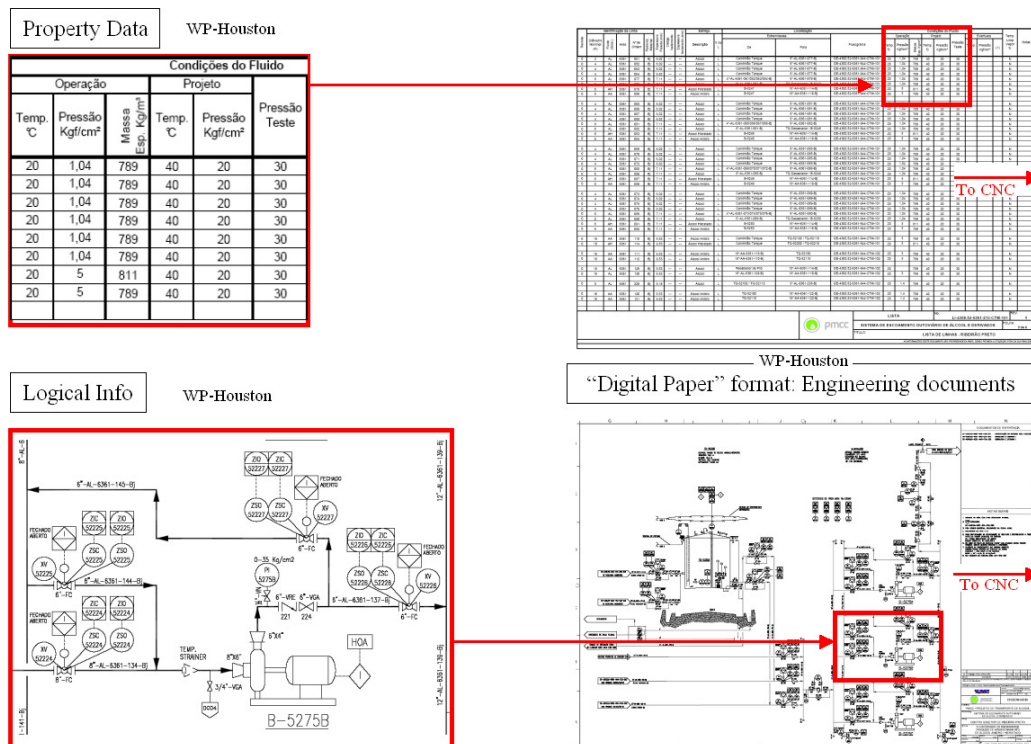


Fig. 26: Traditional supports for engineering information.

Registry data and physical information, which were spatially and objectively represented, contractually required⁹ the use of 3D “virtual environment” format using the commercial plant design system PDMS¹⁰ (Plant Design Management System) during development phase. Only after interdisciplinary review and

⁸ The process by which engineering documents are formalized and made accessible are also known as “issue”.

⁹ Petrobras requires the use of PDMS in order to ensure proper material selection (from certified material databases) and precise spatial distribution of plant elements, improving the quality and time execution of the project.

¹⁰ PDMS is a proprietary system of the British software house AVEVA Group Plc. (<http://www.aveva.com>).

consolidation this information could be brought into the “digital paper” format by a specific functionality of the PDMS, which transformed information from the 3D “virtual environment” format into a 2D dimensional document called “drawing”, up to be “issued” through the electronic document management system.

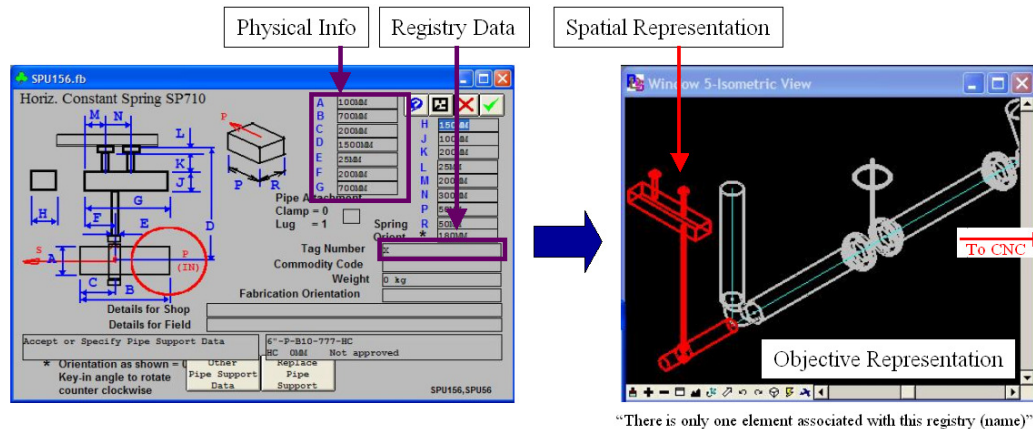


Fig. 27: New supports for engineering information.

Although the application of plant design systems in oil & gas projects is widespread, a clear approach on how engineering disciplines must interact within 3D “virtual environment” to fully realize the benefits offered by such systems remains elusive. In the absence of a consolidated knowledge on the subject most companies allow interdisciplinary spats to be negotiated among discipline members on an *ad hoc* basis under mediation of a project coordinator. Such random approach, however, overlooks the risks associated with late detection of interdisciplinary problems which ultimately result in schedule overrun or costly re-works. This situation is further complicated by the fact that engineering disciplines operate on different timeframes, if not interactively, with several feedback rounds needed before an optimal solution is reached. As such, if formalize, distribute and consolidate information in 3D “virtual environment” format were already challenging in internal environments, across different stakeholders, geographically, culturally and financially separated it proved yet more challenging.

Intuitively, the most obvious way to overcome this problem was to anticipate the process of transforming information from 3D “virtual environment” format into “drawings”, and send them up to CNC through the electronic document management system. However, physical information is far more subject to change than properties and logical information. Subsequent changes would require several drawing revisions, escalating the costs and time delays associated with the process of information transfer. Furthermore producing and issuing drawings also carried the risk of information lag time, that is, upon arrival information is already overdue. An additional problem with this approach is that drawings are composed of multiple elements, requiring that all elements within a drawing were ready for release prior to drawing issue, further delaying information arrival at CNC.

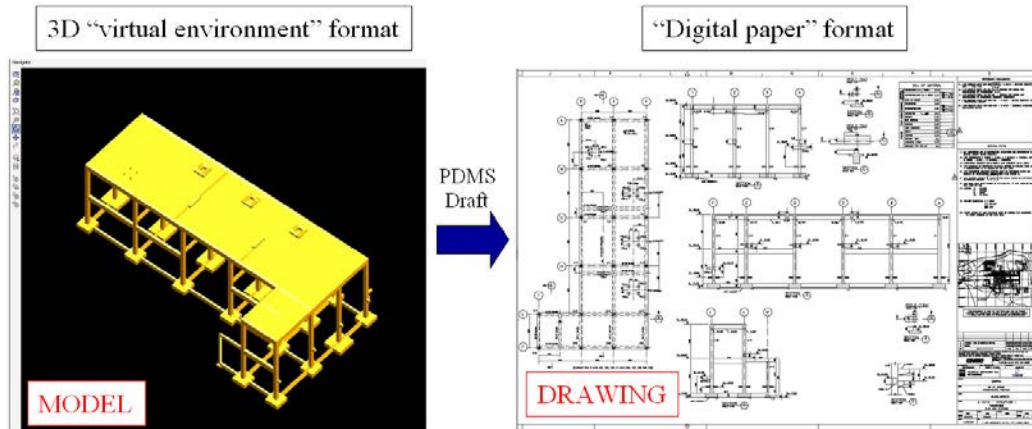


Fig. 28: 3D model transformation to 2D engineering documents.

Despite the fact that CNC was a far more experienced PDMS user, WP-Houston took the lead in addressing this problem. 3D "virtual environment" information was populated and stored in two identical databases physically located in WP-Houston and CNC-SãoPaulo offices, which were paired overnight enabling partners see each other work with a maximum lag of one day. WP-Houston then decided to segregate CNC scope elements in database areas whose name spotted the suffix "TEMP". When such elements were ready for CNC examination, a database attribute was changed and the released element acquired the color red on the screen. The next day, when accessing the 3D "virtual environment", CNC project members could spot the released element by its color and began their part of the work, reviewing interdisciplinary implications, obtaining the necessary spatial information, to further detailing and consolidating the design element initiated by WP.

The so-called "look at the model" approach, although requiring additional work on the CNC part, initially performed relatively well, thus building up confidence in the solution. In the beginning of the project as there were only few elements modeled, it was a boring but relatively simple task to visually screen the 3D "virtual environment" for changes in the color of the elements whose name carried the mark "TEMP". As a minor partner and frequently downplayed in technical discussions. CNC members did not complain of the additional task nor proposed any other procedure in order to improve the process of physical information turn over. WP-Houston, on its turn, considered the problem solved and the minor setbacks as due to CNC lack of experience or inability in working in the 3D "virtual environment".

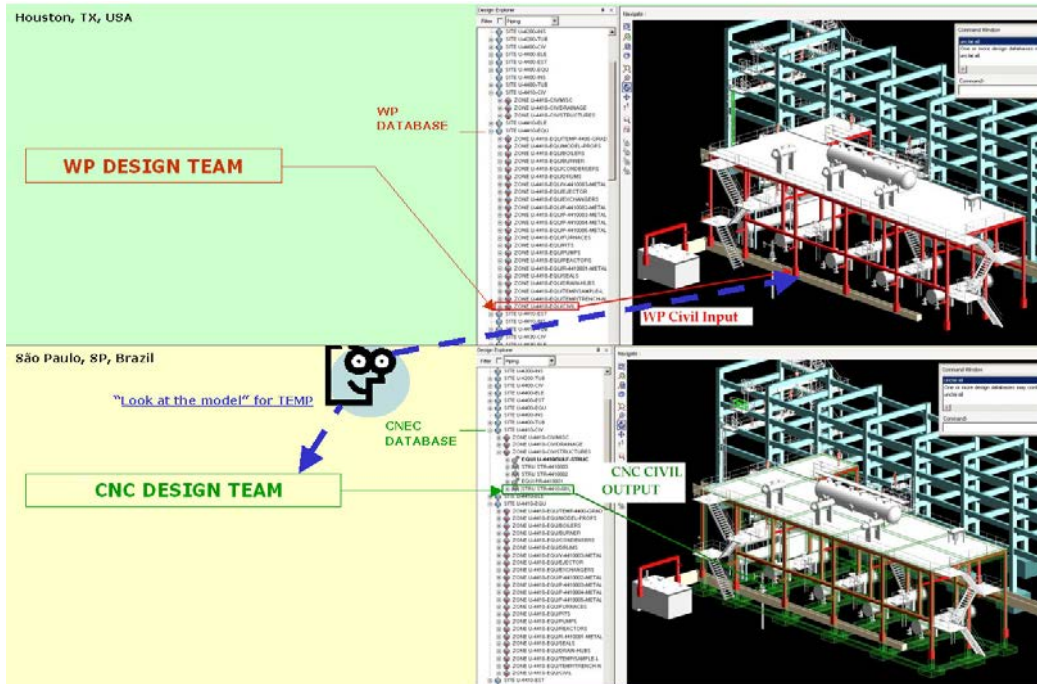


Fig. 29: Schematic representation of the “look at the model” approach.

As WP-Houston worked progressed, 3D “virtual environment” element population grew exponentially, making the screening task increasingly difficult. In response, more and more CNC people dedicated time to the task of checking for released elements within 3D “virtual environment”. At a certain point a selected professional (G.A.J) integrally assumed the task. As he heavily relied on his attention and memory to spot released elements, beyond time consuming the task became imprecise. In addition, a systems engineer (A.R.A.) was appointed to help him by creating database filters capable of reducing the number of elements to be screened. Nevertheless, the amount left was still considerable.

CNC additionally faced another lateral effect caused by the lack of a systematic approach to physical information turn over. After WP released and CNC analysis, the element remained in WP control, allowing further adjustments and corrections. As WP inadvertently changed priory released elements, it forced CNC into re-work to adjust the project to Petrobras expectations materialized in the 3D “virtual environment”. When questioned about last-minute changes WP-Houston bluntly denied letting the financial burden of re-work fall completely upon CNC.

With the “look at the model” approach increasingly dysfunctional, problems start to hit the quality and the schedule of CNC work. WP-Houston hard stance towards the correctness of its procedure locked CNC into internally find ways to overcome the problem unsuccessfully. At some point, WP-Houston started to threaten CNC to send personnel to Brazil in order to show how it should work with the 3D “virtual environment” to accomplish its task, embarrassing CNC leaders and threatening CNC reputation. K.G., PDY CNC project manager, assigned a project coordinator specific to the problem, D.C.C. Few weeks later I joined the team.

6.3.2- Entering the Field

My first contact with the PDY project team was in 21st of September 2009 when K.G. talked to me for the first time. He looked busy and after a couple of interruptions on which he made me wait for 20 minutes and testify his fluency in German and English we start to talk about the project. He acknowledged that the partnership between WP and CNC suffered from coordination problems and without furthering much more information or his opinions asked me to follow him into an internal coordination meeting that was taking place in the next room. Field diary notes show my impressions over the meeting:

“In that meeting room I saw only white haired people, mostly CNC project coordinators, previously unknown to me. I was presented by K.G. as a PDMS expert that would be incorporated into the project to help in the coordination work. I was coldly welcomed and could perceive a sense of disbelief in my ability to help in the project problems. When I left the room and get back to K.G. desk I noticed hanging on wall a note saying: “As vezes só a violência gera a compreensão.” (Sometimes only violence brings understanding, author translation). Never had heard anything “violent” about him. In fact, apart of his German-like formality, the few times we had been in contact conveyed an impression of determination and openness. Nevertheless, such message sounded quite scary and made me thing about the limits in getting things done.” (Field Diary, 21st September 2009)

Two days later I was urged to attend to a videoconference involving six people took place to officially discuss the problem. The field diary notes show the content of the meeting:

From CNC, there were D.C.C. and A.R.A. From WP, V.S., and 3 more Houston technicians. I stood by as a watcher, since I assumed a simply advisory role. The meeting was fully conducted in English. Before the meeting, with the telecom system off, V.S. admitted that he personally could not help much on the risk of behaving like an “armchair quarterback¹¹”. However, he would participate in the meeting to help communication became more clear to both sides.

D.C.C. opened the meeting with a 15-minute presentation explaining the hardships CNC was facing in extracting data out of the 3D “virtual environment” and the consequences it had on measuring project progress and planning. He come out with an example of how hard was to the CNC Civil team to figure out how many equipments it should provide supporting bases. To support his argument he displayed a complex set of spreadsheets showing that information preliminarily made available in “paper format” was not aligned with the “3D virtual environment”. His English, however, proved poor and the frequent word misplacements made it hard for the English-speaking audience to follow the explanation. The opacity of the spreadsheets also did not help.

WP technicians argued that the spatial representation and the timing of the releases followed WP designer’s interpretation what could explain the mismatch between what was seen in the 3D environment and found in the “digital paper” format. WP technicians insisted they were doing their job right and it was just to pay attention on the naming convention (elements with “TEMP” in the name) and “look at the model” to see the releases. Confronted with the argument that previously released elements were changed after release they blamed the PDMS system on being “too opened¹²” compared to the PDS system that they were used in WP-Houston. Though they conceded some deviation on the releasing process they rebuffed the idea that this was a major issue. The poor quality of the videoconference sound system also made it hard for the Brazilians to

¹¹ A person who offers advice or an opinion on something in which they have no expertise or involvement (<http://dictionary.reference.com>)

¹² System engineers refer to *open systems* as those systems that allow for more user discretion while inputing (or not) data. *Closed systems* on their turn require the user to abide by pre-configured system rules while inputing data, which under circumstances (consistency checks) might prevent users either from inputing mismatch data or leaving data unpopulated. Usually open systems are easier to configure and more user friendly, while closed systems are more difficult to configure and less user friendly.

understand what WP personnel said. V.S. amended saying that “time was running out” and a compromise should be reached.

D.C.C. discontent on the stalemate was visible. He urged that people involved in the problem should “go back to standards” and that this compromise should involve the work of CNC and WP around a more structured procedure on how information should be turned over. WP technicians looked bored and displayed a certain lack of interest in problem. In face of that, D.C.C. assumed the job to correct and align the information turned over process. WP technicians replied that anything CNC proposed to improve the turned over process would receive their immediate support and steady implementation. (Field Diary, 23st September 2009).

The figure displays two spreadsheets. The left spreadsheet, titled 'CNC Engenharia S.A. São Paulo - BRAZIL', is a summary table for equipment lists. It has columns for equipment types (CIV, LNM, MAL, MNL, SFC, TAG) and a 'Total geral' column. The rows list various equipment items with their respective counts. The right spreadsheet, also titled 'CNC Engenharia S.A. São Paulo - BRAZIL', is a detailed equipment list. It has columns for description, location, and status. It includes sections for 'Area Section' and 'Water Treatment'.

Fig. 30: Early spreadsheets used to control the information turnover process

After V.S. left the room, CNC members remained and in a private talk could not hide their criticism on WP-Houston managed the whole information turned over process, not only in relation to the “3D virtual environment” format but also in relation to “digital paper” format. In their opinion, WP-Houston had not, nor did want to have, any control over the downstream information flow. Out of this first “multicultural” meeting it became clear to me that beyond communication and cultural problems, the project suffered from poorly defined interface relationship.

Besides, I realized that the information turn over problem was more acute in the Civil discipline, though the Electrical discipline worried quite much. D.C.C and A.R.A argued that since the beginning of the project the Electrical team proved much more proactive in working in the “3D virtual environment” and thus managed by themselves to workout the information turn over problem. The other two disciplines Architecture and HVAC (ventilation) experienced little problem as most of their work was confined to the “digital paper” format domain.

A week later, still allocated in the RPBC project, I managed to talk to P.R.W., Civil coordinator, in order to gain deeper understand on how the turn over problem affected their work. He acknowledged that this was the first time he was forced to

work departing from information embedded in a “3D virtual environment” and was uneasy on how he should manage this process. Such uncertainty, he said, made it difficult to plan and allocate resources. He raised questions beyond his coordination role, including how he should orientate their supervisors to proceed. He also demonstrated uncertain about my activity in the project and how I would be able to help them. As this conversation did not add much to my understanding of the problem, I decided to talk to project supervisors individually as soon as officially arrived at the project. After intense pressure to anticipate my displacement from RPBC to PDY, I settle down that I would definitively move on the 5th October, 2009 after completing some obligations in RPBC.

6.3.3-Project Organization

In the Brazilian engineering environment, the transition period among “hot” projects require a considerable effort on the part of the professionals to attend to different structures within the company for a certain time. The prior project management try to extract as much as possible from the former project member because as soon as he leaves the project and stop charging hours on their budget, their very specialized helps comes for free. On the other side, as much as the recently arrived project member dedicates to tasks other than those of the new project they represent a financial burden and not an additional resource. As project members prefer not to turn their backs to a project manager on the risk of being turned down in his future projects, more likely the professional has to cope for some time with extended work hours, usually unpaid.

As I entered the PDY project I could confirm the tale that PDY was the “no stress” project. With loose management, stretched schedules, and additional working hours paid in cash, project members indeed could emulate a relaxed work environment, way different from the RPBC project marked by constant discussions, complaints, and heavy workload. Nevertheless, this was about to change as the calm in the surface of the project hide the turbulent business environment behind the entrepreneurship. With Petrobras and the three other Brazilian petrochemical groups fighting a silent war, the unpredictable result of the consolidation process started to affect the very basic function of the PDY complex, ranging from a fully dedicated petrochemical complex to a large scale refinery.

The fact that I previously knew a few project CNC project members made my integration easier. These long time colleagues introduced me to the unknown ones and along the days. As CNC office followed a open office philosophy, desks had very low height divisions and were placed one in front of the other, in groups of four, what did not allowed much privacy and stimulated neighbors to talk while working. As such it was inevitable to take part in some conversations most of them with one colleague teasing the other. With the unknown ones conversation more frequently involved work related issues or superficial personal questions.

Among the structural characteristic of the project organization attracted my attention the fact that most of the contact between CNC and WP occurred among higher ranks

with CNC lower ranks relying on their superiors' interpretation of both organizational and technical information. Very differently from an international joint project (at least as I would expect) exchanges and contacts were minimum. Not to mention about technology transfer and learning. Clearly the most important and complex part of the project, the "Lyon's part", was in charge of WP with CNC restricted to give shape to what was conceived in Houston. With restricted contracts and almost no shared experience, the promise of an exciting place to work remained elusive for most CNC team members. Exception for A.R.A. who helped to implement the PDMS Global (workshare enabled), the first implementation in Brazil.

The overall project structure, as I came gradually to know (see fig. 31), was a double shell hierarchy, with CNC hierarchy subordinated to the WP hierarchy, with few apparent direct interface connections (dotted lines).

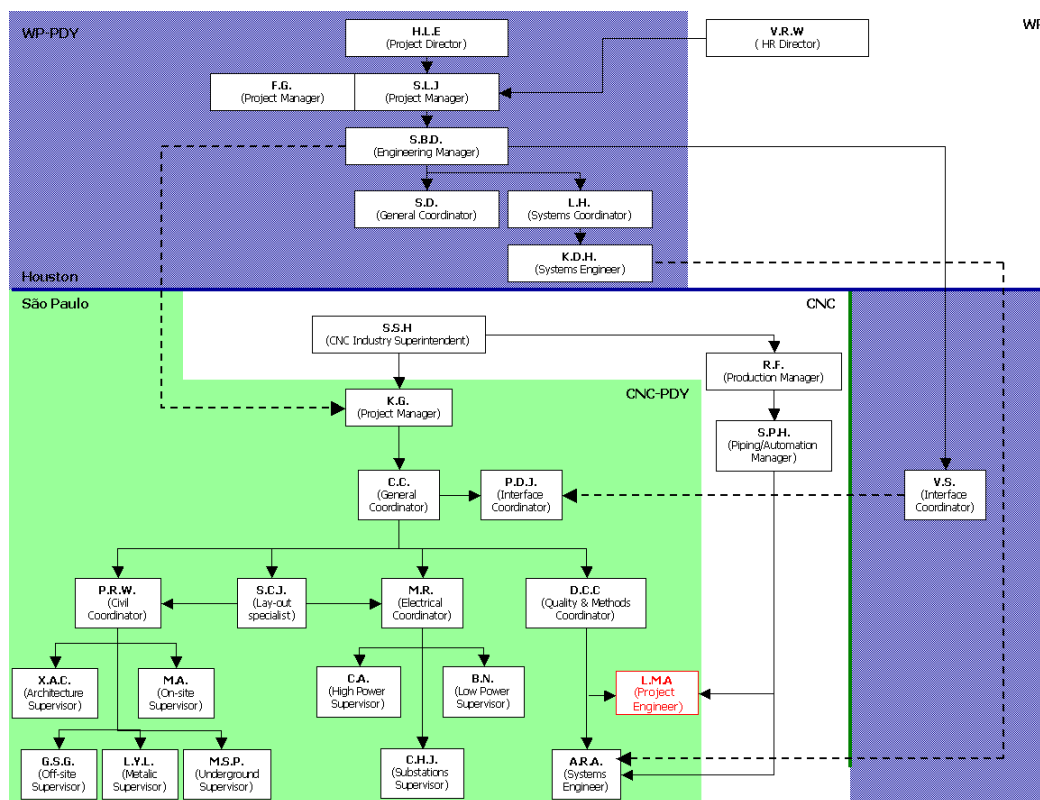


Fig 31: PDY project organization as per 05th October 2009.

The relative position of CNC in the PDY project by the time of field entry can be gauged by the content of K.G. discourse during a project balance presentation that coincide with my arrival at the project and was almost self-explicative on the project situation I found:

"Very briefly, I'd like to inform you about the progress of our project. Won't take long... Most of you perceived that in the last month we made a great effort in identifying and defining what has been left to do in or project. It involved many scope alternatives and schedule alternatives and this process is reaching an end. Today, O.F., Petrobras manager, will be here to negotiate a schedule for this scope. I'd like to keep everybody informed in order to keep the anxiety level down.

Here we have our progress graphic until today... so today we are around 60% physical progress in our project...and we have 40% to further advance, according to the last accomplishment effort estimation to complete the scope. What's the scope? The scope is the same scope, without any reduction. We have been discussing possible reductions with Petrobras, but in the end we reached conclusion that we should keep the scope the way it is... progress graphic shows that until... May next year (2010), particularly until April next year, we a lot of work to do and in an very aggressive manner will try... will need consistent progress around 6% to 7% per month... so it a very aggressive target and will have to mobilize additional resources to the present ones. So to succeeded in the task, the company will free space in the 2nd floor, block A, so we can proceed with this mobilization, therefore nobody needs to worry about work for the next 8 months, well the contrary. Translated in terms of engineering documents, it represents a very bold target, we are here today with almost 6000 issued documents in our project, and we still have a similar number ahead. In terms of applied resources, we also have to complete a very expressive mobilization, reaching almost 200 people in the project team, counting on internal and external resources... so almost the double we have today... 70% beyond current team.

Well... it's like that... I guess that may let us very satisfied... happy...hummm... at least we know that the engineering market is somehow shaken, with many companies laying people off because they lack work, so this won't be our problem... our problem is different... is to accomplished that all and that... we cannot hide that we also have some problems. Our project history until now let us, managers and coordinators, worried if we will effectively succeed. So let's take a look at the monthly quality report that I had just received so you will be able to see where are the problems. You might have noticed that in the project entrance, I asked D.X. to hang our quality graphs per discipline, and if we take a look we can see that in a not so large universe the total number of error in the documents, although improving, is still disappointing. We are talking about a formal document quality evaluation... number, stamp data, format..., we do not evaluate technical content, this one we take for granted because of the issuer technical expertise. You will see that is not exactly the case, unfortunately. So, this is a point that requires extensive work to improve this score....

What worries me most is our productivity. How is productivity measured? It's the physical progress that I should have according to the hours estimates that I receive from each discipline against the effective physical progress. And if we look our history, from March to July, that's when we halted the score calculation, because we begin discussing the scope, so...without a clear scope it is not possible to calculate the score... but you can see our score tumbling down... he had already started above expectations... what should be expected a score of 0.95. We are far from this score and getting worse month to month, what's worst...so, we do not foresee an improvement.

So forth this has passed unnoticed because Petrobras was paying us for worked hours, and did not questioned this at any moment, by luck. From now on, back into the beginning of September, this contract turned into a global price contract, that is, we are committed to do what has been left in our scope on a fixed price. There is no easy way now guys. So the way this contract and the work of each one of you is managed will also change radically. We have to ensure that within our agreement with the client we will be able to do the work and the company will profit... Because that's the company's goal. So we are going to implement controls for hours spent for documents and hours spent per person on a document to accomplish this task.

One of our main problems has to do with quality and productivity are the "mark-ups". I know there are a number of explanations, but essentially what is written in this numbers is that we have an enormous quantity of "mark-ups" that are not answered within the contractual time limit, whatsoever the reason. So if we look in the project as a whole and in each discipline, we will find an expressive number of documents that suffered many revisions, or were not approved on a client comment process the way they should be, and take much more time than previously expected. Our commitment is to answer a "mark-up" in 10 days and we will comply with that, otherwise our estimations will be tore apart. As an incentive to all of you and those who will come to the team to abide by the time estimates in a more consistent way, we are thinking about implementing a remuneration bonus plan linked to the quality and productivity. I do not have this formulate right now but I am committed that until the end of the month I will made it public a plan that to those who effectively participate, will represent a substantial gain in the end of the project. As a counterpart, we are limiting to extreme cases the use of additional hours. Both our hour estimations and project schedule take in consideration 168hours/month. And that's what we are committed to. So, additional hours will only exist on a voluntary basis to those who perceive that they won't be able to reach for the schedule or in emergence cases.

So people that's what I had to say. I think we have a great challenge ahead, I count on everyone so we can face that. Our project today is the one that sustain the company, it's the largest that the company ever had in its industrial area, apart from the ALUMAR, which was mainly a workforce lease and not that much a project. So, I think that this project that add to anyone of us in terms of curriculum and in terms of technical challenge, ad I hope you will be with me in that". (CNC K.G., recorded meeting, 07th October 2009 – Author Translation)

6.4- THE KNOWLEDGE CHANGE PROCESS

6.4.1- Current Knowledge Weakening

Well before the number of CNC scope elements in “TEMP” areas topped 30473 individual elements, the approached collapsed and no longer partners could precise how many elements truly belonged to CNC scope, which they were, and if they were released or not.

In a reserved talk with me and A.R.A., D.C.C. expressed his worry about how to adequate the control and the planning of engineering production to the “3D virtual environment” information turn over. He reminded us that in our last videoconference with WP-Houston they did not know how to do it, and apparently did not want to know at all, leaving it to the Brazilian team to organize the flow of information downstream. Then he asked us how to fit the “3D virtual environment” information generated at the US team with the standard controls of a “traditional project”, and illustrated the picture below:

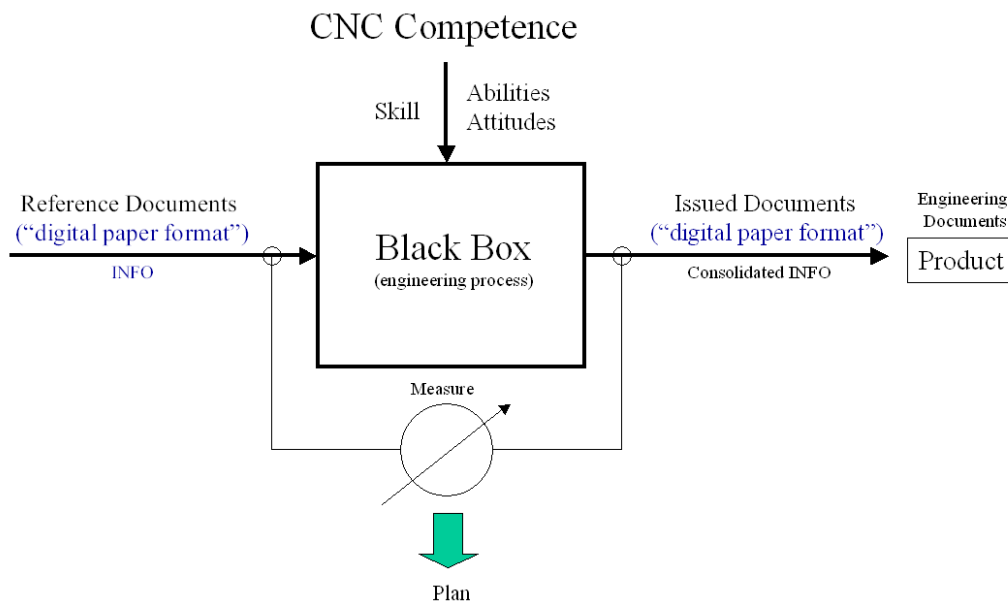


Fig. 32: Schematic representation of the information flow in the traditional engineering process.

Noteworthy in his argument was how ingrained the traditional *modus operandi* was even in the head that was supposed to unravel it, as the excerpt below demonstrates:

“It’s been two months that we are trying to desperately hunt down these elements that we have to chase. (...) Because our work is intrinsically linked to a set of input data (...) they have to come inside a set of reference documents... because information when the client turns over, whoever it might be, has to come in a platform (...) this a have in a set of documents. These are the taken-for-granted platforms of engineering... engineering documents. So, the reference documents uphold this basic information and let us aggregate knowledge, qualities and attitudes, and come out with another set of documents that are the platforms that carry both things, basic data and my knowledge, ability and attitude. Ok, that’s a platform that I measure. I measure and I charge. My list of reference documents today has 6,660 documents, OK?! (...) these are the basic documents that I have to use to do my project (...) these are the documents that carry the information that I have to process. They

generate here at CNC, 13,303 documents (...) It has to get out of here and arrive here. There is no other way to do project in the mother-fucking life. It's like this. ((CNC) D.C.C., recorded meeting, 05th October 2009 – Author Translation)

Attempts to reduce the complexity of the new situation to make it fit back into the traditional model generated confusion and stalemate, as in the excerpt below:

Therefore, this is what you're looking at is the beginning and the end of the Project. In the middle there is a PDMS. This PDMS, you have to do what? Get exactly all this input and output information and make them speak the same language of PW. Because this is the set of documents that I am charging. So, my PDMS cannot speak a different language... it must have an intrinsic relationship with my input documents. (...) I have to know how many, who they are and where are they ("3D virtual environment" information elements). (...) today He says to me: " Hey fellow... it's green in the model! You can finish it". This is a stupid statement! Because I don't have the totality. How will I be able to calculate my work setting? I don't know! I need to know the total." ((CNC) D.C.C., recorded meeting, 05th October 2009 – Author Translation)

And also in the following dialogue:

(CNC) D.C.C.: " So, M.S.P has been charged it a heavy load of work. (...) and where is he going to control? He is going to control through the drawings. So, which are the (information) elements that I will place in this index? (...) what I will put in this control? I will put exactly his drawings. " Have you already done the drainage of this shit?"... "Damn, I didn't received this..." (...) And what do I have to receive of information regarding this? Then I go to M.S.P. "What do you need to receive?" (...) He has to tell me exactly what he wants. (...) The information that he needs. Why? Because it has to come in the middle of these 6,660 documents. If he did not find this in these 6,660 documents where is he find it?"

(CNC) L.M.A.: "They (WP) are going to tell this is in the model..."

(CNC) A.R.A: (Laughs)

(CNC) D.C.C.: "It cannot be!"

(CNC) A.R.A: "So, it cannot be...that's what we were talking about..."

(CNC) D.C.C.: "It cannot be... It is not in the model. I am talking about basic information. So, this is the relation... you see the list of engineering documents and the list of reference documents. PDMS is in the middle...it is not an end in itself. It is only a tool. And its based on the management that it has to operate. Because, I don't even care about drawings, I don't even want to see it...I want to know it is in the index. That's why we need his index well done. (...)" (recorded meeting, 05th October 2009 – Author Translation)

Out of that, the impression was that team leaders where trying to mend an outdated frame of reference into a new situation. Neither the WP nor CNC teams where used to work with the information arrangement embedded in the contract (and enforced) by Petrobras, without knowing its exact implications. The traditional frame of reference made it harder to assess the present one.

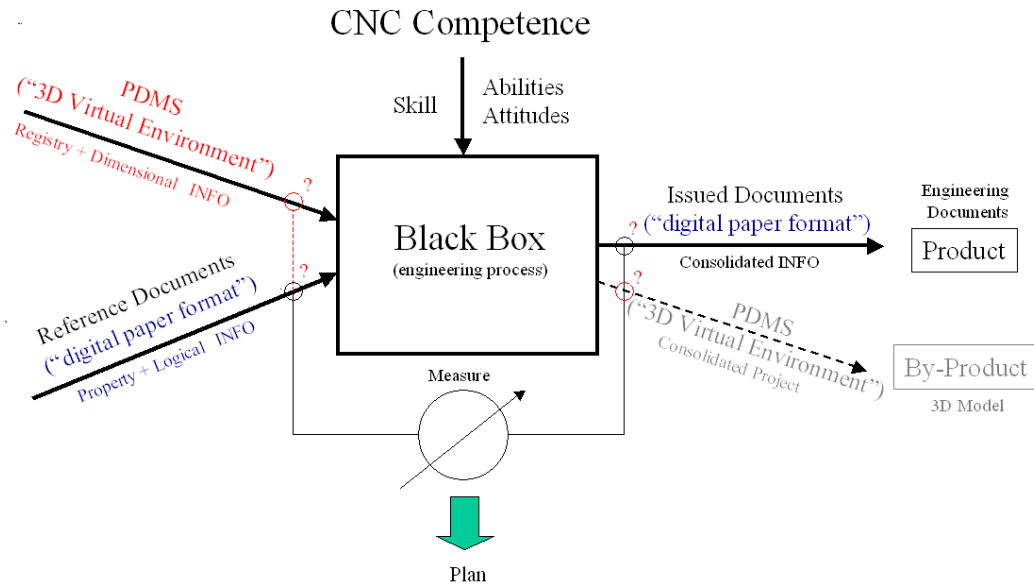


Fig. 33: Schematic representation of the information flow found at the PDY project.

Nevertheless, as more people joined the meeting important concepts emerged:

"What we settled with them (WP) in terms of structures... it applies to piperacks, to all...they model a structure anyway...out of their minds (...) what matter to us? The level of the pipes, the axis of the pillars, of the frames, ... we have to obey that... we cannot change their scope, that is the pipes and equipments...the rest is ours. Next, we are going to model our beams, our pillars and tell WP "section X has been modeled". He goes there and remove his (elements) and only ours stays." ((CNC) P.R.W., recorded meeting, 05th October 2009 – Author Translation)

"It comes from WP "element X" and an image. You assign a tag to it, open a registry in the index, and work as you like. From now on...until the end of the project, it will carry this tag. ((CNC) L.M.A., recorded meeting, 05th October 2009 – Author Translation)

After they (WP) release a structure, they can change everything that A.R.A will not perceive. ((CNC) M.A., recorded meeting, 05th October 2009 – Author Translation)

"The problem in this all is that you cannot evaluate the progress upon an cyclical element. It advances to 70% then it returns to 50% (...) There must be a model event where the guy there (WP) beat hammer and says this is how it is. (...) We have a document event (issue), we will need a model event.(...) The same way we will need an event on model arrival, we will need another one on model delivery. We are issuing that document based on the model that day. If the model change the model afterwards he makes the document invalid. ((CNC) L.M.A., recorded meeting, 05th October 2009 – Author Translation)

Even though, the initial idea was to develop a strong set of procedures and database filters in order to associate information elements in the "3D virtual environment" to tangible input/output documents, and thus, make them easier to be spotted during the screening process.

On the 6th of October, A.R.A. extracted from the PDMS database a list of potential CNC information elements using a set of filter it had designed, and sent it for D.C.C to work on. On the 7th October 2009, D.C.C. sent an e-mail attaching the information and associations he had found around a new set of documents he had created. He sent the following e-mail all supervisors and coordinator, and copied it to the project manager (K.G.):

Dear sirs

This is to issue the following document: PDMS STATUS REPORT – 91001
 This file comprehends the following spreadsheets:

1. PDMS-SOW
 Scope and Split of Work. Shows CNC understanding about its scope of work plus people in charge and dates according to present schedule.
2. SIC
 Scan and Insertion Control. Shows periodically status of PDMS according to Scan process. Elements to be controlled are very important.
3. Extraction – oct-01-2009
 Idem. Shows scan PDMS process (in case referred to oct/01/2009)
4. Summary
 Idem. Shows accounting on scanned elements.

From now on, CNC will issue this report once a week (on Fridays, referring to Thursdays database released by WP).

Regards,

(CNC) D.C.C.

Below it is possible to see the four initial controls created by D.C.C. and A.R.A. to track changes in the status of information elements within the "3D virtual environment" (fig.34: Extraction), how responsibilities were spotted (fig.35: SOW), element registry (fig. 36: SIC) and a quantitative control (fig. 36: Summary).

A	B	C	D	E	F	G	H	I	J	K	
1		01-out-09	Data Blank								
2	FLO	SITE	PURP OF SITE	AREA OF SITE	ZONE	PURP OF ZONE	NAMN	TYPE	FELCNEC	PURP	DESC
3	0001	AU-2100-CIV-VAP	CIV	2100	AU-2100-CIV-VAP/BUILDINGS	CIV	U-2100-CIV-VAP/BUILDINGS/SE-2100	STRU	false		Civil Site for Atmospheric and Vacuum Distillation Unit
9393	8387	AU-6000-CIV	CIV	6000	AU-6000-CIV/BUILDINGS	CIV	U-6000-CIV/BUILDINGS/U-6000	STRU	false		SECURITY GUARDPOST LOCKER ROOM BUILDING
9390		01-out-09	Advanced filter 02								
9381	FLO	SITE	PURP OF SITE	AREA OF SITE	ZONE	PURP OF ZONE	NAMN	TYPE	FELCNEC	PURP	DESC
9382			EQUI					EQUI			DINA
9383			EQUI	<2100				EQUI			ESTA
9384			EQUI	<2100				EQUI			ESTA
9385			EQUI	<2100				EQUI			PACK
9386		*VAP	EQUI					EQUI			DINA
9387		*VAP	EQUI					EQUI			ESTA
9388		*VAP	EQUI					EQUI			PACK
9370	FLO	SITE	PURP OF SITE	AREA OF SITE	ZONE	PURP OF ZONE	NAMN	TYPE	FELCNEC	PURP	DESC
9371	0300	AU-2100-EQU-VAP	EQUI	2100	AU-2100-EQU-VAP/COLUMNS	EQUI	T-200005	EQUI	false		CDU/LPG EXTRACTOR
20041	8002	AU-4000-EQU	EQUI	6000	AU-4000-EQU/TANKS	EQUI	Tq-400004	EQUI	false		SPENT NDEA TANK
20042		01-out-09	Advanced filter 02								
20043	FLO	SITE	PURP OF SITE	AREA OF SITE	ZONE	PURP OF ZONE	NAMN	TYPE	FELCNEC	PURP	DESC
20044											
20045											
20046											
20047	FLO	SITE	PURP OF SITE	AREA OF SITE	ZONE	PURP OF ZONE	NAMN	TYPE	FELCNEC	PURP	DESC
20048	0300	AU-2100-EQU-VAP	EQUI	2100	AU-2100-EQU-VAP/COLUMNS	EQUI	T-200005	EQUI	false	ESTA	CDU/LPG EXTRACTOR
20049	0301	AU-2100-EQU-VAP	EQUI	2100	AU-2100-EQU-VAP/DRLMS	EQUI	V-200009	EQUI	false	ESTA	CDU AMINE-PG SEPARATOR
20050	0302	AU-2100-EQU-VAP	EQUI	2100	AU-2100-EQU-VAP/DRLMS	EQUI	V-200021	EQUI	false	ESTA	AMINE SUMP
20051	0303	AU-2100-EQU-VAP	EQUI	2100	AU-2100-EQU-VAP/EXCHANGERS	EQUI	P-2000049	EQUI	false	ESTA	CDU LEAN AMINE TRIM COOLER
20052	1370	AU-2200-EQU-VAP	EQUI	2200	AU-2200-EQU-VAP/COLUMNS	EQUI	T-2000008	EQUI	false	ESTA	CDU/LPG EXTRACTOR
20053	1371	AU-2200-EQU-VAP	EQUI	2200	AU-2200-EQU-VAP/DRLMS	EQUI	V-2000023	EQUI	false	ESTA	CDU/DECONTAM DRUM
20054	1372	AU-2200-EQU-VAP	EQUI	2200	AU-2200-EQU-VAP/DRLMS	EQUI	V-2000020	EQUI	false	ESTA	CDU AMINE-PG SEPARATOR
20055	1373	AU-2200-EQU-VAP	EQUI	2200	AU-2200-EQU-VAP/DRLMS	EQUI	V-2000029	EQUI	false	ESTA	AMINE SUMP
20056	1374	AU-2200-EQU-VAP	EQUI	2200	AU-2200-EQU-VAP/EXCHANGERS	EQUI	P-2000017A	EQUI	false	ESTA	CDU LEAN AMINE TRIM COOLER
20057	1375	AU-2200-EQU-VAP	EQUI	2200	AU-2200-EQU-VAP/EXCHANGERS	EQUI	P-2000037ED	EQUI	false	ESTA	CDU LEAN AMINE TRIM COOLER
20058	1376	AU-2200-EQU-VAP	EQUI	2200	AU-2200-EQU-VAP/IMPUR	EQUI	Z-2000005	EQUI	false	ESTA	CDU STATIC MFR
20059	1377	AU-2200-EQU-VAP	EQUI	2200	AU-2200-EQU-VAP/PUMPS	EQUI	B-2000036A	EQUI	true	DINA	CDU WASH WATER CIRCULATION PUMP
20060	1378	AU-2200-EQU-VAP	EQUI	2200	AU-2200-EQU-VAP/PUMPS	EQUI	B-2000036B	EQUI	true	DINA	CDU WASH WATER CIRCULATION PUMP
20061	1379	AU-2200-EQU-VAP	EQUI	2200	AU-2200-EQU-VAP/PUMPS	EQUI	B-2000038A	EQUI	true	DINA	CDU MAKE-UP WATER PUMP
20062	1380	AU-2200-EQU-VAP	EQUI	2200	AU-2200-EQU-VAP/PUMPS	EQUI	B-2000036B	EQUI	true	DINA	CDU MAKE-UP WATER PUMP
20063	3880	AU-3100-EQU-VAP	EQUI	3100	AU-3100-EQU-VAP/COLUMNS	EQUI	T-3100025	EQUI	false	ESTA	AMINE REGENERATOR
20064	3881	AU-3100-EQU-VAP	EQUI	3100	AU-3100-EQU-VAP/EXCHANGERS	EQUI	P-3100100	EQUI	false	ESTA	LEAN AMINE AIR COOLER
20065	3882	AU-3100-EQU-VAP	EQUI	3100	AU-3100-EQU-VAP/EXCHANGERS	EQUI	P-3100101	EQUI	true	ESTA	REGENERATOR PUMP-AROUND TRIM-COOLER
20066	3883	AU-3100-EQU-VAP	EQUI	3100	AU-3100-EQU-VAP/EXCHANGERS	EQUI	P-3100102A	EQUI	true	ESTA	FEED BOTTOMS EXCHANGER
20067	3884	AU-3100-EQU-VAP	EQUI	3100	AU-3100-EQU-VAP/EXCHANGERS	EQUI	P-3100102B	EQUI	true	ESTA	FEED BOTTOMS EXCHANGER
20068	3885	AU-3100-EQU-VAP	EQUI	3100	AU-3100-EQU-VAP/EXCHANGERS	EQUI	P-3100103C	EQUI	true	ESTA	FEED BOTTOMS EXCHANGER
20069	3886	AU-3100-EQU-VAP	EQUI	3100	AU-3100-EQU-VAP/EXCHANGERS	EQUI	P-3100103D	EQUI	true	ESTA	FEED BOTTOMS EXCHANGER
20070	3887	AU-3100-EQU-VAP	EQUI	3100	AU-3100-EQU-VAP/EXCHANGERS	EQUI	P-3100104	EQUI	true	ESTA	LEAN AMINE TRIM COOLER
20071	3888	AU-3100-EQU-VAP	EQUI	3100	AU-3100-EQU-VAP/EXCHANGERS	EQUI	P-3100105	EQUI	false	ESTA	REGENERATOR PUMP-AROUND AIR COOLER
20072	3889	AU-3100-EQU-VAP	EQUI	3100	AU-3100-EQU-VAP/FILTERS	EQUI	FT-3100001	EQUI	true	ESTA	AMINE SOLUTION FILTER
20073	3890	AU-3100-EQU-VAP	EQUI	3100	AU-3100-EQU-VAP/FILTERS	EQUI	FT-3100022	EQUI	true	ESTA	AMINE CARBON FILTER
20074	3891	AU-3100-EQU-VAP	EQUI	3100	AU-3100-EQU-VAP/FILTERS	EQUI	FT-3100023	EQUI	true	ESTA	AMINE PARTICULATE FILTER
20075	3892	AU-3100-EQU-VAP	EQUI	3100	AU-3100-EQU-VAP/FILTERS	EQUI	FT-3100024	EQUI	true	ESTA	RICH AMINE FILTER
20076	3893	AU-3100-EQU-VAP	EQUI	3100	AU-3100-EQU-VAP/FILTERS	EQUI	FT-3100025	EQUI	true	ESTA	AMINE SUMP FILTER
20077	4006	AU-3100-EQU-VAP	EQUI	3100	AU-3100-EQU-VAP/PUMPS	EQUI	B-3100060A	EQUI	true	DINA	LEAN AMINE PUMP
20078	4007	AU-3100-EQU-VAP	EQUI	3100	AU-3100-EQU-VAP/PUMPS	EQUI	B-3100060B	EQUI	true	DINA	LEAN AMINE PUMP
20079	4008	AU-3100-EQU-VAP	EQUI	3100	AU-3100-EQU-VAP/PUMPS	EQUI	B-3100062A	EQUI	true	DINA	REGENERATOR PUMP-AROUND PUMP
20080	4009	AU-3100-EQU-VAP	EQUI	3100	AU-3100-EQU-VAP/PUMPS	EQUI	B-3100062B	EQUI	true	DINA	REGENERATOR PUMP-AROUND PUMP
20081	4010	AU-3100-EQU-VAP	EQUI	3100	AU-3100-EQU-VAP/PUMPS	EQUI	B-3100063	EQUI	true	DINA	AMINE SUMP PUMP
20082	4011	AU-3100-EQU-VAP	EQUI	3100	AU-3100-EQU-VAP/PUMPS	EQUI	B-3100064	EQUI	true	DINA	FLARE KID DRUM PUMP
20083	4012	AU-3100-EQU-VAP	EQUI	3100	AU-3100-EQU-VAP/PUMPS	EQUI	B-3100065A	EQUI	true	DINA	AMINE MAKE-UP PUMP
20084	4014	AU-3100-EQU-VAP	EQUI	3100	AU-3100-EQU-VAP/REBOLER	EQUI	P-3100101A	EQUI	true	ESTA	REGENERATOR REBOLER
20085	4015	AU-3100-EQU-VAP	EQUI	3100	AU-3100-EQU-VAP/REBOLER	EQUI	P-3100101B	EQUI	true	ESTA	REGENERATOR REBOLER
20086	4016	AU-3100-EQU-VAP	EQUI	3100	AU-3100-EQU-VAP/TANKS	EQUI	P-3100071	EQUI	true	ESTA	AMINE FLASH DRUM
20087	4017	AU-3100-EQU-VAP	EQUI	3100	AU-3100-EQU-VAP/TANKS	EQUI	V-3100073	EQUI	true	ESTA	AMINE SURGE STORAGE DRUM
20088	4018	AU-3100-EQU-VAP	EQUI	3100	AU-3100-EQU-VAP/TANKS	EQUI	V-3100074	EQUI	true	ESTA	AMINE SUMP

Information Element

Fig. 34: Extraction

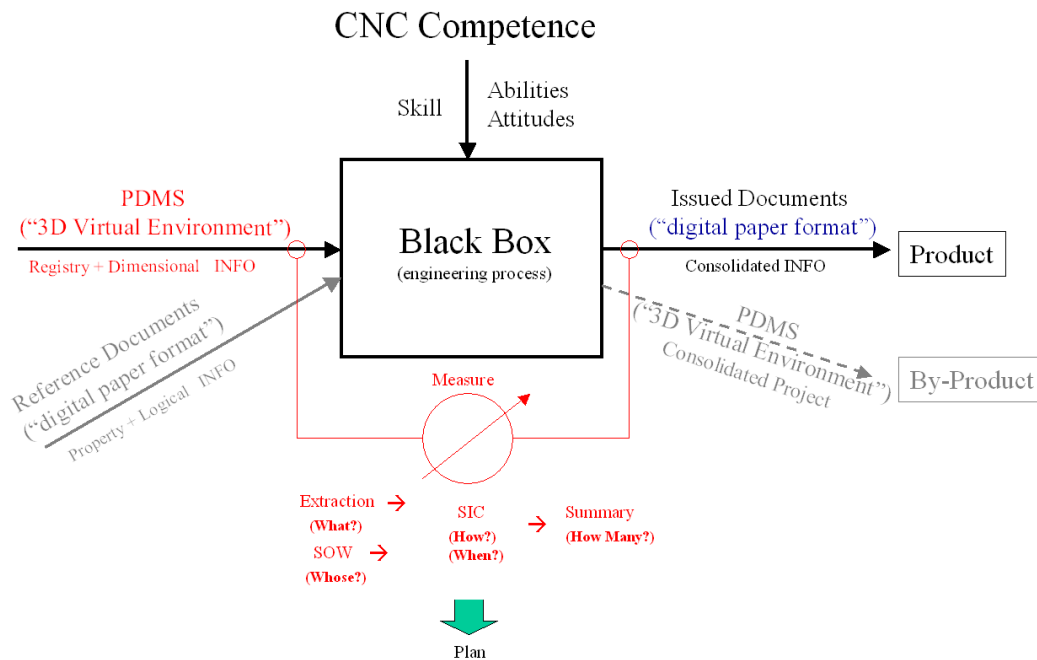


Fig. 37: Schematic representation of the information flow with the first set of controls

It also proved difficult to implement due to several limitations. First, the diversity of information elements within made it hard to generate association rules capable of covering the full range of possible information element versus document association. Not to mention that this association is a very discretionary one. Second, attribute setting on the part of WP-Houston proved lousy, and without precise data, the results of the filtering process were disappointing. The nature of information elements were hard to be identified based on their name (fig.38) once WP failed to enforce a naming convention among its designers. Elements that were CNC responsibility passed unnoticed while elements belonging to WP scope appeared as CNC ones, as we can see in the dialogue below:

(CNC) A.R.A.: Theoretically that's where we should find our work (elements in area TEMP). But I don't guarantee...I can not confirm...But that is what we have to look for...

(CNC) D.C.C.: So...I don't trust but that's is what I have... (..) inside that mess we should find something that allow us to do something... all that is in TEMP...(..) let's see this guy (information element) here...

(CNC) A.R.A.: You will not find it in the TEMP...

(CNC) D.C.C.: Of course I will not find it in the temp...evident I will not find it in the TEMP...Things like this... with this face... I would find at TEMP?(...)

(CNC) A.R.A.: Can you see?? Rack, platform, metallic structure...all that would be an input to us ... They are telling "this is what you (CNC) detail... I'm just showing more or less what I want and you will detail. (...)

(CNC) D.C.C.: Dou you agree that I am looking to disaster?

(CNC) A.R.A.: A disaster... that's what we talked to them. They have not defined a naming convention...

(CNC) D.C.C.: We are looking at a disaster... because nobody there is doing shit...(Recorded meeting, 14th October 2009 – Author Translation)

AREA OF SIT - ZONE	NAMN
5412 /U-5412-EQU/TEMP/201-RACK	=16763/11286
5412 /U-5412-EQU/TEMP/201-RACK	=16763/11390
5412 /U-5412-EQU/TEMP/201-RACK	=16763/11545
5412 /U-5412-EQU/TEMP/201-RACK	=16763/11649
5412 /U-5412-EQU/TEMP/201-RACK	=24955/21809
5412 /U-5412-EQU/TEMP/201-RACK	=24955/21943
5412 /U-5412-EQU/TEMP/201-RACK	=24955/22117
5412 /U-5412-EQU/TEMP/201-RACK	U-5412-EQU/201-PLAT3
5412 /U-5412-EQU/TEMP/201-RACK	U-5412-EQU/201-PLAT4
5412 /U-5412-EQU/TEMP/201-RACK	U-5412/201-LADDER6
5412 /U-5412-EQU/TEMP/201-RACK	U-5412/201E-W-INTERM
5412 /U-5412-EQU/TEMP/201-RACK	U-5412/201E-W-RACK
5412 /U-5412-EQU/TEMP/201-RACK	U-5412/201N-S-INTERM
5412 /U-5412-EQU/TEMP/201-RACK	U-5412/201N-S-RACK
5412 /U-5412-EQU/TEMP/401-RACK	U-5412-EQU/401-BL-PLTF
5412 /U-5412-EQU/TEMP/401-RACK	U-5412/401-LADDERS
5412 /U-5412-EQU/TEMP/401-RACK	U-5412/401E-W-INTERM
5412 /U-5412-EQU/TEMP/401-RACK	U-5412/401E-W-RACK
5412 /U-5412-EQU/TEMP/401-RACK	U-5412/401N-S-INTERM
5412 /U-5412-EQU/TEMP/401-RACK	U-5412/401N-S-RACK
5412 /U-5412-EQU/TEMP/FDN	FDN-B-5412002A
5412 /U-5412-EQU/TEMP/FDN	FDN-B-5412002B
5412 /U-5412-EQU/TEMP/FDN	FDN-B-5412002C
5412 /U-5412-EQU/TEMP/FDN	FDN-B-5412002D
5412 /U-5412-EQU/TEMP/FDN	FDN-B-5412002E
5412 /U-5412-EQU/TEMP/FDN	FDN-B-5412002F
5412 /U-5412-EQU/TEMP/FDN	FDN-B-5412402A
5412 /U-5412-EQU/TEMP/FDN	FDN-B-5412402B
5412 /U-5412-EQU/TEMP/FDN	FDN-B-5412402C
5412 /U-5412-EQU/TEMP/FDN	FDN-B-5412402D
5412 /U-5412-EQU/TEMP/FLARE_SUPPORT	TEMP-5412001A
5412 /U-5412-EQU/TEMP/FLARE_SUPPORT	TEMP-5412001B
5412 /U-5412-EQU/TEMP/FLARE_SUPPORT	TEMP-5412001C
5412 /U-5412-EQU/TEMP/KO_DRUM_SUPT_STRUCT	KO_DRUM_SUPT_STRUCT_001
5412 /U-5412-EQU/TEMP/KO_DRUM_SUPT_STRUCT	KO_DRUM_SUPT_STRUCT_002
5412 /U-5412-EQU/TEMP/KO_DRUM_SUPT_STRUCT	KO_DRUM_SUPT_STRUCT_003
5412 /U-5412-EQU/TEMP/KO_DRUM_SUPT_STRUCT	KO_DRUM_SUPT_STRUCT_004
5412 /U-5412-EQU/TEMP/KO_DRUM_SUPT_STRUCT	KO_DRUM_SUPT_STRUCT_005
5412 /U-5412-EQU/TEMP/KO_DRUM_SUPT_STRUCT	KO_DRUM_SUPT_STRUCT_006
5412 /U-5412-EQU/TEMP/MISC-LADRS_PLATFS	=16763/100155
5412 /U-5412-EQU/TEMP/MISC-LADRS_PLATFS	=16763/100453
5412 /U-5412-EQU/TEMP/MISC-LADRS_PLATFS	=16763/100657
5412 /U-5412-EQU/TEMP/MISC-LADRS_PLATFS	=16763/100769
5412 /U-5412-EQU/TEMP/MISC-LADRS_PLATFS	=16763/100879
5412 /U-5412-EQU/TEMP/MISC-LADRS_PLATFS	=16763/100997
5412 /U-5412-EQU/TEMP/MISC-LADRS_PLATFS	=16763/101113
5412 /U-5412-EQU/TEMP/MISC-LADRS_PLATFS	=16763/101216

No standard naming convention:
Hard to tell by the NAMN what these elements represent

Fig. 38: Tag discrepancies

In some cases a single database element was composed of several physical objects (fig.39) violating the principle of registry uniqueness. This limitation was particularly problematic since it made CNC to underestimate the real number of elements it had to work on.

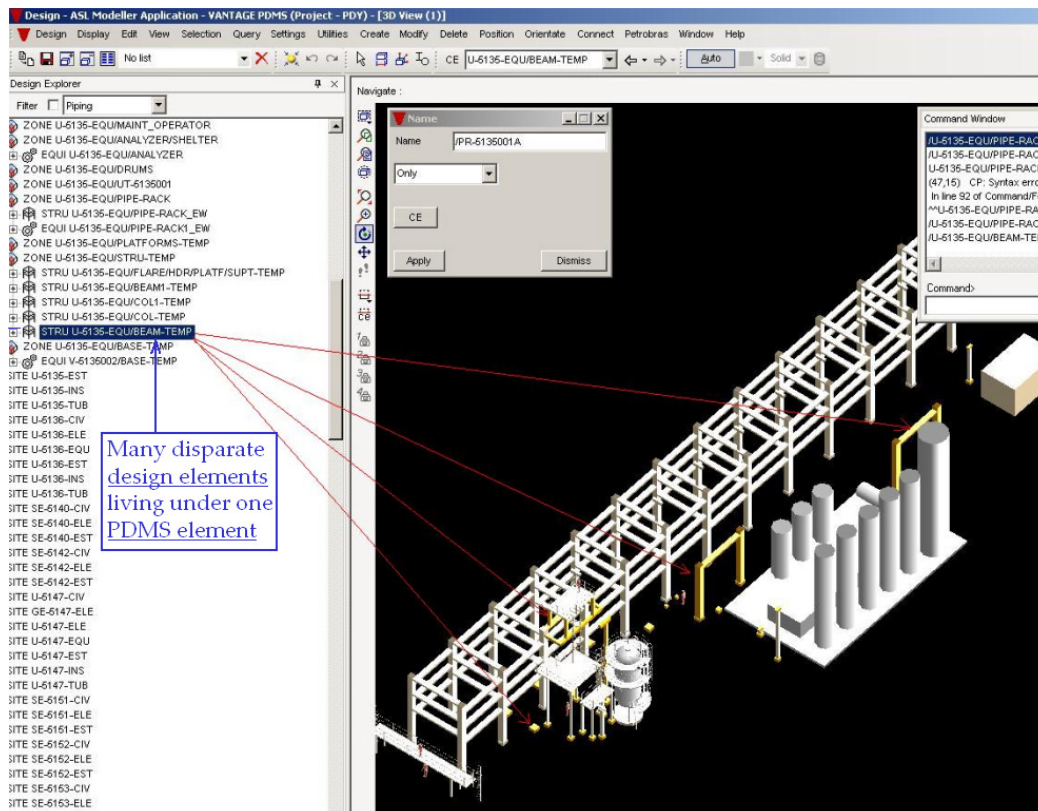


Fig. 39: Classification discrepancies

Moreover, this initial strategy overlooked two essential features necessary for an effective information control: a relationship between information elements within and destination engineering documents to be issued, and a way to feed information back to WP concerning detection and execution. Another problem is that although this system was capable of controlling changes in the number of the elements, this approach was unable to detect the very essential change in the information they carried which was also very important.

Above all the approach was too complex to catch on. As it involved several interlinked control instruments (i.e.; SOW, SIC, Extraction and Summary), it was hard to navigate through. It was necessary a strong involvement in the control process to understand how information registry flowed among them and what supervisors have to do.

In a reserved conversation involving A.R.A., D.C.C., and me on the 7th October 2009, some concepts gained strength while others were added to the overall solution framework, as we can see in the excerpts below:

(...) First, I disassembled concrete and metallic (split of work) ... we are not much sure about what to place in metallic, did I understand?...we are not much sure but it's certain there will be (something) ... (...) So, absolutely anything that is raised through its forum has to go to this control, and when it goes to this control, it has an owner. Somebody will do this concrete structure...somebody will be responsible to the metallic structure... so every item here (in the control) will have to have a guy here inside. This guy here tells what do I have to do and who will do. The owner...((CNC) D.C.C., recorded meeting, 07th October 2009 – Author Translation)

There is the "frozen" stuff...right?...I will made the hell out of it...put a very strong effort... so that it becomes something called "issue"... "frozen" in reality is not different from a "issue event". I am already pushing this subject when I say that I will do a screening in the model once in a week. I pushing this subject...I don't care about what you did along the week...only what will you do on Friday's.... Therefore, it is equivalent to "weekly issue events", right?! ((CNC) D.C.C., recorded meeting, 07th October 2009 – Author Translation)

(...) but the screening I think I can do this...(...) You know why is it better that I do this, because if come out any "freaks" in the middle of the way (D.C.C. laughs...) It might happen to come out anything that disturbs this planning I'll be able to alert promptly. (...) so we have more working that is not being filtered yet. (...) Along this is screening process that I will do A.R.A. I get in contact with the supervisor and I already assign a tag to that element then he enters the D.C.C. spreadsheet (...) ((CNC) A.R.A, Recorded meeting, 7th October 2009 – Author Translation)

By the 08th of October, pressure over the CNC Civil team increased to the point that K.G. asked for a meeting in attempt to have a broader understanding of the problem. The dialogue below gives a snapshot of the questions involved:

(CNC) K.G.: "One of the points in our Civil work that is being criticized by WP, is the fact that, we don't design directly into the model ("3D virtual environment"), no PDMS. The idea of this project has been that we made a rupture from the traditional form of CNC to work with the model, that required the Piping personnel to receive inputs in 2D (drawings) from the other disciplines and proceed modeling, and here, we would like to set a step further, and assign the modeling to each discipline. Because of that, far in the beginning, on F.L. (former Civil discipline manager) time, we did a considerable effort in training personnel from the many disciplines, and in the case of the Electrical we had a considerable success...Electrical nowadays work direct into the model.... For sure it is simpler ...we are talking about cable trays and connection boxes ...the idea of the meeting is to discuss what are the difficulties for we to do that in the Civil, where it holds still, what do we have to do go ahead. WP wants to send a bunch of guys to teach as to model. A think it is not what is missing, there must be another thing. (...)

(CNC) P.R.W: To design it directly into the model, in the G.S.G. area its impossible... because of the deadlines.

(CNC) K.G.: The vision of WP is that the fact of not designing (directly) into the model is what leads to the extension of the deadlines.

(CNC) P.R.W: This if we had started back in time...To start today its is impossible. Personnel is already delivering product, we received 40 drawings yesterday, (...) all the rest is going ahead, I cannot stop...cannot change the procedure now otherwise we won't deliver.

(CNC) K.G.: Piperack involves the work of third-party...

(CNC) P.R.W: Yes...one part inside and two other parts made outside.

(CNC) G.S.G: I had three people there (on the team) that are very good in modeling, however, we have to substitute this personnel by others to keep on designing...understand? Because, today...what am I doing? I'm supporting the third-party that are outside...the third-party do not have access to the model. So, we will have to keep on working this way. I model as soon as we finish (the drawing). (Recorded meeting, 08th October 2009 – Author Translation)

The dialogue above demonstrate that the turn over problem made part of a larger question concerning the ability of the CNC Civil team to work on the “3D virtual environment”, just like other disciplines like Piping and Electrical. It also illustrates two complicating factors that the Civil team presented in its operation: the tight schedules and the high level of subcontracting, elements that made the information processing capability of the team under even more pressure.

With pressure mounting, it was necessary to quickly address the information turn over problems. The overall picture and how to streamline the process in a fast and effective way was still unclear. As we begin to work with a “frozen” database extracted on a determined date we detected further misalignments, involving WP information coming from different sources, as illustrate below:

REFERENCE DOCUMENTS			Problem	PDMS		
TAG	DESC	SOURCE	ARE	NAMN	ZONE	
B-2200039 A	DCU MAKE-UP WATER PUMP	IJI-6000.67-2200-600-VAP-001	X	2200	B-2200039A	IJI-2200-EQU-VAP/PUMPS
B-3120065E	Amine Make-up Pump	IJI-6000.67-3120-600-VAP-001	X			
B-3120066	Amine Transfer Pump	IJI-6000.67-3120-600-VAP-001	X			
A-4200001	Static Mixer	IJI-6000.67-4200-600-VAP-001	X			
B-4200013A	Amine Sump Pump	IJI-6000.67-4200-600-VAP-001	X	4200	B-4200013 A	IJI-4200-EQUI/PUMPS
B-4200013B	Amine Sump Pump	IJI-6000.67-4200-600-VAP-001	X			
F-4200012A	Lean Amine Air Cooler #3	IJI-6000.67-4200-600-VAP-001	X	4200	P-4200012 A	IJI-4200-EQUI/AIR_COOLERS
F-4200012B	Lean Amine Air Cooler #3	IJI-6000.67-4200-600-VAP-001	X			
FT-4400001A	Combustion Air Blower Filter	IJI-6000.67-4400-600-VAP-001	X	4200	UQ-4200001	IJI-4200-EQUI/UQ-4200001
FT-4400001B	Combustion Air Blower Filter	IJI-6000.67-4400-600-VAP-001	X			
FT-4400001C	Combustion Air Blower Filter	IJI-6000.67-4400-600-VAP-001	X			
B-4410001E	Sulfur Surge Pit Pump	IJI-6000.67-4410-600-VAP-001	X	4400	P-4400007	IJI-4400-EQUI/SULFUR_DEGASSING
B-4430001A	Sulfur Surge Pit Pump	IJI-6000.67-4430-600-VAP-001	X	4400	T-4400001	IJI-4400-EQUI/SULFUR_DEGASSING
GVC-4430001	Waste Heat Boiler	IJI-6000.67-4430-600-VAP-001	X	4400	Z-4400001	IJI-4400-EQUI/SULFUR_DEGASSING
B-4450001E	SULPHUR SURGE PIT PUMP	IJI-6000.67-4450-600-VAP-001	X			
GVC-4450001	Waste Heat Boiler	IJI-6000.67-4450-600-VAP-001	X	4450	F-4450001	IJI-4450-EQUI/FURNACES
B-4470005A	AMINE SUMP PUMP	IJI-6000.67-4470-600-VAP-001	X	4450	GVC-4450001	IJI-4450-EQUI/BOILERS
B-4470005B	AMINE SUMP PUMP	IJI-6000.67-4470-600-VAP-001	X	4470	B-4470005 A	IJI-4470-EQUI/PUMPS
			X	4470	B-4470006/DIKE	IJI-4470-EQUI/CIV_TEMP
			X	4470	U-4470-EQUI/CIV/FTDN	IJI-4470-EQUI/CIV_TEMP
			X	4470	UQ-4470003/DIKE	IJI-4470-EQUI/CIV_TEMP
			X	4470	V-4470003/DIKE	IJI-4470-EQUI/CIV_TEMP
B-4510002B	NO. 1 SLOP OIL PUMP	IJI-6000.67-4510-600-VAP-001	X	4490	AS-4490001	IJI-4490-EQUI/MISC_EQUI
B-4510004B	NO. 1 FEED TANK SLOP OIL PUMP	IJI-6000.67-4510-600-VAP-001	X			
B-4510009B	SOUR WATER SUMP PUMP	IJI-6000.67-4510-600-VAP-001	X			
B-4510010B	SOUR WATER FLARE K.O. DRUM PUMP	IJI-6000.67-4510-600-VAP-001	X			
B-4530002B	No. 2 Slop Oil Pump	IJI-6000.67-4530-600-VAP-001	X			
B-4530004B	No. 2 Feed Tank Slop Oil Pump	IJI-6000.67-4530-600-VAP-001	X			

Fig. 40: Database discrepancies.

In comparing the number of equipments in the reference documents and in the “3D virtual environment” we found several discrepancies. Same information elements were tagged differently, some were missing in one format, some in the other one.

Noteworthy, however, was that some information elements modeled as equipments did not appear in any place of the reference documentation about equipments. During the screening process we realized that some of these unregistered equipments were in fact Civil structure elements, thus objects belonging to CNC Civil team. The filtering process relied on the assumption that it was possible to separate information elements from WP and CNC based on database attributes such as tag/name.

6.4.2- The Innovation Moment

As we realized that not only the separation between WP and CNC information elements were faulty but also we could not rely in much of the information provided by WP as reference to organize it, no other option was left other than to require WP to create an attribute to formally assign each information elements to its responsible partner. Once identified, these elements would be immediately transported to the CNC database and registered in a list to be built from scratch which would serve as a map for CNC supervisors to guide their work. The exact moment in which such solution arose follow below:

(CNC) L.M.A.: He have to mark these elements so that we can generate reports of them. Either we create an attribute called "type", and assign the letter (which denote the item classification) so that it comes out in the report or we change its tag in a manner that we build a traceable tag.(...) We have to see what is "legal" in Petrobras terms. (...) "O" is civil equipment, we mark it ... when you generate a report you say: select everything that is an "O". It (PDMS) will give you exactly what is here and all that is new and comes after will receive this attribute. Or we change its tag and add an element that is traceable.

(CNC) A.R.A.: The problem of this tag is that we are talking about a WP database. We have to work with them. To do this we have to ask them.

(CNC) D.C.C.: And this talk of the attribute?

(CNC) A.R.A.: This too. This is their database. I cannot write one single thing...(...) they can say: "I can do nothing"...they will not grant access for us...

(CNC) L.M.A.: So what we can do is to copy those elements to the Civil area (CNC database) and we go ahead. But it will be duplicated, it will be in their EQUI area....Civil equipments are not meant to be in EQUI.

(CNC) A.R.A.: Let's talk to them. We do this. (...) We say to them, "we are going to copy all elements to the Civil area, because these elements are not equipments"...So, OK!? ... By the time we copy that they eliminate in their database. But, they can say "no, we need to revise something"...

(CNC) L.M.A.: No, they revise on the Civil Area...

(CNC) A.R.A.: No, they also cannot...Only one of the sides can. If he (K.D.H.) needs to change something he will to ask us and then we pass it to him.

(CNC) L.M.A.: That's even better, because if he changes we can track what has been changed.

(CNC) A.R.A.: A question that remains (...) Are these elements(Civil Equipments) ours?

(CNC) D.C.C.: That it! I don't know!

(CNC) A.R.A.: We have to ask P.R.W....

(CNC) D.C.C.: *Do you know why? Because I don't have any other place in the planet...(...) That's what we talked before...Where should this mess be? In a list... There should be a list...These circumstances make me think that once again ... the only place a have this information is in the PDMS.*

(...)

(CNC) A.R.A.: *We can say "Petrobras, we need an attribute here to identify our elements!"*

(CNC) D.C.C.: *Let's do! Can we do?*

(CNC) A.R.A.: *We can do.*

(CNC) D.C.C.: *Let's do! Forcefully, if necessary... there is no other way... otherwise we don't get out of this place.*

(...)

(CNC) D.C.C.: *I am going to tell you something... I will adopt a procedure here... it's maybe not the best, not the most correct...but I don't see any other form that we act...(...) there is a cognitive dissonance. We don't have a decent communication protocol... I don't believe we are going to build this communication protocol on a efficient manner on time... By our conversation on Monday (5th October, 2009), we won't get nothing. We would really need a quite strong interaction, its not about one day or two...(...) Do you feel how hard is to talk to me because of lack of knowledge...(...) So I see no other way than we do it forcefully...if we have this possibility, of building an attribute...place an attribute on a file ... so we can filter to build this list ...let's do! And how do we inform it? We inform exactly during the (list) "issue". I am going to say "these guys (information elements) are here (at CNC)" (Recorded meeting, 14th October 2009 – Author Translation)*

Also during this conversation, a key distinction was made which help us to better understand the information turn over structure. Once we have been able to see that information elements possessed two different natures we were able to grasp a better picture of the problem and of possible solutions.

(CNC) L.M.A.: *But I think we are talking about different things. We are mixing what is a "transfer element" with things that belong to them but imply in work in our scope. Do you understand? (...) This table that I sent is a table of things that "imply" work for us. What A.R.A is showing us are things that they placed there so we can get here.(...) These are elements that they placed in their area but in fact belong to us... Therefore, they send work to us in two different manners...or they create something inside the TEMP, or they create something here that imply in work (...)*

(CNC) A.R.A.: *But you got things that in fact do not imply in work... they are ours. That's what you got in your analysis.*

(CNC) L.M.A.: *No... Now I am not sure... All that is in that table imply in work for us...the equipment is theirs but the bases are ours...But here, the platforms is in their EQUI but its ours, the element is ours...it is only temporarily in their area...*

(CNC) A.R.A.: *Exact...I understood since beginning that it is not an equipment...*

(CNC) L.M.A.: *Get me some paper...Look, there is two universes of project. (...) There is two groups of things to... (...) I have to draw... it must be drawn otherwise D.C.C. will not understand. (...) Our project has two universes... that do not intercept...WP and CN. Here there is EQUI and TUBE, its their two databases... and here we have the CIV and ELE, our two databases...(...) he create an object but this implies that I create a base here... so there is a correspondence in here, this implies that... and there is another way that he wants that I do something here, so he places in his database something ... it does not imply. It must be transferred...*

(CNC) A.R.A.: *So these BBCs (an example of information element), if a get here the "PURP"...you see "ESTA", "DYNA"...that's here that he committed a mistake...if this is a basin, it cannot be a "ESTA"...*

(CNC) D.C.C.: *It should be what??*

(CNC) A.R.A.: I don't know... That's the problem... He is attributing carelessly... It should be anything but "ESTA", DYNA", "PACK"...that is my trouble...If he (K.D.H.) told me in that meeting "We are going to attribute all the zones (database areas) as temporary, and what it third-party will be "VLPT".

(CNC) L.M.A.: He should have a work transfer list to us...otherwise it will be left in this madness.(...) We are mining data about what to do... he should send this to us... (Recorded meeting, 14th October 2009 – Author Translation)

Such “marking” mechanism would place the responsibility assignment back into WP hands and away from the need of CNC data mining. In the case of the implied items, CNC would have to them by itself, however, in the case the transfer elements, WP would have to go at each of the 30473 elements in the database and tell if it was WP, CNC or third-party responsibility, a considerable workload. As this approach was expected to find resistance in WP, so D.C.C went for support of K.G. and asked him to take the lead in this process. On the 16th October, D.C.C. wrote an e-mail formalizing this requirement to K.G.:

(CNC) K.G.,

The firm identification of elements on PDMS to be detailed by CNC is critical to achieve established goals according to the contract. It is being very hard CNC to perform this identification according to the instructions released by WP up to now. This leads to unacceptable misunderstandings and risks at this stage of the project. So, it is demanded from WP to introduce a mark on the PDMS Data Base elements that allow us to perform this identification in a clear and unmistakable way. This must be done by means of an attribute defined by WP (CNC can help) taking in account that this is ruled by I-ET-6000.67-0000-941-PDY-017, rev. H. Both WP and CNC must be in accordance in such adjustments.

The two great groups of elements are:

- 1) Transfer element. Executive project element identified as needed by WP, whose detailing, however is CNC scope of work. (ex.: Pipe-rack).*
- 2) Imply element. Executive project element detailed by WP that needs CNC action to detail additional elements to complete the installation. (ex.: Vessel that demands equipment basis)."*

(CNC) D.C.C.

On the 19th October (three days later), K.G. re-wrote the message on its own terms, to the WP-Houston project manager (F.G.), copied to all coordinators and managers on both sides, as we can see below:

(WP) F.G.,

It is essential for CNC work that the elements of each discipline to be modeled are precisely known, identified, and defined. It is not possible to perform this identification just by "looking into the model", good engineering practice requires that each element is listed and specified/described in an adequate manner. Equipment for example is supposed to be listed in an Equipment List, and adequately described in Data Sheets, Specs, etc.

We made an effort to identify these elements, using the data base of the model and the documents available on Sharepoint, which, as per Coordination Procedure, should contain all documents issued for the project. As you can see from the attached spreadsheet (Tab "Comparative Analysis DS"), we could find 1547 elements. From these, 943 are contained in 28 identified equipment lists, although 158 out of those are not modeled. There are also 416 modeled but not listed, without counting what we called Civil Equipment (130 elements) and Special Equipment (58)

It is being very difficult for CNC to perform this identification without having proper basis. This may lead to dangerous misunderstandings and risks at this stage of the project. To mitigate this situation we propose WP to introduce a mark on the PDMS Data Base elements that allow us to perform this identification in a clear and unmistakable way. This must be done by means of an attribute defined by WP (CNC can help) taking in

account that this is ruled by I-ET-6000.67-0000-941-PDY-017, rev. H. Both WP and CNC must be in accordance in such adjustments.

The two great groups of elements are:

- 1) *Transfer element. Executive project element identified as needed by WP, whose detailing is CNC's scope of work. (ex.: Pipe-rack).*
- 2) *Imply element. Executive project element detailed by WP that needs CNC action to detail additional elements to complete the installation. (ex.: vessel that requires equipment base, ladder, platform, etc.).*

I propose to have the issue discussed briefly between the PDMS people of both companies, to implement the system asap.

Regards,

(CNC) K.G.

The very same day, S.B.D., WP-Houston engineering manager, answered:

"This issue will be item number one on the videoconference agenda for tomorrow morning at 7 am Houston, 10 am Sao Paulo."

In the videoconference of 20th October the D.C.C. and A.R.A tried to explain the problem and ask for a change in procedure. Key dialogues in this meeting follow below:

(CNC) D.C.C.: So we make this analysis here and we have..have the needed...that you put in the PDMS...first...how we can match this data... documents...basic documents...how do we match these basic documents with PDMS? Is the first question, the second question is we have to be sure what we have inside the model to work because it's very hard to identify this things in the model. So we have two experts here... to show to you how we should receive from you the PDMS...a mark of each register there. Because if we don't have this information the risk of work... in the wrong equipments and the wrong elements in very high. Did you understand what my problem is?

(WP) S.B.D.: Yes. We understand the problem.

(CNC) D.C.C.: If you don't have any questions for this explanation about basic equipment..the basic documents and PDMS...I'd like to put Mr. A.R.A to explain what we need to receive from you.

(WP) S.B.D.: OK! Go ahead. Put them on.

(WP) L.H.: I have a question....A.R.A, what report criteria are you using in PDMS to determine that something has been modeled as a piece of equipment but is not in the equipment list.

(CNC) A.R.A: We use that one that we talk about once is that all equipment on a zone identified as EQUI with purpose "ESTA", "PACK" and "DYNA"...so this was...the...the... rule we used... O.K.?!

(WP) L.H.: O.K.

(WP) S.B.D.: Do you understand what they are looking at?

(WP) L.H.: Yes.

(WP) S.B.D.: Do you agree?

(WP) L.H.: Yeah, I agree. So, its just the matter we had things mislabeled as modeled. Which the owner should pickup and the designer should correct.

(...)

(CNC) L.M.A.: *What happens is that some elements that are identified as equipments but...apparently its not an equipment it's a basin, it's a sump pit...so its an element that must be detailed by the Civil discipline. Am I correct?*

(WP) C.H.: *Yes. That's correct.*

(CNC) L.M.A.: *What have we found is that the way he are separating things between you and our teams... it works for a part of the elements but it's not working for the rest of the elements. So what we want you to do... For equipments we can easily separate what we have to do or what we don't have to do. But for the other elements it's kind a hard to do. For example, the basins... the basins if you keep using the old rule we are using they would not be done by us...for example.*

(WP) C.H.: *Rule? What rule?*

(CNC) A.R.A.: *That rule, about "ESTA", "DYNA" and "PACK"of equipment...if we understand it is equipment we just need to create a base and not to detail by Civil. This is a problem.*

(CNC) D.C.C.: *Are we propose...We are showing to you the problem we have...but we have a...the first we...we have a proposal to do... the first hard "tough" we had was identify this. If you had put a mark in the database here, I don't know in the database the first task becomes a little bit easy to us to identify the things...if we identify the things, scope of our work, the further questions are easily to make to you. It's has been a very "tough" task to identify this...A.R.A. has to make a lot of filters in the database to achieve this bunch of tags. Let's say... I would like to discuss the solution we have...*

(CNC) L.M.A.: *What we need is an attribute that show us the responsibility of work of that element. For example...if you put an attribute called responsibility you can fill in with CNC, or WP and we know this is ours, it's not ours*

(WP) K.H.D.: *I think there is already too many attributes to identify work for CNC. The first attribute is "release to CNC", and the other one is the purpose set to TEMP.*

(CNC) L.M.A.: *Yeah, but the problem is that things are passing through these filters and attributes... and for example...if you have few elements passing through we have to control all the elements in order to find these few elements. So it's kind hard to find these few elements that are passing through our scheme.*

(CNC) L.M.A.: *David, what...our feeling is that it's ...the way we are controlling passing the work from WP to CNC it's kind a little hard for implementing. What we are asking you is to clearly mark each element are responsible for WP, CNC or Vendor... Three responsibilities possible, then we filter just this attributes and we keep on working in our elements. (...) for vendor it's OK, there is no problem with vendor stuff but for breaking it for WP to CNC we are still finding some trouble. The filter are not working properly and the few elements that are passing through are getting our work very messy.*

(WP) L.H.: *Will change the whole system...*

(CNC) L.M.A.: *I believe that if we place an attribute called "responsibility" and mark it as VPLT is clearly vendor, WP is clearly WP, and CNC clearly from CNC. We just filter this and keep going working.*

(WP) S.B.D.: *Can you get me an example of something that we should mark...clearly done by WP?*

(CNC) L.M.A.: *Yes, for example a pump... if you get a pump it's clearly WP (...) if you place a basin...they you are putting basins right now make we think this basins are not ours.*

(WP) C.H.: *All the basins are theirs...*

(CNC) L.M.A.: *OK, but they way we are doing things today they seem like them are yours. But we know that it is not.*

(WP) S.B.D.: *You think they are WP because the basins are coming as pieces of equipments.*

(CNC) L.M.A.: *For us they are static equipments...*

(...)

(WP) L.H.: That is on the P&ID!

(WP) S.B.D.: And I agree with you...however, however... inside the PDMS model... we are...it appears to me that we are tagging the basins with the same type of identifier as a pump, or as a heat exchanger...

(WP) L.H.: That is on the P&ID!

(WP) S.B.D.: I understand...

(WP) L.H.: When I extract the Plot Plan...that's where it has to come from to get the naming convention on the Plot Plan. The Plot Plan has to match with the P&IDs. OK?! Their naming convention

(WP) S.B.D.: But the basins don't come on the equipment list...

(WP) L.H.: Yes they do!

(WP) S.B.D.: On the mechanical equipment list?

(WP) L.H.: No, on the Plot Plan.

(WP) S.B.D.: I understand...however... we are creating some confusion with CNC with these basins having a tag...of being identified the same way in the list as a pump...

(CNC) L.M.A.: Yes, yes, we are reaching the problem... the problem is that the naming convention that you are using...used to work it does not split the work between WP and CNC clearly. And what we are proposing to forget the naming convention, you keep on using the naming convention you use to generate Plot Plans but we mark with an attribute the elements that should be done by WP and CNC. We stop using naming convention for this and start using an attribute.

(WP) S.B.D.: OK! Hang on a second... Let just me ask you (L.H.) a question...Can we just find and replace what we have TEMP and type CNC instead of that?

(WP) L.H.: I think there is two issues. The TEMP is not working because there is states in our model that are marked TEMP and shouldn't be.

(...)

(WP) S.B.D.: Can I replace TEMP with CNC?

(WP) L.H.: Yeah. Or we can do another attribute just to (...) but then we need to check to make sure they are only valid objects should be going to CNC.

(WP) S.B.D.: Well, somehow, someway...

(WP) L.H. I don't pick that...

(WP) S.B.D.: Either way we I think we have to change TEMP to CNC or put another attribute that says CNC.

(...)

(CNC) D.C.C.: Our proposal is to put an attribute in another field...yes, this is mine... looking for this...Is this CNC or no?

(WP) K.D.H.: I guess what you are saying that everything that has the attribute TEMP is CNC.

(CNC) D.C.C.: We are proposing to change because we are not sure of this attribute here. This is the reason of this meeting.

(WP) S.B.D.: Yes, we understand...so, we are going to make another column, with another attribute, and we are going to identify WP and CNC.

(CNC) D.C.C.: Perfect! The rest is over to us.

(Recorded meeting, 20th October 2009 – Exact Transcription)

My impressions after the meeting can be gauged through the following field diary notes:

"In many way, this videoconference surprisingly came up with a completely different outcome than expected. First, called my attention the fact that the English domain of the Brazilian side was very poor. It was very hard to understand what was being said by them, not only because they lacked the English spoken skills but even worst was they capability to frame their ideas in a way that could be understood by their American audience. Flat and direct, I presumed. At some point of the discussion I panicked, because putting me in their (WP) position I knew I would not had understood a word. However, it happened that despite of the jeopardizing ideas thrown on them in a poor English, they managed to pick up a few key words and expressions and framed the problem themselves in a quite precise way, almost as if all had been said correctly and precisely framed.

At the end of a calm and straight meeting they came to accept the CNC demand that there must be an attributed that clearly separate the responsibility of elements among WP, CNEC or Vendor. Even the hard part of the discussion that was to explain why the current methodology to separate the work (through Naming Convention) settled months ago was flawed (that was quite difficult to capture even to us that were insiders to the problem) and let many items wrongly assigned was understood straightforwardly. Somehow those guys on the other side of the screen managed to overcome the hardships, of communication technologies, language and framing in order to get a precise picture of the problem and quickly settled it down despite the amount of re-working it represented." (Field Diary, 20th October 2009)

At the end of the day an e-mail was sent by the American team informing the measures adopted.

All,

A new PDMS attribute has been added to PIPE, EQUI, and STRU. The attribute is called :WORKRESP (Work Responsibility). This attribute is to indicate who has design responsibility for items in the PDMS mode. The attribute will better enable CNC to determine what work in the model is their design responsibility. There are three values for the attribute:

WP WP Responsibility
CNC CNC Responsibility
VEND By Vendor

The default value is WP. During the PDMS outage, a macro was run to set the value of :WORKRESP based on the purpose value of the ZONE. The value for all STRU and EQUI in a ZONE with PURP set to TEMP was set to CNEC. The value for all STRU and EQUI in a ZONE with PURP set to VPLT was set to VEND.

We need to make sure that all of the items in the TEMP ZONE's are definitely being turned over to CNC for design continuation. All EQUI and STRU residing in a TEMP ZONE have had their PURP attribute changed to TEMP.

The work can be checked by running the report template WORK-RESPONSIBILITY.tmp.

Please let me know if you encounter any problems or have any questions. The modify attribute form will be modified after lunch. The value may be set at EQUI, PIPE, or STRU by typing:

:WORKRESP 'value' (e.g. :WORKRESP 'CNC')

Thank you for your cooperation, you may go back into PDMS.

(WP) K.D.H.

On the 28th of October the consolidated procedure was communicated by A.R.A. through the following e-mail to K.D.H and L.H.:

Gentlemen,

Now we have a consolidated procedure to follow, where it is easily possible to identify what on PDMS is CNC scope, we want to walk one more step.

The action CNC needs now is to own WP inputs whose :WORKRESP is set to "CNC" and :RELCNEC is "TRUE".

For this we are going to copy these elements and request you to delete yours from WP DBs. We are going to provide a List with elements we have already copied for you to know what you need to delete.

In the first time, the elements copied by CNC are going to have "Copy-of-" on their names. Please, it is very important for us that you delete yours as soon as we request it.

Please, let me know if you have any question.

Thank you

(CNC) A.R.A.

6.4.3- New Knowledge Expansion

Beginning on the 28th October, every Friday, A.R.A. extracted from the database elements whose attribute WORKRESP was set to CNC and the release status (RELCNC) set to TRUE. These elements were visually checked and copied to the CNC database. After the copy process, the information element, now in the CNC database, received an official tag and were registered in the new unique control document (new-SIC), with the date of the copy process considered as the "issue" date of the information element.

Once the element had been copied to CNC database, A.R.A. sent an alert to K.D.H. and L.H. in Houston to delete the element from the WP database to avoid duplicity. After that, WP designers still could see exactly the same element, with the same information he added, however, they no longer could change it inadvertently. This way, the information carried by the 3D elements became "frozen". Any further change then would require WP personnel to ask back for the information element so they could updated it and once again release it to CNC. In case they introduced a novel element with the necessary updates, the operation would be unmasked by the appearance of duplicity (WP new element X CNC priorly copied element).

Next, these information elements were disclosed to supervisors so they could extract the information they need and associate to them a corresponding CNC engineering document. As the design work progressed within CNC, these information elements could be updated to consolidate the project. Depending on the match of the element in relation to its final document a status level was assigned enabling the measurement of the overall "3D virtual environment" project progress. With elements identified, frozen, assigned, and with their progress measured, the control process become complete and could be periodically feedback into WP for planning.

The diagram ahead is representative of how the procedure took shape around a unique document, the new-SIC, continuously fed with the weekly extractions made by A.R.A., submitted to the procedure explained above:

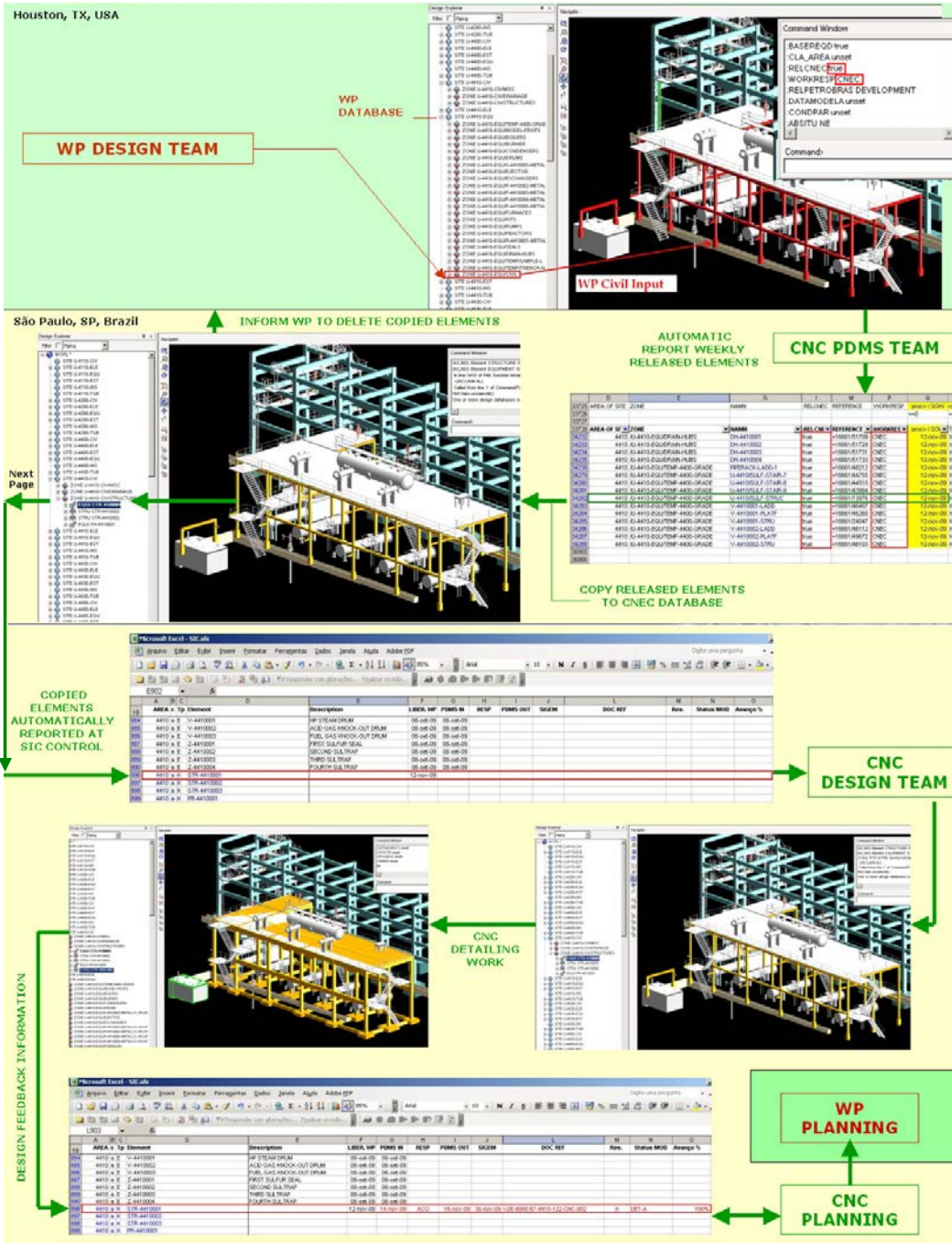


Fig. 41: New workshare flow.

1	AREA	TYPE	NAME	Description	LIBER WP	P	P	M	SUPPLY	RES	P	I	M	S	DOC	CNC	Flow	Status	MOD	N	A	N	O	P	P	
5302	4550	STRU	STRU4550004		23-out-09		27-jan-10		AMS	APO	27-jan-10	16-nov-09			DE-6000-67-6100-130-CNC-004	A	DET-A	100								
5304	4550	BASE	T-4550005	N01 SOUR WATER STRIPPER	23-out-09		19-jan-10		AMS	APO	20-jan-10	20-out-09			DE-6000-67-6100-122-CNC-004	B	DET-B	100			0,33	0,33				
5305	4550	BASE	TG-4550006	N01 SOUR WATER FEED TANK	23-out-09		19-jan-10		AMS	APO	20-jan-10	27-out-09			DE-6000-67-6100-122-CNC-005	A	DET-A	100			0,33	0,33				
5306	4550	CME	TG-4550007	N01 CAUSTIC FEED TANK	23-out-09		19-jan-10		AMS	APO	20-jan-10	27-out-09			DE-6000-67-6100-122-CNC-005	A	DET-A	100			0,33	0,33				
5307	4550	BASE	TG-4550008	N01 CAUSTIC FEED TANK	23-out-09		19-jan-10		AMS	APO	20-jan-10	27-out-09			DE-6000-67-6100-122-CNC-005	A	DET-A	100			0,33	0,33				
5308	4550	PAVE	U-4550-CV4P04EL-8000		23-out-09		19-jan-10		AMS	APO	20-jan-10	27-out-09			DE-6000-67-6100-122-CNC-006	0	TID	0			1	0				
5309	4550	MET	V-4550009	TABEL 2075	23-out-09		19-jan-10		AMS	MARCODE	3-nov-09	3-nov-09			DE-6000-67-6100-140-CNC-004	0	COPY	25			1	0,25				
5310	4550	MET	V-4550010	PLATEL 24375A	23-out-09		19-jan-10		AMS	MARCODE	3-nov-09	3-nov-09			DE-6000-67-6100-140-CNC-004	0	COPY	25			1	0,25				
5311	4550	MET	V-4550011	PLATEL 24378B	23-out-09		19-jan-10		AMS	MARCODE	3-nov-09	3-nov-09			DE-6000-67-6100-140-CNC-004	0	COPY	25			1	0,25				
5312	4550	MET	V-4550012	TABEL 1950	23-out-09		19-jan-10		AMS	MARCODE	3-nov-09	3-nov-09			DE-6000-67-6100-140-CNC-004	0	COPY	25			1	0,25				
5313	4550	MET	V-4550013	TABEL 2075	23-out-09		19-jan-10		AMS	MARCODE	3-nov-09	3-nov-09			DE-6000-67-6100-140-CNC-004	0	COPY	25			1	0,25				
5314	4550	BASE	Y-4550014	N01 SOUR WATER FLASH DRUM	23-out-09		19-jan-10		AMS	APO	20-jan-10	20-out-09			DE-6000-67-6100-140-CNC-004	0	DET-A	100			0,33	0,33				
5315	4550	BASE	Y-4550015	N01 SOUR WATER STRIPPER OVERHEAD	23-out-09		19-jan-10		AMS	APO	20-jan-10	20-out-09			DE-6000-67-6100-122-CNC-003	A	DET-A	100			0,33	0,33				

Information Element Date Released CNC Check-in Owner CNC Check-out Destination Engineering Document Information Element Progress

Fig. 42: New SIC spreadsheet

Below we can see an outline of the resulting approach to the control of information previously represented compared to the former ones:

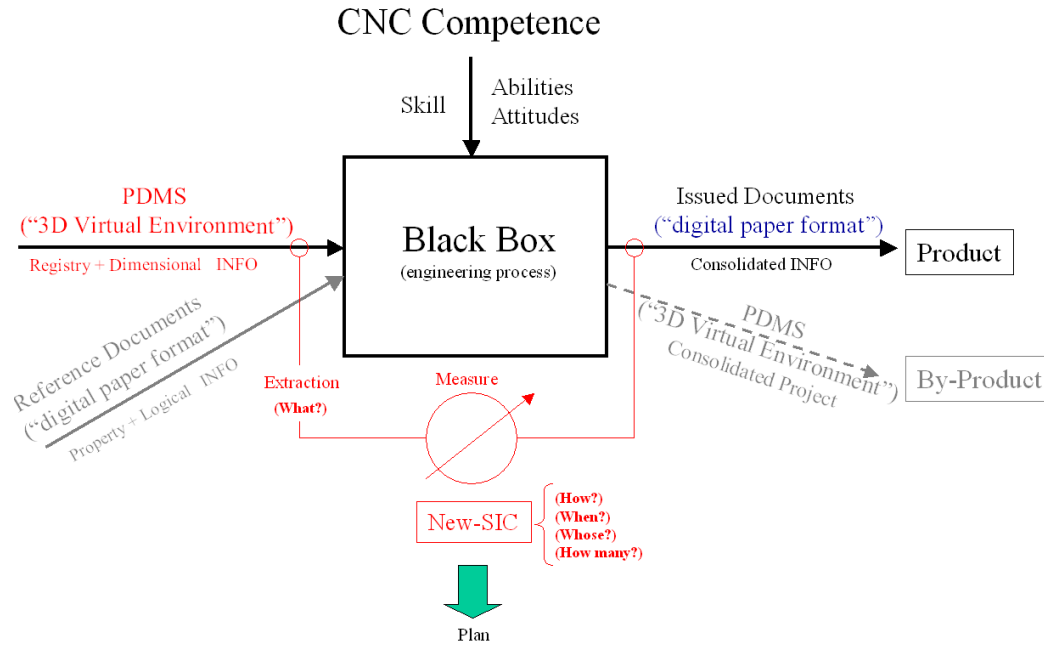


Fig. 43: New information workflow

Overall, the implementation process proceeded quite smoothly both considering its impact in WP and CNC work. On the part of WP, few reinforcement e-mails concerning the removal of copied items were enough for the procedure caught on. As the amount of information elements to be checked and have their responsibility re-assigned was very large, this process mounted to be a gradual one and thus did not flooded CNC with an impractical amount of things to be checked, copied and registered. In the new information turn over procedure it was much easier to identify the problems in “3D virtual environment” information flow coming from WP and was easier to require changes what was done by e-mail, instead of videoconferences, what made communication clear and faster. Ahead follows an example of e-mails exchanged on the 23rd November, 2009:

(WP) L.H.,

Please, take a look on the elements below. They have the Purpose VPLT and :WORKRESP CNC on the same time.

Could you please verify Purpose and :WORKRESP of these elements?

SITE	PURP OF SITE	AREA OF SITE	ZONE	PURP OF ZONE	NAMN	TYPE	:RELCNEC	PURP	REFERENCE	:WORKRESP
/J-4400-EQU	EQUI	4400	/J-4400-EQU/V-4400006-METALLIC-VPLAT	VPLT	V-4400006/LADD/IEL23950-VLADD	STRU	true	VPLT	=1718713082	CNC
/J-4400-EQU	EQUI	4400	/J-4400-EQU/V-4400007-METALLIC-VPLAT	VPLT	V-4400007/LADD/IEL23980-VLADD	STRU	true	VPLT	=1718713348	CNC
/J-4400-EQU	EQUI	4400	/J-4400-EQU/V-4400007-METALLIC-VPLAT	VPLT	V-4400007/LADD/IEL24480-VLADD	STRU	true	VPLT	=1718711782	CNC
/J-4400-EQU	EQUI	4400	/J-4400-EQU/V-4400007-METALLIC-VPLAT	VPLT	V-4400007/LADD/IEL26350-VLADD	STRU	true	VPLT	=1718712121	CNC

Thank you,

(CNC) A.R.A

(WP) L.H.,

Sorry I'm insisting on this subject, but we need to issue SIC today and this information is important for us to have it consistent.

Could you please inform which is the correct one: the Purpose or the :WORKRESP?

Thank you again,

(CNC) A.R.A.

(CNC) A.R.A.,

These are Vendor supplied items, not CNC's responsibility.

Thanks,

(WP) L.H.

On CNC side, however, the range of operational details concerning the operation of the new information control system in the CNC Civil team were more extensive.

The first problem was to align CNC project advancements within PDMS so that WP could see the CNC work in the "3D virtual environment" clearly flowing. To take the pressure out of CNC project management, it was necessary to get people mobilized for that work, however, as the information control system was still under implementation, a great amount of uncertainty still surrounded the work. It was necessary to buy time to keep on improving the system before a severe test was placed, otherwise the tool could be discredited. This became clear in a meeting involving CNC Project management and Civil discipline key personnel the discussions were as follows:

(CNC) K.G.: (...) The problem keep on being the same. Apparently Civil modeling did not move yet...they we expected...I am waiting that someone solve my problem but until now, evident nothing happened...and WP keep on complaining that Civil modeling update does not show up...I'd like to know how it goes on... You asked an intervention to try to organize that... (...)

(CNC) C.C.: All that D.C.C. said is this side... he developed a system to obtain an inventory of what should be designed by Civil in a controlled way...ok... when things come from WP the inputs in the model. What we have to discuss here... this stage has been won...D.C.C has made this tool here ... He have now...Things get into the Civil project departing from the inventory of the inputs, that can be WP and 8000 area, the project comes from 2D for Petrobras issue, and has to come out in 3D the model update. We are discussing now the resources. How to update the model? We already won this stage, now we have to mobilize people to update that.

(CNC) D.C.C: (...) we had imagined to get to the end of the registry (SIC), it would be more convenient, (...) we will have to do something in parallel. ,... this we are going to see how we are going to do... inside this today here is that a need an army to do this in the PDMS. (...) It does not help to place a bunch of people... because it there is too much people it's more people to get stuck on the problem. (...)

(CNC) L.M.A.: What happens... there are two work lines... we attacking the line that has origin at WP. W have another line whose origin is CNC. The bigger problem is the interface with WP because there is a complicated information flow that is still being defined (...) They throw out things in their database anyway, does not help to run, because while its I their database we can do nothing, cannot erase, cannot rename, cannot transpose, cannot remove...

(CNC) K.G.: We have to get out of this corner...take WP from the comfortable position...We just get beating by them...And when we go at the details its depending on WP... so make this to be known. (...) Look I can model if you do not do this and that, and you have the ball...

(CNC) L.M.A.: In the last days we transposed 3500 elements from their databases...3500 things without tag, with nothing...I did not know if it was a ladder, a building, a substation...it's throw out there...it's their tagged with a database number... I don't know what is that... while we do not click on that to see what it is, bring to our database, and get into the list we cannot pass the work on... This is WP line...What is CNC line it's just the supervisors to pass me tag of the things...

(CNC) C.L.E.: And handle the 2D documents...

(CNC) L.M.A.: Yes, handle 2D documents...a calculation, a initial issue, an final issue...that depends on the supervisors they have to feed us with information (...)"I want 10 structures... give me tag for them..." I go there in PDMS create structure 1, 2, 3,... give a description and say G.L.G. model this one and that one. Assign check-in date, when he finishes I assign a check-out date and tell the supervisor its modeled. Here I don't see any problem... We just need to be fed adequately by the supervisors.

(CNC) K.G.: P.R.W. and C.L.E. are telling that there is a considerable volume of information that can be handed to you to be modeled.

(CNC) C.L.E.: By several supervisors... be it piperack, be it buildings, be it substations, be it many things... we have all in 2D that are still not in 3D. What we need is put this on the model...according with the 2D.

(CNC) L.M.A.: Substations and buildings is controlled, we are tracking the documentation, we just need to assign the task for someone to do...

(CNC) C.L.E.: Someone who?

(CNC) L.M.A.: I don't know... any guy..

(CNC) C.L.E.: That's where we must arrive... who are the people who execute that.

(Recorded meeting, 11th November, 2009 – Author translation)

As a result of these meeting we got more time to work on the problematic WP transfer elements while provided that we start working with “CNC born” elements into the “3D virtual environment”. Unexpectedly, however, resource mobilization to accomplish this task proved very challenging. With CNC running many simultaneous projects, hard-work skilled professionals were avidly sought by project leaders among discipline managers. In the Civil team few professionals had PDMS skills, and the few who knew it were so deeply involved in 2D project tasks that supervisors do not accepted to lend them. First, PDY coordinators asked Civil discipline manager for these professionals but she replied she had no such professional available and it would be impossible to hire them on time. Then they asked for the Piping discipline manager, who had the largest pool of PDMS skilled professionals, to provide personnel to the task. He also declined arguing he also need some as the RMAN project was about to start. In the end, three CNC professionals, one from the Piping discipline and the two other from the Civil discipline were assigned to the task with more to be sub-contracted from a third-party company.

On the 12th November, under D.C.C. request, we created a small presentation explaining how information was turned over through the PDMS before and after the procedure changes and sent for K.G. comments, which returned excited:

Gentleman,

I've prepared a presentation in PowerPoint that maybe help not only WP personnel but also ours to better understand the organization work we are doing in the PDMS.

Any doubt or correction just talk to me.

(CNC) L.M.A.

Very Good!

How did you plan to propagate this presentation, particularly to WP? Next week I'll be in Houston with C.C., that would be a good opportunity to present it - talk to me.

(CNC) K.G.

In the mean time, along the first week of November, WP sent five professionals to CNC office to provide faster assistance to eventual project doubts. Their arrival moved CNC as it long waited to work directly with WP professionals.

Noteworthy also was the arrival of the members of the American team which came to Brazil to support the last months of the project. Four guys in their early 40's and mid 50's dressed on common clothes and carrying their backpacks freely circulated from one meeting to another escorted by V.S. during whole morning. By the end of the afternoon they finally arrived at the floor and start to occupy their new desks. As they walked into the office, English could be heard more and more frequently, even among Brazilian team members as they somehow to sharpen their English by joking to one another. First the coordinators, then the supervisors and even the secretary talked to the newly arrived in order to compliment or to solve final arrangements for their stay. While they were unpacking their things and getting used to the office, a small meeting gathered around them and together with some members of the Brazilian team they (a group of 8 to 9 people) subtly engaged into a conversation. Not much of this meeting could be heard from my place but the overall atmosphere was one of understanding and cordiality. (Field Diary, 3rd November 2009)

Upon their arrival project structures changed towards a more interactive role as shows the following chart:

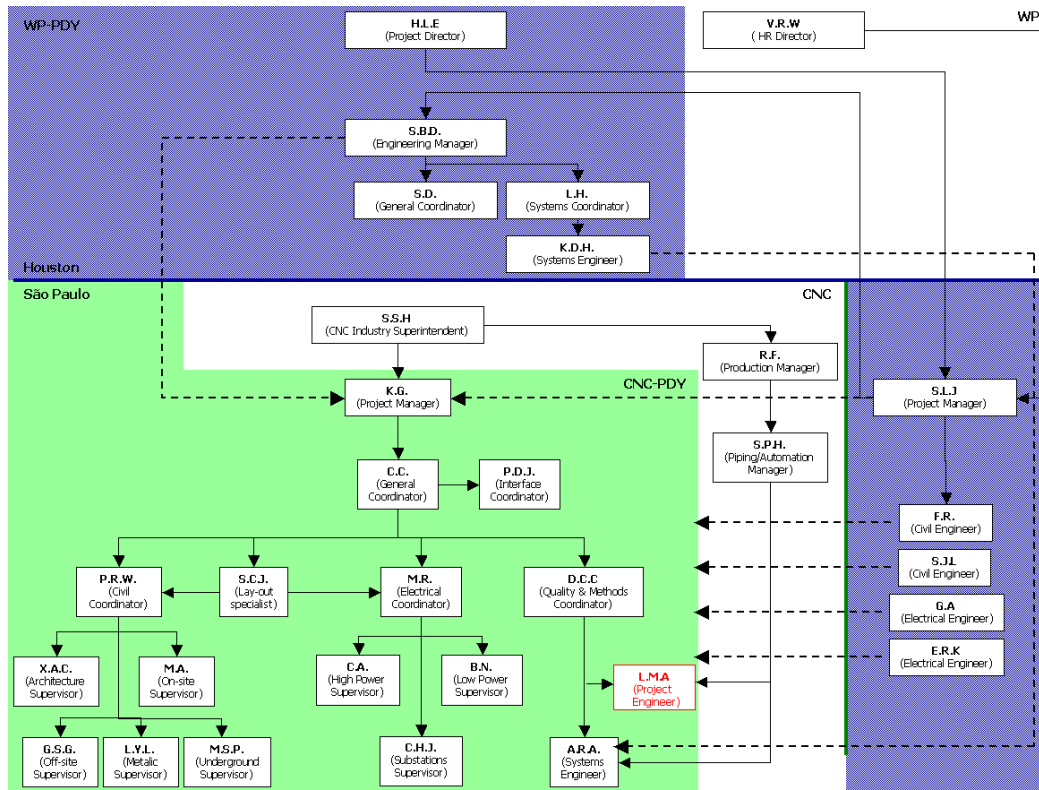


Fig.44: PDY project organization as per 05th November 2009.

I end up by sitting side by side with two of them: G.A., a Colombian radicated in the U.S., and E.R.K., an Afro-American. Both electrical technicians. They did not introduce themselves, so it took many days so that we get to know each other. Moreover, the first time I talked to G.A. it was not as cordial as it should be, like the field diary notes below shows:

As the guy arrived back at his desk he spoke something to himself and few seconds later turned to me and angrily said something like: "Next time you disconnect the cable from my computer, please ask me!" I was taken by surprise with that tone and that charge and it took me sometime to think of an answer. I then said: "Sorry, but I did nothing. I just opened the compartment in order to ...(lost the word from pulling out)...arrange my network cable, but I did not touched any other thing" (...)He then softened the tone just a little and started to speak in Spanish, probably because he was not understanding my truncated English and kept on complaining that someone had unplugged his power cable. I also started to talk in Spanish and said "Es que no lo he hecho. No lo he hecho!" and offered help to find another plug for his computer. The other guy didn't said a word and just kept observing us. (...) I asked them in English to check his side of the desk division, if he could find a place for his power cable and then we started to have a confusing conversation using both English and Spanish terms trying to convey as best as possible our ideas with few success. Little later he left but saying "goodbye" quite gently easing the clout that has just happened. (Field Diary, 4th November 2009)

This bad first impression faded away as G.A. gradually started talking to me asking for help in translations, and then about travel tips and doubts about the way things work at CNC. While talking to him I was never sure about using English or Spanish, however, there was good communication. Soon, he revealed he had a good impression of work with the Brazilians as he considered them receptive and open-minded. With time he showed up quite an open character as we can see next:

(CNC) L.M.A.: Y cuéntame... tu que has viajado tanto por diversos sitios, has trabajado con tantas personas, te parece que aprendes algo con ellas, o estas siempre enseñado algo???

(WP) G.A.: Oh, si... cada sitio una cosa... siempre estamos aprendiendo. Lenguas por ejemplo... yo estoy aquí en Brasil ahora y quiero aprender portugués. Yo te cuento que... no sé porque no he estudiado lenguas en la universidad... no que me arrepienta porque mi carrera en ingeniería me dado todo lo que tengo y comodidad a mi familia pero es que me gusta demasiado las lenguas. Y además no es sólo la lengua, simplemente como forma de comunicarse, pero la lengua como parte de la cultura, de cómo la gente piensa, como hacen las cosas, las cosas que les gustan...(Interview, 4th November 2009 – Exact Transcription)

Differently, E.R.K., barely talked to me and many much effort towards other desk neighbors. Nevertheless, I could see that he developed a considerable friendship with several other project members, even from unrelated professional activities.

In the beginning, they were quite upset about CNC delays. Sometimes they expressed impatience over the relaxed stance towards national holidays in face of schedule overruns. They also frequently complained about the Internet infrastructure and frequently left to work in the hotel. Apart from the early idiomatic and cultural misunderstandings as well as initial prejudices on both sides, WP team members apparently felt very comfortable in CNC, and thus, communications improved fast and a relationship grew up. Working meetings were very frequent and apparently cordial, with very a technical and collaborative atmosphere. Soon they recognized that Petrobras imposed several limitations to how fast CNC could do its work and understood that many delays were not due to unfinished work but due to the strict and personalistic approval conditions imposed by Petrobras inspectors.

Although quite reserved, they were frequently involved in small cordial meetings across de project floor with their Brazilian counterparts. With time more and more Brazilian colleagues went to talk to them, inviting for lunch, a ride across the city, a night out, or helping them with travel tips. Many Brazilian members went to talk to them just to practice English what they understood and tried to help. In the end, G.A. end up taking Portuguese classes as he wished to qualify to for future job offers in Brazil.

Noteworthy on their behavior was how much time they spent talking on the telephone, dealing with personal problems back in the U.S. They even used handset in their heads all the time. This contrasted with Brazilians, for which to talk too much on the phone over non-job related subjects is seen as loafing. Also characteristic was there strictly adherence to the work schedule, arriving and living together and punctually at the time expected (7:00-16:00, with one hour lunch), while Brazilians practiced a much more flexible schedule, arriving and living randomly.

A key element in their relationship with WP appeared on an interview with G.A.:

(CNC) L.M.A.: Pero lo que preguntaba era, si de los sitios donde has ido, cuál es lo que gustó más? Cuál el sitio donde te sientes más cómodo?

(WP) G.A.: Más cómodo... no sé... no he estado en mucho sitios.... Irak, China, Casaquistán, Canadá y ahora en Brasil.... No me gustaría quedar en China... es que los chinos fuman demasiado... y en todos los sitios... no ves el sol... la impresión que tienes es que estás en un gran cenicero.... Imaginate que la gente fumaba dentro de las oficinas... y en China hace mucho frío, está todo cerrado siempre.... ellos elegían una sala de reunión y allí transformaban en un sitio de fumadores, entonces cuando abrían y cerraban la puerta salía el olor y por debajo de la puerta también pasaba el humo... y yo detesto cigarrillas, no soporto el olor del humo. Pero...pero lo peor seguramente es el oriente medio. En Saudí...oohhh!... tu no puede tocar en ellos. Estás contaminado, eres infiel, te toman por inferior, por sucio. Si tu no has nacido en Saudí no eres árabe y por tanto no tiene derechos, no eres gente. No interesa que tu mamá y tu papá son árabes, si no has nacido allí no eres nada. Son como los alemanes, se tu padre es alemán y su madre es Italiana aunque haya nacido en Alemania no eres alemán. Se estás conduciendo tu coche y viene un árabe y se choca contra su coche, tu eres el culpable (lo cuenta bastante exaltado) porque una vez que tu no eres de Saudí, se tu entrastes en Saudí para lo que sea y estás allí, tu eres el culpable por estar en aquél sitio y tu por estar allí provocaste el accidente. Los extranjeros tienen que vivir en "compounds" donde tienen todo lo que necesitan. Pero eso no es vida... No podría vivir así... São Paulo...es una ciudad un tanto ordenada. Tiene... un tamaño parecido con Bogotá.... que tiene 8 millones de habitantes... aquí cuantos son?

(...)

(CNC) L.M.A.: E a ti te parece que la WP reconoce todo este trabajo de desplazarse por el mundo con los proyectos? Tienes alguna compensación en términos de rango o financiera? Tu te sientes que tienes la confianza de tus jefes e eso reverte en algo para ti?

(WP) G.A.: Si....tengo la confianza de mis jefes... pues que ellos saben que pueden contar conmigo para hacer lo que se necesita.... no que sea un experto, un genio como ingeniero... así como (¿?) ... como (¿?) (miembros de el equipo de eléctrica de Brasil) que saben mucho... son genios... pero es que hoy estoy en un punto donde sé lo que hacer.... yo estoy listo... puedo llegar y sé donde comenzar el trabajo y lo que hay que hacer... Las compensaciones financieras si que las hay pero no es tanto así que justifique... Yo ya gano bien... en mi rango de salario, la mayoría ingenieros, no hay más de un 5 por cien de todo equipo técnico... yo ya llegué a jefe de el equipo de eléctrica. Entonces no es mucho por el dinero. Es que un trabajo y como los otros. Si que estoy lejos de casa pero uno se acostumbra. Yo me quedo aquí en la oficina hasta las 9 de la noche, cuando salgo me voy al hotel, como, duermo y vuelvo a la oficina, no hace falta que esté en mi casa. Pero hay mucha gente que está cómoda en la empresa y cuando aparecen estas oportunidades de trabajo a ellos no interesan y yo nunca he recusado un pedido de desplazamiento que me haya pedido un jefe.... siempre que tiene que ir me voy.... siempre... ahí que cuando hay cortes, como ahora en la crisis, todos están allí muy inseguros y mi jefe llega para mí y dice: "Queda tranquilo que a ti nadie te va a tocar". Entonces eso es un tipo de reconocimiento. (Interview, 4th November 2009 – Exact Transcription).

On the 18th of November, while K.G. and C.C. were in WP-Houston, a videoconference was set to present the information turnover systematic to the newly arrived WP professionals in São Paulo and to the WP managers in Houston. Asked by S.B.D about their understanding of the whole process, WP-Houston personnel provided very positive views on the procedure as we can see in the dialogue below:

(WP) S.B.D.: Can you get me a minute??? Do you (K.H.D.) understand everything?

(WP) K.H.D.: That they just presented...We are already doing this...

(WP) S.B.D.: So you have been working with D.C.C., A.R.A and L.M.A., on this already.

(WP) K.H.D.: What I do is pick attributes and L.H. guys set the attributes.(...)

(WP) S.B.D.: So we are using this process already ...

(WP) L.H.:There is only one issue that we have...

(WP) S.B.D.: And it's kind of working very well...

(WP) K.H.D.: Yeah, I get a list back kind that I'm showing to you...I get a list back of what they moved to their area so we can (...)

(...)

(WP) L.H.: Under the net it's seems working fine... We get a list when they copy them over (...)

(WP) S.B.D.: We don't have any questions on this??? We understand the concepts???

(WP) L.H.:No, I think it works faster...

(...)

(WP) S.B.D.: That is a very good presentation made me understand much much better. You made it simple enough that I can understand the problem, so thank you.

(CNC) K.G.: Please, distribute a copy of the presentation to all presents here.

(Recorded meeting, 18th November 2009 – Exact Transcription)

The only issue mentioned by WP personnel was that once released the information element they could not change it anymore and in some situations it was needed. However, that was exactly to avoid these last minute changes that the system was developed and implemented. In the end of the videoconference, one of the WP professionals in São Paulo, suggested a procedure for turning back elements for WP adjustment, something that could easily be done by e-mail since it was copied to the responsible supervisor.

Overall the new information control systematic improved a lot the workshare capability among project offices. The series of e-mails from 24th to 25th of November gives an example on how smooth communications concerning the work in the “3D virtual environment” became:

L.H.,

Looking at the U-4400 and 4400D model there are extra base supports for the exchanger P-4400007 done by CNC.

They copied from our EQUI model twice and placed one set 1.55m north of the original location. Not sure if you're let them know, but.... See attached. I highlighted the base support in red.

R.L. - Piping Designer

R.L.,

Attached is a pic from the model where CNEC is modeling the supports (in red) and they have duplicated. I'm not sure who on our team needs to hand this.



Fig. 45: Image annex to the e-mail

L.H.

A.M.,

Please take a look on the attached picture that shows duplicated supports for exchanger. Please make necessary changes on the 3d model. Thanks

Regards,

R.F.

L.M.A

Attached comments from parsons for the unit 4400.

Attached too the civil design for this structure.

Regards,

A.M.

A.M.

Structures and piperacks at Unit 4400 are being update right now based on recently released documentation.

As some equipment bases became part of the structures in CNEC detailing, some duplication might appear for a while because WP has modeled bases as separate itens

As soon as we finish the modelling of the CNEC structures the initial bases added by WP will be deleted and the duplication will be resolved.

R.F.

As we're implementing new procedures on modelling CNEC elements, let me know anything people at WP might think of strange within PDMS.

Att,

L.M.A

L.M.A.,

Thank you for your explanation regarding this issue. I also forwarded this email to WP Houston to inform them of the situation.

Regards,

R.F.

Although the new approach worked fine with the outset, internally there were still challenges to be met. As the system exposed previously unseen elements turned over by WP, it gradually increased the amount of work under the responsibility of already overstretched supervisors. Confronted with additional work they initially resisted to use the SIC as a work release reference and kept on working with elements released through meetings, phone calls or videoconferences. This way they could concentrate their work on the larger elements and sweep out the smaller ones easing their burden. This strategy, however, left hundredths of information elements incorporated into the SIC control without owners and destination documents, undermining the control and measurement functions of the control system. A problem that persisted while our efforts have been diverted to other urgent needs.

By the end of November, the information control system was put to a hard test. A particular area of the PDY project, known as "8000", was suddenly moved to the top of Petrobras priorities. Due to the particular characteristics of this project area, Civil and Electric (CNC) elements were to be designed first so that as Piping and Mechanical (WP) elements could thereafter be accommodated, inverting the usual information flow used since beginning.

Minutes later P.R.W. came out of a meeting with C.C. and asked us to focus the modeling work on Units 8000. I said that this was exactly the last part of the modeling was planning to deal with to the peculiarities of the underground project. He asserted that WP was required urgency in this modeling work so as they could go ahead with their work in Houston. I said I was not much aware of the progress in this unit because I had no yet put their elements under control. But I told him that few things beyond underground have been released from WP to CNC. He strongly disagreed and said that the work in that units were already about to finish and that plenty of documentation was available. (...) A.R.A. then explained to me that 8000 units were entirely designed by CNC without any input from WP. Then it all made sense because the workflow for these units were the opposite from the other ones, that is, they started with CNC and were to be finished by WP. (Field Diary, 23rd November, 2009)

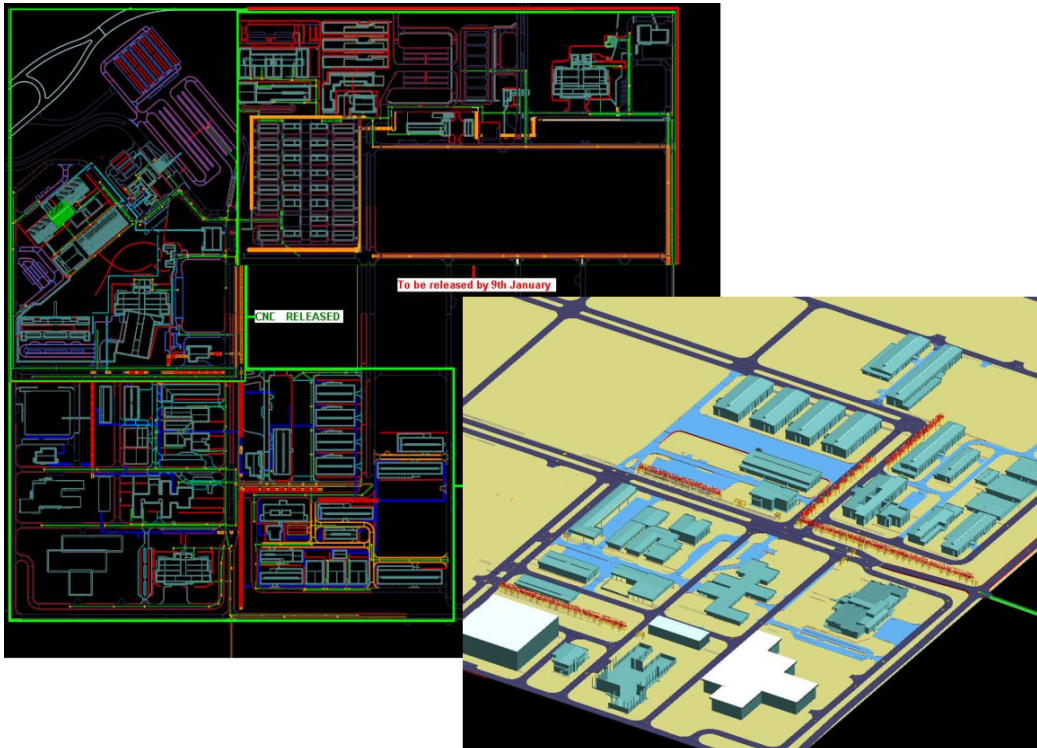


Fig. 46: Area 8000 plan and perspective.

This was a very large area composed of administrative buildings, streets, piperacks, and extensive underground work (i.e.: drainage, electrical channels, sewage system). A great challenge that would require not only skilled and hard work professionals, but also tool improvements and extensive organization so we could sent the information elements developed at CNC in time to WP met the schedule.

With its project backlog declining, CNC increasingly resisted to hire people and commit to further expenses. In that scenario, competition for resources among projects became more common, as can be seen in the field notes below:

When I started my computer and clicked at the PDMS icon, it returned a message that there were no licenses left even with two designers still on the go was exact the kind of problem I feared today. A issue that would be properly handled by A.R.A. who has everything concerning PDMS under control, turned into a two hour battle to me until a get exactly what was going on. (...)

Then , finally, it made sense. S.P.H, who was my boss and were in charge of the RMAN project had inappropriately suppressed 7 of our licenses, while BASF has taken 1. With 12 licenses only production personnel at PDY could keep working. I decided to call S.P.H and cautiously ask him to hand back at least two of the 7 licenses he had taken. He said his project was terrible late, working 24 hours, and in need of more licenses and so on and so forth. I said I had two professionals out of work and in my project it meant complete inactivity for them because I had no work outside PDMS. He said he also had two professionals without I license and he was already having much trouble and I should go easy on him and not bother about these licenses he had taken. I felt upset but I could do nothing against him, because at this point he was both my boss and competitor for resources. I saw at this point that for the second time in the last months he deliberated rushed into my pool of resources without asking and without regret just for the sake of being my boss and have a overwhelmingly power over my earnings and future assignments. (Field Diary, 18th January 2009)

With the human resources settled, the 8000 area task received our full attention. With the information flow operating in reverse mode (CNC → WP), WP pressure upon CNC quickly built up. Fortunately, this role reversal coincided with the arrival of four sub-contracted 3D designers, hired to help detailing CNC information elements back into “3D virtual environment”. Together, we decided to concentrate our work in sectors so we could release complete areas for WP to be working in parallel. Naming conventions were extended to accommodate the unconventional elements to be modeled, new element/document relationships had to be developed to fit into the SIC control, and finally, communication between CNC and WP concerning the “3D virtual environment” has been fully tested.

The area has been divided in three sectors that were released sequentially to WP. On the 17th December (SW Sector), 22th December (NW Sector) and on the 15th January (NE sector), S.C.J., design task job leader, sent e-mails containing pictures of the work developed and a list of information elements released by CNC for WP work. These e-mails were copied to S.C.J. counterpart and copied to all CNC and WP people involved, including the project managers on both sides (K.G. and S.L.J). Communication flow was surprising, and WP work proceeded straightforwardly.

Around 400 information elements were catalogued, modeled and sent through the “3D virtual environment” to WP work in less than 30 days (Christmas and New Year eve holiday in between). The final adjustments in the control system made during this task allowed for the last step in development process of the SIC control system, which was to measure work progress in a periodic and consistent way. Beginning on the 11th January 2010, graphics showing the work progress within “3D virtual environment” were made using SIC information and for the first time we were able to precisely know where we were and how fast we should go to end the job on schedule.

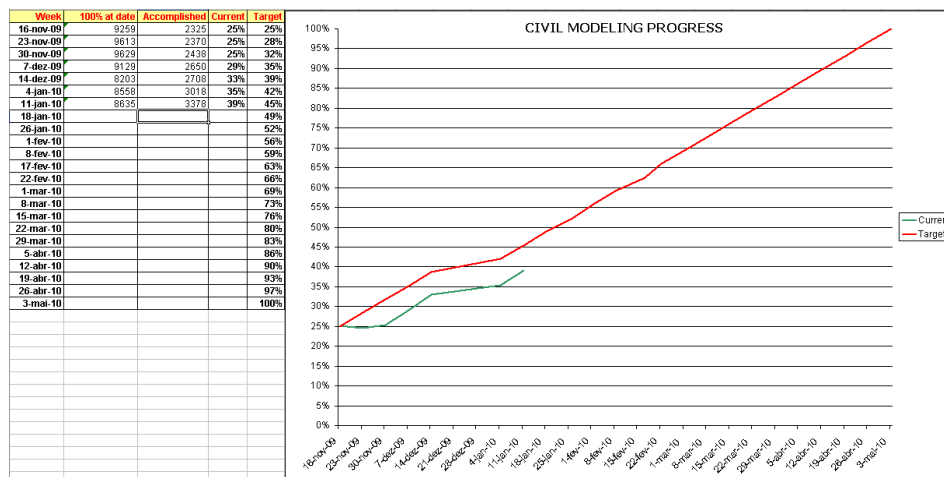


Fig. 47: Model progress curve.

This important information tool however, suffered a setback and end up being hidden from WP, as the field diary excerpt shows:

(...) D.C.C called me at his desk and after a short explain told me that although that graphic was exactly what everybody was waiting for he would not show it to WP personnel. That affirmation puzzled me not more than it made me upset. In my opinion the modeling progress graphic was the ultimate proof that we had everything under control and on the way to cope with the project deadline. D.C.C. argued that as there were many elements without documental reference inside the SIC control and because of that there were too much uncertainty in the resulting graphic, and for now it would cause WP to flood us with questions..(...) I then said that if it were for him to wait for all elements to be addresses to a determined element he would have to wait so long that the graphic would lose its importance, (...) I tried to persuade him showing that most of the unreferenced elements were tiny and unimportant elements with few weight in the overall job (...) He stuck at his point in saying that there was still too much uncertainty for we present the graphic as a part of the SIC control and at most we would have to talk to K.G. in order to evaluate the impact of such a graphic at WP. (Field Diary, 12th January 2009)

Little later an additional graphic was created to accommodate the variation in the workload coming from WP as a result of the dynamic nature of the work.

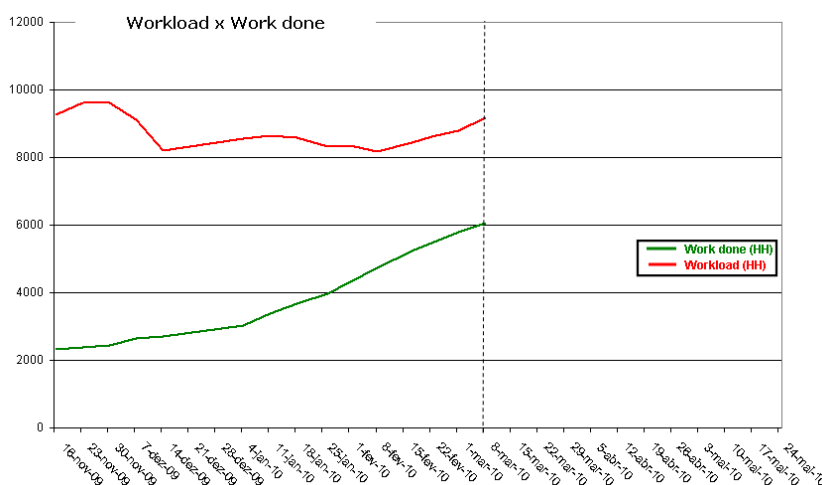


Fig. 48: Work gap curve.

So forth, updated graphics were weekly sent only to the project manager, all coordinators, supervisors and enrolled discipline managers without WP awareness.

6.5- KNOWLEDGE CHANGE OUTCOMES

The 8000 job result however has been eclipsed by the turmoil that succeeded the purchase of CNC by WP on the first working day of 2010. In 4th January, 2001, G.A. sent me an e-mail from WP-Houston, copying the official announcement:

WP to acquire CNC Engenharia S/A

WP and Brazilian conglomerate CCC today announced an agreement for WP to acquire CNC Engenharia (CNC), the standalone engineering and project management operation of the CCC E&C division.

The purchase price will be BRL170.0 million comprising BRL130.0 million in consideration and BRL40.0 million which will be initially retained by the business as a non-core asset. The business' proforma EBITDA (earnings before interest tax depreciation and amortization) for the year ending June 2010 is estimated to be BRL24.5 million.

The capability of CNC, based in Sao Paulo, Brazil complements the existing capabilities of WP' resource and energy businesses and provides a springboard for the next phase of WP' growth across South America. CNC has built a regional and international reputation in thermoelectric and

hydroelectric plants, subways, ports, airports, highways, wastewater, industrial plants, refining and distributing oil and gas, petrochemical and urban development throughout Brazil and in Latin America and Africa .

R.E., Managing Director of WP' United States and Latin America region commented: "The acquisition of CNC is key to WP achieving growth and expanding our hydrocarbons, power, infrastructure, mining and metals capability by incorporating CNC's globally recognized multi-discipline capabilities. CNC will be a significant enhancement to WP' Latin American group.

Also commenting, the President of CNC, C.A.J. said: "Joining WP is an exciting development for CNC, which celebrated its 50th year of business just last year. This merger of complementary talent will enable CNC to grow geographically while adding to our core technical areas of expertise enabling us to provide our clients with a more comprehensive service both domestically and internationally."

AboutCNC

CNC is part of the Engineering & Construction (E&C) Division of the Brazilian conglomerate CCC and became a wholly owned subsidiary in the 1990s. CNC services the downstream hydrocarbons, minerals and metals, hydroelectric, infrastructure (transport, water/wastewater) and environmental industries of Brazil . It is an established leader in Brazil hydropower, with a world-class capability.

The company has around 700 employees with established offices in Brazil; located in the states of Sao Paulo, Rio de Janeiro, Maranhao, Para, Santa Catarina, and Distrito Federal; Argentina and Peru. The head office is in Sao Paulo and the company has a geographic presence in attractive South American markets.

Rumors about an association involving WP and CNC circulated for months, however, a full takeover was completely unexpected. The very same day, C.A.J., the former CNC president (now CNC/WP president), went floor to floor to speak about the takeover. He tried to calm down CNC/WP employees and affirmed several times that WP had been formed around several purchases and because of that it had policy of respecting the local business culture. Moreover this purchase no way would result in lay-offs, on the contrary, that CNC/WP would have to hire more and more people to support a aggressive expansion plan. As a demonstration of respect on the local business culture, he said, CNC purchase has been conditioned to the maintenance of the whole management team that would allow for a smooth transition. It was said that CNC/WP and CCC would keep a special relationship that would span into new project bids, otherwise CNC/WP would be freed to join any other construction company it wished.

After that, colleagues all around the floor showed mixed feelings about the purchase. Some were excited that would make part of an international company, with better training, technology and business prospects, with a plus of job opportunities abroad. Some people believed that away from CCC influence, it would be easier to CNC win and keep contracts, which were previously refrained and diverted by CCC. Others feared this would mean the end of job security and relaxed management. From my standpoint, the partnership established for the PDY project, which resembled a "almost equal partnership" (Field Diary notes, 27th November, 2009), would probably be extended to other projects and situations. Until the end of the month, however, apart from the arrival of a very young manager responsible for the transition process and several meetings and seminars involving high rank CNC and WP personnel (including a visit from G.J., WP CEO, hardly anything changed. Logo, e-mail addresses, website, badges, all remained as nothing have happened.

In the 29th January 2010, another turbulence hit the project. Petrobras had finally reached an agreement with Braskem over the future of the PDY complex. As a result of the agreement PDY plant would change from a single-train refinery and a petrochemical central to a dual-train refinery. Braskem became fully responsible to build and operate a petrochemical central within the complex. After initial fears of project cancellation Petrobras decided to finish developing the areas related to the refinery and cancel those linked to petrochemical central. WP/CNC scope was reduced and the project deadline anticipated in two months to 25th April.

When PDY personnel from CNC/WP begin to be decommissioned, the first striking contrast with the period under CCC ownership could be felt. With no other large project on sight, senior and specialized professionals which usually would be retained and redirected to support CCC business proposals, were immediately laid-off. Almost at the same time equivalent amounts of staff personnel (IT, HR, marketing, legal, finance) were hired to replace the services previously shared within CCC group. Both movements were associated to the WP purchase and rumors spread that CNC/WP was expected to become a project management consultancy and not an engineering company anymore. In a red-hot engineering job market provided by extensive number of Petrobras projects in the hands of non-traditional engineering players, CNC/WP started losing as many professionals to the competition as were laid-off. In two events (C.A.J (President) webconference and M.A.C. (Managing Director) group meeting), management tried to calm employees down and point to a better future, however, discontent among technical staff was just growing, and with that

In that heavy atmosphere, came out the first international business contact provided by new ownership. WP-Edmonton (Canada) had just joined a giant mining project for Vale and its Project Director (A.J.S.) came to São Paulo to evaluate company infrastructure and skills towards a partnership that could take up the growing slack. Along this visit, PDY was presented as a flagship project and the collaborative work between WP-Houston and CNC/WP built around the SIC methodology, an example of what could be provided to WP-Edmonton. This way, most of the A.J.S. visit was directed by K.G. followed by S.S.H., CNC/WP industry superintendent. In order to demonstrate CNC/WP familiarity with 3D project tools and the recently developed “workshare capability”, K.G. asked us (D.C.C., A.R.A. and I) to prepare a quick presentation for A.J.S. what we did adding a little more information to the prior WP-Houston presentation.

The next day (2nd February, 2010), when we arrived at the meeting room we saw it filled up with all high ranks of CNC/WP industry division together with PDY coordinators and project management (from both WP-Houston and CNC/WP). S.P.H. avidly attended to that meeting and took its key supervisor with him, S.S.S. The meeting opened with K.G. showing how large was PDY project and all the range of activities that CNC/WP took part. A.J.S. showed interest in the volume of drawings produced and told that he was planning to use WP-Beijing for the drawings job. The talks however leaned up towards workshare as shown above and

as the presentation evolved several subjects attracted his attention and were largely debated. The presentation was enriched by the testimony of S.L.J., WP-Houston project manager, who told about the challenging circumstances involved in the workshare with CNC/WP, which involved working in parallel rather than sequentially as traditionally done, what surprised A.S.J. After the presentation he required us to stay and participate into another meeting that extended through the day.

As a result of these meetings, A.J.S. look very excited with the possibility to work with CNC/WP. He asked for a communication bridge involving technical personnel in CNC/WP and WP-Houston and this gave rise to the following sequence of communications:

Mr(s),

Yesterday (02-Feb) we began initial contacts towards increasing collaboration between WP Edmonton (Canada) and CNC (São Paulo, Brazil) offices.

The aim of this e-mail is to establish a venue of communication between professionals at these two offices in order to supply local expertise for a major Vale mining project awarded to the WP Edmonton office.

Two collaboration groups have been created and one awaits for the first contact and initial conversations (Architecture). They are:

CAE:

*(WP-Edmonton) S.L. (Engineering Manager)
(WP-Edmonton) D.H. (Piping/CAE Manager)
(CNC) A.R.A. (Systems Administrator)
(CNC) L.M.A. (Project Engineer)*

Civil:

*(CNC) L.Y.L (Concrete Structures Supervisor)
(CNC) A.R. (Steel Structures Supervisor)

(WP-Edmonton) D.C. (Civil & Structural Manager)
(WP-Edmonton) S.L (Engineering Manager)*

Architecture:

*(CNC) X.A.C. (Arch. Supervisor)

(WP-Edmonton) D.C. (Civil & Structural Manager)
(WP-Edmonton) S.L. (Engineering Manager)*

Dear Mr S.S.H (CNC)

We wish to thank you n your team for your kind hospitality and a great welcome accorded to us yesterday.

We think, that presentations were very well laid out and the teleconference calls between the two engineering teams in Edmonton and Sao Paulo was productive.

*The efforts of Mr K.G., L.M.A n other participating members are highly appreciated.
The day long presentations, clarification towards development of a structured long term cooperation and work share opportunities between the two WP entities was very well received by our both project teams in Edmonton and Belo Horizonte.*

In the meanwhile, effective immediately as a part of communication protocol, we would propose Mr Luciano CNEC project engineer, S.L. Engineering Manager, Y.N. Project Engineer (both Edmonton based), C.F. Project

coordination Manager and E.G. Project Engineer (both Belo Horizonte based) to be the communication focal points for the initial phase through the finalizing of WP- IEWO (Inter Entity Work order) it is a term for the final formal contract/agreement between two WP entities before the start of work.

We would like to propose S.L. Engineering Manager to visit your office during his next visit to Brazil in the last week of this month.

Hope this will kick start a successful journey towards long term mutual cooperation and joint success.

*Thank you
A.J.S.
Project Director
WP-Edmonton (Canada)*

Dear Mr. A.J.S.(WP-Edmonton)

*Thank you for your kind words.
CNEC will be pleased to cooperate with Edmonton Office in future Projects for Vale and others. Please copy myself and Mr R.F. in all correspondence related to this subject .
We look forward receiving the visit of Mr. S.L. in São Paulo. Please inform his traveling plans .
We will work with C.F. to expedite the WP-IEWO and start working with Edmonton.
Looking for successfully future cooperation in new Projects.
Best Regards*

*S.S.H.
Projects Superintendent Industry
CNC/WP*

This message has been copied to all high ranks of CNC/WP, including the president C.A.J., and WP-Edmonton. In a parallel correspondence, however, I have been warned by K.G., and later, by S.S.H, that R.F. should have appointed the linkage contacts. I argued that I just wrote what A.J.S. asked for a things could go changing as they progressed. Then, S.S.H. wrote the following e-mail to K.G. copied to me, and K.G.:

(CNC) R.F.

“Ok, let’s validate the subject next week in the meeting about process integration and the implementation plan of BH (Belo Horizonte) office.

Let’s revise the budget of BH office implementation and we adjust the issue of Vale project with the Brazilian Project manager (C.F.) I am coping S.W. the contract manager with this proposal.

(CNC) S.S.H.

In 16th February 2010, a workflow has been sent by a WP-Edmonton member asking for comments. This time, I asked both R.F. and S.S.H. for permission to act. S.S.H. told me to wait until a meeting in two days that would decided about the format of the collaboration (which did not happened or I was not invited to). R.F. however told me to go ahead and answer Y.N. Next on the 3rd March 2010, Y.N. sent a second information request, which R.F. took control and redirected to other professionals. As each day I got less involved into the process, I considered myself off-line. After some time, I came to know that CNC/WP would only supply some professionals do the WP-Belo Horizonte (Brazil) office, what end up being just one professional (L.Y.L). Several times I tried to collect more information about the issue however in my conversation with R.F. he was always vague telling that everything was running

through WP-Belo Horizonte office that acted completely independent from CNC/WP in São Paulo. Despite a common “chairman”, if it were to CNC/WP to participate in that, it would be necessary to enroll in the project almost as a different company.

Also in the beginning of March 2010, another international business opportunity came out. An e-mail was sent to the industry division of CNC/WP asking for resumés of professionals interested in joining a temporary assignment in Abu Dhabi, UAE (United Arab Emirates). Although completely vague about the opportunity, the offer attracted many candidates interested in securing their jobs and grabbing a international opportunity. 5th March, an e-mail bringing a little more information was sent to those interested, as shown below:

I.J. (Abu Dhabi); E.D (Houston); H.G. (Singapore)

E.D. and I have been working the issue of support for AME/ME projects from CNC. We understand that packets of work from the ME may not soon come to Brazil (but maybe one day). F.C. told us yesterday, however, that CNC probably has several personnel who would welcome a 3 to 12 month assignment in the ME, since workload in Sao Paulo is dropping.

(...)

B.G.E.(Houston)
*Managing Director
Global Hydrocarbons*

I.J. (Abu Dhabi); H.G. (Singapore)

In response to the attached message, see the list of resumes of professionals which may be assigned from 3 to 12 months on your projects Please, let me know your evaluation of those resumes(...)

Thank you

(CNC) F.C.

Hi (CNC) F.C.

Thanks for the summary.

I am not sure if you have the background about the imported labour in the Middle East, so I thought that I share with you a brief summary. If further details are required, please give us a buzz.

Majority of technical engineers and designer are Eastern Expatriates with most being Indian Nationals with Filipinos being second. For Engineering work in the office, we tend to use a higher percentage of eastern expatriates (over 80% to remain competitive), while for the Project Management Consultancy (PMC), we tend to use 60-70% eastern expatriates and the remaining are western expatriates which includes Aussies, US, European, etc. Most western expatriates take on the roles of PM, PCM, CM, Contracts Managers, HSE Managers, etc.

For us to determine best utilization of the Brazilian Engineers, we need to understand their current commercial packages and expectations to come abroad. This will help us determine whether they fit with the Eastern Expatriates or the Western.

Please note that I am currently travelling, so I copied my colleague L.J. if you want to have a chat.

Regards

I.J. (Abu Dhabi);

I.J., L.J.

Thanks for your prompt reply.

To provide you with their commercial packages and expectations, it would be important to understand what are the current relocation policies for both (western and eastern) expats you normally apply on projects you have assigned them

This will help us to get back to you

*Regards
(CNC) F.C.*

Hi (CNC) F.C.

R.D.S. our HR Manager will get back to you with an outline of what is normally provided.

(...)

Regards

L.J.
*General Manager.
WP-Abu Dhabi*

Dear (CNC) F.C.

My name is R.D.S. and I am the Human Resources Manager for WorleyParsons in the United Arab Emirates.

Currently we hire candidates for Engineering (In-house) and Project Management Consultancy work (PMC). The engineering staff are considered long term and PMC are considered project hires. Whenever the project comes to an end, we tend to move them to new projects, subject to new project availability clients approval.

For Engineering we provide staff with single status or married status employment contracts. The difference between the single status and married status is; single status staff are provided with 3 economy class tickets per year to their point of origin, whereas the married status staff receive only one ticket per annum, they also receive one ticket each for their spouse and up to 2 children less than 18 years of age. Married status staff are also eligible to receive medical insurance in the UAE and company pays for their UAE visa costs.

PMC staff are provided with only single status, as they are expected to travel to other countries and/or leave at site locations.

Regardless of the status, every employee is eligible for the following: (...)

R.D.S.
*Human Resources Manager
WP-Abu Dhabi*

These contacts came to nowhere, and once again, nothing happened, as CNC/WP did not provide any professional to international assignments. Rumors gave an account that WP Abu Dhabi office thought Brazilian professionals were too expensive, although they did not account the comparison criteria (Asian – technical workers X European/American – managers).

Parallel to that integration process, the correct implementation of the SIC methodology had to be reinforced internally as we perceived that supervisors

excessive workload and tight schedules made it difficult to them to embrace the methodology. After several requests were made by D.C.C. for the supervisors to identify the correct owner and the destination document of identified but unassigned elements what in 4th February 2010 generated a harsh e-mail from K.G. copied to all senior professionals in the project, both at CNC and WP:

Gentlemen,

In a recent conversation with D.C.C. and W.L.C. we realized that many of you, despite having received periodically the SIC, never looked to its content. This is inadmissible as a managerial behavior. The document reflects information collected that must be analyzed and commented by you, because this makes part of your supervision task.

(CNC) K.G.

After that, supervisors made an extra effort to address the problem and P.R.W. settle down that elements that did not find reference in issued drawing would be referenced towards material lists, to indicate that they were taking into account for quantitative evaluation.

The “look at the model” procedure also proved persistent as some supervisors kept on searching the “3D virtual environment” in order to find their work even after being presented to the new system. The e-mail below from 14th of December, 2010 shows an example:

Good Morning (CNC) A.R.A:

By the way the pictures taken from área of U-5412 are ready with the color differentiation for CNEC scope? Please inform.

Thanks,

(CNC) L.Y.L

This situation in some cases persisted until 05th February when D.C.C. decided to talk to P.R.W. in search for action:

(CNC) D.C.C.: Yesterday, L.M.A. brought me a situation that let me very apprehensive. Involving the SIC, the control of PDMS...L.Y.L look for him apparently... completely unaware of what would be the SIC. And this let me very apprehensive because it is the instrument of PDMS control. And he still keep talking about colors... apparently he not looking at the control index. (...).

(CNC) L.M.A.: (...) the question that L.Y.L. brought demonstrate it is not clear what the SIC is. L.Y.L. come to ask me the following: “We are working on a structure on area 6310 and I asked J.C. to take some images and dimensions and we started working and so on ...then I needed to confirm something and when I got there was an additional level...It cannot be...” I said, it cannot? Wait a minute... let’s take a look at the PDMS, we find the structure... “yes, this is the one! This level was not here yesterday”, he said....so a query the database to check the attributes, what I found? WP responsibility... Then I said, “L.Y.L you cannot work on it. It’s WP”. He replied “ No, but this is ours, this is ours, I’ve been to a meeting yesterday and the guy said it was ours...” I replied “L.Y.L. it’s WP and is no released!” ...“Oh! But I looked there and that was green”... I said “L.Y.L there is no more color code anymore...Who says what you have to do is the SIC...the SIC opens your work responsibility.... (...) If you go to a video conference and he tell you that it is released and you go their at the SIC and it is not...then you have to come to me and A.R.A and ask us to charge them attribute and bring the object to our database” ... But he argued, “No, but I can’t wait...” ...I replied, “But you have to wait...Why? Because as you don’t tell us and me bring it here, they will keep on changing things...(...) you “life insurance” against last-minute changes is let us to bring it here...(...) while I do not bring it here, registry in the SIC and release, you cannot work on it...that’s not because of me... that’s because if you work, it is subject to further change and you lose you work”(...)

(CNC) L.M.A.: Then I looked for D.C.C. and talk to him that in the meeting, at least in that part I participated, I believe the issue has been approached from the middle to the end, and then it looks that people did not make a connection.

(CNC) D.C.C.: Given that the system is already known.... So, my doubt is... if isn't it worth to gather the people in the room and give a refresh...

(CNC) P.R.W.: They are probably not looking at it...damn, such things are tough...

(CNC) D.C.C.: This explanation will not take long.

(CNC) P.R.W.: Will have to do this...

(...)

(CNC) L.M.A.: We wanted to work on structure that in reality is not up to be worked...

(CNC) P.R.W.: But it is ours..

(CNC) L.M.A.: Until this point is not... while they do not attribute it an we bring it here it is not...

(CNC) D.C.C.: Otherwise it is a big risk... we are trying to eliminate the risk...

(CNC) L.M.A.: The guys relapsed to him (in the meeting), but it was not ready... they run and finished the structure, added more things in that.. and he started to working onto something ... he bought the good faith of the guys (WP)... he cannot go on that...

(CNC) D.C.C.: He cannot go on that...

(CNC) P.R.W.: He cannot ... they change even what has already been released...

(CNC) L.M.A.: What is released that cannot change. Do you know why? Because we bring it to our database and it's game over... the structure disappears from their database... they cannot erase, copy, and change...

(CNC) P.R.W.: Ohhh.... That is the big advantage of the system... I talked so much to G.S.G.. do like this ... he did not and get fucked up... we are still fucked up because of this...

(CNC) D.C.C.: So the system has been assimilated by the owner there (WP), they understood, (...) they are doing just fine...So there is no way we can get out of the procedure...my suggestion is let's make a specific meeting to further clarify this...(Recorded meeting, 05th February 2010 – Author Translation)

During a first specific meetings, all Civil and Electrical coordinators where invited to receive a more detailed explanation of how the system worked to better directed its supervisors. Attracted my attention during this meeting P.D.J., a coordinator that left much of its relevance when WP-Houston members came to Brazil, has been critical of the system almost without having participation in the process of development and tests, nor had been hit by any of its benefits.

After the general reprimand and the meeting supervisors reinforced the use of the SIC control before looking into the model, what can be demonstrated by the e-mail below of 12th February 2010:

(CNC) P.R.W.,

For your information and action:

According to SIC – 2010FEB08, the platform of support for following exchangers are not release yet.

U-6310 BASE

P-6310001-BASE

PROPYLENE

U-6310	BASE	P-6310002-BASE	PROPYLENE
U-6310	BASE	P-6310005-BASE	ETHYLENE VAPORIZER

(CNC) L.Y.L.

Early March 2010, with the SIC methodology consolidated and operating accordingly, two initiatives towards knowledge reproduction take place.

In 3rd March 2010, S.P.H. (RMAN *de facto* project manager) caved into the pressure made by K.G. (RMAN official project manager) to adopt in the RMAN project a similar form of control as in the PDY project. The objective of RMAN project was to generate an updated 3D model of an old refinery in Manaus (northern state of Amazon) based on laser scanning measurements. This project was supposed to take 3 months but has heading to its seventh month completely out of control with no ending perspective¹³. As we could not involve directly with this task two professional have been sent to training. in order to learn the operation of the SIC system and try to implement it on RMAN.

As the knowledge embedded in the SIC system were very subtle and flexible (as all projects display different features), there was no such thing as an off-the-shelf procedure to be taken out and implemented. It was necessary to understand how it worked, appropriate what would be similar and adapt the rest. As such both training and explanations were based on the very essentials of 3D modeling and project control. Emphasis was in capturing the information flow, identify elements to be controlled and the key work processes to only them adapted the methodology to the new situation. Something that would certainly work immediately but we could assist in the development. Few weeks after the training, however, both young professionals required their bosses to reassign them to other tasks in other projects. This apparently happened due their lack of experience in working with “3D virtual environment”, to the critical situation in which the project find itself, and to the authoritative character of S.P.H. which did not abide to the idea of controls.

In the 5th March 2010, D.C.C. put forth the idea of disseminating the knowledge and the reflections obtained through the development of the project control system across the industry division in order to improve the project management prospects of CNC/WP. In a e-mail sent to R.F., CNC/WP production manager, and copied to S.P.H., D.C.C. makes acknowledgements and suggests the organization of a workshop dedicate to spread the knowledge developed:

(CNC) R.F.,

As required, follows topic suggestion to be approached in the requested Workshop (Workshop - PDMS Management). The material to be used is being prepared (...)

The focal point is the control instrument developed and implemented with recognized success within PDY (SIC – Scan & Inserction Control _ technically a control index) This control allows to precisely extract the state of the

¹³ RMAN Project ended in January 2011, with a 12 month delay. Despite hard negotiations and contract extensions given by Petrobras, this project brought a US\$ 1,5 million loss to CNC in contract fines and additional unpaid hour, almost the same value of the contract. Even though, S.P.H. has been hailed at top ranks as a company innovator due to implementation of laser scanning technology.

modeling work, in terms of physical progress, beyond helping in the planning work, eliminating subjectivities and objectively pointing deviations and helping management decision making.

Important to observe that the success of such work in PDY could only be reached through the dedication and effort applied upon this challenge by the engineers, A.R.A and L.M.A.

These two professionals are fully capacitated to disseminate this knowledge through the technical staff, as CNC/WP multiplication agents. It is also of fundamental importance has been the sponsorship of the PDY management, Eng. K.G., to the development of the system. (...)

(CNC) D.C.C.

In an e-mail sent two days later (7th March 2010) S.P.H. wrote:

Gentlemen,

It's a reason of proud, not only mine, but from the whole Piping team, have the work of these two young engineers recognized.

Once again congratulations, to both of you, and thank you very much.

(CNC) S.P.H.

By 9th of March 2010, 27 professionals from CNC/WP industry division were invited. Among them all discipline and project managers as well as project coordinators and key supervisors. The workshop was first dated to 22th of March and then to 5th April as the training room was requested by CNC/WP presidency. To our surprise however, F.R. required the workshop to be run from 4:00PM to 6:00PM and that one hour would be given by the company but the other would have to be compensated by each professional by extending in half-hour the exit time for as much as a week. During this time the number of people appointed to attend to the workshop grew up to 40 to include people of all ranks and we decided to split into two sessions with different focus, one on the 05th April and the other on the 12th April.

After all delays and inclusions the first workshop, on the 5th April, who was supposed to attract 20 people all project managers, project coordinators and discipline manager joined only 6 people (four discipline managers, and two coordination assistants). Apparently, R.F., who was supposed to sponsor the workshop, was busy with another meeting and did not mind to reinforce it to the attendance. Even tough, the presentation approached the fundamental concepts of project management used in approaching the PDY problem and to the development and consolidation of the SIC. In addition we proposed to extend the use of the SIC system towards the traditional problem of interdisciplinary interdependence.

Despite the strong argument that if the system had worked to coordinate the work between different disciplines across two different offices it could provide a much greater help to improve the local interdisciplinary workflow, discipline managers as a whole displayed little interest and received the idea with skepticism. They looked more concerned over practical problems like the lack of qualified personnel and who would pay for that implementation if they did not had hours enough even for the project work.

Particularly notable has been the oppositional stance of S.P.H., the piping manager, whose discipline traditionally had responsibility over all “3D virtual environment” work within projects ran by CNC. Along the presentation, he nodded negatively many times and seemed uneasy in his chair to show discontent and disagreement. He also argued that the system was no novelty since in other projects it was usual to measure the “3D virtual environment” to receive payments from Petrobras. Though we agreed that the very origin of the SIC was the “3D virtual environment” measurement practiced by Petrobras we explained it was a further development out of that and had a much important role in project management as we conceived. The concepts competition established helped to lift the complexity of the issue (which were not usual to the other participants) and further weaken the overall knowledge impact of the presentation.

During the second presentation, on the 12th April, dedicated to supervisors and higher technical staff, attendance was even lower. Only 5 people appeared and among them there were no key personnel. This time, in the presentation, we clearly differentiated model measurement from the SIC system to avoid further misunderstandings. The initiative was then abandoned by D.C.C., which could not hide his disappointment with the people lack of interest.

By 23rd March 2010, WP personnel in São Paulo begin their return to Houston. This same day, G.A. looked for me almost by the end of the day and said he almost did not have words to thank for such a warming and friendly stay, and added that I have been his first friend in Brazil and invited me to stay with his family anytime I went to Houston. The next day, R.F. to whom I had very few contact, also came and personally thank for the good time he spent in Brazil and said he enjoyed very much to work with all of us, and expected to come back someday for more. This feeling was been extended to several other Brazilian project colleagues. E.R.K. and S.J.L. also went across the floor thanking those people who had been more close to them.

Few weeks later, by 13th April 2010, WP-Houston personnel begin to be decommissioned from PDY towards other projects in other locations, as we can see in the e-mail below:.

(WP) L.H. – Understand your still in Houston and haven't left yet for the big sand box in Iraq. Safe travels & good luck Pal.

(WP) K.H.D. - Please let us know if there is anything additional needed from A.R.A. and team down here and if not, please forecast a completion date for the below listed activities.

Thanks,

(WP) L.S.J

I was particularly impressed by how good relationships with WP-Houston developed around the PDY project. The initial north-American distrust and the Brazilian oppositional stance progressively turned into a quite collaborative relationship. This two opposing forces neutralized each other when a stage of closer collaboration work began. The same way north-American distrust was met with energy and confidence on the Brazilian side, their pragmatic approach to the

problems, opened room for new ideas and firm commitment to agreed solutions no matter where they came from, what helped in the assimilation of Brazilian-led initiatives. This cordial and open aura grabbed even those team members which have never met, as shows de e-mail below:

13/04/2010

(CNC) L.M.A,

Please it is no bother. Please contact me anytime you have any questions or needs.

(WP) K.D.H.

(WP) K.D.H.

We are working on the 6310/6312 right now and I believe for these areas the scope is quite clear. I've instructed guys here that whenever the find object that are CNC but are eventually marked as WP to inform A.R.A. that will collect this information and send you at completion of these units to eliminate duplications, OK?!

We are running at 85% of our modeling work so we will make an extra effort to keep things as straightforward as possible and not bother you much until 10/May.

(CNC) L.M.A.

Also remarkable was that north-American managers did not missed a opportunity to congratulate over a good job and were polite enough to bring Brazilians into responsibility whenever necessary without damaging the relationship.

(CNC) C.C.

Really important for Jairo and team to stay on track and complete the other quadrants as forecasted.

Thank you,

(WP) L.S.J.

(E-mail 17th December 2009)

+++++

All,

Just FYI. All revised documents related to Auxiliary Units and Substations have been reviewed and approved by Petrobras (30/3) and will be issued into SIGEM by close of business today (1/4).

C.C. and team – Job well done, many thanks.

Regards,

(WP) L.S.J.

Very good!

Thanks to everyone.

(WP) L.H.E.

Project Director

(E-mail 1st April, 2010)

Parallel to those events, technical people lay-offs and mass departure continued as well as high level management hires. Two new superintends were hired (Sales and Finance) as well as the two employees in charge of human resources and technology information who previously just channeled CNC administrative problems to CCC resolution, were suddenly promoted to the status of managers and awarded with a considerable staff. The transition site has been launched bringing information about the changes underway, however, towards the middle and lower ranks nothing changed apart to the impression that CNC/WP administrative staff of the company benefited from the transition far more than technical one. More and more CNC/WP looked like a traditional company and not like the flat and technically advanced company it used to be. My personal impression at the time was that the good parts of CCC have left while bad ones remained and took over.

As the project approached its end, final adjustments had to be done in the SIC system to match all elements to its respective engineering documents and close out the job at 100%. Currently at 97%, the persistence of D.C.C. in enforcing some minor controls he created unilaterally, made it difficult to achieve 100% without direct participation of the supervisors what would hardly be achieved as they had already left the project. When D.C.C. realized his controls had been eliminated he became furious and shouted "*when you be in the coordination chair you can do what you want but now it's like this and it's enough!*" (Field Diary notes, 24th May 2010). We were surprised by his intransigence and mesmerized by his attitude, which did not fit into his behavior along the whole project. He urged A.R.A. to return it to the previous state and I was sidelined from further SIC discussions. It came to my mind how easy it was at that point to shout and impose ideas. How easy it was to be intransigent with problems 97% solved.

In 28th of May, all Civil modeling work has been completed and our participation in the PDY project has reached an end.

Gentlemen,

I inform that we finished we successfully finished in the programmed date the modeling Civil works of PDY.

To all in the team (quote the names) I thank the excellent job done.

Thank you all.

(CNC) L.M.A.

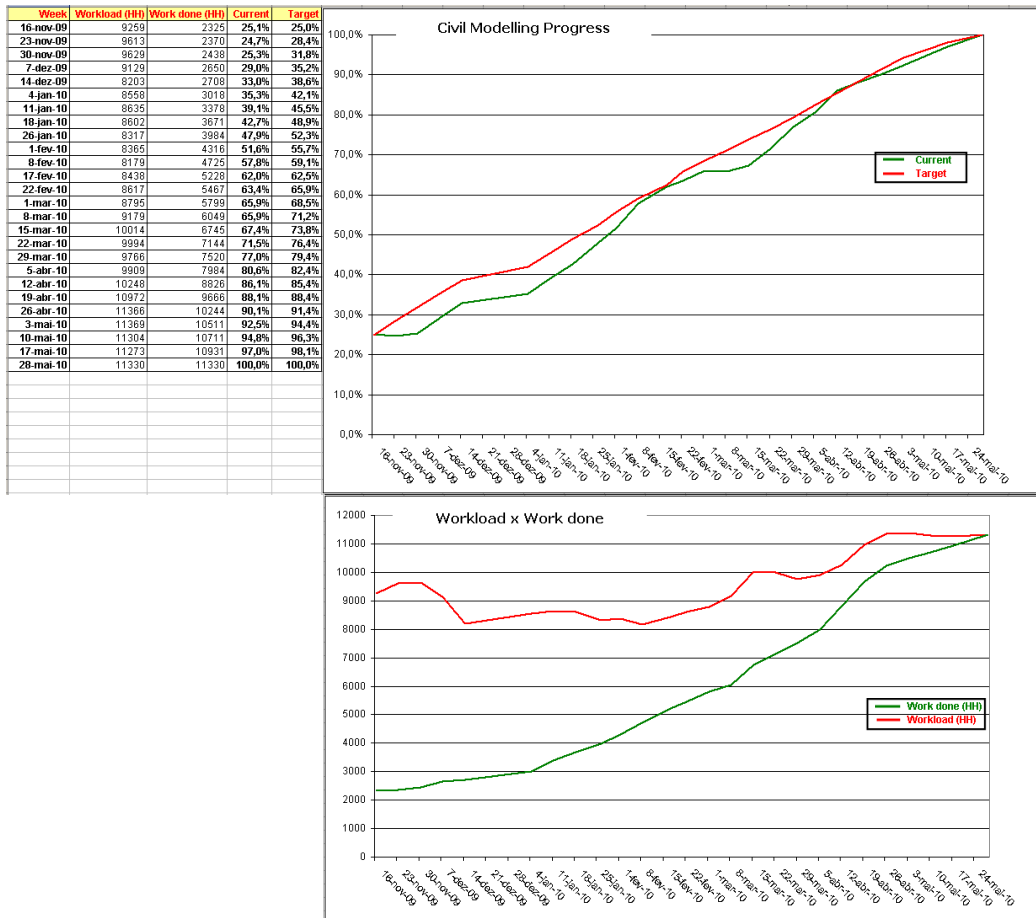


Fig. 49: 3D information turnover progress graphics as per 28th May 2010

In response K.G. sent the following e-mail to all PDMS team members with copy to all superiors involved:

Thank you all for the effort, and congratulations for the excellent work done.

(CNC) K.G.

In 20th may 2010, K.G. assumed his new assignment as head of the new Petrobras PRM Refinery proposal, again in a joint work with WP-Houston. He immediately required S.P.H. that I continued to work with him and assume the Piping and 3D design supervision of the proposal what was accepted. A.R.A went to RMAN project and D.C.C. also was also appointed as one of the coordinator in the proposal. With K.G. facing wealth problems and increasingly distanced from the proposal, communications abruptly broke up and the task force was dismissed. Due to my knowledge in another 3D design system (PDS) I was required to join the UNAS3 proposal by another project manager, T.D.

Two months later, during a routine examination, K.G. discovered he had lung cancer in advanced stage. He died 3 weeks later, in 2nd August 2010. With few supporters in the company and anticipating a lay-off, D.C.C. decided to leave for a competitor a few weeks later.

CHAPTER VII

UNA3 PROJECT

7.1- PROJECT OBJECT

UNA3 is planned to be the third nuclear power plant built by Eletrobras Eletronuclear in the Almirante Alvaro Alberto nuclear complex (CNAAA), located in Itaorna beach, municipality of Angra dos Reis (Rio de Janeiro state, Brazil). When ready, UNA3 will generate 1,405 Mw and together with its two older sisters (UNA1 and UNA2) will be responsible for most of the electricity available in the Rio de Janeiro state, the second most populous in Brazil.

The entrepreneurship also represents the full return of the Brazilian Nuclear Plan (PNB), which involves the construction of a nuclear submarine (together with France), the completion of a full capable uranium enrichment unit and the consolidation of a nuclear supply chain initiated with the creation of Nuclep, a heavy metal industry responsible for a considerable part of the equipment necessary for the construction of the nuclear equipment. UNA3 investment is estimated at US\$ 6,0 billion with almost US\$ 750 million already spent with earthwork preparations and equipment purchases prior to the project interruption in 1986.



Fig.50: UNA3 location (Source: Google Maps).

In early 80's, Eletrobras Eletronuclear divided UNA3 project into several bid packages to be publicly auctioned. In 1981, Andrade Gutierrez (a giant Brazilian construction conglomerate) was awarded the first block, a US\$ 780 million contract for civil construction. Works began on 1984, with foundation and drainage services which were interrupted two years later due to lack of public resources resulting from internal economic crisis, to doubts concerning the Brazilian energetic matrix and to the public concern resulting from the Chernobyl accident in April 1986.



Fig.51: UNA3 initial earthworks as per April 1986 (Source: www.eletronuclear.gov.br)

Several UNA3 equipments and materials have also been purchased from Siemens/KWU (now Areva), which was awarded with a EUR 770 million (US\$ 1.08 billion) contract to supply basic engineering, heavy equipment, control systems and specialized services. Other local heavy industry suppliers like Nuclep, Bardella and Confab also were awarded contracts for specific equipments. With the interruption of the project, imported equipments were stored facilities close to the construction site and kept under careful conservation at a cost of estimated in US\$20million a year.



Fig.52: UNA3 imported equipment storage and conservation (Source: www.eletronuclear.gov.br).



Fig.53: UNA3 important material and equipment storage and conservation (Source: www.eletronuclear.gov.br).

During 1998 to 2001, Eletrobras Eletronuclear did an intense lobby effort for the continuation of the UNA3 program, conducting several feasibility studies together with national and international entities. Parallel, it did a great effort to address all environmental and safety concerns involving the project. In July 2003, project debates restarted involving commissions of four Ministries (Mines & Energy, Planning, Science & Technology, and Environment). In 2005, a new environmental impact study has been submitted to IBAMA (Brazilian environmental protection agency) for preliminary approval.

In the late 2007, the intensification of economic growth in Brazil sparked fears of an imminent energetic disruption. With environmental licenses for hydroelectric plants increasingly difficult to obtain under new stricter environmental rules, projects with undergoing licensing processes were quickly brought back on table. Soaring energy prices, European (mainly France and Germany) interest in further providing technology and financing to the project and a nationalistic development push from the incumbent federal government converged into positive reevaluation of UNA3 and helped to accelerate its environmental licensing process.

In July 2008, a preliminary authorization for the plant construction has been issued and in March 2009, after an extensive renegotiation with Andrade Gutierrez, civil works were resumed. Early earthworks were adapted to the new environmental requirements and completed. Parallel, several awarded contracts were renegotiated among equipment and civil engineering suppliers. With the Brazilian economy weathering the economic turmoil of late 2008, and foreign companies increasingly eager to recover lost orders in the developed economies, the project plans were kept at full pace. In early 2010, a final construction license has been issued while Andrade Gutierrez had further advanced in the delicate foundation works for the plant core.



Fig.54: UNA3 foundation works as per July 2010 (Source: www.eletronuclear.gov.br).

In mid-2010, the international bidding processes for the rest of the project packages were also resumed. Among the large scale services to be auctioned were engineering (US\$370million), electromechanical assembly (US\$617million), and additional equipment purchases (US\$1.78billion). Engineering services were split in four bid packages: reactor (nuclear package), generator (non-nuclear package), utilities and off-sites. Worth US\$150million and requiring approximately 350.000 man-hours of engineering work, along estimated 6 years, taken its size only, the nuclear package was by far the most tempting one. Other project characteristics, however, made it even more interesting as engineering business opportunity: the bid format and the future business prospects.

First, alleging task complexity, Eletrobras Eletronuclear devised a bidding process with both price and technical criteria, limiting bidders to only those wealthy enough and with prior nuclear experience. However, UNA3 has been planned as a copy of UNA2 with only minor modifications to attend recent IAEA (International Atomic Energy Agency) requirements, what provided a considerable reduction in the risk and complexity involved in the project, thus embedding a premium in the contract. Not to mention that the technical criteria may as well accommodate a considerable level of subjectivity. Second, through Federal government sponsorship, Eletrobras Eletronuclear has plans of building 5 more nuclear power plants until 2025, all using the same technology of UNA2 and UNA3, increasing chances of further contracts and additional gains based on asset mass efficiencies.

7.2- PROJECT STAKEHOLDERS

7.2.1- The Client: Eletrobras Eletronuclear

The creation of Centrais Elétricas Brasileiras (Eletrobras) was proposed in 1954 by President Getúlio Vargas. The Bill faced opposition and was only passed after seven years in the National Congress. The company officially started on June 11, 1962, with the role of fostering studies, construction projects and operation of generating plants, transmission lines and substations designed to provide electric power to the country. The company decisively contributed to the expansion of electric power offer and development of the country. Institutional reforms and privatizations in the 90's caused the company to lose some of its functions and to have its profile changed. In this period, the company also started to operate, by legal and transitory order, in the distribution of electric power, through companies in some states. In 2004, new regulation of the sector excluded Eletrobras from the National Privatization Program (PND).

Nowadays, Eletrobras is a mixed economy and open capital stock corporation, with shares traded at São Paulo, Madrid and New York Stock Exchange. The Brazilian federal government is the controlling stockholder with 53,3% of voting stock, however only a 16% of non-voting stocking. Eletrobras has installed capacity to produce 39,453 MW, including 50% of the power of Itaipu plant belonging to Brazil, and has approximately 60,000 kilometers of transmission lines. It is also responsible for 37% of Brazil's total generation capacity, owing 29 hydroelectric plants, 15 thermoelectric plants and 2 thermonuclear plants (UNA1 and UNA2). Eletrobras controls six subsidiary companies, six distribution companies, the Electric Power Research Center (Eletrobras Cepel), Eletrobras Participações S.A. (Eletrobras Eletropar), 50% stake in Itaipu Binacional and many other minority participations in private electric generation and distribution companies. In 2010, the holding revenues reached US\$ 17.1 billion and profits US\$ 1.35 billion.



Fig.55: Eletrobras Holding structure (Source: www.eletronuclear.gov.br).

Eletrobras Eletronuclear is a wholly-owned subsidiary of Eletrobras Holding established in 1997 with the purpose of operating and building thermal nuclear power plants in Brazil. Eletrobras Eletronuclear originated from the merger of the two state-owned companies: the nuclear division of Furnas Centrais Eletricas S/A, responsible for UNA1 operation and for the construction of UNA2, with Nuclen – Nuclebras Engenharia S/A, the engineering company responsible for the technology employed in UNA2. The result was a vertical company capable of designing, constructing and operating nuclear power plants.

The history of Eletrobras Eletronuclear, however, is better understood through the developments of the Brazilian nuclear program (PNB), described by Kuramoto & Appoloni (2002). The program dates back to the 1930s, when scientists began researching nuclear fission, however, only after 1945 nuclear energy became a recurrent issue in Brazilian affairs. After World War II, North Americans were the only ones to hold the nuclear technology and by law were prohibited to exchange nuclear information with the rest of the world. At the same time U.S. needed access to radioactive material, which were abundant in Brazil, and, in 1946, an export agreement of radioactive material was established between the two countries.

The strategic importance of the nuclear energy was quickly understood by the military, who found in the Admiral Alvaro Alberto da Mota e Silva, a key interlocutor. In 1951, under his guidance, the nuclear research program was incorporated into the creation of the Research National Council (CNPq). He also tried to move ahead with a programme in which U.S. would compensate Brazil for radioactive material exports with technology transfer unsuccessfully. In 1953, the same Admiral Alvaro Alberto close a secret deal with Germany to purchase equipment necessary to developed uranium enrichment process, however, information leaks and the U.S. blocks the operation. In 1955, faced with the decision to exchange radioactive material with the U.S. for wheat, the Admiral resigns from CNPq.

In 1956, during the nationalist government of Juscelino Kubitschek, the debates about radioactive material exports start over again. He creates the National Council of Nuclear Energy (CNEN), agency linked to the Ministry of Sciences and Technology, to be responsible for planning and controlling nuclear activities in the country. In 1959, the first movements towards the construction of a nuclear reactor began restricted however by the availability of enriched material from which the country was dependent on the U.S.

In 1964, the military took the power and so the nuclear agenda. Four year later, CNEN signed a agreement with Furnas (a Eletrobras subsidiary) which became responsible for the construction of the first nuclear power plant (UNA1). In 1965, Brazil signed a nuclear cooperation agreement with the U.S. guaranteeing it a power plant. Putting aside nationalist plans, in 1971, the first nuclear reactor (PWR – Pressurized Water Reactor) was purchased from Westinghouse (U.S.) to use with imported enriched uranium. The contract, however, did not include any technology transfer. Construction began in 1972, but only in 1984 the plant started to operate

commercially. UNA1 construction and operation has been marked by a long trajectory of incidents and project mistakes. Several key imported equipments required to be changed and redesigned locally to overcome operational limitations. In 1974, the lack of support in the plant commissioning and the embargo of enriched uranium exports broke up nuclear cooperation with the U.S. It also resulted in a complete revision of the nuclear program towards a more nationalistic stance, with the objective of internally develop the complete nuclear power generation cycle.

In 1975, still under the military, a new nuclear agreement was signed with Germany. On the one side, there was the state-owned engineering company, Nuclebras, on the other, the German private company SIEMENS\KWU. The agreement included supply of equipments and technology to design, build and operate eight new nuclear power plants, two of them (UNA2 and UNA3) immediately. The agreement also included the transfer of the outdated jet-nozzle uranium enrichment technology in place of the more modern ultracentrifuge process. In exchange, Germany would have access to Brazilian uranium and open a captive market for its nuclear industry, which faced increasing scrutiny at home. Brazilian government was required to sign an agreement with IAEA to not use any this technology to build weapons.

The first power plant built under the Brazilian-German agreement was UNA2. Its civil works began on 1976, while construction itself started only in 1981. In 1983, due to intense economic crisis, its pace of construction has been delayed until total interruption. In 1991, government decided to resume construction but only in 1996 the electromechanical assembly began. UNA2 was finished only in 2000 (24 years after beginning) and became commercially operational in 2001. The nuclear fuel to be used in the two power plants would be enriched at certain level in the Nuclebras installations to a certain level and then sent to Germany or Canada for final enrichment.

In the late 1970s, with the jet nozzle nuclear enrichment program leading to frustrating results, Brazilian President Figueiredo (the last military one) approved a clandestine parallel nuclear program. Several research facilities were built to pursuit different technologies until the Navy, in 1987, reached the level of uranium enrichment necessary for power generation using a nationally developed technology based on allegedly smuggled German ultracentrifuges. After that, the Brazilian nuclear program underwent increased transparency as a direct result of the redemocratization process. During the 90's, the program stalled on the lack of financing, and only in 2007, under the presidency of Luis Inácio Lula, received substantial financing for conclusion. Nowadays the Navy program has split into a civil commercial enrichment plant in Resende (for local power plant supply and future exports) and a technological complex in Aramar to build a nuclear reactor for submarine propulsion.

Parallel to the development of the nuclear fuel problematic, Eletrobras Eletronuclear personnel struggled to improve the problematic operational performance of UNA 1 and set UNA2 into operation in an environment marked by lack of resources and hostility to the nuclear power generation and all that remembered the military

government. Nevertheless, the relative insulation and lack of resources helped to create a genuine national nuclear power capability at least concerning the PWR technology. After several improvements UNA2 capacity was extended in 10% and in 2008, UNA 2 was considered by WANO (World Association of Nuclear Operators) one of the ten most efficient power plants in the world.

Since UNA2 conclusion, in 2001, Eletrobras Eletronuclear dedicated its efforts to consolidate a favorable stance towards the construction of UNA3, what involved:

- Nuclear licensing;
- Environmental licensing;
- Feasibility studies;
- Renegotiation of prior contracts;
- Construction planning updates;
- Construction field preparation;
- Reference documentation updated;
- Definition of contractual marks;
- Control System specifications;
- Mechanical specifications;
- Electrical specifications;
- Software customization

(General Report 2007 excerpt – Author Translation. Source: Eletrobras Eletronuclear)

With a methodology of continuous improvement in mind and an increasingly confident staff it was a matter of time for the Eletrobras Eletronuclear to resume UNA3 project.

7.2.2- International Partner I: WP-Reading (U.S.)

Nuclear power in the United States is provided by 104 commercial reactors licensed to operate at 65 nuclear power plants, producing a total of 806.2 GWh of electricity, 19.6% of the nation's total electric energy generation in 2008.

The first nuclear power plant in U.S. started to operate in 1958, in Shippingport, Pennsylvania. Along two decades, from 1960 to 1970, construction boomed to make nuclear energy America's second largest source of energy, only exceeded by coal. However, concerns over its risks and the environmental damage caused by radioactive waste have led to a complete halt in its expansion. After the incident in Three Mile Island in 1978, no new nuclear power plants have been built in the U.S., and a considerable number have been decommissioned well before their design lifetime.

The decline of nuclear power in the U.S. let many specialized engineering companies adrift, competing for the remaining improvement and maintenance services with large corporations, like General Electric (BWR) and Westinghouse (PWR), which supplied key equipments and thus exerted firm controlled over the technical packages, restricting even more their working field. As such, these companies ended incorporated by other multidisciplinary engineering firms. It is against this background that the WP-Reading office has emerged.

The origins of WP-Reading office, dates back to 1906, when the engineering firm W.S. Barstow and Co. opens in New York. It is the in-house engineering arm for a group of power companies in the young electric-utility industry under the ownership of General Gas and Electric Co. William S. Barstow was an associate of Thomas Edison, and a pioneer in the history of electrical engineering. Barstow supervised the construction and operation of some of the first U.S. electrical power plants.

In 1917, Barstow opens an office in Reading starting with 20 employees to provide service to local power utilities. In 1933, following the retirement of Barstow, the firm's name is changed to E.M. Gilbert Engineering Corp. in honor of Ernest M. Gilbert, president and chief engineer. Gilbert established itself as the engineer of choice for the scores of companies and their successors that it had served under General Gas and Associated Gas. From 1940s into the 1970s, well before global economy became a buzzword, Gilbert's work was in demand on an international scale. Its divisions included utilities, environmental, industrial, construction services, operations, management consulting, quality assurance and computer applications.

In 1973, Gilbert acquires Commonwealth Associates to become the Gilbert/Commonwealth Associates employing more than 2000 people. In 1979, the accident at the Three Mile Island nuclear generating plant occurs. Gilbert had designed the Unit One reactor, the part not affected by the accident. Even though, the firm's profits plunge to US\$2.7 million from US\$9.0 million in the previous year. A subsequent increase in compliance-related work initially increases work for the company, roughly 60 percent of whose revenues were tied to nuclear-related plants, but ultimately has a negative effect as the nuclear-power industry declines in the United States. The firm's overreliance on nuclear-related work, a sector that had resulted in the tremendous expansion of its work force, left it ill-equipped to deal with the sudden decline in nuclear-plant construction in the United States and elsewhere.

In 1980, Gilbert attempts to diversify by buying non-engineering companies and venture itself into telecommunication business. The diversification however, fails and in 1995, Gilbert/Commonwealth Associates is sold to WP to form the WP-Reading office, nowadays considered excellence center of WP in nuclear energy.

7.2.3- International Partner II: WP-Sofia (Bulgaria)

In 1994, WP first venture in Bulgaria was made through its Reading (U.S.) office, which used an international team to carry on improvement studies for the Kozloduy nuclear plant. In 1998, WP established a permanent office in the country (WP-Sofia) to support the modernization process of the same plant, an investment worth US\$ 713million (EUR 492million). Starting from 2001, WP-Sofia conducted several modernization studies under EURATOM (European Atomic Energy Community) requirement. In 2003 it was also hired to carry on feasibility and environmental studies for the new Belene nuclear power plant, and in 2005 it was selected for its complete design and construction a 9 year long contract worth EUR 3.9 billion. In

2006, WP-Sofia has been awarded a contract for a feasibility study for the expansion of Mochove nuclear plant in Slovakia.

The office that had initially opened to attend a single contract and employed only 40 people (mostly foreigners) grew up to 200 permanent people in 2010. Although was conceived as operational platform of WP-Reading, WP-Sofia evolved into an independent multi-task unit, and nowadays is considered a key resource provider inside the WP group for nuclear power projects. The experience acquired with WP-Reading professionals allowed WP-Sofia to expand its engineering business over the Eastern Europe what resulted in several contracts and even a branch of its own in Bratislava (Slovakia).

WP-Sofia took advantage of the Bulgarian government limitation of a maximum of 10% of foreign employees to quickly build up its management and technical capabilities by hiring and training a considerable set of young engineer that today make up for 50% of its workforce. The relationship with WP-Reading is still alive and nowadays both offices are developing a joint project for SIEMENS in Belgium for a last generation combined cycle thermoelectric plant. In this opportunity several WP-Sofia technical staff went to the U.S. for six weeks of training in the most advanced project technology and currently many other visit the Reading office to follow the management meetings and decision processes that affect the remote work executed in Bulgaria. This new capability under development is expected to yield further businesses opportunities for the WP-Sofia in the coming years..

7.3- CASE CONTEXT

7.3.1- CNC/WP Debut

The period between PDY and UNA3 was a turbulent one for CNC/WP as the company struggled to fit into the new corporate structure. Management decoupling from daily activities reflected in the outcomes of events like the PRM bid and RMAN contract extension. CNC/WP debut as an effective WP entity happened in 26th of May 2010, by virtue of a Petrobras international bidding process requiring basic engineering and FEED services for two identical new oil refineries to be constructed in the northern Brazilian states of Maranhão and Ceará (PRM1 and PRM2).

Petrobras invited for the bidding process three international oil refining technology providers: UOP (U.S.), Chevron (U.S.) and Axens (France). As the bid required also basic engineering and FEED services, and none of them could provide the entire service package, consortia have been built around these three competitors. Under an international agreement, UOP invited WP-Houston to be the bid integrator and take part of the engineering service. WP-Houston following the partnership established during the PDY project, took CNC/WP as its local partner. Engineering estimation work has been divided like in the PDY project, WP-Houston with basic engineering and CNC/WP with FEED detailing. The UOP consortium also involved other international companies and their respective local partners in total of nine companies.

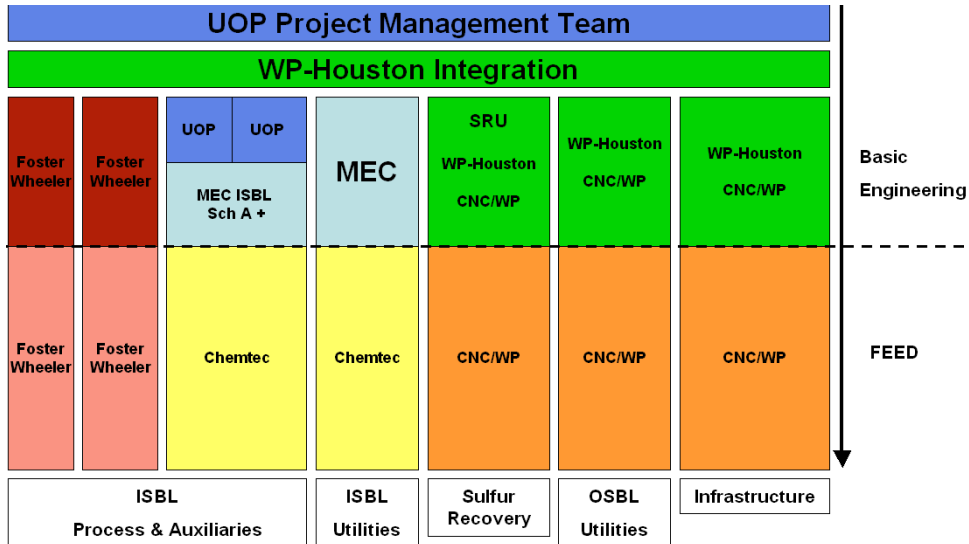


Fig.56: UOP consortium arrangement (Source: WP presentation)

Although CNC/WP team was composed by the same professionals that participated in the PDY project, the WP-Houston team was, with few exceptions, completely different. Initial contacts were marked by a competitive, almost hostile, stance on the part of WP-Houston technical staff, materialized in the watermark of WP-Houston kick-off presentation saying: *“when the experience counts”*. This was particularly problematic in this case because, due to budget limitations, there were few project management hours available, and thus, communication and arbitrations heavily relied on a peer-to-peer, less controllable basis.

Instead of providing the necessary information downstream for CNC/WP estimation, WP-Houston adopted a reactive stance in the information flow, well exemplified by the expression *“What do you want?”* used by the WP-Houston Civil leader to open the kick-off discussions. This lack of commitment to anticipated CNC/WP information needs resulted in fragmented, truncated and missing information what jeopardized CNC/WP estimation work.

Moreover, the FEED estimation in charge of CNC/WP depended on a considerable larger amount of definitions compared to the basic engineering estimation, up to WP-Houston. Most definitions were supposed to come from WP-Houston, which would hardly be able (or put an effort) to precise at that conceptual stage. In the absence of clear definitions coming from WP-Houston and UOP, instructions were to premise based on PDY. The fact that CNC/WP knew Petrobras far better than incumbent WP-Houston personnel translated into quite a different hours estimate than expected as it included several provisions. In a demonstration of distrust, WP-Houston technical staff took time to replicate CNC/WP estimation and arrived at less than half of expected hours.

Description	WBS5 UNIT	Technical Manhours Only			Description	WBS5 UNIT	Technical Manhours Only		
		CNC	WP				CNC	WP	
Telecoms Systems	5510	677	3.920	-3.243	Coke Storage	6821	11.242	8.315	2.927
	6210				Sulfur Storage	6822	12.256	571	11.685
Crude Oil	6311	13.970	4.600	9.370	Chemical	6825	3.515	1.015	2.500
	6319				Parking	8121	1.796	530	1.266
Finished Products	6315	18.486	6.517	11.969	Internal Access	8124	11.445	2.538	8.908
	6410				Admin Buildings	8210	4.301	1.530	2.771
Truck Loading	6420	8.141	0	8.141	Restaurant	8214	3.655	1.181	2.474
Proc & Util Intercon	6100	38.571	16.809	21.762	Medical Center	8215	2.144	1.103	1.041
	8270A				Telecoms Building	8217	3.022	1.425	1.598
Solid Waste	8270B	0	644	-644	Integ Control Center	8221	3.688	1.519	2.169
Ground System	5146	576	322	255	Lab	8222	4.524	1.175	3.349
Public Illumination	5149	961	418	544	Maint Workshop	8224	14.153	3.131	11.022
Heliport	2001	1.302	425	878	Warehouse	8226	6.552	2.170	4.382
	5142				EPC Buildings	8244	8.136	2.621	5.515
	5144				Environ, HSE Build	8320	2.728	1.267	1.461
	8251				Turnaround Area	8130	1.132	308	825
Substations	8252	71.475	26.754	44.721	Caustic Soda	6330	5.550	2.498	3.052
HVAC/Chiller Bldg	HVAC	2.898	1.113	1.785	Local Operator Bld	8600	1.861	910	951
Metering Stations	6250	5.317	4.456	861	Liquid Fuels Loading	Liquid	1.908	3.126	-1.218
Intermediates	6312	18.493	8.104	10.389	General		13.008	23.071	-10.063
					TOTAL		297.483	134.082	163.402

Fig.57: Hours per PRM1 unit estimated by CNC/WP (CNC) and WP-Houston (WP).

The divergence in the estimates exacerbated WP-Houston competitiveness, which turn into lecturing the Brazilian team in a harsh tone like shown in the e-mail next:

(CNC) X.A.C.

Per our conference discussion this morning am responding to the greenbelt and urbanization issues. Must state again that we only want to give Petrobras what they ask for and no more. We have to win first. This is a competitive bid and we can always request change orders when they ask for more.

Item 2.1.6 – Preliminary drawings for roads, paving, and urbanized areas. The main focus here is preliminary. You must define and show enough that a quantitative estimate can be done, but no great detail or small scale drawings. Simple and preliminary. Must also define as such.

2.1.22 – Description and Pre-specification of the Greenbelt – Need a general written description of the greenbelt design, philosophy and function, including use of native plants, no irrigation, and bio-swales to collect and detain water. Again note that it is a pre-specification.

2.1.23 – Preliminary drawings for Greenbelt-Distribution – Again it is preliminary. No small scale drawings, only large scale preliminary drawings.

2.1.24 - List of Quantities of Elements for Greenbelt – Only need a list with quantities/number of, or square meters of, planting materials. General and simple with native plants.

Did I mention preliminary, simple, no small scale, and to define what you are producing? Did you understand to clearly state what you are providing, which is not more than Petrobras is asking, and keep it short? Did I make it clear? Was I ambiguous? Was it kind of fuzzy? Am I not making sense? Clarify, win, change?

We call this the KISS method. Keep It Simple Stupid.

Thank you.

H.R.T.

Principal Architect

WP-Houston

(E-mail sent on, 24th June 2010, copied to WP-Houston discipline leader and project management – Exact transcription, sender highlights)

Project management on both sides had to intervene to control the situation and peer-to-peer communications were partially interrupted. CNC/WP was required to re-elaborate the estimations without allowing for provisions. As resulting numbers were still not satisfactory from WP-Houston point of view, project division was further modified to include new participants at expense of CNC/WP participation. Some important units under CNC/WP scope were claimed back by WP-Houston, while other were redirect to other sister offices like WP-Monrovia (California). In a critical moment of proposal consolidation, WP-Houston urged CNC/WP to give up on 30% of its remaining scope to open room for the participation of WP-Beijing (China).

In 5th of October, UOP was the selected as PRM technology provider in a contract estimated in more than US\$100million. UOP, however, turned its back to WP and decided to sub-contract GENPRO (an emerging local engineering company owned by the giant construction conglomerate Odebrecht) to assume the FEED package.

7.3.2- "Global Price Contracting" Current State of Knowledge.

Brazilian law (8.666/93) require that state-controlled enterprises shall contract engineering & construction (E&C) services beyond R\$ 1.5million (US\$1million) through a public bidding processes called "competition" (art.23-1:c). The competition is used for large-scale contracts and it runs largely in public in order to ensure the participation of all interested entities. It does not require previous registration of the proponents with the bidder, provided they accomplish with the requirements made explicit through the "bidding instructions" document.

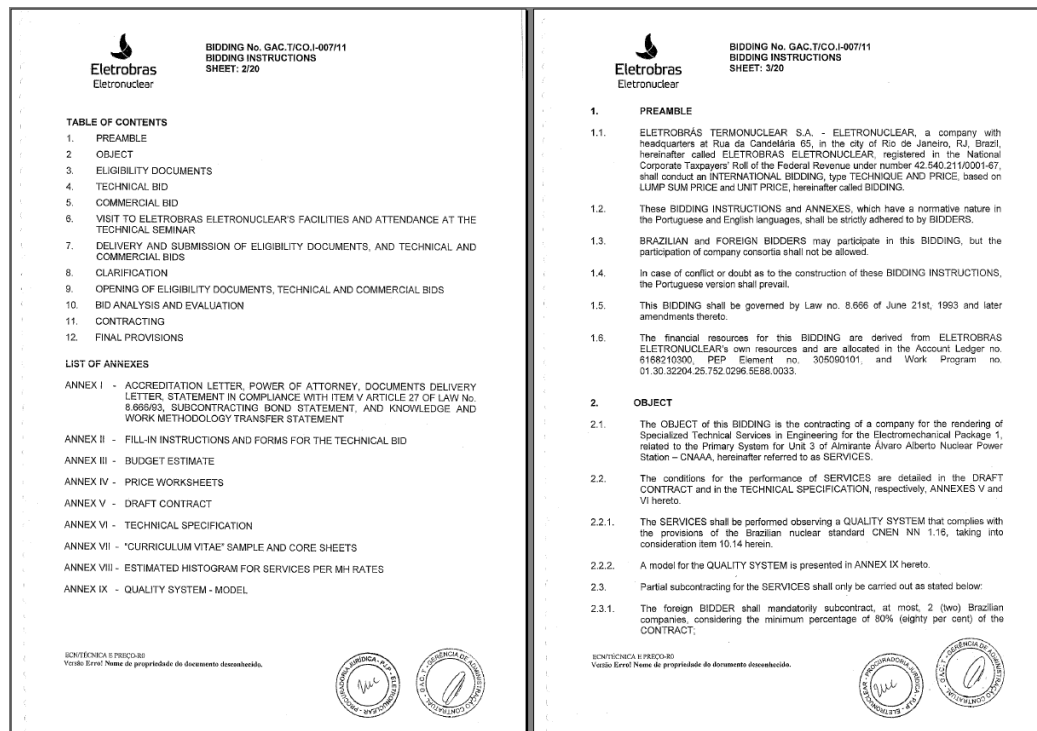


Fig.58: Bidding Instructions Document (Source: Eletrobras Eletronuclear).

The general judgment criterion for competitions is *smaller global price*. Under the specific conditions and requirement provided by the “bidding instructions” and through the examination of the technical documentation made available, competitors define a global price for the whole undertaking, and submit it to the contractor evaluation in a public session on due date. Among qualified offers, the cheapest one is declared winner and the others are made publicly.

In special cases and when justified, bidding process may involve judgment criteria different from *smaller global price*. *Best technique* is used for predominantly intellectual services such as calculations and preliminary technical studies. *Technique & price* is a combination of the last and take as judgment criterion a weighted relation between points obtained in both price and technical proposals, and under law 8666/93 is the obligatory criteria for the selection of IT services in state-controlled companies.

Although not directly restrictive to the participation of foreign companies, the law 8666/93 in its art. 42 require that, to allow foreign participation, bidding instructions shall comply with the directives of the “monetary authority, foreign commerce, competent entities” what does not always happens and end up blocking their participation if they do not have a official representation in the country. Therefore, *international bidding processes* are those specially designed to attract international participants even in the absence of a local representation. Usually, this happens when the number of local competitors is considered low in face of the bidding requirements.

Nevertheless, law 8666/93 in at least two of its articles displays a developmentalist bias that privileges Brazilian interests in detriment of foreign ones. In art. 3 § 2, it make provisions that in case of a draw preference should fall over made in Brazil (1^o), made by a Brazilian company (2^o), or made by a company which invest in research & development in the country (3^o). More important maybe is art. 3 § 5, which allow for the requirement of a variable percentage of national content in products and services supplied. That means, even though a foreign company win a bidding process contract may required it to generate its products and services locally. Alternatively, if a local company wins a determined contract it cannot further subcontract the services or products in the international markets.

On top of that, a common practice among Brazilian E&C companies make it even harder for foreign companies to win a competition. As the great majority of E&C competitions in Brazil involve *smaller global price* criteria and local content requirements of 70% on average (the remaining barely covers equipment imports), they usually are crowded out by non-traditional local players that drive prices down until such impractical level, that international companies unable to relocate the service to lower cost locations are forced out of the dispute. Once they win the competition with unrealistic prices, these non-traditional players usually run the contract until a “point-of-no-return” when, blaming on changing conditions or problems in the conceptual project, ask for contract extensions.

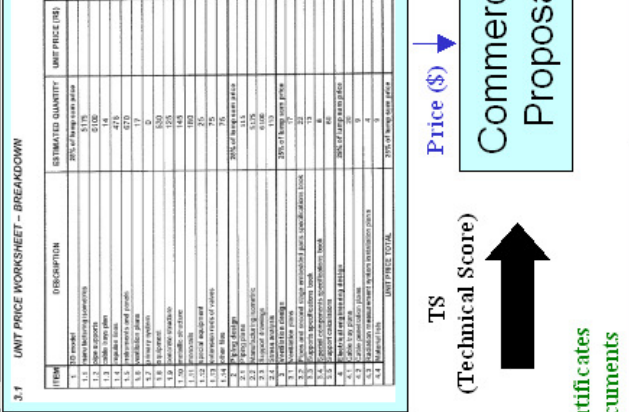
Another hardships that E&C companies face in doing business in Brazil, and these ones not limited to the public sector competitions, is the high level of operational flexibility required in the projects and the complex fiscal and labor institutional set. The first problem preclude international E&C companies from offering “closed packages”, that is, mature projects sold with minor changes to several clients, thus enabling the companies to reduce service prices through scale economies. Brazilian engineers require so much modifications to allow for a flexible and independent operation that “closed packages” end up being “taylor-made projects” with a substantial price increase. Second, its is very hard for an international E&C company to navigate in the fiscal and labor Brazilian institutional field without the help of a local company. The costs that this almost unavoidable partnership incurs usually reap a substantial part of its technical comparative advantage in relation to local E&C companies.

In the first rumors of UNA3 project reactivation, WP-Reading eagerly asked for a meeting with Eletrobras Eletronuclear (granted with CNC/WP help) to present WP nuclear expertise and to evaluate business prospects. After that meeting and while the bidding conditions were unknown, an initial arrangement was set that WP-Reading would lead eventual works supported by CNC/WP, which although did not have any nuclear engineering experience, was highly regarded in Eletrobras as it had designed most of its hydropowers.

However, when bidding instructions were finally disclosed conditions showed up more challenging. UNA3 competition has been conceived as an international bidding process, under a *technique & price* criteria and with a minimum national content requirement of 80%. The national content requirement represented a blow to WP-Reading ambitions, however, the technical evaluation criteria relentlessly tied it up to the venture. To compensate for the loss of attractiveness of the proposal for WP-Reading and the lack of nuclear credentials in CNC/WP, WP-Sofia office was brought into the task force to help in the proposal design.

Henceforth, although apparently plain and clear, bidding instruction implicitly embedded conflicting requirements that jeopardized the way WP traditionally handled proposals. These three offices had to engage into intense negotiations among themselves and other corporate entities in order to overcome the limitations imposed by the current WP way of doing business towards new standards that enabled a viable proposal.

UNA3 Competition Phases



ITEM	DESCRIPTION	ESTIMATED QUANTITY	UNIT PRICE [R\$]	TOTAL VALUE [R\$]
1.1	SEALING MATERIALS	5175		
1.1.1	SEALING MATERIALS	14		
1.1.2	SEALING MATERIALS	4715		
1.1.3	SEALING MATERIALS	117		
1.2	STEEL WORK	5		
1.2.1	STEEL WORK	1485		
1.2.2	STEEL WORK	32		
1.2.3	STEEL WORK	115		
1.2.4	STEEL WORK	4186		
1.2.5	STEEL WORK	37		
1.2.6	STEEL WORK	58		
1.2.7	STEEL WORK	13		
1.2.8	STEEL WORK	46		
1.2.9	STEEL WORK	68		
1.2.10	STEEL WORK	9		
1.2.11	STEEL WORK	5		
1.2.12	STEEL WORK	9		
1.2.13	STEEL WORK	6		
1.2.14	STEEL WORK	8		
1.2.15	STEEL WORK	5		
1.2.16	STEEL WORK	5		
1.2.17	STEEL WORK	6		
1.2.18	STEEL WORK	7		
1.2.19	STEEL WORK	9		
1.2.20	STEEL WORK	10		
1.2.21	STEEL WORK	11		
1.2.22	STEEL WORK	12		
1.2.23	STEEL WORK	13		
1.2.24	STEEL WORK	14		
1.2.25	STEEL WORK	15		
1.2.26	STEEL WORK	16		
1.2.27	STEEL WORK	17		
1.2.28	STEEL WORK	18		
1.2.29	STEEL WORK	19		
1.2.30	STEEL WORK	20		
1.2.31	STEEL WORK	21		
1.2.32	STEEL WORK	22		
1.2.33	STEEL WORK	23		
1.2.34	STEEL WORK	24		
1.2.35	STEEL WORK	25		
1.2.36	STEEL WORK	26		
1.2.37	STEEL WORK	27		
1.2.38	STEEL WORK	28		
1.2.39	STEEL WORK	29		
1.2.40	STEEL WORK	30		
1.2.41	STEEL WORK	31		
1.2.42	STEEL WORK	32		
1.2.43	STEEL WORK	33		
1.2.44	STEEL WORK	34		
1.2.45	STEEL WORK	35		
1.2.46	STEEL WORK	36		
1.2.47	STEEL WORK	37		
1.2.48	STEEL WORK	38		
1.2.49	STEEL WORK	39		
1.2.50	STEEL WORK	40		
1.2.51	STEEL WORK	41		
1.2.52	STEEL WORK	42		
1.2.53	STEEL WORK	43		
1.2.54	STEEL WORK	44		
1.2.55	STEEL WORK	45		
1.2.56	STEEL WORK	46		
1.2.57	STEEL WORK	47		
1.2.58	STEEL WORK	48		
1.2.59	STEEL WORK	49		
1.2.60	STEEL WORK	50		
1.2.61	STEEL WORK	51		
1.2.62	STEEL WORK	52		
1.2.63	STEEL WORK	53		
1.2.64	STEEL WORK	54		
1.2.65	STEEL WORK	55		
1.2.66	STEEL WORK	56		
1.2.67	STEEL WORK	57		
1.2.68	STEEL WORK	58		
1.2.69	STEEL WORK	59		
1.2.70	STEEL WORK	60		
1.2.71	STEEL WORK	61		
1.2.72	STEEL WORK	62		
1.2.73	STEEL WORK	63		
1.2.74	STEEL WORK	64		
1.2.75	STEEL WORK	65		
1.2.76	STEEL WORK	66		
1.2.77	STEEL WORK	67		
1.2.78	STEEL WORK	68		
1.2.79	STEEL WORK	69		
1.2.80	STEEL WORK	70		
1.2.81	STEEL WORK	71		
1.2.82	STEEL WORK	72		
1.2.83	STEEL WORK	73		
1.2.84	STEEL WORK	74		
1.2.85	STEEL WORK	75		
1.2.86	STEEL WORK	76		
1.2.87	STEEL WORK	77		
1.2.88	STEEL WORK	78		
1.2.89	STEEL WORK	79		
1.2.90	STEEL WORK	80		
1.2.91	STEEL WORK	81		
1.2.92	STEEL WORK	82		
1.2.93	STEEL WORK	83		
1.2.94	STEEL WORK	84		
1.2.95	STEEL WORK	85		
1.2.96	STEEL WORK	86		
1.2.97	STEEL WORK	87		
1.2.98	STEEL WORK	88		
1.2.99	STEEL WORK	89		
1.2.100	STEEL WORK	90		
1.2.101	STEEL WORK	91		
1.2.102	STEEL WORK	92		
1.2.103	STEEL WORK	93		
1.2.104	STEEL WORK	94		
1.2.105	STEEL WORK	95		
1.2.106	STEEL WORK	96		
1.2.107	STEEL WORK	97		
1.2.108	STEEL WORK	98		
1.2.109	STEEL WORK	99		
1.2.110	STEEL WORK	100		
1.2.111	STEEL WORK	101		
1.2.112	STEEL WORK	102		
1.2.113	STEEL WORK	103		
1.2.114	STEEL WORK	104		
1.2.115	STEEL WORK	105		
1.2.116	STEEL WORK	106		
1.2.117	STEEL WORK	107		
1.2.118	STEEL WORK	108		
1.2.119	STEEL WORK	109		
1.2.120	STEEL WORK	110		
1.2.121	STEEL WORK	111		
1.2.122	STEEL WORK	112		
1.2.123	STEEL WORK	113		
1.2.124	STEEL WORK	114		
1.2.125	STEEL WORK	115		
1.2.126	STEEL WORK	116		
1.2.127	STEEL WORK	117		
1.2.128	STEEL WORK	118		
1.2.129	STEEL WORK	119		
1.2.130	STEEL WORK	120		
1.2.131	STEEL WORK	121		
1.2.132	STEEL WORK	122		
1.2.133	STEEL WORK	123		
1.2.134	STEEL WORK	124		
1.2.135	STEEL WORK	125		
1.2.136	STEEL WORK	126		
1.2.137	STEEL WORK	127		
1.2.138	STEEL WORK	128		
1.2.139	STEEL WORK	129		
1.2.140	STEEL WORK	130		
1.2.141	STEEL WORK	131		
1.2.142	STEEL WORK	132		
1.2.143	STEEL WORK	133		
1.2.144	STEEL WORK	134		
1.2.145	STEEL WORK	135		
1.2.146	STEEL WORK	136		
1.2.147	STEEL WORK	137		
1.2.148	STEEL WORK	138		
1.2.149	STEEL WORK	139		
1.2.150	STEEL WORK	140		
1.2.151	STEEL WORK	141		
1.2.152	STEEL WORK	142		
1.2.153	STEEL WORK	143		
1.2.154	STEEL WORK	144		
1.2.155	STEEL WORK	145		
1.2.156	STEEL WORK	146		
1.2.157	STEEL WORK	147		
1.2.158	STEEL WORK	148		
1.2.159	STEEL WORK	149		
1.2.160	STEEL WORK	150		
1.2.161	STEEL WORK	151		
1.2.162	STEEL WORK	152		
1.2.163	STEEL WORK	153		
1.2.164	STEEL WORK	154		
1.2.165	STEEL WORK	155		
1.2.166	STEEL WORK	156		
1.2.167	STEEL WORK	157		
1.2.168	STEEL WORK	158		
1.2.169	STEEL WORK	159		
1.2.170	STEEL WORK	160		
1.2.171	STEEL WORK	161		
1.2.172	STEEL WORK	162		
1.2.173	STEEL WORK	163		
1.2.174	STEEL WORK	164		
1.2.175	STEEL WORK	165		
1.2.176	STEEL WORK	166		
1.2.177	STEEL WORK	167		
1.2.178	STEEL WORK	168		
1.2.179	STEEL WORK	169		
1.2.180	STEEL WORK	170		
1.2.181	STEEL WORK	171		
1.2.182	STEEL WORK	172		
1.2.183	STEEL WORK	173		
1.2.184	STEEL WORK	174		
1.2.185	STEEL WORK	175		
1.2.186	STEEL WORK	176		
1.2.187	STEEL WORK	177		
1.2.188	STEEL WORK	178		
1.2.189	STEEL WORK	179		
1.2.190	STEEL WORK	180		
1.2.191	STEEL WORK	181		
1.2.192	STEEL WORK	182		
1.2.193	STEEL WORK	183		
1.2.194	STEEL WORK	184		
1.2.195	STEEL WORK	185		
1.2.196	STEEL WORK	186		
1.2.197	STEEL WORK	187		
1.2.198	STEEL WORK	188		
1.2.199	STEEL WORK	189		
1.2.200	STEEL WORK	190		
1.2.201	STEEL WORK	191		
1.2.202	STEEL WORK	192		
1.2.203	STEEL WORK	193		
1.2.204	STEEL WORK	194		
1.2.205	STEEL WORK	195		
1.2.206	STEEL WORK	196		
1.2.207	STEEL WORK	197		
1.2.208	STEEL WORK	198		
1.2.209	STEEL WORK	199		
1.2.210	STEEL WORK	200		
1.2.211	STEEL WORK	201		
1.2.212	STEEL WORK	202		
1.2.213	STEEL WORK	203		
1.2.214	STEEL WORK	204		
1.2.215	STEEL WORK	205		
1.2.216	STEEL WORK	206		
1.2.217	STEEL WORK	207		
1.2.218	STEEL WORK	208		
1.2.219	STEEL WORK	209		
1.2.220	STEEL WORK	210		
1.2.221	STEEL WORK	211		
1.2.222	STEEL WORK	212		
1.2.223	STEEL WORK	213		
1.2.224	STEEL WORK	214		
1.2.225	STEEL WORK	215		
1.2.226	STEEL WORK	216		
1.2.227	STEEL WORK	217		
1.2.228	STEEL WORK	218		
1.2.229	STEEL WORK	219		
1.2.230	STEEL WORK	220		
1.2.231	STEEL WORK	221		
1.2.232	STEEL WORK	222		
1.2.233	STEEL WORK	223		
1.2.234	STEEL WORK	224		
1.2.235	STEEL WORK	225		
1.2.236	STEEL WORK	226		
1.2.237	STEEL WORK	227		
1.2.238	STEEL WORK	228		
1.2.239	STEEL WORK	229		
1.2.240	STEEL WORK	230		
1.2.241	STEEL WORK	231		
1.2.242	STEEL WORK	232		
1.2.243	STEEL WORK	233		
1.2.244	STEEL WORK	234		
1.2.245	STEEL WORK	235		
1.2.246	STEEL WORK	236		
1.2.247	STEEL WORK	237		
1.2.248	STEEL WORK	238		
1.2.249	STEEL WORK	239		
1.2.250	STEEL WORK	240		
1.2.251	STEEL WORK	241		
1.2.252	STEEL WORK	242		

7.3.3- Entering the Field

The first contact with the UNA3 problematic happened during a technical visit to CNC/WP of a senior WP staff, in March 2010. Followed by C.C., he came to my desk so as to verify CNC/WP expertise in working with 3D design. We showed him some aspects of the PDY work done using PDMS and also discussed about CNC/WP expertise in another 3D plant design system, called PDS¹⁴. As he showed interest in CNC/WP 3D design capabilities, I recommended them to visit RMAN project to check for the use of laser-scanning technology, which was at a quite advanced stage. After the brief meeting and without further explanations he handed me a visit card where I could read: G.L.G., Vice-President, Director of Nuclear Projects, WP-Reading.

After a few weeks, S.P.H. asked for a private conversation as described in the field notes below:

(...) He asked me it would be technically possible to develop a tool capable of creating PDS 3D models directly out of 2D paper drawings. I argued that it would not be possible due to fundamental information limitations existing in 2D drawings. He replied that he said that in a meeting and people (that I interpreted as being WP-Reading) insisted that indeed there was a tool capable of that. I contested saying that indeed, PDS had a tool capable of reading binary data and converted it to 3D models, however, no way these binary data could be extracted out of 2D drawings. He said he knew that. I continued and said if such tool existed it would be the "philosopher's stone" of project engineering and I would love to see how it worked. He agreed. Then he asked me to keep in complete secret and told me that as something about UNA3. I thought there was something about the WP-Reading visit I joked and said that the only tool capable of turning 2D drawings into 3D models where a huge Chinese team of designers, reading and manually modeling. As we discussed a top CNC/WP sales manager passed by and questioned S.P.H. that at that point he could not talk to me about the subject and he left. I have the impression that WP-Reading is promising something "magic" to Eletrobras Eletronuclear in order to reap the job in the name of CNC/WP and send it to WP-Beijing as it is trendy nowadays. (...) (Field Diary, 29th April 2010).

The same day, I and S.P.H. were required to meet T.D., the project manager in charge of the issue, to receive further information.

(...) T.D. told that UNA3 bid was about to come out and he needed to estimate hours to establish a PV (sales price) for such a project. He said he did not have bidding instructions yet, however, he would send us a spreadsheet containing a list of services to be done and their quantities for estimation. We both argued that it would be difficult to evaluate that without further information about the characteristics of the project and the tools to be used. T.D. confirmed the rumors about the "magic" tool and said that he had inside information (from Eletrobras Eletronuclear) that it existed and we should consider that it worked because it would be supplied by Eletrobras Eletronuclear who had developed it. (...) (Field Diary, 29th April 2010).

In the end of the day, a unidentified spreadsheet was sent us me and S.P.H. and planning department personnel.

¹⁴ PDS is a proprietary system of the American softwarehouse INTERGRAPH Corp. (<http://www.intergraph.com>)

	A	B	C	D	E	F	G	H	I	J	K	L	M
1			LUMP SUM						UNIT PRICE BY DELIVERABLES				
2			Quantity (unit)	HH Est.	Unit price (R\$)	Total price (R\$)	Unit price (HH)			Quantity (unit)	Unit price (R\$)	Total price (R\$)	Unit price (HH)
3							140,00						140,00
4	1	Office installation, mobilization, training, network installation, installation of data processing hardware and software, and implementation of OM system	NA						1				
5	2	3D modeling							2	25% da quant			
6	2.1	fabrication isometrics	20700						2.1	5175			
7	2.2	pipe supports	24400						2.2	6100			
8	2.3	cable tray plan	55						2.3	14			
9	2.4	impulse lines	1910						2.4	478			
10	2.5	instruments and junction boxes	2680						2.5	640			
11	2.6	ventilation plans	67						2.6	17			
12	2.7	primary circuit	1						2.7	0			
13	2.8	components	2120						2.8	530			
14	2.9	concrete structure	500						2.9	125			
15	2.10	steel structure	580						2.10	145			
16	2.11	monorails	720						2.11	180			
17	2.12	special equipment	100						2.12	25			
18	2.13	valve extension stems	300						2.13	75			
19	2.14	other models	300						2.14	75			
20	3	Piping design							3	25% da quant			
21	3.1	Piping plans	460						3.1	115			
22	3.2	fabrication isometrics	20700						3.2	5175			
23	3.3	Support drawings	24400						3.3	6100			
24	3.4	Stress analysis	450						3.4	113			
25	4	Ventilation design							4	25% da quant			
26	4.1	Ventilation plans	67						4.1	17			
27	4.2	2nd stage embedment pipes book	85						4.2	22			
28	4.3	Support book	50						4.3	13			
29	4.4	Special component book	24						4.4	6			
30	4.5	Support calculations	240						4.5	60			
31	5	Electrical design							5	25% da quant			
32	5.1	Cable tray plans	80						5.1	20			
33	5.2	Cable penetration plans	35						5.2	9			
34	5.3	Radiological measurement system installation drawings	15						5.3	4			
35	5.4	Materials list	35						5.4	9			
36		TOTAL								TOTAL			
37													

Fig. 60: Initial man-hour estimation spreadsheet.

Through the night I worked on a very detailed man-hour estimation taking into consideration several premises according to what was said by T.D., and sent it to S.P.H. for evaluation. The next day he answered me as follows:

(CNC) L.M.A.,

Very good work. Congratulations.

Estimate is a little lower, maybe I won't do a new one and take advantage of yours with a few corrections. When I finish, I'll send it to T.D. and copy you.

Thanks,

(CNC) S.P.H.

(E-mail sent on, 01st May 2010 - Author Translation)

While I was wondering based in which assumptions he thought it was "a little lower", he sent another e-mail correcting:

(CNC) L.M.A.,

Disconsider the comment "a little lower", I saw the value (...) and I thought it was for (...) but I think it is just for (...), is it?(...)

Thanks,

(CNC) S.P.H.

(E-mail sent on, 03rd May 2010 - Author Translation)

The very same day he complemented the spreadsheet and sent it to T.D. copying me. Only minor changes were made concerning professional category distribution but changes in the overall estimate were almost imperceptibly. No further movement happened until 1st June 2011 when bid instructions were finally disclosed by Eletrobras Eletronuclear.

7.4- THE KNOWLEDGE CHANGE PROCESS

7.4.1- Current Knowledge Resilience

In 7th June 2011, T.D. set up a meeting with R.M.Z. (project coordinator), G.H. (electrical discipline manager), A.G.R. (senior planning analyst), S.P.H. and I, to resume proposal activities. He required that all participants should read the bidding instructions and adjust their estimates as well as bring the doubts to the next meeting. All should be done as fast as possible because estimates should be submitted to WP for comments. As S.P.H. was already working in other refining proposals and UNA3 showed up a very heavy workload (more than 150 pages of thoroughly reading) he was forced to step aside and let me ran this estimate review. Nevertheless, again, he urged to check the results prior to T.D. release.

The next day, the complete bidding instructions were made available and the uncertainty regarding competition rules finally began to fade. In the first step of the UNA3 bidding, companies were required to comply with the “eligibility documents” which set the level playing field of the competitors. To have their proposals considered, proponents should fulfill certain financial and technical conditions. It was required to show evidence of net equity position (assets minus liabilities) of at least R\$15million (US\$ 10million) and evidence of holding at least one large scale project of at least 250.000 man hours (a full sized refinery). Since there were no such large contracts in Brazil for almost 20 years, these two requirements completely ruled out the participation of non-traditional local engineering players.

- 3.8.5. *Evidence that it possesses Net Assets of at least R\$ 15.000.000,00 (fifteen million reais).*
- 3.9.2. *Submit certificate that expressly and clearly prove that the BIDDER, as main contractor, has already performed multidisciplinary engineering design detailing services in a large project such as: electrical power generation, chemical or petrochemical industry, ore processing facility or cellulose and paper plant, including support during construction phase and using an amount equal to or bigger than 250,000.00 man-hours in a single project, considering in this amount at least 200,000.00 man-hours for design.*

Fig.61: Eligibility requirements (Source: Eletrobras Eletronuclear).

The bidding process divided into “technical bid” and “commercial bid”, with considerable higher weight for the technical criteria (75%) over commercial ones (25%).

- 10.12. *For the judgement of this BIDDING, an EVALUATION FACTOR (FA) shall be set for each BIDDER, according to the following formula:*

$$FA = 7,5 IT + 2,5 IP, \text{ where:}$$

FA = Evaluation Factor;
IT = Technical Index
IP = Price Index

Fig.62: Bid weighing (Source: Eletrobras Eletronuclear).

Despite the fact that a higher weight of the technical criteria strengthen WP-Reading role, a strict national content requirement of 80%, represented a blow to its leadership ambitions and placed CNC/WP at the forefront of the proposal.

- 2.3.1. The foreign BIDDERS shall mandatorily subcontract one Brazilian company, considering the minimum percentage of 80% (eighty per cent) of the SERVICES;
- 2.3.1.1. The SERVICES shall be entirely performed in Brazil and the foreign BIDDERS undertakes the formal responsibility to pass on to the Brazilian subcontracted company the knowledge and work methodology related to the nuclear projects during the whole contractual term and on the foreign BIDDERS's full responsibility, as per item 6 of ANNEX I hereto.
- 2.3.2. The Brazilian BIDDERS can subcontract one foreign company up to the limit of 20% (twenty per cent) of the value of the SERVICES.
- 2.3.2.1. The SERVICES shall be entirely performed in Brazil upon full responsibility of the Brazilian BIDDERS.
- 2.3.3. The remittance of amounts abroad shall be limited to the maximum percentage of 20% (twenty per cent) of the value of the SERVICES.

Fig.63: Execution requirements (Source: Eletrobras Eletronuclear).

Nevertheless, the criteria set for awarding technical points, relentlessly tied WP-Reading to the proposal as it put company's experience and staff experience as the most valuable item in the scorecard (fig. 64, in red). WP-Reading walking-out would mean the end of the proposal for both offices and an opportunity lost for the whole company.

In order to prepare and submit the TECHNICAL BID, the BIDDERS shall take into consideration the following items:

- ✓ Company's Experience
- ✓ Technical Staff's Experience
- ✓ Technical Staff's Fidelity
- ✓ Quality System
- ✓ Expertise on the Object
- ✓ Methodology and Work Plan
- ✓ Organizational Structure
- ✓ Knowledge and Work Methodology Transfer Plan
- ✓ Subcontracting Percentage

2.9. SCORING CRITERIA

In relation to Expertise on the Object, Methodology and Work Plan, and Organizational Structure, Bids shall be examined based on the thorough analysis carried out by the Special Bidding Commission of each item of the mentioned topics.

1.1. COMPANY'S EXPERIENCE

In order to demonstrate its COMPANY'S EXPERIENCE, the BIDDERS shall submit at least one of the following documents:

- 1.1.1. Design Engineering Services Performance Certificate, as required in item 3.9.2 herein, including items 3.9.2.1, 3.9.2.2, 3.9.2.3 and 3.9.2.4. If two or more documents are presented, they have to be different concerning the type of project, but they may be the same Certificates presented with the ELIGIBILITY DOCUMENTS;
- 1.1.2. Mechanical, electrical and I&C design engineering Services Performance Certificate, considering at least 75,000 man-hours in one large project, as provided in item 3.9.2 herein;
- 1.1.3. Supporting Engineering Services Performance Certificate during construction and/or mechanical, electrical and I&C erection and commissioning, considering at least 25,000 man-hours in one large project, as provided in item 3.9.2 herein.
- 1.1.4. Design Services Performance Certificate for a thermonuclear power generation project, with installed (gross) output equal to or bigger than 450 MWe, in one project comprising:
 - 1.1.4.1. project electrical design, including auxiliary systems, considering the use of at least 25,000 man-hours in total;
 - 1.1.4.2. project mechanical design, including piping, considering the use of at least 25,000 man-hours in total;

COMPANY'S EXPERIENCE - N1

COMPANY'S EXPERIENCE shall be scored according to the number of Certificates submitted by the company, also taking into consideration, for items 1.1.1 through 1.1.3 herein, the attributes "nuclear" (N) and "non-nuclear" (NN) related to the services performed, as presented in the table below:

ITEM	POINTS PER NUMBER OF CERTIFICATES					
	01		02		≥ 03	
	NN	N	NN	N	NN	N
1.1.1	7	12	14	24	26	36
1.1.2	6	8	12	16	18	24
1.1.3	4	5	8	10	12	15
1.1.4.1	2		6			10
1.1.4.2	2		6			10
1.1.4.3	2		6			10
1.1.4.4	1		3			5
1.1.4.5	1		3			5
1.1.4.6	1		3			5


Fig.64: Technical Scoring Criteria (Source: Eletrobras Eletronuclear).

This set of rules completely jeopardized the initial structure planned by WP for the proposal and eventual venture. The initial plan, which involved WP-Reading leadership and CNC/WP support, reverted into CNC/WP leadership and WP-Reading support. However, due to technical point awarding criteria, it was necessary to keep WP-Reading formally as leader of the proposal even though in the future it would both have a subdued role and be forced to create a corporate competitor. WP-Reading reacted stepping aside and tried to enroll only into minor documental

support for the proposal. CNC/WP, however, needed more help as a considerable number of technical points were to be awarded for technical documents (write-ups) describing in details how the proponent would run the undertaking (fig. 64, in green), something it thought would heavily rely on WP-Reading.

The thoroughly reading of the bidding instructions helped to further understand the scope of the work and demonstrated that most of the project involved redesigning UNA2 into “3D virtual environment” and then adapt it to UNA3 requirements. In terms of man-hours estimate, it meant that project automation knowledge alone would be much more important in price terms than the sum of all other technical knowledge. In the UNA 3 competition, project automation comprised 60% of the work, against only 25% of piping project, very different from traditional work distribution (15% for project automation and 40% for piping project).

Despite of the information supplied by the bidding instructions, a great uncertainty still surrounded many tasks, as CNC/WP did not have any nuclear engineering experience. Even more problematic, Eletrobras Eletronuclear used proper methods and terms which were unknown to even to experienced people enrolled in the company. Therefore, the expected costs for each activity helped understand the level of complexity of the unknown activities what helped in the inference of what they would be and further enhance CNC/WP estimates.




BIDDING No. GAC.Y/CO.1/04/10
BIDDING INSTRUCTIONS – ANNEX III
SHEET: 3/8

1. SUMMARY WORKSHEET

ITEM	DESCRIPTION	VALUE – R\$
1.1	Lump Sum Price Worksheet	R\$ 60.664.316,64
1.2	Unit Price Worksheet	R\$ 11.003.337,38
1.3	Unit Prices Based on MH Rates Worksheet	R\$ 85.082.058,16
ESTIMATED TOTAL VALUE		R\$ 156.749.702,18

1.1 LUMP SUM PRICE WORKSHEET

ITEM	DESCRIPTION	PRICE (R\$)
1	Rendering of engineering services based on LUMP SUM PRICE for the office setting up, mobilization, training, installation of the network, equipment and software, and the implementation of the Quality Assurance system for the development of 3D modeling, piping, ventilation and electrical engineering design. (A)	4.163.329,69
2	Rendering of engineering services based on LUMP SUM PRICE for the development of 3D modeling design for UJA, UJB, UJC, UJD, UJE, UJF, UJG, UJA, UJH, UJIKY AND UJIOZ Structures of ALBERANTE ALVARO ALBERTO NUCLEAR POWER STATION- CNAEA – UNIT 3. (B)	18.277.927,87
3	Rendering of engineering services based on LUMP SUM PRICE for the development of piping design for UJA, UJB, UJC, UJD, UJE, UJF, UJG, UJA, UJH, UJIKY AND UJIOZ Structures of ALBERANTE ALVARO ALBERTO NUCLEAR POWER STATION- CNAEA – UNIT 3. (C)	33.349.178,70
4	Rendering of engineering services based on LUMP SUM PRICE for the development of electrical engineering design for UJA, UJB, UJC, UJD, UJE, UJF, UJG, UJA, UJH, UJIKY AND UJIOZ Structures of ALBERANTE ALVARO ALBERTO NUCLEAR POWER STATION- CNAEA – UNIT 3. (D)	2.392.849,14
5	Rendering of engineering services based on LUMP SUM PRICE for the development of structural engineering design for UJA, UJB, UJC, UJD, UJE, UJF, UJG, UJA, UJH, UJIKY AND UJIOZ Structures of ALBERANTE ALVARO ALBERTO NUCLEAR POWER STATION- CNAEA – UNIT 3. (E)	1.521.031,33
TOTAL PRICE (A+B+C+D+E)		55.664.316,64



BIDDING No. GAC.Y/CO.1/04/10
BIDDING INSTRUCTIONS – ANNEX III
SHEET: 4/8

1.1.1 LUMP SUM PRICE WORKSHEET – BREAKDOWN

ITEM	DESCRIPTION	ESTIMATED	TOTAL VALUE
1	Office setting up, mobilization, training, installation of equipment, equipment and software, and implementation of the QA system.	64	4.163.329,69
2	3D model	16370	18.277.927,87
2.1	manufacturing activities	20760	2.235.312,12
2.2	new vessels	4460	6.753.004,64
2.3	pipes to plates	48	23.051,48
2.4	pressure vessel	1970	238.216,70
2.5	locks and accessories	3000	238.054,40
2.6	ventilator plate	67	913.109,10
2.7	pressure vessel	1	4.086,00
2.8	components	2100	2.582.186,20
2.9	pressure vessel	600	7.650,00
2.10	pressure vessel	500	4.480.410,00
2.11	pressure	120	193.608,00
2.12	type of material	198	95.391,48
2.13	pressure of system	380	17.844,00
2.14	other vessels	300	14.932,80
2.15	pressure vessel	1	13.978,76
2.16	pressure vessel	400	4.415.104,76
2.17	pressure vessel	20000	6.931.444,00
2.18	pressure vessel	24000	132.761.114,00
2.19	pressure vessel	400	944.714,00
2.20	pressure vessel	400	7.701.844,00
2.21	ventilation plate	40	206.240,00
2.22	plate and pressure vessel without pipe attachments	60	490.114,00
2.23	pressure vessel	50	2.831.717,00
2.24	pressure vessel	20	17.073,20
2.25	pressure vessel	120	138.931,40
3	Structural engineering design	35	4.570.770,00
3.1	3D model	35	4.570.770,00
3.2	3D model	35	161.844,00
3.3	pressure vessel	35	133.870,00
3.4	pressure vessel	35	17.976,76
3.5	pressure vessel	35	17.976,76
LUMP SUM PRICE TOTAL			156.749.702,18

The items/descriptions above are the products to be billed, including all appropriate products, as per items 2.7.1 (3D modeling), 2.5.1 (piping), 4.5.1 (ventilation) and 4.5.1 (structural engineering) of Annex V hereto.

$1.068 \times VO = \text{Value estimated by ELETROBRAS ELETRONUCLEAR, updated to May/2010.}$

$PT = \text{Total Price of the bid under analysis, which cannot exceed in 15\% (fifteen per cent) the VO. In case of prices higher than the stipulated limit, the BID shall be disqualified.}$

Fig.65: Pricing Criteria (Source: Eletrobras Eletronuclear)

In 8th June 2010, T.D. asked for a meeting with CNC/WP top personnel to be involved in the proposal to align their activities. Production managers from both industry and infrastructure division, HR manager, Planning Manager, IT manager and all discipline related managers (Piping, Electrical, Mechanical) were invited to the meeting. S.P.H. which was enrolled in a key RMAN activity sent an e-mail on behalf of the team as an attempt to change the meeting schedule. He wrote:

Piping personnel will be in COMOS training the whole day until the end of the month. I suggest that all meetings will be in the end of the day, beginning at 16:00.

Reagards,

(CNC) S.P.H.

(E-mail sent on, 08th June 2010 - Author Translation)

T.D. answered two days later as such:

My dear colleagues,

I know that some of the invited have duties scheduled for this afternoon, however I cannot change the agenda because of available space and personnel availability.

The objective of the meeting is to clarify doubts concerning the budget estimation and present /discuss the structure of how will be estimated the hours, equipments and so on...

I request those invited to the Conduct code presentation this afternoon to get in contact with HR and ask for a change to the next session tomorrow morning.

Thanks,

(CNC) T.D.

(E-mail sent on, 10th June 2010 - Author Translation)

People attendance to the meeting was expressive, approximately 20 people, most of them difficult to see simultaneously on the same room, what demonstrated the appeal of the proposal. Some people have even advanced through e-mail questions regarding the proposal. Impressions over the meeting follow in the field notes below:

The room was filled with important people, some difficult to see gathered together. Even S.S.H. (industry superintendent) inadvertently showed up at the meeting for a few minutes. His presence made people more eager to participate and they fired up several questions and concerns to T.D. T.D., however, did not answered any individual question as he did not want to hold people for long. He clarified the scope and the importance of the proposal and asked for a quick estimation and documental work. He went through the main guidelines to be followed and said individual questions should be brought to him and R.M.Z. (an industry coordinator that would be helping in the proposal). For the technical documents they would have the help of F.M.C. which worked for the infrastructure division and was very used to writing documents for technical proposals. The meeting was a short one and I was impressed by the mobilization involved which looked compatible to the size and importance of the competition (Field Diary, 9th June 2009).

In the 14th June 2010, I transferred the man-hour estimates to the standard CNC/WP sheet (the same previously used by CNC) and sent it to A.G.R. which were in charge of consolidating the estimates. In the 23th June, T.D. sent the consolidated man-hour estimate for WP-Sofia for evaluation, which was quickly responded as can be seen next:

Hi L.S.V. (WP-Sofia)

3D MODELING

My first intension is that these hours are very strickted. For modeling of isometrics they estimate 1,33MH/Sheet (codes 2.3.1.1 and 2.3.1.2) it seems very short time for this task. So I made a test - I picked up 7 isometrics (with different complecsity) from T-Power and model them for 1 hour (just pipes, fittings, flanges, valves; without supports). In conclusion I would say that if we have a complete isometric which needs only to be incorporated into the 3D model, and the complecsity is low then it is doable. I did the same and for supports (codes 2.3.2.1 and 2.3.2.2), with the same conclusion. Very important thing is that I used a pipe spec which was already done.

The same with rest of the codes: 2.3.1.3, 2.3.1.4, 2.3.1.5, 2.3.1.6, 2.3.2.3, 2.3.2.4, 2.3.2.5, 2.3.2.6, 2.3.2.7, the hours look not enough but if everything is done and complete it's another story.

On the other hand all of this hours (143895) are for the next buildings: UJA, UJB, UJE, UJF, UJG, UKA, UKH, 1/2UKY and 1/4UQZ and they might be enough. But I need some more time to see what is available on a previous projects and say it for sure.

PIPING DESIGN

Something strange is that for stress analysis the engineers work is 10%, designers's 50% and the drafters's 40%. Stress analysis is an engineering work, but maybe they include supports design after the stress analysis is completed. Other things should be discussed.

L.S.V.

Very important thing! Try to take some isometrics and supports drawings, if it is possible off course. WP-Sofia, 3d model, complecsity of the model, how inteligent is the model, things that can give us a better idea of what they have and what they want.

Best regards,

(WP-Sofia) G.G.

Piping Engineer

(E-mail sent on, 23^h June 2010 – Exact transcription)

The speed and the content of the response demonstrated that WP-Sofia personnel have only superficially approached the problem without further entering into the details of the bidding instructions. WP-Sofia personnel evaluated the estimates made by CNC/WP for UNA3 task plainly as a traditional project using traditional tools whereas in the bidding instructions it was clearly explained that it would be a "clone project" from UNA2 with several minor operational details and using project automation tools developed by Eletronuclear specially for this purpose.

On the 24th June 2010, L.S.V., engineering manager from WP-Sofia, and G.J., project manager from WP-Reading, arrived at CNC/WP for several meetings. R.M.Z. invited us to discuss with them the parameters used in the evaluation on both sides. The meeting content can be gauged by the field notes below:

(...) As we arrived at the meeting we have been presented to both L.S.V. and G.J. L.S.V. looked uneasy to discuss estimate reviews with two young engineers like me and F.F.M. Right from the start L.S.V. argued that his team in WP-Sofia thought that man-hours for the project automation and piping job were underestimated and he also thought so. Then we asked him if they had thoroughly read the bidding instructions and analyzed the exact scope of work. He argued that they had just received the bidding instructions in English and have gone through this generally. Then we told that we were confident on our estimates because we realized through the bidding instructions that there would be a lot of document repetition in the project as the reactor was composed of 4 redundancies, and the same was supposed to apply to pipe supports. Moreover, some documents like piping stress analysis that

usually take a lot of time, in the case of UNA3 project, would only have to be some of them re-checked against additional minor constraints and re-issued saving a lot of time. L.S.V. said that they were basing their observations on their project experience. We argued however that we should take a closer look to what bidding instruction said, instead. As we stood by our estimate, L.S.V. somehow felt intimidated and most of the time talked to R.M.Z. and G.J. My impression was that we were talking about different things: they about a conventional project and we about the specific UNA3 project. G.J. who remained most of the time listening to the conversation, after the meeting handed me a visit card and asked me to send my curriculum what I understood as recognition of our upper-hand in the argument. (Field Diary, 24th June 2010).

On the 30th June, I asked for a confirmation that we (CNC/WP) would be in charge of the “knowledge of the object” document while the “methodology and work plan would be in charge of WP, however T.D. did not answer me and only required that I should attend the next day to a meeting involving WP and SIG (local representation of Intergraph Corp., PDS supplier). The next day, however, I was not called for the former meeting, which was wholly conducted by the IT manager.

Also in 1st July 2010, several points were discussed in a CNC/WP meeting involving T.D., R.M.Z., F.F.M., F.M.C. disclosing the intrinsic relations and roles expected for the team in charge of the UNA 3 proposal, as can be seen in the meeting notes below:

On write-up responsibility:

(CNC) T.D.: (...) So, our scope is practically to design... to model in 3D and make the plants of these piping... all these isometrics... and do the duct part... the ventilation, and electrical trays, that interfere in the space. Is it? That is the scope of the service. And we have a proposal that follows the Law 8666, something that there isn't in the industry (CNC/WP industry division)...practically...because the largest client is Petrobras, and Petrobras is not government. Despite there is State participation it is not government. So the contracting process of Petrobras is different. So they follow certain things but don't ... so what happens, we a proposal ... he are going to handle three envelopes: one envelope is the eligibility...WP is taking care of this we are helping them...the other envelope is technical proposal, the other envelope is commercial. In the technical propose they will assign a score, and there is three requirements... three chapter... that is that chapter... “knowledge of the object”, “work methodology” and the other “organization”...

(CNC) L.M.A.: In truth, there is four... “knowledge of the object”, “methodology and work plan”, “organizational structure” and “technology transfer plan”....

(CNC) T.D.: Yes... so... that's this one...there are four... So what happens...WP said the following... As we dig deep in the bidding instructions to quantify man-hours, to evaluate the scope, they said: “you there know the scope better than us, so do first the draft” ...our responsibility is to make the better draft as possible. Is to write what we understand to subsidized them. Then, they will come out with further stuff ... “technology transfer plan” I don't even want to know. They will have to write, unless we have any contribution to provide. (...) but maybe in the methodology part, we can... we must say something on how it's going to happen this technology transfer.

On F.M.C. role:

(CNC) T.D.: Is from Infra (CNC/WP infrastructure division), he is in the house for a long time, so he know ways that you don't know here inside. Even I don't know...so, maybe he is going to say “There is a proposal that we did there in the environment (CNC/WP division), with has a chapter about...” If he did not know right away he knows the people who he can ask during a coffee...(...) He know where to copy things from... The important today is to bring things... So, maybe there is a chapter about quality written, then we get that and adapt (...)

On WP-Reading role:

(CNC) T.D.: For example, WP suggested us the following. The big manager of the project, or project director...whatever...should be CNC/WP. Why? Because this guy is the guy that will directly relate with the client and to the future ventures, it is better to have this relationship...Portuguese-Portuguese...Brazil, so... But, below this guy, there is what they call “engineering manager”. This engineering manager, that is the guy that will run the engineering, this guy will have to be a nuclear curriculum that big, to say “ they put a heavy weight

that know about nuclear", this guy is WP. And below him, comes the disciplines, so there would be a coordinator for each discipline, lets say so... or supervisor...this guy also specific from the discipline that think we have to put the curriculum of the guy of WP...these coordinators...but this guy from WP, will not come to stay 7 years in Brazil...so this guy has to have a CNC/WP guy together with him, and like this process part of the technology transfer, to the point that after one year, this guy can go away and at distance.. or let's say, come from time to time... (...) The technology transfer is not to Eletronuclear is for the Brazilian sub-contractor...(...) The expectation is that in the future... no so distant, I expect, there will be more nuclear plant in Brazil (...) and they (Eletronuclear) wants to qualify Brazilian companies to make nuclear projects. (...) So, in fact, WP is thinking about putting 7 guys in our organizational structure, that are the great guys they have, (...) and attach a Brazilian professional to each one of them (...) Particularly because, in reality... in reality, the guy comes here and the guy don't want to know ... he explains everything...the experience I have is the following... but he don't want to know that there is "20 drawings to finish tomorrow"... They to bit into this... Production, manage the team is not up to them...they want to discuss the technical subjects, orientate how is it done... production end up being to us...(...)

On CNC/WP strategy to the write-up's:

(CNC) T.D.: My strategy is the following one; the more this draft remain in our hands, creates the expectation... they would say "You have a long time to do something perfect." Do you agree? Let's say we take one month to do this drafts...so I prefer... let's send what we have until next Thursday (11 days)...

(CNC) L.M.A.: I am going to do a critic right now. You please excuse me, but we did an enormous effort to build the man-hours estimates... We did a man-hour evaluation very careful, very complete ... the guys came here (G.J. and L.S.V) just took a look and said..."I think its low!"... "But did you take this into consideration?"... "No."... "And this?"... "No.".... "And this?"... "No.".... So..

(CNC) T.D.: Yeah... with these guys we run this risk...

(CNC) R.M.Z.: But we a know-how of working with WP. What he wants to say is something different. I don't know... I don't think these guy will work like WP-Houston in PDY.

(CNC) L.M.A.: Which guys?

(CNC) R.M.Z.: L.S.V., G.J. and B.M.... They are different... don't think they are just like Houston guys ...laid back... So, what I think T.D. is arguing is that... I think it's super important... I would go further ... my opinion is the following... Let's send it to the guys ... because if there is something wrong, he will come up "Damn, it's rubbish! Don't you know how to do?" ... Then we say..." We know how to do like this. Did you like? If not do it yourself!" Then if he says, you are on the way, it's going fine... then he might help, aggregate...

(CNC) T.D.: It's missing here, it's missing there...

(CNC) L.M.A.: I agree with you... but I got really pissed off to make a proposal (man-hour estimate) and sent to the guy validate and the guy did not have any conviction to validate that.

On WP-Sofia role:

(CNC) T.D.: L.M.A, let me explain to you? The L.S.V., that is the manager of the nuclear projects (WP-Sofia), The guy has just arrived from his vacations on the 16th...and 17th he was already traveling to Brazil...(...) so, on the other hand, for you to see how they are taking it seriously... What did he do? He talked to you. We gave him (the estimates) one day... the next day he asked to talk to us, he called the guys there in Bulgaria and said so "Measure the time it takes to pass an isometric from 2D to 3D", ok?!.. and the guys there did 7 to 8 isometrics to measure how much time they spent" if that estimate you did was ok, gave him feedback.... So they looking all this... So I think that these guys from Bulgaria that inclusive are probably the guys that will work more with us...Because, they are doing plants (nuclear) in Egypt, in Jordan...

(CNC) R.M.Z.: In Jordan and Saudi Arabia...

(CNC) T.D.: Jordan and Saudi Arabia...So, they guys in the U.S....

(CNC) R.M.Z.: They haven't done any nuclear plant for more than 10 years...in the U.S.

(CNC) T.D.: And they are cheaper than the Americans. So, if we're going to be helped... maybe (...)

(Recorded meeting, 01st July 2010 - Author Translation)

On the 5th July 2010, WP-Sofia made additional comments that although acknowledged some points discussed on the 24th of June 2010 with L.S.V. (in green) still did not reflect a full understanding of the bidding instructions (in red), as can be seen in the e-mail below:

(WP-Sofia) L.S.V.

Few thoughts related to UNA3 bid:

- **the scope of work for UNA3 is "torn out" from regular engineering/design work on a normal project.** Our work on UNA3 will require a lot of work related to existing/UNA2 piping specs, p&IDs, dbm, design basis, adjustment of structural supports etc... this extra work most likely is not adequately reflected in our present man-hour estimate.

- for crosschecking purposes **standard WP piping man-hour estimates could be used.** It could be used to check if all types of work or activities have been included. Excel file is attached. Probably similar templates exist for HVAC and electrical man-hour estimate.

- **there are existing EMS procedures for Engineering Isometric Procedure EPP-0151 and Stress Isometric Procedure EPP-0155.** We should check if we can follow these procedures for Angra 3 or we have to create alternative approach. (...)

- at the moment our Brasil office does not have experience in 3D modeling in PDS and **SmartPlant.** SmartPlant is considered future standard platform for WP design. I guess it is better to train people for SmartPlant now, rather than train people for PDS now and retrain them for SmartPlant again in 2-3 years.

- from the ratio of assumed number of isos (~21000) and pipe supports (~24000) it could turn out that isos are very simple comparing to a "regular" iso (...) so **that could indicate that isometrics are: either very simple comparing to the "regular" one, or that assumed number of isometrics, or more likely supports, is incorrect.** If possible, we should clarify/further investigate this with Eletrobras.

(...)

Regards,

(WP-Sofia) S.J.

(E-mail sent on, 5th July 2010 - Exact Transcription – Author highlights)

The image shows a complex spreadsheet titled 'PIPING ENGINEERING / DESIGN - STAFF/HOUR ESTIMATE'. It includes sections for project information, a detailed activity breakdown table with columns for Activity ID, Description, Hours, and various resource types (Civil, Mechanical, Electrical, etc.), and a summary table at the bottom. The spreadsheet is filled with data for various engineering tasks, including design, calculation, and review.

Fig. 66: Standard WP estimation spreadsheet.

The corporative discipline of WP-Sofia in trying to apply WP corporate estimation tools to a completely atypical project like UNA3 was noteworthy. Together with the e-mail above they sent a WP standard estimation form so as CNC/WP could apply to its estimates as they believed it should be done. However, most of the activities needed for the UNA3 project could not find a match to those detailed in there. Even worst, the standard WP estimation form did not match with the work breakdown as

required in the bidding instructions. Response e-mail has been written to T.D. and copied to R.M.Z. to be sent to S.J. and L.S.V. clarifying the items discussed as understood by CNC/WP, however, there is no evidence that this has ever been sent to WP-Sofia.

In the 5th of July, F.M.C. in reply to the “knowledge of the object” sent in Portuguese by F.F.M., and me, the same document “goggle translated” and with a different cover page. In terms of content it remained untouched with several items depending on HR, planning and project management contributions to be completed. Required to help in the making of the “methodology and work plan” document, in 6th July 2010, L.S.V. sent to T.D. and R.M.Z. procedures posted in the WP EMS (Electronic Management System) to which CNC/WP did not have access.

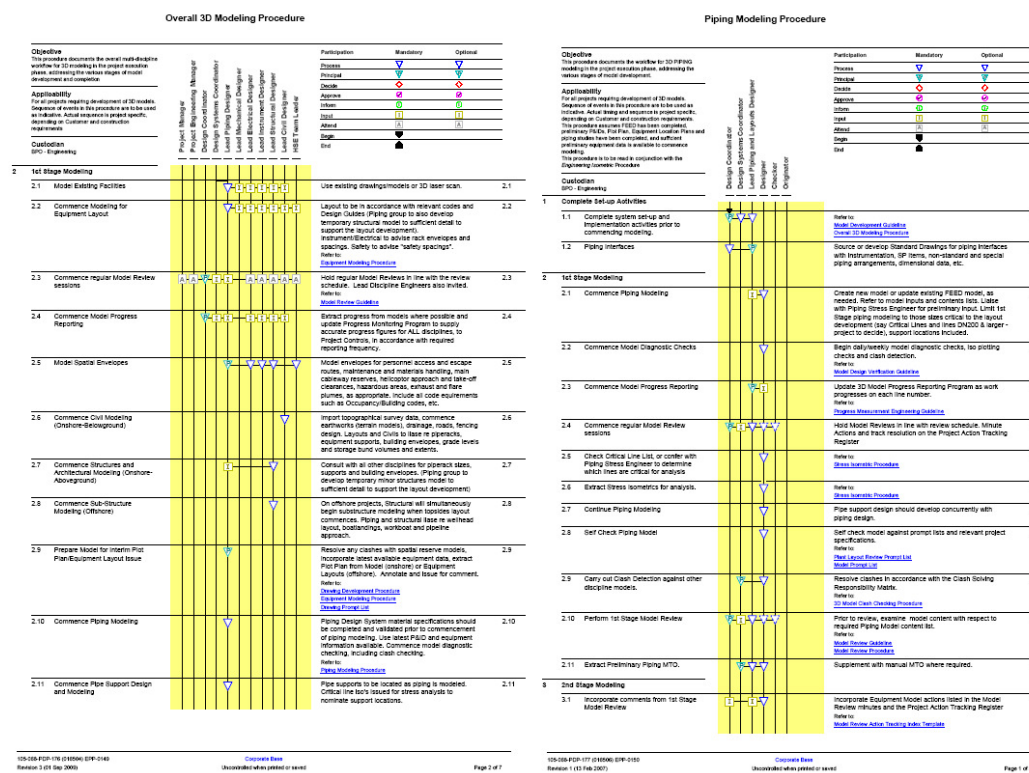


Fig. 67: Standard WP Workflow for 3D modeling and Piping Modeling.

On the 7th July 2010, L.S.V. suggested several approaches to the “methodology and work plan” document, which ranged from a simple replication from what was already described in the bidding instructions to adding some information:

Gentlemen,

The methodology and work plan part is developed in details in Appendix VI – Technical specification. Items B.16.1 and B.16.2 are almost fully presented. What is the best approach:

- just to confirm that we'll follow this methodology and add information concerning other items,
- to rearrange the text given in Appendix VI and add information concerning other items,
- used 1:1 wording from Appendix VI and add information concerning other items.

Please check Appendix VI and send me your comments and advices.

Regards,

(WP-Sofia) L.S.V

(E-mail sent on, 7th July 2010 – Exact Transcription)

In response to this e-mail we argued:

Guys,

I don't believe that things are that simple. Annex VI is covered with ambiguities and hides some traps. Moreover, activities are only grouped, they don't comprise a logic chain, and that is what I believe they want to see. Whoever reads this (in Eletrobras Eletronuclear) has to be confident that we know what we are dealing with. The procedures sent by WP contribute for some topics and relationships, however, it does not fix the problem because the bidding instructions are very specific in relation to the steps to be worked through.

We are working in this text and tomorrow we expect to have something minimally detailed to distribute.
Att.

(CNC) L.M.A.

(E-mail sent on, 7th July 2010 – Author translation)

This time R.M.Z. answered to our observations and wrote:

Ok, in my opinion you go ahead. You commented well L.S.V. position, I understand your position, go ahead.
Att,

(CNC) R.M.Z.

(E-mail sent on, 7th July 2010 – Author translation)

Adding to the uncertainty surrounding the write-up's elaboration, a fresh debate sparked concerning the 3D plant design tool to be used in the project. Despite clear indication in the bidding instructions requiring the use of PDS as the main 3D plant design system, WP-Reading and WP-Sofia begin to promote the use of another software from the same supplier (Intergraph) called, SmartPlant 3D¹⁵. The argument behind this endorsement was that PDS was on the verge of obsolescence, and SmartPlant 3D which represented its natural evolution, should be offered to Eletrobras Eletronuclear as plus in the proposal, as a way to indirectly embed productive gains on behalf of WP. Such reasoning, however, assumed that Eletrobras Eletronuclear was stuck in time with a tool it knew well and was resistant to change into another technology it did not know.

On the 06th July 2010, a conference call was set involving several offices to discuss the issue. The difficulties in coordinating and extracting useful contributions from this event could be seen in the following dialogue:

(CNC) L.M.A.: *Why can't we change the meeting schedule (9:00Am)?*

(CNC) R.M.Z.: *I want but T.D. doesn't.*

(CNC) L.M.A.: *Just switch to 10:30AM...Where are the guys?*

(CNC) R.M.Z.: *In Bulgaria its 5:00PM. They are leaving office... We cannot anticipated that because in the U.S. it's 5:00AM...Pay attention, it's 6:00AM in the U.S. and 5:00PM in Bulgaria...*

¹⁵ SmartPlant 3D is a proprietary system of the American softwarehouse INTERGRAPH Corp. (<http://www.intergraph.com>)

(CNC) L.M.A.: I still did not understand... what it has to do with our proposal...

(CNC) R.M.Z.: I don't know... it has to do with the use of SmartPlant and doubts of PDS...

(CNC) L.M.A.: But it does not affect the proposal...

(CNC) R.M.Z.: The guys from SIG will talk to the guys there...

(CNC) L.M.A.: I don't see how does it affect nothing that we are doing here... because the bid is PDS...there is no other way...

(CNC) R.M.Z.: They say there are some problems in the SmartPlant in Australia and U.S. and in Sofia... The guy said today morning, what I understood, that looks like the problems that there were in the SmartPlant they have already corrected. So, tomorrow they will see if it is possible to use the SmartPlant ...something like this... (...)

(CNC) F.F.M.: The discussion will be among the guys from SIG and people from???

(CNC) R.M.Z.: From Sofia and...Reading...people from the U.S.... I am not sure if Reading but I think there is also Houston... and maybe I guy from Australia... and they will talk about PDS.

(Recorded meeting, 6th July 2010 – Exact Transcription)

Out of this meeting, a compliance matrix (document which described activity, responsible and deadline) has been designed by WP (Sofia and Reading) towards the proposal completion. In that document, however, although paper work required for eligibility and commercial parts were quite well defined and assigned, technical documents (write-ups), which accounted for 75% of the proposal score, were only broadly defined (with all individual items together) and assigned (to the offices and not to people).

Client: Eletrobras Eletronuclear
Project: Electromechanical 3-D Model and Engineering
Dial in Information: -US 866-528- International 854-334-
Participant Code: "982954"

COMPLIANCE MATRIX
TABLE OF CONTENTS AND RESPONSIBILITIES

SUGGESTED REVIEW DATES AND OTHER KEY DATES:

RED TEAM
 GREEN TEAM
 EPR SUGGESTED DATE
 SITE VISIT & OFFICE VISIT
 TECHNICAL SEMINAR
 DELIVERY DATE: (IN PERSON - BRAZIL)

July 2010							August 2010						
Sun	Mon	Tue	Wed	Th	Fri	Sat	Sun	Mon	Tue	Wed	Th	Fri	Sat
			1	2	3		4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20	21	22	23	24
25	26	27	28	29	30	31	1	2	3	4	5	6	7

Item	RFP Requirement	RFP Section	Proposed Section	Proposed Table of Contents	Strategic Actions/Key Issues (What to include to make it stronger)	Primary Responsible	Secondary Responsible	Status	Due Date		Comments/Open Items/Analysis
									Pre-Draft	Final Draft	
65	<p>In order to demonstrate the METHODOLOGY AND WORK PLAN, which will be used in the performance of the BIDDING object, the BIDDER shall submit an analysis of the following subitems:</p> <p>1.6.1. Detailed description of the project methodology that will be used for the performance of services, including at least a list of activities per installed design capacity and a detailed description of them.</p> <p>1.6.2. Description of the Work plan (phases and products) to be employed for the performance of design services, describing at least the design manual's outline, the performance sequences, solutions for the most relevant services to be accounted for and allocation of estimated inputs.</p> <p>1.6.3. Detailed description of the IT software and corresponding licenses deemed to be used for the performance of services as well as for the Control and Records of Documents during the diverse phases of execution, presenting at least: planning, programming, documentation control, control of correspondence, meeting records, report templates.</p> <p>1.6.4. Submitting of basic activities schedule that shall be part of the future service contract.</p> <p>1.6.5. Description of measures to be taken for the services aiming at lower costs and higher productivity with the best possible efficiency and timing, focusing at least on the optimization of the use of human resources, materials and supplies.</p> <p><i>Documented by description in 30 pages or less or less form 10p.</i></p>	1.6	B.16	Methodology and Work Plan		CNC	Reading/ Sofia				We have drafted the outline of the section while using in Cas-Prado and CNC, since Rest being aware of the scope details will take the first shot and then Sofia and Reading will finalize
66	<p>In order to demonstrate the ORGANIZATIONAL STRUCTURE to be used for the execution of the BIDDING object, the BIDDER shall present an approach to the following subitems:</p> <p>1.7.1. Description covering at least: material resources to be spent, equipment, vehicles, physical facilities for support and performance of services, transport logistic for the personnel engaged in the services when working at site.</p> <p>1.7.2. Description of hardware resources to be made available during the performance of the services, pointing out at least the potential for use, suitability of these resources to the services and their updates.</p> <p>1.7.3. Presentation of the organizational structure proposed and basic assignments, considering at least: main positions and functions, education of the key staff, education, organization chart, flow chart or interrelationship between functions and activities to be developed, definition of responsibilities.</p> <p><i>Documented by description in 20 pages or less or less form 10p.</i></p>	1.7	B.17	Organizational Structure in 20 pages or less	Sofia/ Reading/ CNC	CNC	Reading/ Sofia	7/9	7/16		We have drafted the outline of the section while using in Cas-Prado and CNC, since Rest being aware of the scope details will take the first shot and then Sofia and Reading will finalize

Fig. 68: UNA3 compatibility matrix – Items Methodology and Organizational Structure (calendar and punch list).

On the 07th July 2010, right after the conference call, which according to R.M.Z. only served to discuss problems concerning previous uses of SmartPlant on WP offices, T.D. set another meeting with SIG sales (H.C.L.) and technical (F.L.P.) managers, S.M.C (CNC/WP IT manager), and R.M.Z. to discuss commercial advantages and eventual strategies to offer SmartPlant to Eletrobras Eletronuclear.

(CNC) T.D.: The discussion concerning PDS x SmartPlant pass through three elements... in my point of view... One, to know if the man-hour estimate we did hold to the SmartPlant solution or PDS. OK?! He (SIG sales manager) is telling me that the SmartPlant has a productivity gain, is more friendly, and so... on the other side, not everything that comes from PDS ... will be just to press a button and will become SmartPlant... so we will be gaining productivity on the one side, and we will have an additional work to adequate the rest... The second... I need to know how much does it cost to embark in the PDS solution, in terms of software cost, and how much is it for the SmartPlant solution... we have to close the number... this package...the best number of PDS is this... so we can be competitive and win, and the best number of SmartPlant is this one... Then comes the third question, which is the interface with the client. It's a decision that you can help us but it is a decision CNC/WP with Eletronuclear (...) Let's suppose that... I expect... that the solution SmartPlant is very attractive commercially and significative in terms of the competition... so I have to decide I will be at heads with the solution SmartPlant ...(...) or not, I will go with the solution PDS, and after winning I can try this... So these are the three steps that I think we have to do to close the deal...(...)

(CNC) L.M.A.: F.L.P and H.C.L...look... I am living inside the bidding instructions for more than 20 days, writing the work procedures and I can say the following...my contribution to this debate is the following... First, the bidding instructions are PDS. The procedures are being written in PDS. It's mandatory...there is no discussion. I am writing the work procedure considering PDS. Period. While they don't open the envelope, we can do nothing...

(CNC) R.M.Z.: But in the bidding instructions it doesn't say...

(CNC) F.F.M.: The piping part of L.M.A. is very specific on PDS.

(CNC) L.M.A.: (...) there is so many details in the bidding instructions... items requested that specific from PDS. So I can do a work procedure to SmartPlant I will have to change everything... bidding instruction items inclusive... I think it is unviable to do this...because there are things that are typical from PDS...(...) one of the items required in the "work methodology" document is to describe the software...to explain in its own words what the software is ...(...) So, in terms of proposal it does not help to change anything like this...(...) after winning the contract, there will be a period of one to two months, before signing the contract we get together with them and try to change that...(...)

(CNC) T.D.: What is he saying is that the technical proposal...OK?!...it has scores...and I'm sure who will evaluate that technical proposal specially on the part of piping is M.R.L., and if he has it's mind totally...he has already written thinking... he gave me the impression... I have never met him... met just before the competition starts, in a visit... and he gave me the impression... to be very methodic...OK?!... and also to know very well what he really want to do. He has everything in his mind... "How I will going to do... this...and that way...like this, and that ...and so forth... I already thought about this years and I know it quite well"...So that is what you are saying. I read there and there is no other different way to do what the guys is saying. ...So...But this don't invalidate we sit here and say "I need the best price, of the best solution in PDS and I need also the best price, of the best solution in SmartPlant... we need to have that... Why? ...Because this is a commercial decision ... I can say something like this... I will believe that I will be able to turn heads, but I cannot guarantee I will get into the competition in PDS and then I might assume in competition some not so good commercial conditions I tried to go for a better solution with SmartPlant afterwards... So, I need these two possibilities (Recorded meeting, 7th July 2010 – Exact Transcription)

A point that became clear through this meeting was the huge cost of the licenses as we were estimating the service. The expected number of licenses of PDS plus additional software would cost approximately US\$ 1.5 million, far above the expectations and commercially damaging to the project profitability. The use of SmartPlant would represent a cost 30% lower compared to PDS.

7.4.2- Project Organization

On the 8th July 2010, G.J., a late-30s project manager from the WP-Reading office, arrived at CNC/WP to closely follow the bidding process, re-ignited the discussion over the PDS versus SmartPlant subject. However, On the 9th July 2010, T.D. went on vacations and let R.M.Z. in charge of the proposal until the 29th July 2010. The arrival of G.J and B.M., consolidated the project organizational structure as follows:

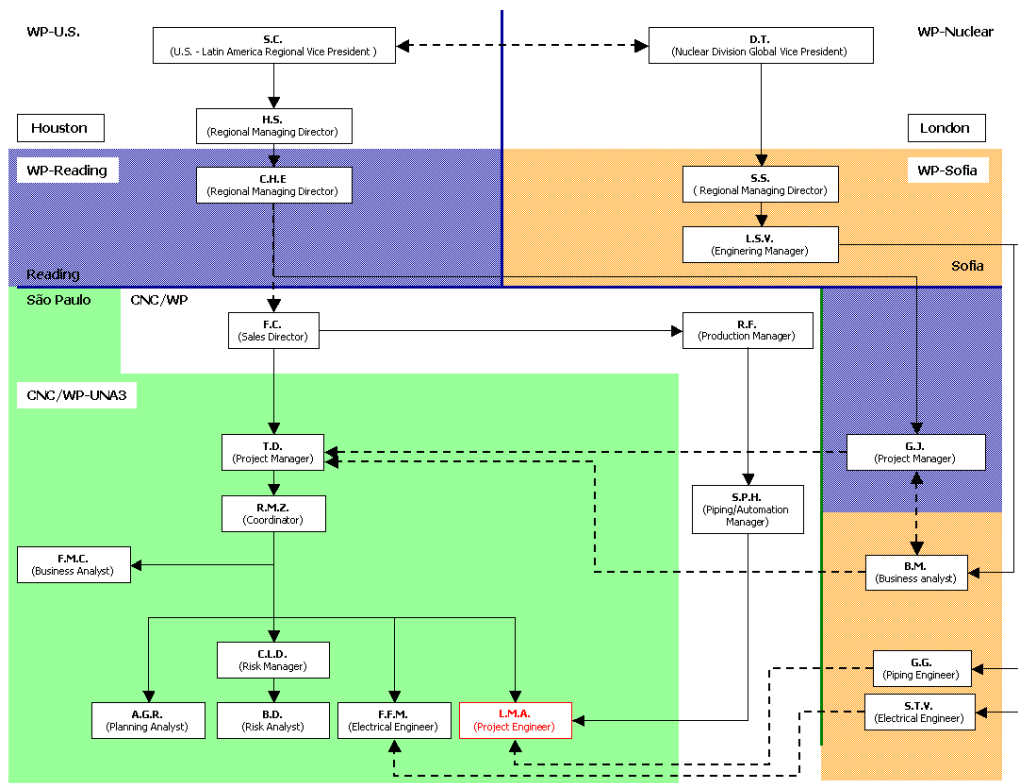


Fig. 69: UNA3 Project Organization (only key participants).

On the 12th July 2010, in a private conversation with R.M.Z., G.J. and F.M.M., additional points of the issue were debated:

(WP-Reading) G.J.: Is that the meeting?

(CNC) R.M.Z.: G.J., did you know F.M.C.?

(WP-Reading) G.J.: No, I don't know... G.J. please to meet you...

(CNC) R.M.Z.: F.M.C. is the other guy who's helping us to write the methodology ... (...) F.M.C. is preparing the beginning of the part of the work scope... the first part... and we are talking about PDS and Smart Plant and L.M.A. will explain to you why do we need to say on the bid that we are going to use clearly PDS.

(CNC) L.M.A.: This week that we have been working with this, we found some noise about this question about and PDS and SmartPlant 3D, and something that was supposed to be just a small discussion, ideas for an initial kick-off for the work, just came out to be a issue for long debate. Last week on Friday, we met with people from Intergraph Brazil and... just came to me in the middle of the meeting... that we cannot make a bid different from PDS. There is some reasons for this. The first reason is that PDS is a subject in many other items that are required for the bid. So, they speak about PDS in many items that's in the very surface level... if you go a little bit deeper you will find that many of the third-party softwares they are asking us to use, because they have their reference databases... at some point... just work with PDS. For example, PDS/RHALT... the software they use for piping support... the BQCAD, that is another software they are using... they are all softwares that only work with PDS. They do not work with SmartPlant 3D... Why? Because they are softwares that have been developed to work with Microstation¹⁶. PDS works together with Microstation. But SmartPlant 3D does not have a CAD interface... he has a proprietary CAD... and they hardly would be able to develop a software that works with a proprietary graphical interface...

(WP-Reading) G.J.: I maybe wrong... but a think we are using SmartPlant with Microstation...

(CNC) R.M.Z.: They told us it is not necessary Microstation, just SmartPlant...

¹⁶ Microstation is a proprietary software from Bentley Systems Inc. and serve as CAD interface for the operation of PDS.

(CNC) L.M.A.: They do the following, they work in the SmartPlant 3D with models then they export the drawings in Microstation and at some point they make changes in drawings with Microstation. They do not do that changes in the 3D model...So it's a final step onto the drawing. (...) Smart Plant 3D has anything to do with Microstation.

(WP-Reading) G.J.: I think that I am understanding what you are saying... you can export to Microstation, but you can't manipulate the core drawing... that I believe it's true... I believe that. I guess... what you are saying is that in PDS, Microstation can be used to manipulate the core file...

(CNC) L.M.A.: Yeah... for example, that some elements that if you don't want to use equipment module, you can work in Microstation and attach this model inside PDS. The same thing you cannot do in SmartPlant 3D because he does not read a Microstation file in the core graphic interface that he uses.

(WP-Reading) G.J.: So my question would be... that these additional files that are called for... I understand that the modules that have been designed to work with PDS ...I wonder if ...SmartPlant also... because essentially SmartPlant was created to do what lot of companies were doing with PDS andPDS was not capable of doing a lot of functions, people built special modules to attach to PDS, we did that also at WP, and Intergraph discovered that there were a great need for this suite of services like pipe stress analysis, and cable routing and all kinds of other things... and so they essentially took probably what was the best available modules on the market, bought them and then attached to integrate everything into SmartPlant suite. So, I am wondering if it is available in SmartPlant now, but it is not exactly the same software but perhaps with a similar capability...

(CNC) L.M.A.: Sure we can do the same job with PDS and working on SmartPlant and another bundle of softwares, but the problem is... the bid asks for those softwares.

(WP-Reading) G.J.: It does ... (...) there is one place where they mention...

(CNC) L.M.A.: Yes... I know this... it's this one... "other programs and modules of PDS of proved efficiency ..."

(WP-Reading) G.J.: All we have to do is... I mean we don't have that ...I've already kind of talk to my around this issue, about a dozen times and right now I am comfortable doing the PDS only, and just offering in there "we are comfortable with SmartPlant if you want us go to....if you want that too...then we will negotiate the price difference..." That's kind of I want to say in the proposal.

(CNC) L.M.A.: I agree with but I would go a little bit further... As I was talking to R.M.Z. before you came, we can do this, that's fine... there are two ways they can accept that... the first thing they can say "OK, you are not going to use all that softwares I did, all the reference databases I did... and you are going to give me that on SmartPlant 3D ... but the initial idea that they will have is that we want charge more for this... that's not true... we have to be confident that ... this will be saving money with this...but they don't need to know that... right?! ...We are going to say "you are asking for PDS, we are going to make exactly what you want but we will charge X hours... but if you want we can do the same job... exactly the same job... with Smart Plant 3D... and we charge the same hours... you decide.

(WP-Reading) G.J.: That's going to be a tough one...We didn't think about that... We'll have to import all their databases...make sure all things function

(CNC) L.M.A.: Very hard work...to reconstruct these databases in SmartPlant 3D...

(WP-Reading) G.J.: Very hard work...

(CNC) L.M.A.: We have to make... be really sure... we can make some gain by using SmartPlant 3D...

(WP-Reading) G.J.: I think all we have to do is bid it ... the more I think about it ... is bid it PDS, offer to use SmartPlant, and then negotiate after the award what the additional time and materials cost would be for transferring the existing modeling to SmartPlant 3D, and getting the existing tools as good as they are with Eletrobras now, into the SmartPlant suite, to make sure that they have equivalent function and then...you know... whatever that costs... we may estimate a cost of doing that an extra Y hours, or something like that, and we will make that offer for time and materials, above and beyond the original work was... but then we will make a very aggressive bid, and we want them to know that it is in their best interest for a lots of reasons to go with SmartPlant, and they have an experienced user in us to help their transition through the process... So I want to make they fell good about us... and I am willing we to do this, but you are right I think the price is...

(CNC) L.M.A.: Price is a very sensitive issue for them... (laughs) ..I believe they are insisting in PDS because they have an extensive work, building reference databases and they probably spent a lot of money doing this partial model they want to give us...

(WP-Reading) G.J.: He have the same investment in PDS... we have a tremendous investment in PDS and our engineers and designers are very comfortable with PDS and our modules that go on with it... but SmartPlant is a superior product, it's a better product...(.) I think when we are writing this section "methodology and work plan" you have the right concept in writing about PDS ... only... and at the end...I think we then begin with our argument ... and say "however, if we use SmartPlant... it is an Intergraph product, it has lots of advantages, and these are the advantages we are saying... and then we can talk a little bit about descriptions of the measures for lower costs, higher productivity, and then I think we should talk about obsolescence, of the PDS program... I know in Brazil it is not imminent... but in U.S. it is... that this program will be obsolete, and will not be supported by Intergraph, going forward... and this is a five year, six year long project. So by the time this plant gets turned over, and comes on-line they are going to work definitively with a piece of software that is very outdated... it has to go to SmartPlant eventually...

(...)

(CNC) L.M.A.: Did you read, the paper work that we have been working?

(WP-Reading) G.J.: No..

(CNC) L.M.A.: We are describing how to do this PDS. We describe commands, we describe what to do (...) including the items of quality control we are describing, because our feeling is that the guy that is going to check it, he must read it and must know that we know what we are talking about, and that we are able to do the job, just like in the bidding guidelines.

(WP-Reading) G.J.: So you got this part covered...some... after that is covered that's when we need to talk about SmartPlant 3D. And I think the things we need to cover here are what we are just talking about... first, that we have experience with SmartPlant 3D... it has benefits... it avoids the risks... particularly of obsolescence... it has efficiencies... and productivity gains...we know they know because they talked to Intergraph about using it... they are interested...so we tell them we know... (...) and that they are concerned about their existing model ...can be... can ... be... imported...(.) they are worried about their existing model ... right?! ...

(Recorded meeting, 12th July 2010 – Exact Transcription)

7.4.3- Current Knowledge Weakening

Days later, G.J. vented that in case SmartPlant 3D would be adopted, it would be completely set up by WP-London (UK) or WP-Perth (Australia) professionals, who would remotely hold control of the system, with few capability building on the CNC/WP side (similar to what happened with PDMS Global during PDY project, whose control was in charge of WP-Houston). Therefore, the potential adoption of SmartPlant 3D may as well be approached as an attempt of WP-Reading and WP-Sofia to bring key processes into their control and this way supply key technological services as a black-box to CNC/WP, with the help of the centers who had developed this expertise (WP-London and WP-Perth).

All that debate, however, fell apart after the visit to Eletrobras Eletronuclear on the 25th July, where we could see its extreme software expertise in developing tools specific for nuclear projects where PDS, was merely used a integration tool prior to model review generation. Not only it became clear that the use of SmartPlant 3D would be incompatible with all those tools developed to speed up design work based on prior documents from UNA2 but also the expected number of PDS licenses was

cut by 2/3 as it became clear it was merely a integration tool, soothing the financial hurdles of its requirement.

While this PDS versus SmartPlant 3D debated unfolded, several other important issues like idiom and division work were overlooked as can be seen in the field diary notes below:

Along this meeting were also discussed the idiom of the documents and the division of work. Due to the short time available and the need for WP to evaluate and complement the documents, it was set that the documents would go straight into English. However, G.J. also asked to have the documents in Portuguese so that a sworn translation could be done. Awkward as it seemed everybody agreed at that time. The division of work in relation to the write-up's was even more confusing. Hardly each partner could tell for sure what was he about to do and nowhere there was a registry of that. I asked if there were people from planning and document control working on their sections however, R.M.Z. could not confirm. R.M.Z. passed on the work to WP-Reading and, G.J. to WP-Sofia. Where definition was required they fired up with a conference call to define it. F.M.C., however, remained as the final assembler of the documents and responsible for proofreading them prior to WP examination. (Field Diary, 12th July 2010).

Also on 12th July 2010, arrangements for the Eletrobras Eletronuclear office and site visit began. From WP-Sofia would go, S.T.V (electrical engineer), G.G (piping engineer) and B.M. (business analyst), from WP-Reading, G.J. (project manager), and from CNC/WP would go T.D., R.M.Z., F.F.M. and I.

In the 13th July 2010, the first difficulties began to appear. Technical staff experience that since beginning was WP-Reading responsibility, proved hard to comply with Eletrobras Eletronuclear requirements (regular employer, long company tenure, 15 to 10 years experience, nuclear project preferable). As WP-Reading begin to falter on this subject, they tried to work out some alternatives.

(CNC) F.C.

L.M.A. meets the requirements for the PDS administrator on the project, and it would be good for him to be the representative for this proposal. However, he took the courses when with SIG/Intergraph, and they did not issue him a certificate, which he needs to be able to show.

Would it be possible for CNC/WP to request for this certificate to be issued retroactively to L.M.A using his completion of the courses required as a basis? We think the request would be better coming from an executive rather than from the worker directly to SIG. Please share your thoughts on this.

Sincerely,

(WP-Reading) G.J.:

(WP-Reading) G.J.:

We will be working with SIG, however it is important to take into consideration that although CNC/WP can get such certificate, the bidder is WP and you also have to present someone as the representative, not only for this function but also for other functions requested

(CNC) F.C.

(E-mail sent on, 13^h July 2010 – Exact transcription)

Despite it was WP-Reading responsibility, F.C. (CNC/WP sales director) asked S.M.C. (CNC/WP IT manager) to require SIG to issue a certificate, confirming that I was qualified as PDS System Administrator, what was made available by 19th July 2010. Few days later, G.J. also required WP-Houston to grant me a WP e-mail address (which I so forth did not have) in order to have access to the WP global document exchange system, just like R.M.Z. and T.D. For some reason the e-mail and the access was not granted.

Still facing a great uncertainty concerning the definitions and assignments of the write-up's, a conference call was set in the early hours of 15th July 2010. The content of this meeting can be gauged from the field notes below:

The quality of the communication in this conference call was quite good and, as such, we could get along with the issues. WP-Sofia began by pushing us to speed up the write-up's so we could send it to them for completion, however, we said that it would take longer because we were in the middle of the process and if we sent it now it could be a little confusing for them. Then, G.J. start to discuss about difficulties in finding personnel qualified enough to match Eletrobras Eletronuclear requirements and even concealed the idea of hiring people for that. (...)

Most of the meeting, however, was dedicated to assign responsibilities to the specific items of the write-up's, which were very poorly defined until now. After an item-by-item discussion, the Brazilian team part of the write-up's was enlarged as more items end up being assigned because local tools such as ProjectWise software would be used instead of WP standard ones. An agreement was also reached that the Brazilian team would create master write-up's composed of the parts supplied by each team and would distribute them on a regular basis. (...)

There was also a debate concerning financial issues on the contract division. G.J. said that agreement was that the contract would be 5% WP international and 95% CNC/WP, and they had to make sure that these 5% would cover for WP people to stay in Brazil for six months to one year. Finally, we discussed again about writing and delivering technical documents to Eletrobras Eletronuclear in Portuguese, what would save considerably time, however the need to go through WP-Sofia for completion and primary examination and WP-Reading final examination turn down the idea (...)
(Field Diary, 15th July 2010)

With the meeting almost finishing a debate concerning the relationship of CNC/WP and WP emerged as can be seen in discussion below:

(CNC) R.M.Z.: Why?... Don't you have the PDS guy?...

(WP-Reading) G.J.: We have them...we have lots of them...but it's a pain in the ass to have them to come here...he (L.M.A.) is better...and you have him here on-site...and we can put him in your contract...he is also a lot cheaper...because we don't have to pay all that taxes...anybody you don't bring from the U.S. and you don't have to bring those taxes it ... this is a hell a lot less expensive...

(CNC) R.M.Z.: But you can't use L.M.A. as your guy... because you are the bidder (official) and the bidder is WP...

(WP-Reading) G.J.: You are me...you and me are the same...We work for the same company...(...)

(CNC) R.M.Z.: We know this but for the guys at Eletronuclear we are two different companies...

(WP-Reading) G.J.: We are not two different companies...(...) when you say things like he can't be on the proposal because his not from WP ... I mean that... you are a little confused... because of this dual thing that we have been living... you know what I mean... You got to get in your mind that we are the same company... F.C. is the same way...He thinks of us as two different companies...he thinks you can't be in our proposal as a private individual because you are not WP employee. In fact you have been here for four years... when I put your certificate forward you have four years experience with WP... because you are WP affiliate and you got the fidelity of one of subsidiaries, fully acquired...(...)

(Recorded meeting sent on, 15th July 2010 – Exact Transcription)

Later in the afternoon, an internal meeting was prepared to anticipate the discussions of the official risk analysis meeting that would happen the next day over a conference call with WP-Reading, WP-Houston and WP-Sofia offices. Were invited for this meeting all key CNC/WP personnel from both industry and infrastructures divisions were asked to attend to this meeting, however, were absent due to a managerial meeting in a hotel nearby São Paulo, invoked by CNC/WP president. The main concerns shown by the Brazilian team in this meeting were:

Despite the importance of the proposal attended to this meeting only the risk manager (C.L.D.), the risk analyst (B.D.), R.M.Z., two discipline managers, F.F.M. and I. It began quite late as everybody was returning for lunch. After R.M.Z. show his concern over the low attendance to the meeting, the risk analyst advised us that this would be the first time that CNC/WP would take part on a risk analysis with WP. As they did not know how that would proceed, they suggested to make an internal risk analysis (which in their opinion would be as good if not better than the one used by WP) and simulate what be the relevant items and in the official meeting they would follow through them. Great concern has been shown towards communication difficulties due to the lack of fluency in most of the Brazilian team, the complexity of the issues and to the particular characteristics of the English as spoken by the partners. (...)

A noteworthy point discussed during this meeting concerned the different business environments to which WP and CNC/WP were submitted and thus developed different risk analysis approaches, she said: *"(...) we could make this analysis in contingency terms... because... what happens... they (WP) don't add contingency. Because they are not normally used to work with global price. Global price is something new for them. And we (CNC/WP) are used to work with global price. For this we have thought ...(...) we were thinking about running the "Monte Carlo simulation" that they knew a little bit and they feel quite safe in this area. Then, to show something Brazil is doing as a new thing, to present this material to them with this simulation (...)"*

Another important point discussed during the meeting was the hardships in using formal employee wage estimations to build the proposal price, as WP required. Because hardly any senior engineer would accept to work as a formal employee and have to pay 30% in taxes. Despite strong opposition to the use of informal employment in the proposal prices by G.J., R.M.Z. said that F.C. was already convincing WP that a combination of formal and informal employment should unavoidable otherwise the bid would surpass the price limits. The risk manager said that as it would bring an increase to the risk of labor liabilities this should be taking into consideration in the risk analysis. (...)
(Field Diary, 15th July 2010).

This meeting has been far too long, as it lasted from the beginning of the afternoon until late at the night. Apparently, it has been too broad in terms of issues approached and considered in the analysis. One problematic factor was the atypical format of the project which, together with the transitional state of the company and the uncertainty concerning appropriate interpretations from WP, generated many doubts and long discussions among the participants. Moreover, aside of R.M.Z., F.F.M. and me none of the participants were really aware of the project details and had little power to lay down a decision or an interpretation, undermining the quality of the discussions, which frequently slipped into a personal knowledge showdown.

By the end of the day, B.M. sent some sections of the documents that were under WP-Sofia responsibility. To CNC/WP surprise, great part of the content of the documents concerned the application of SmartPlant and other softwares that were standard at WP but were not compliant with UNA3 requirements. Furthermore, except for the company organizational details, most of their content applied only to traditional projects and not to specific tasks and requirements expressed in the UNA3 bidding instructions. As this material showed up useless to complete the

document as we agreed, it fell upon CNC/WP to also write the parts that belonged to WP-Sofia. Also worrisome, key staff assignment to comply with technical staff experience item in the organizational structure was almost all blank with only two names (out of 11) confirmed.

On the 19th July, B.M., a young Bulgarian business analyst from WP-Sofia, arrived at CNC/WP to support G.J. in the organization of the proposal and of the formal steps towards proposal approval. Our first contact was a tepid one, maybe reflecting a sort of an office rivalry. When told that he “needed to exchange some e-mails” in order to receive some updates, she answered harshly “no, we need to finish the procedures”. This harshness, however, did not last a day and she quickly turned into a very receptive and helping person. As I made available upon the CNC/WP network the master copies of the write-up’s, she quickly thanked for the updates and sent more sections commented by WP-Sofia we had priorly released. The comments again did not help much there was only minor English mistakes and itemization of the items already clear in the bidding instructions.

The official risk analysis meeting took place the next day, on the 19th July 2010, and was marked by difficult communications, a tortuous translation process and a complete lack of knowledge of the competition rules. As a result, not only calculated contingencies account for a considerable rise in the proposal price but also considered some legal requirements of the contract as unacceptable for WP. The repercussion of the WP risk analysis on the CNC/WP office were as described above:

(...) in front of the two discipline managers (S.P.H. and M.J.O.), the risk manager and those who were participating in the meeting, R.M.Z. again complained that people at CNC/WP was not taking the proposal as seriously as had invited several key executives and none of them showed up....and except for F.C. and those directly working in the proposal people (...) He explained that within WP, proposal should be approved by two commissions the “red-team”, to the proposal was selected, and the “green-team” before going ahead. The first one would comprise of a technical team in charge of checking if the technical terms of the proposal were carefully appreciated and if people knew what they were doing, or check why a determined technical assumption or amount of hours was taken into consideration on the proposal. The second one, the “green-team”, comprised of a financial team, which will argue about the economic and financial aspects of the proposal. Therefore, it would be important to key executives and discipline leaders to participate in that in order to get used to this kind of procedure. (...)

Moreover, he told that as a result of the prior risk analysis, WP went deeper into the contract and highlighted some points considered of high potential risk, nevertheless they were common place in Brazilian business. As they were providing contingencies for all those items the final price of the proposal could be lifted to uncompetitive levels. The conclusion of all participants is that everything requirement that did not make part of standard WP contract was faced a source risk. He added that in the case of the technical warranty, because Eletrobras Eletronuclear want more months covered than the usual for WP, they suggested to change the contract... what would be impossible as governmental competitions were laid down on non-negotiable rules. As they were explained several times of that, they argued that if it could not be changed then it would have to be covered by a contingency value. And despite all the effort of F.C., it was hard to go ahead with the proposal because the Brazilian lawyers said it was an interpretation problem of the U.S. lawyers that on their turn blocked the proposal. Even the key lawyer that responded directly to the CEO said that it was an unacceptable risk. Even though after he explained her that all this contractual risks were already embedded in to the price, she did not completely agreed. As such, R.M.Z. called attention to the kind of problem that they were facing and that could extend to other proposals from CNC/WP as WP was only used to work with over hourly contracts and not global price ones. (Field Diary, 19th July 2010).

This meeting has been interrupted by F.C. who was worried about the technical score impact on the financial strategies of the project, as can be seen in the following dialogue:

(CNC) F.C.: Let me tell you something.... Right now, I was talking to C.H.E, G.J., everybody... we need to take a time ... I have this... I have that analysis spreadsheet, I need to talk to you and... based on this ... because we are trying...

(CNC) R.M.Z.: The score...

(CNC) F.C.: Yes. ... If I get everything where do I arrive (in terms of score)? Because I have that spreadsheet if I get that far in the technical, I can get that far in the commercial one... I have many analyses... We have to do it today because G.J. and C.H.E. (WP-Reading Managing Director) were discussing the remittance problem. (...) And depending on the score I have, it's one strategy different from the other... So, we must take a time and say "If these guys cover me on here, here and here... I am going to get here". If they do not cover where it will go? (...) To make a series of analysis so we can take a decision... because it does not help to say to remit or not the money because I don't know where I will be in the technical (evaluation)... the technical is that will decide! ... For god sake!

(CNC) R.M.Z.: We must do that right now...

(CNC) F.C.: We have to do that right now. I am sending a message to T.M. (Global Power Managing Director), to H.S. (US-Latin America Senior Vice President)... I am throwing the problem up to the space... so that they can solve it...

(CNC) R.M.Z.: They are asking quite much, that they require your presence in the risk analysis review that will take place Wednesday. They want your presence in the "green team" meeting...

(CNC) F.C.: In this one I will be... in the other I will not go...

(CNC) R.M.Z.: Because he says the following...

(CNC) F.C.: Its technical? ... (discussion about the date) ... Green team is commercial... This one I will participate... I told you... Wednesday is technical I will not go...

(CNC) R.M.Z.: Wednesday afternoon they want set up a meeting 1:00PM about risk analysis... (...) Today we had a meeting with C.H.E...

(CNC) F.C.: We were now on the phone.... him, G.J., R.M., S.C. (U.S.-Latin American Vice President) with me... everybody online with me...

(CNC) R.M.Z.: We made a meeting today and analyzed several points in the contract... we have even asked C.A.A. (CNC/WP lawyer) ...

(CNC) F.C.: I have several questions to make to you... to whoever read in the dept the contract... Where is the place where I have to declare the percentage I have to remit overseas???... (...) These are the things that are important... How do I have to do to win?... What must be filled or not is their (WP-Reading) problem and give to us... (...) these things... What do I place here to take out of there... To make number guys ... Important is to be smart... How do we going to get out of this situation?... I charge him what must be done... So, I need you soon up there (4th floor), let's re-analyze this, I need somebody from risk analysis to tell me "its in the item X, that you have to tell the percentage"... because it (bidding instructions) does not say... He says that... If I do not tell it will assume 20%.

(CNC) S.P.H.: Do we have condition to any better than this 20%?

(CNC) F.C.: Less! I want 0%... I will say its zero... My business is not to be penalized ...

(CNC) S.P.H.: You want to justify to go from 20% to 0%??

(CNC) F.C.: I want to know where it should be indicated.... How will I justify?... I am going to say the shareholders the following... will not remit any money... I am going to say its zero... (...)

(CNC) F.C.: To win... Guys... it's not about paper... It's about thinking... Engineers just know how to calculate... throw the engineers in the trash can and let's think like businessmen... How do I do to transfer and

knock the others (competitors) down? (...) We have to do a spreadsheet and make some conjectures what happens in the commercial (proposal) if I change this here... Can I go up?... go down?... Can I be more expensive than any other... understood... this I have to do right now! .. If we don't do this, any paperwork you do it's mathematic calculation stuff, to send to someone to do... it does not matter... this is a competition....(...) I need to know where am I going to fall in the technical proposal, so that I will pass it over to the commercial proposal...OK?!... that is it!... I told to them (WP executives), it does not help to worry about the commercial proposal ... I have just talked to C.H.E., to G.J., to everybody! ...I told S.C. (U.S. - Latin America Vice President)... you are the president of this here.... it does not help... I have to take maximum score in the technical... commercial goes together... because this represents 75% (technical)... if you don't get those 75% any number that you chose it's already expensive... because of the difference in the score...it's one to three...

(Recorded meeting, 19th July 2010 – Author Translation)

In the end of the day, we met B.M. to discuss the situation of the write-up's and some strategies to speed up their writing/checking process. We showed her a spreadsheet we created to track the progress and responsibility of elaboration of the technical documents and discussed strategies on how to speed up and share the work in order to have all items covered and assigned. After that conversation, both I and F.F.M. had an impression that B.M. was more opened, pragmatic and hands-on than G.J.

Item	Sub-Item	Sub-Item 2	Responsible	Check	Status	OBS
EXPERTISE ON THE OBJECT						
1	15.1. Services Contract Development					
4	15.1.1. Technical Specification		L.M.A.		80%	
5	15.1.2. Site visit		L.M.A.		0%	HOLD SITE VISIT
6	15.1.3. Technical seminar		L.M.A.		0%	HOLD SITE VISIT
7	15.1.4. Consulting the available documentation		L.M.A.		0%	HOLD SITE VISIT
15.2. Approaches to Implementation Services						
9	15.2.1. Technical Standards		L.M.A.		80%	
10	15.2.2. Previous Experience in the Use of Tool		L.M.A.		80%	
11	15.2.3. Internal Procedures for Implementation		L.M.A.		80%	
15.3. Management and Project Supervision						
12	15.3.1. Technical Standards		???????? - Define w/R.M.Z. & G.J.		0%	
13	15.3.2. Internal Procedure Manual		???????? - Define w/R.M.Z. & G.J.		20%	L.M.A. START DRAFT
14	15.3.3. Work Processes		???????? - Define w/R.M.Z. & G.J.		0%	
15	15.3.4. Support Team Qualification		???????? - Define w/R.M.Z. & G.J.		0%	
15.4. Physical Factors and Management						
17	15.4.1. Availability of manpower at site places		R.M.Z.		20%	L.M.A. START DRAFT
18	15.4.2. Recruitment		???????? - Human Resources		0%	
19	15.4.3. Mobilization of manpower from other locations		R.M.Z.		20%	L.M.A. START DRAFT
20	15.4.4. Facilities leasing of real estate and IT equipment		R.M.Z.		20%	L.M.A. START DRAFT
15.5. Services Oversight and Internal Monitoring						
22	15.5.1. Development of technical analysis		L.M.A. - ELE (R.J.) - HVAC (R.J.)		20%	L.M.A. START DRAFT
23	15.5.2. Technical and Administrative Support		???????? - Define w/R.M.Z. & G.J.		0%	
24	15.5.3. Executive Planning		L.M.A.		0%	
25	15.5.4. Production Control		L.M.A.		0%	
26	15.5.5. Discipling Interfaces		L.M.A.		80%	
15.6. Knowledge of the Object after visit						
28	15.6.1. Detailed Explanation on the object after technical visit		L.M.A.		0%	HOLD SITE VISIT
METHODOLOGY AND WORK PLAN						
16.1. Job Execution Methodology						
34	16.1.1 - List and Description of Activities per Specialty					
35		16.1.1.1 - 3D Modeling	L.M.A./F.F.M.	VP SOFIA	80%	
36		16.1.1.2 - Piping Project	L.M.A.		60%	
37		16.1.1.3 - Ventilation Project (HVAC)	F.F.M.		0%	
38		16.1.1.4 - Electrical Project	F.F.M.		80%	
39		16.1.1.5 - Biomechanization	L.M.A.		0%	
16.2 - Work Plan (phases & products):						
41	16.2.1 - Project Manual Draft					
42	16.2.2 - Executive Planning					
43	16.2.3 - Solutions to the most relevant issues:					
44	16.2.4 - Resource Allocation					
45	16.2.5 - Risk					
46	16.2.6 - HSE					
47	16.2.7 - Detailed description of software to be used in production and doc control:					
48	16.2.1 - Production Software:					
49	16.3.11 - PDS					
50	16.3.12 - PPA1					
51	16.3.13 - BOCAD					
52	16.3.14 - SIMLEISO					
53	16.3.15 - INVRCH/PIPP/STRESS					
54	16.3.16 - CALSIP/HOCAS/SPRO/SUPERS					
55	16.3.2 - Project Controls:					
56	16.3.3 - Project Schedule Development and Monitoring					
57	16.3.4 - Correspondence, Meeting Records, and Report Templates					
16.4 - Chronogram Draft:						
59	16.4.1 - Chronogram Draft					
16.5 - Quality and production measures to be implemented:						
61	16.5.1 - Quality and production measures to be implemented					
ORGANIZATIONAL STRUCTURE						
62	16.6.1 - Quality and production measures to be implemented					

Fig. 70: Spreadsheet to control the completion of the sections in UNA3 proposal technical documents (write-up's).

That impression hold up through the next days as the presence of B.M. in the CNC/WP office speed up response from other offices and the completion of write-up's, which were supposed to be ready prior to de EPR (executive proposal review) meeting on 23rd July 2010. As such, greater pressure on other people around the company was made to supply necessary non-technical information to complement the technical documents. The dynamism gained with her arrival can be gauged from the following thread:

Time is OK with me.....IT guys still have time for Projectwise no worries. Document Management system description can be added whenever ready by the end of the week. We do not need the description for the EPR, but the methodology and Scope understanding is more vital.

Regards,
(WP-Sofia) B.M.

(WP-Sofia) B.M.

Comments received. I'll read and merge comments ASAP.
Talked to F.F.M. and we can meet at 18:00 to check the completion of this section.
We are waiting for IT persomel to release a Projectwise procedure in English. If they do not will keep it as SPF/Encompass to save time.

Att,

(CNC) L.M.A.

Guys,

As promised attached is a revision of the methodology section that you sent last week with track changes kept and whole sections inserted.

Please have a look and let's meet later today (whenever you can) to discuss what else we have left from this section. Georgi and Sasa worked mainly on this section and put some suggestions/ comments. Feel free to keep/ remove whatever you like or do not like.

With regard to the **ProjectWise**' question below my understanding was that this is what you will use and the reason to have Encompass and SPF described is that this write-up was developed 10 days ago when this was not clarified. So you need to substitute the Encompass and SPF information with what you have available for **ProjectWise**.

Kind regards,
(WP-Sofia) B.M.

(E-mail thread copied to F.F.M., R.M.Z. and G.J. sent on, 19th July 2010 – Exact transcription)

+++++

(CNC) L.M.A.

Attached is the spreadsheet with the Organizational Structure and Technology Transfer Sections breakdowns included. When G.J. comes later today we will sit and may introduce some other changes to these sections since we are responsible for their completion however for the purpose of tracking at the moment these should be OK. (Note that I have kept the original name of the file you sent).

Kind regards,
(WP-Sofia) B.M.

(WP-Sofia) B.M.

HSE write-ups merged into master Methodology and Work Plan.

I am sending you the control spreadsheet so you can include other documents and their status.

Att,

(CNC) L.M.A.

Guys,

Please, find attached the general HSE section. We need to check with G.J., R.M.Z. and the other guy that you said suggested to have this section or we need to have something more specific about this particular project with regard to HSE.

I agree with your idea that will be useful to have the Organization and Transfer of Knowledge sections in this format as well. Let me know if you want me to place them your spreadsheet or you prefer to do it yourself.

*Kind regards,
(WP-Sofia) B.M.*

Guys,

*Attached follows spreadsheet describing **item X responsibility X status** of the 1.6 - Methodology & Work Plan and 1.5 - Knowledge of the Object documents.*

As a suggestion we should consider in this control list the other documents of the technical proposal (1.7 – Organizational Structure & 1.8 Knowledge Transference Working Plan) in order to keep on tracking their completion.

Att,

(CNC) L.M.A.

(E-mail thread copied to (CNC) F.F.M., (CNC) R.M.Z. and (WP-Reading) G.J. sent on, 20th July 2010 – Exact transcription)

Nevertheless, several problems showed up on the eligibility documents of WP as well on the technical staff experience documents. On then 20th July 2010, F.C. was very worried with the score of the technical proposal, as he needed to adjust the cash flow to WP in order to arrive at a final price for the proposal. As such, he asked for an urgent meeting to simulate the score level attainable that far and the problems we had to be awarded more technical points. R.M.Z. explained to F.C. that several key technicians that should integrate the proposal were still not assigned as WP-Reading were experiencing difficulties in finding them. Additionally, WP-Reading were not being able to prove his participation in other nuclear projects as most of the projects have been done by Gilbert/Commonwealth prior to WP purchase and these certificates were attached to the WP-New York, an office that only existed in the paper to reap fiscal benefits. This way, my role in the proposal PDS administrator grew in strength. To make sure that in case they did not find a qualified PDS administrator in Reading, CNC/WP provided a quick admission as a formal employee for me.

Parallel, R.M.Z. tried to organize a preparation meeting for the “red-team”, however due to mounting problems in the risk assessment of the proposal this meeting had to be postponed. When it happened there were not enough people and R.M.Z. cancelled the preparation meeting. With problems and doubts mounting, all official meeting scheduled were postponed until the site and office visit. These problems became even more evident in the early night conversation involving B.M. G.J., F.F.M and me, described in the field notes as follows:

(...) A debate began concerning the logo to be used in the proposal. According to G.J. it was important to have the CNC/WP logo stamped into sheets of the official proposal to make Eletrobras Eletronuclear aware of the relationship involving the two companies. B.M., however strongly disagreed as she argued that the bidder officially would be WP, therefore that should be the only logo

carried on the proposal. She conceded that at some point of the proposal it could be disclosed that WP and CNC/WP already have a workshare agreement and, in fact, they would be the same company. Nevertheless, the proposal should bear the WP logo all the way through. G.J. again insisted that the dual logo should not be seen as an aberration, because CNC/WP and WP would be, in his opinion the same company, with CNC/WP a simple local office of WP. It did not help to explained G.J. that in Brazilian business each company would be individualized by its CNPJ (Cadastro Nacional de Pessoa Juridica) number and CNC/WP had one and WP none, and that there must be one company (one CNPJ or foreign company) to hold the technical certificates to win the contract so that CNC/WP (another CNPJ) could be subcontracted for the work. After a lengthy debate, he said that C.A.J., CNC/WP president were to decide about that. (...)

Another discussion initiated as G.J. said to be surprised by the fact that I was not a regular CNC/WP employee, but a contract worker. He said that the fact that most of CNC/WP personnel were not regular employees would represent a risk for the proposal and for the company. Because it the client discovered it they could be sued over having people illegally enrolled in the company. We tried to explain to him that it was a common in Brazil to have high salaries personnel as contract works because high employment taxes in Brazil represent a severe hurdle for engineering companies, and that was the way engineering business was ran in Brazil. (...)

He also expressed worry about the amount of money already spent in the proposal (around US\$ 300.000) and that they could not afford losing it. There were still too many things to be done and arranged and he was worried about the schedule. He realized that to have the write-up's written here in English, sent to Sofia for a primary check, then complement and sent for U.S. to be verified, to be consularized and only then to be translated back to Portuguese by a sworn translator would take too much time and make them miss the schedule. After discussing what consularization meant in Brazil, we expressed doubts on how to do it. I suggested that he should ask for WP-Houston because they have been through all the proposal and contracting process with Petrobras in PDY project and probably knew how that was supposed to work. He agreed and said the next day he would look for someone in Houston to give him advice. Nevertheless he argued that we were still far behind the curve and that want to get things done on time we should have a plan B. B.M argued that we should think about doing the write-ups in Portuguese what would save a considerable time in writing and translating. He said they would not be able to do that because he was being pushed by WP-Reading to hand in the write-ups. Then B.M. suggested to hand in directly to WP-Reading without going through WP-Sofia, saying that the documents would look like crap if not checked and corrected and they would be ridicularized, what made me fell embarrassed. After that, I left the conversation to get back to work and saw that G.J. and B.M. discussed harshly until he left the office. When I went to say B.M. goodbye she told me that G.J. had been out for a walk because he was too nervous (...)(Field Diary, 21th July 2010).

On the 22th July 2010, B.M. sent additional doubts concerning the proposal raised by WP-Sofia engineers. Their doubts however showed certain confusion, particularly in relation to the terms used and the modus operandi required by Eletrobras Eletronuclear. At some questions they even questioned the very essence of the task required in the bidding instructions, a lack of abstraction power that did not help much in describing a method or evaluating man-hours. As we were close to the site visit that would begin in the 25th July, we sent the following response

UNA 3 - List of Questions

Type of questions: ETN – for Eletronuclear, WP – for WorleyParsons, ETN/WP – for Eletronuclear and WorleyParsons, WP/ETN - check if/ouse first, and then if no answer is available go to Eletronuclear, TR - translator.

Expected effect on project cost: **green letters** – minor, cost delta < \$10000;
Blue letters – medium; \$10000< cost delta < \$50000;
Red letters – significant, cost delta > \$50000;
Violet letter – cost delta increase expected, but not easy to estimate;
Black letters – cost delta not expected or not considered,
Orange letters – cost delta not clear.

Other colour coding: - question unclear for other reasons,
- try to find an answer if/ouse first,
Bright green letters - check if included in margin estimate,

Please classify next 3 questions properly before sent to the client! (may go under general questions)

Question 1: When can we expect first IFC drawings ready so Eletronuc can start construction? (It is not reasonable to wait to have all IFC IFC and then start construction, we can probably have some IFC IFC in 4-5 months period? Check with proposed project schedule). OR include in WP schedule submitted with bid.

Question 2: Can we check with EB what is that number of 34000 supports? Do they expect 24000 types of supports? Do they expect drawing for each support? How are going to produce typical support drawings? Is the data export from the 140 typical supports. Then 95% or more of the supports should be some kind of combination of standard and make, very few special supports that really need separate drawing. Is it not like that?

Question 3: We plan to issue 21000 isometrics in 10 months & in 1200 less a month, 4-6 people can probably check, backdraft and issue around 200 drawings a month (assuming average iso complexity of 3-4 supports, 2-3 changes in direction, and 4-10 components/items in 60M). We may need 4 teams like that which is around 20 people. And this is usually very high experience level (except backdrafting person which could be lower to mid intermediate).

General questions

EN

1. If we refer to our EMS procedures in our bid, should we translate them to Portuguese and attach them, or we can translate them later, or maybe translation will be not required at all. (Technical Specification DC/3/0234/0082/008400 Rev0 says on PG 9 "CONTRACTOR shall issue a work method and its work procedure to Eletronuclear for comments.")

2. Also, we should check when we can use EMS procedures and when we have to use ETN procedures/guides/datasheets and other standard documents.

3. Different Technical Instructions (ES/3/0237/4700/N90207 and other with similar numbers) that are referenced in the Technical Specs are most likely not translated. We should estimate how its could affect overall project cost, (if it is possible at all).

Technical Specification DC/3/0234/0082/008400 Rev0

1. PG 15/133 ETN
"Progress Step A – item 2.7.1"

2.7.1 is "Measurement criteria for lump sum work". How is it related to Step A and/or why it is referred here?

2. PG 15/133(16 and 17) WP/ETN
"Progress Step A – item 2.7.1"
Does not give the number of ISOs to be done. Check first if some other document indicate it. If not try to deduct all other type ISOs from total. If this is not doable for whatever reason ask EN.

3. PG 15/133 ETN
Last sentence in second last paragraph says: "In the first phase the material to be modeled should replicate the material in the database provided by Eletronuclear."
Does this mean that materials will be changed later? Only once, or couple of times, maybe?

4. PG 15/133 ETN
First sentence last paragraph says: "Contractor shall provide a printed copy of the Fabrication Isometrics and..."
Does this mean that electronic files will be given to Contractor and Contractor is responsible for making paper/hard copies? How many of them? Does Eletronuclear want its own copy? Or it is just one copy as Master for new isometric development?

5. PG 16/133 WP/ETN
First sentence first paragraph says: "... by importing APLs or by..."
What is APL? Is it a tool for converting isometrics to 3D model?

6. PG 16/133 ETN
9th paragraph: "... the quality control process shall be repeated..."
Not clear how it should be repeated? First control is by piping checker and piping engineer probably, but who will do the second one, once it is transferred to instrumentation model?

7. PG 16/133 ETN
9th paragraph: "... behind components..."
Should it read "downstream" instead of "behind", or something else?

8. PG 17/133 ETN
First paragraph first sentence: "All lines designed as bundles and all... analysis."
Which lines are designed as bundles? What kind of analysis is required?

PG 17/133 WP/ETN
Paragraph 6: "... the division of isometrics as per ES/3/0237/4700/N90163... ES/3/0237/4700/N90205..."
These two documents can tell us a lot about real amount of work to be done? I was wondering if they are translated to English. My feeling from information available at the moment is that either isometrics are very simple comparing to "standard" isometric or ratio of supports and isometrics is incorrect.

PG 17/133 WP
Paragraph 6: "... ES/3/0237/4700/N90163 ..." This document can also tell us a little bit more details about the scope. However, if it is not translated yet it could be too time consuming and not affect pricing too much.

PG 17/133 WP/ETN
Last paragraph: "Embedment sheet..."
What is embedment sheet? Can we get any examples?

Fig. 71: List of Questions sent by WP-Sofia engineers on the 22nd July 2010.

Things were not better for the support we received from the other local colleagues. On the 22nd of 2010, required to help in the description and functionalities of the software that would be responsible for the document management system, CNC/WP manager IT, who few weeks ago were the responsible for its implementation replied us sending the software manual. On the same day we (R.M.Z., F.F.M. and I) had a conversation with P.D.J., a coordinator we knew from the PDY project, and also were developing proposals with WP. In this conversation it was possible to see how difficult it was to make even internal people to understand the unconventional character of the UNA3 proposal. It was also perceptible how standardized methodologies were ingrained within WP.

(CNC) P.D.J.: *By what I am "smelling"... by three phrases that I saw... it smells like the PEP... Project Execution Plan...*

(CNC) R.M.Z.: *More or less...*

(CNC) P.D.J.: *What he is asking here is a PEP.*

(CNC) R.M.Z.: *They are asking for a technical proposal. Describe what we know about our work method...*

(CNC) P.D.J.: *WP... don't know if it helps... if it would be good or bad...it must be discussed...*

(CNC) R.M.Z.: *Don't talk about the EMS, what they have there...forget... We are talking about our project... (...) that EMS that has all the norms and procedures ...*

(CNC) P.D.J.: *Let's say... you never had done a PEP until today and you don't know what is inside...I think what is there inside is a directive of it...and is WP... it is in the house... I can show you that I did for the FPSO (proposal)... you take a look at it... get its structure and try... I read three phrases, It might be that I am talking bullshit...if we are not going to do something close to this... you can get the PEP WP... it was a structure...and there you go fitting these blocks in a manner that explains how you are going to do the project.*

PEP is this... (...) apparently what the guy here wants is a project plan (PEP) ... where I am going to get workforce, what do I do, which are the keys to develop the project ..is it?

(CNC) L.M.A.: The problem is that this document has 10 pages. ...

(CNC) P.D.J.: WP's has 120 pages...

(CNC) L.M.A.: That's because I think it is not this... (...) Let's go I think 1.5.3. (section in the "Knowledge of the Object" document) is not the PEP. It falls upon this... "General appreciation of the modern concepts of project management..." something very conceptual...

(CNC) P.D.J.: Inside the PEP... it will say to you how you going to do each activity... (...) and then there is something ours... it is from the house...I read it here, I read it at Houston... the guy know what I am talking about... (...)

(CNC) P.D.J.: PEP is in the network (WP network, not CNC/WP network)...I did one for the FPSO ... and I did it in three days...you go filling the blanks... it says what you have to write there... there is a manual to build the PEP...(...) Maybe it is not what you want but I would recommend to do things in the way the company works (WP).

(... he go a get the PEP elaborated for PDY...)

(CNC) P.D.J.: This one S.B.D. did for PDY. And if you want I handle mine for the FPSO that is filled up and digital...

(CNC) R.M.Z.: The problem now is to develop this item here (1.5.3.)

(CNC) P.D.J.: This here will be integrated inside your PEP. (...) They spent years thinking about how to structure that... Am I going to think all that again to make a report?...(...) It going to give all that...This is because this guy here (Eletrobras Eletronuclear) does not know the PEP... ours... This guy here (point to the bidding instructions)... obviously does not know...What you are going to do is handle it (to Eletrobras Eletronuclear) and say "We work this way!"

(...)

(CNC) L.M.A.: If they have asked for a PEP or the document format opened was free, it would be perfect... the problem is that they asked for it in pieces and for each item he will assign a score...and this score account for technical evaluation...

(Recorded meeting, 22th July 2010 – Author Translation)

After a long conversation, P.D.J. accepted to write some paragraphs on the subject we requested instead of using the standard WP proposal tool. The resulting contribution, however, was almost useless. Whereas the item requested more practical concepts involving the operational work, he wrote about project top-management organization and concerns, as shown below:

1.5.3. *General analysis of usual and modern concepts related to design management and supervision, technical and administrative support related to the type of design to be developed, taking into consideration different variables and intervening factors, comprising at least: internal procedure manuals, work process, supporting staff qualification;*

(...)The project will be executed by an Integrator Program Management Team (IPMT) responsible for the development and implementation of a Project Execution Plan (PEP), the details of which will be developed after the Contract signature. The PEP will be developed following careful and detailed consideration of the complexities of the project and will be based upon implementing a series of strategies to minimize risk and maximize the certainty of a successful project.(...) IPMT Responsibilities:

(...)

- Issuance of the List of Documents (deliverables) for the scope of work
- Issuance of the preliminary List of Documents for the Integration effort
- Issuance of the List of Actions (LOA)

- Implementation of Report of Occurrences (RDO)
- Issuance of the Project Execution Plan (PEP)

(...) In order to manage the overall engineering during the detailed design phase, the IPMT will utilize a Project Management Team (PMT) as the project organization responsible for the day to day execution of the work. The IPMT will accomplish this through a Project Management Team (PMT) composed of personnel from WP organization. The PMT Coordinator will have management oversight responsibility for the execution of the detailed engineering design by assisting the IPMT with:

- Ensure compliance with Project' Specifications and Procedures.
- Participate in meetings and screenings with Eletronuclear to coordinate key project milestones affecting the scope of work.
- Coordinate with the IPMT any proposed changes by the Eletronuclear affecting the scope of work
- Implement early application of Constructability reviews during detailed design. (...)

(E-mail sent on, 23th July August 2010 – Exact Transcription)

The days right before the visit, work was quite intense as we needed to get the write-ups as close as possible to the end, so that we could quickly complement them with the information gathered during the three days of client visit, and sent them as soon as possible for WP-Sofia and WP-Reading review. I change that also occurred in this task was that after a conversation between R.M.Z., G.J., B.M., F.F.M. and I, where, supported by a official Eletrobras Eletronuclear note, we decided that the write-ups would be written and handled to Eletrobras Eletronuclear in Portuguese and only after being finished would be “goggle translated” and sent to WP for review. Initially that generated a considerable workload as more than 50 pages had been already written in English. However, as many sections were still waiting for the technical visit at Eletrobras Eletronuclear, the damage would be compensated.

7.4.4- Sequential Knowledge Change

The three days visiting the Eletrobras Eletronuclear office in Rio de Janeiro, the UNA2 nuclear plant in Angra dos Reis, and attending the technical seminar were a key moment in the project. We were able to see that everything that have puzzled us during almost two months really made sense, and Eletrobras had everything ready for resuming UNA3 project. All documentation from UNA 2 project that would be used to build UNA3 was clearly organized, many softwares have been internally developed to speed up the project process and the competence of the Eletrobras Eletronuclear technical staff impressed everybody, especially those who were skeptics about the adequacy of technical requirements and the directions given by the bidding instructions. In their visit report, WP-Sofia engineers say:

On the Eletrobras Eletronuclear office visit:

(...)

Conclusion:

The documentation that had been preseneted was very detailed and completed and should be enough to perform the job.

Senior Piping Engineer: G.G. (WP-Sofia)

On the Eletrobras Eletronuclear site visit:

(...)

Conclusion:

The site visit was very usefull and interesting. I assume that Electronuclear is very precise in their work, has a well trained and experienced staff, and gives great care to this project.

Senior Piping Engineer: G.G. (WP-Sofia)

Also important, the time out enabled team members to know each other better. We could talk much more with G.J. and B.M., who he have been working with us for several weeks, and understand their motivations and personal stories. It was the first time G.J. traveled outside the U.S. and he was excited and impressed to all that he was seen in Brazil. He told about the resistance of his colleagues to come to Brazil but said that he would love move with his family for some time and his kids were excited to live by the beach in Rio. B.M. was a globetrotter. She had traveled too many countries, especially in the Eastern Europe. But she loved Bulgaria and the quite life she lived there. Curious and vibrant she never refused an invitation for going out, visiting places and talk for hours.

On arrival, we met G.G., an early-30s Bulgarian piping engineer who had just arrived from the WP Sofia office to follow us on the visit. Two days later, we met S.T.V., a late-40 electrical engineer. Very reserved and somehow wary in the beginning, slowly through the days they relaxed and showed up to be very friendly. For four days we traveled, went out for dining and drinking and for some sightseeing. Despite the apparent cultural difference, a sentiment that we Brazilians shared was that we got along much better with the Bulgarians than with the Americans though were much more used to them.

S.P.H. behavior during the visit attracted my attention as can be seen in the field notes below:

(...) Overall during the trip, he talked very few to me and whenever he did was in lecturing tone as a should have done or paid attention to something only him noticed. During the technical documentation examination in the office visit, in front Eletrobras Eletronuclear technical staff he constantly tried to be friendly and pretend that he was aware of everything. Every time I asked something to Eletrobras Eletronuclear he get into the subject and mimicked the answer usually to make my question look like trivial.

(...) While we get into the van to go back to Rio, he insistently repeated to everybody, even in English, that it was a trivial project and we could halve the man-hours estimates, what gave me a chill in the spine (...) On return he realized that he had not checked-out at the hotel before living and how his things were at the reception as the room was already reserved for another guest. He had not also booked his ticket back to São Paulo, and as all flights were full he would have to get another hotel in Rio what was also hard to find. As he must get back to São Paulo early in the morning to get I flight o Manaus, he had to booked I flight at 5 o'clock in the morning, in international airport (35Km away from Rio) and stay the night in the flat of a former CNC/WP colleague that were living in Rio. All that made me wonder which organizational skills qualified this man for manager, if he wasn't able to even set with the secretary a business trip to Rio ...(...)(Field Diary, 28th July 2010).

On the 30th July 2010, we took the day to work on the Rio de Janeiro office of another WP affiliated, ITCS, which worked with deep-sea drilling. This day, working on a round table we tried to line up information, organize the work left and decide where

to concentrate the efforts. The content of this day long joint work can be gauged through the field diary notes next:

(...) T.D. was worried about the impact of the technical certifications in the overall technical score and the room left for cutting prices. As he simulated many different score scenarios he realized that the competition depended even more on the technical point than previously imagined, with price discounts not compensating for lost technical points. Taking some limitations into consideration, his calculations showed that a single technical point ahead of competitors would cover for a price increase of 5% in the overall project cost over competitors. On the other hand, large discounts would not compensate for low technical score because limiting factors in the competition calculation formula would block their effect. (...) as we could calculate, objective score, corresponding to technical certificates from the company and the key technical staff accounted for 70% of all technical score, while subjective score, corresponding to the write-up's accounted for 30% of technical score (...) As this look counter-intuitive we read again altogether and checked if all these calculations were correct. (...) after all this process T.D. said "Discount does not matter! What matters is technical score!" (...)

(...) While I, B.M. and F.F.M spent time updating document status and responsibilities in the write-up control, T.D., R.M.Z. and G.J. discussed about the technical certificates supposed to be supplied by WP-Reading (...) (Field Diary, 30th July 2010).

With T.D. return and the awareness of the importance of the technical certifications, which heavily depended on WP-Reading, pressure upon G.J., build up. As he was also losing ground for the active and pragmatic B.M. actuation, he felt the hit and end up isolating himself from the group. After this week, G.J. returned to the U.S. to speed up certificates expedition and B.M., G.G. and S.T.V. returned to Bulgaria. Communications and cooperation also improved, as can be seen below:

Hi All,

Please see the attached files with my comments and addition to write-ups from 30/07/2010. I have used track changes so it should be easier to recognize them. I have checked also and Section B 18 - Knowledge Transfer_23Jul2010 - on page 8: "...of Technical Consultant to Kozloduy NPP in a Euro 492 bln. project for Units 5 – 6 modernization..." should be "...mln (million)..." . Anything else looks fine for me.

(CNC) L.M.A.

The part 1.6.1.1.2.2 - STRESS ANALYSIS and SUPPORT CALCULATION REPORT I have modified in Angra3_B16_MethodWorkPlan. I have added some paragraphs that I think are important but still you check them. Especially the usage of ASME and KTA standards.

If there are any else I can do, don't hesitate to contact me.

Best regards,

(WP-Sofia) G.G.
Piping Engineer

Hi L.M.A. (CNC)

Good to know that you guys are back to Sao Paulo and everything is ok. I missed my fly to Sofia because the flight from Rio had late. So I had to stay one night in a hotel at Paris airport. It's not nice but sometimes happens.

About the write-up I'll take a look and see what I can do. As soon I'm done I'll write you back.

Regards,

(WP-Sofia) G.G.
Piping Engineer

Hi (WP-Sofia) G.G.

What about the trip back to Sofia? Everything just fine?

Here we are back to São Paulo and fully dedicated to write these write-ups.

Maybe you can help us on the STRESS ANALYSIS and SUPPORT CALCULATION REPORT as we discussed in Rio.

Attached follows what I have written prior to the visit. Feel free to change this as you wish.

Regards,

(CNC) L.M.A.

(E-mail thread copied to (CNC) F.F.M., (WP-Sofia) B.M., (WP-Sofia) L.S.V. and (WP-Reading) G.J. from, 02nd August 2010 to 05th August 2010 – Exact transcription)

On the 2nd August 2010, back to CNC/WP office in São Paulo, we realized that much of the technical documents had to be updated to reflect the information gathered during the visit. Nevertheless, S.P.H. eagerly wanted to cut down the man-hours estimation, the intense debate involving this issue can be gauged by the field diary notes below:

(...) However, early in the day S.P.H. stop at my desk and eagerly said that we would have to work on an intensive cut in the man-hours previously estimated. I said ok, but before I need to tell him about the technical seminar and explain how the project automations tools developed by them worked. He said ok, but it was less important, and that based on what he had seen in the project documentation and UNA2 site visit we could cut 50% in the man-hours estimated. Then, I told him about the conversation we had with T.D. where it would not help much to cut the man-hours because we were already working close to the client estimation and that the competitions rules did not benefit low prices but higher technical scores, and maybe it did not worth the time to revise man-hours in face of so much to do in the technical documents. Loudly, he said that what I was saying did not make sense and that we must cut the hours to win the bid. As, I tried to further explain he got angry said that my desk was not place to discuss this. I said we should then look for T.D. and he would explain everything. Then he went away complaining about me so that people around could see. I went to talk to R.M.Z. to complain what have happened while we were talking, S.P.H. came to us and asked us to follow him and look for T.D.(...) (Field Diary, 2nd August 2010).

We asked T.D. a small meeting to clarify the issue. In this meeting several problematic issues concerning the proposal have been discussed as follows:

(CNC) R.M.Z.: *The discussion is this the following... after the technical visit... all that we saw... S.P.H. saw that it is possible to reduce the number of man-hours in a relevant way. (...) This morning we were talking, and L.M.A. said "Oh, is it worth to change the man-hours now because T.D. did an calculation (...) and maybe it is not worth to invest time in changing the man-hours because it will change price and that's not what matters". In my opinion, we indeed have to change the man-hours because ... it's something somehow philosophic...operation has to deliver an amount of man-hours enough to do that project. (...) So, what's the idea... I think we have to improve the man-hours.... Because he (L.M.A.) also said something important he have to spent a time that I could be working in the technical documents. I said "That's true... this that you are saying is important"...but what I also think, is that we are going to get that table and work on the man-hours because, although the technical documents are as much or even more important than that, we have to run the PV (proposal price), we have to run several things... he have to run the risk analysis that depend on the amount of man-hours...so, I think we must have a reliable amount of what we need in terms of man-hours.*

(CNC) T.D.: *Yeah... let me take advantage of the moment to explain something. There is people that has a work style... ok... to hide from the rest of the team ... ok... something..."Look, I only tell this to you because for me you only has to know this and so I will only tell this"... This is a way ... don't want to make any further evaluation if it right or wrong... I don't work like this... I think the team... of course there is certain things, certain questions, that are not appropriate for the team but I think the more information the team knows, the better we are aligned to get the project done...ok?! So, when I did that in Rio a simulation and show to you that*

the price sensitivity is not as big as the technical score problem...that's because you are involved in doing... it happened that what was expect WP to do... ok... We end up increasingly absorbing things... texts to do about the methodology, about the knowledge transfer, of this and that...

(CNC) S.P.H.: *This was a WP task?*

(CNC) T.D.: *For me it was WP task. Has always been... because they are the proponents, they know nuclear projects, they should do... Then, they came up with the following argument... "But you (CNC/WP) went deep down in the technical specification, you know well the scope. So create a draft to me... I said "Ok, as a draft I accept...but it keep being yours (WP)"...Then, while I was on vacation, it changed... the text can go straight into Portuguese...don't need to translate...*

(CNC) R.M.Z.: *We did the draft in English... and sent to them...*

(CNC) T.D.: *They did not talk about it... did not added to this...(...) What I wanted to show to you is highlight the importance of getting the maximum technical score... so these texts, these things... we have to do and if it is necessary we have to beat these WP guys because it has to become the best technical proposal as possible.*

(CNC) S.P.H.: *Are we on this way?*

(CNC) T.D.: *I think they are working well, but we have to ... don't be shy to finger point this guys (WP) ... you have to do this...for example, the came here when I arrived, to talk ... "Look, we are writing about project management...". Hey, project management... despite all of your effort... they are not specialists...WP comes here with a lot of "gringos" bothering us that they have more than a thousand procedures ... WP has to say: "My way to manage a project with more than 70.000 documents is like this"... it is already in the procedures... So, why us "tupiniquins" have to be writing if the guys have a procedure? But look... it does not help to say I will grant access to T.D. and then he goes there in a place where there is 1500 procedures, and go look for what talk about what. So, my importance is this one... to highlight that the technical score... yes, is very important. But now let's go back to the man-hours to the money...what happens...we must have the leanest proposal as possible... achievable, that you are...it is not comfortable...today we cannot be comfortable...(...) that's what we need to know. Why? Because there are a bunch of thinks ... for example there is a bunch of risks the guy (WP) are identifying, and this risk is about to revert in money... contingency... There is a great discussion today.... Between us here... CNC/WP and WP... because WP says that everybody has to be CLT (formal employees)... if we assume everybody as CLT either we will pay few and won't have employees or will pay too much and we are out... (...) all this will reflect on price... then this debate we will have with F.C., C.A.J...(...) Summing up, let's optimize the man-hours, taking into account what we understood of the scope... ok...we need to revise...(...)*

(CNC) S.P.H.: *(...) What worries me is that if we are awarded the contract... (pretend applauses) ...if we are not awarded let's do a analysis... Why we lost the bid? ... look Promon estimate X hour and we 2X hours...(...) Then, I be very transparent " But T.D. said it was not that important and we did not care much about this"... "Errr, but you get that wrong".*

(CNC) T.D.: *OK! It is important! ... so let clarify... I want from the production the leanest proposal. It is not me, T.D. ...CNC/WP wants...*

(CNC) S.P.H.: *We are going to revise this... it will come down, we don't know how much , but we are going to revise it...Another thing... technical documents are the most important...this inclusive was WP task... we are doing it here, the technical procedures internally... Will WP check this giving its approval?... Will confirm that?*

(CNC) T.D.: *Yes, they will have to... You (R.M.Z.) are saying no, but I am to get G.J. now and say "My fellow, this is your duty! Let's get into F.C. room and I am going to tell "it is you obligation!" ... "If we receive a bad score in the methodology it is your fault not mine, all right?!"*

(... a noisy discussion ...)

(CNC) R.M.Z.: *That is what happens... We began doing it in Portuguese, because we need to send them a draft so that they could read and comment. What we perceived... correct if I am wrong... is that not only they did not do that, but they don't have enough knowledge on the proposal and what they did was to go their in 1500 procedures in the EMS and send some to us... so that at least two times the sent me documentation that I*

forwarded to him (L.M.A.) and he looked made many comments and said "No, this is what is there (EMS), we need what is in the project!" Then we set that it does not help to be waiting them, let's to it here... (...)

(T.D. leave the room to talk to M.A.C., engineering director)

(CNC) F.F.M.: So there must be someone that go there and charge G.J. ... Everytime we talk to him he never comment it...

(CNC) L.M.A.: It is not the worst... the worst is that a document were in their hands (WP-Reading), is now on our hands... the technology transfer plan...

(CNC) R.M.Z.: The problem is that the document that were in their hands for 10 days, 15 days... (...) and if we were to do that ... 10 days ago we could think about something... but he (G.J.) took 10 days to read a document from B.M. that he did not take a look, and sent it to us... that means...

(CNC) S.P.H.: What were those guys doing here (G.J. and B.M.)?

(CNC) R.M.Z. (...) They understood what we need in terms of technical certificates... I mean, they think they understood... and requested this to the U.S. They think they understood the people that has to work in the project... on the rest... (...) "no, because we are sending them a draft"... we did it...and nothing... we made F.M.C translate to English... and no return...

(CNC) L.M.A.: When the technical documents were at 1/3... "oh, no it was to come in English"...we spent time translating... then we did another 1/3.. he had 2/3... again... "oh, no it has to be done in Portuguese"... and then we went to the technical visit... when you read the bidding instructions you understand one thing, and you go there talk to the guys (Eletronuclear) and see what it is... it's another job...

(CNC) F.F.M: There is so much work to be done.

(...)

(CNC) L.M.A.: So, what we are doing goes back and forth ... AND... new things keep coming... When you get rid of an item you get two more to be done.

(CNC) R.M.Z.: It is important to understand why he did that...When we read the proposal... They discovered that there were items that depended on the visit to complement the technical part of the proposal. (...)

(CNC) L.M.A.: There were items that it does not worth to work on them because without knowing exactly what that meant it would be impossible to say something...

(CNC) R.M.Z.: (...) Then the guys (WP) arrived and said: " Send it to us that the way it is we will translate it and..." But there are missing things... This depend on the visit, that depends on the visit...Then they get desperate... Then came a note (from Eletronuclear) telling that if the technical documents were written in Portuguese they did not need to be sworn translated. Then they said "So send it in Portuguese"

(CNC) S.P.H.: And do they know Portuguese?

(CNC) R.M.Z.: No!

(CNC) F.F.M.: They will not evaluate...

(CNC) R.M.Z.: They will not evaluate, but this is their responsibility.

(CNC) L.M.A.: In my opinion what happened is that they get these guys as the best in the nuclear field ... that they would solve everything ... First, that they solved nothing... Second that the project there is nothing to do with nuclear ... there will be 10% of project ...

(CNC) R.M.Z.: It's a copy...

(CNC) L.M.A.: And half is electrical stuff, half is piping stuff... there is 5% nuclear piping project work... the rest is data processing work...So, they put too much responsibility in the hand of these guys and they didn't hold it up... and then it keep coming back things for us...

(CNC) R.M.Z.: They did not read the Technical Specification, as they should... they did not understand what was supposed to be done...

(...)

(CNC) S.P.H.: Without losing focus... we cannot get paranoid... you (L.M.A.) go ahead with the technical documents because you are focused... if you stop now to revise man-hours you are going to say "Good damn!" It is! So if it is not necessary we will not to that... you finish what you are doing... because the man-hour revision will take few hours... one day we will address this... (...)

(CNC) R.M.Z.: No, because of the following ... when you run the PV (sale price) you have to do the risk analysis... (...) I need the man-hours before, so that I need to close the PV ...WP has already separated a contingency of US\$10 million because of the technical warranty of 5 years. Do you understand... if we keep separating contingencies this way ...there is no way to compete... so we have to arrive at a price as soon as possible.

(CNC) L.M.A.: So, let's do it...

(CNC) S.P.H.: Let's take a time tomorrow and do it...

(Recorded Meeting, 2nd August 2010, Author translation).

On the 3rd August. T.D. talked to F.C. and together they put more pressure on G.J. so that WP-Reading personnel verify and comment the documents sent. This pressure however has been transmitted to WP-Sofia as two days later they sent comments on the partial documents previously sent. This time also comment represented more substance instead of being disconnected excerpts of previous works and standard procedures.

The next day, WP-Reading succeeded in certifying their PDS administrator, so my name would not be used in the proposal anymore. Not only the certificate supplied by Intergraph displayed a very recent date, what could make Eletronuclear suspicious, but also it did not prove he had the necessary experience required in the bidding instructions. I advised R.M.Z. which wrote to T.D. advising to ask for another certificate with older date. Surprisingly he called me to discuss the situation. As he thought it was not important but show some hesitation, I again advised him to discuss about it with somebody because any false information would mean declassification and ruin all effort done. In the end he decided that it was not important and left it untouched. Even though, for safety I decided to tell R.M.Z., which wrote a e-mail to T.D., copied L.S.V. describing the problem:

(CNC) T.D.,

According item 1.2.7. from the BID we need to prove the experience of the PDS administrator informing all contracts that this guy worked as PDS administrator.

And in compliance with page 131/132, proof of staff experience, the PDS administrator shall be at least 5 years experience in the area.

Is our guy in compliance with this 2 item? The certificate was issued in 2010, remember this, please!

(CNC) R.M.Z.

(E-mail sent on 04th August 2010 – Author Translation)

On the 5th August, T.D. invited me to discussion about the organizational structure of the UNA3 project where relevant issues about CNC/WP organizational history and culture emerged, as can be seen in the field diary notes below:

(...) While I was working in the write-ups, T.D. and R.M.Z. passed by my desk and asked me to come with them. We took a round table available near R.M.Z.'s desk and start to discuss about the organizational structure of the project. T.D. had some doubts about the project structure to be presented because he were used to the traditional project structure of the CNC/WP infrastructure division, and the UNA 3 project would better follow a project structure more close to those of the industry division. As such they intended to use the organizational structure of the PDY project as a model, because this project involved workshare between U.S. and Brazil. Then I and R.M.Z. began discussing who did what in the project and highlighted that although it was a nice idea to go in that direction, the PDY structure presented some problems that required correction. The role of the coordinators in the project (R.M.Z. had been electrical coordinator), for example, in our opinion required some changes. Then T.D. reminded the figure of the P.E., or project engineer, who was traditionally assigned with the technical responsibility of the project. Then T.D. also invited P.D.J. whose desk was close to join the conversation about the P.E. role. (...)

We then engaged a debate concerning the use of two coordinators, one technical the other for production control. T.D. intervene to say that they would have to think it well because expatriates should be assigned to high positions and these should not be inflated. Otherwise, he said, either they might not accept to come to Brazil or the client impression about the expatriate importance would be affected. We then argues that WP usually raked people one grade above the usual in Brazil, with Project Manager turning into Project Director, and so on... T.D. said that it depended on client's top-management, which might refuse to talk to someone with a lower rank, with directors only speaking to directors, managers to manager and so forth. Then he said it resembled what happened in CCC. (...)

T.D. then began to tell us about what happened prior to CNC sale. He told that in CCC the environment was highly politicized and rivalries build a great secrecy in the company. Working in private offices with their secretaries and direct collaborators, CCC managers and director begin to make deals on the edge of legality all for competition. According with T.D. the chief of one of the competing groups manage to be in the succession line, just waiting for the CEO to retire. In his account some CNC executives (which he does not tell) were just waiting this to happen to move to key CCC positions. Little before, however, the Federal Police broke into CCC office with a mandate looking for corruption proofs. After that, the family that controls the group decided to hire an external executive to assume in the place of the retiring CEO. In T.D. words, "when somebody comes from out of the structure, he has a mission". The new CEO dismantled all parallel power among political groups, making everybody work close to one another, changing positions and breaking command lines. Also during this process CNC sale was sealed. Curiously, this discussion start to attract more and more people when we saw there were at least 7 people watching and participating on the discussions (...).

This story made me wonder about the fact that F.C. still used CCC e-mail and that CNC/WP president, C.A.J., was almost a ghost president with little involvement with the company. Also make me wonder a picture in the 4th floor, where all CNC/WP top executives had private offices, with the CCC directorship still hanging on the wall. (...)(Field Diary, 5th August 2010).

With the proposal deadline of 24th August 2010 looming and pressure upon the write-ups mounting up, F.M.C., who was introduced as a key person in the company to help the proposal, and till then had only done few trivial work, decided jump out when he was most needed, for the reasons described below:

(CNC) F.M.C.,

Below follows the text for translation and verification: 1.6.2.1 – Project Manual Draft: BY WP SOFIA

Design Manual will incorporate our proven (...)

Att,

(CNC) L.M.A.

Dear (CNC) R.M.Z. and (CNC) L.M.A.,

Today I will finish the translation of this text here – 1.6.2.1 and I'll sent it to you.

About the 2 others, I think I won't be able to help on time, because there is another urgent proposal of the TAV (high Speed Train) Rio – SP – Campinas, to which I was required!

Can you sent the 2 other texts to other people?

Sincerely,

(CNC) F.M.C.

(CNC) F.M.C., good afternoon,

Let go, we can handle that.

Thanks

(CNC) R.M.Z.

(E-mail thread on 05^h August 2010 – Author Translation)

To cover for the work left, R.M.Z. required two junior engineers from his origin discipline (electrical). These two junior engineers received several sections of the technical documentation to translate and write and did a fairly good job even when they did not know much about subject under their responsibility as they searched other colleagues for help. Parallel, both R.M.Z. and T.D. also took sections to write and revise. As a result of all these efforts the write-up job advanced steady through the 11th of August, and as soon as each document was completed in Portuguese, F.F.M. and the other two junior engineers “google translated” them to English so that they could be sent to WP-Reading for final review and help in the EPR (Executive proposal review) preparation.

On the 11th August, A.G.R. sent the man-hours estimates for the final review. As nothing changed in this mean time, they have just been just confirmed. Parallel, final versions of the write-ups prepared by the Brazilian team began to be sent to WP-Sofia for review and comments. The “organizational structure” was the first one to be sent for analysis. On the 13th August, the first comments arrived on this document, as can be see below:

(CNC) T.D., (CNC) R.M.Z., (WP-Reading) G.J,

*Attached is Sofia revision of the Organizational structure you sent on Wednesday with track changes. As discussed yesterday on the conference call with D.T. (Nuclear Division Managing Director – WP-London formerly WP-Sofia Managing Director) for projects of this size it is standard practice in WP worldwide to introduce such Steering Committee. Generally we do not have two committees but in the preliminary conversations we had with F.C. he suggested that usually you have another committee at Technical level. That is why we decide to introduce two – **Executive Steering Committee**: with really high level executives (suggestions are D.T. and C.A.J.) that will meet every 3-4 months with same high level Client's representatives and another **Technical Steering Committee** to resolve technical issues (suggestions are S.S. (Regional Director WP-Sofia), J.C.K.(Nuclear Division General Manager),F.C.) and similar level representatives from Eletrobras. This committee will meet more often ~ monthly.*

Please note that these are just suggestions and general practices in WP but might be something totally untypical and not very acceptable by the Client. Your advice on this will be very important since you know the Client and you know what they are used to see in Brazil. Also any changes that you want to make to the suggested people for each committee are also welcome.

At the OrgChart we tried to put the two Committees the way we see them and the connection lines with the other boxes but feel free to remove and adapt these consequently.

After the OrgChart we have represented two sections including the main functions of the key individuals with specific attention given to the technical guys in the last section stressing on their educational and professional background as per the RFP.

Hope you will have chance to discuss among the management and get back to us with your comments.

We are working on the revision of the other sections as well and will send them shortly.

Kind regards,
(WP-Sofia) B.M.

(E-mail sent on 13th August 2010 – Exact Transcription – sender highlight)

Together with this message B.M. sent pictures of the WP organizational chart in corporative, divisional and project terms to be added to the “Organizational Structure” document to be delivered to Eletrobras Eletronuclear.

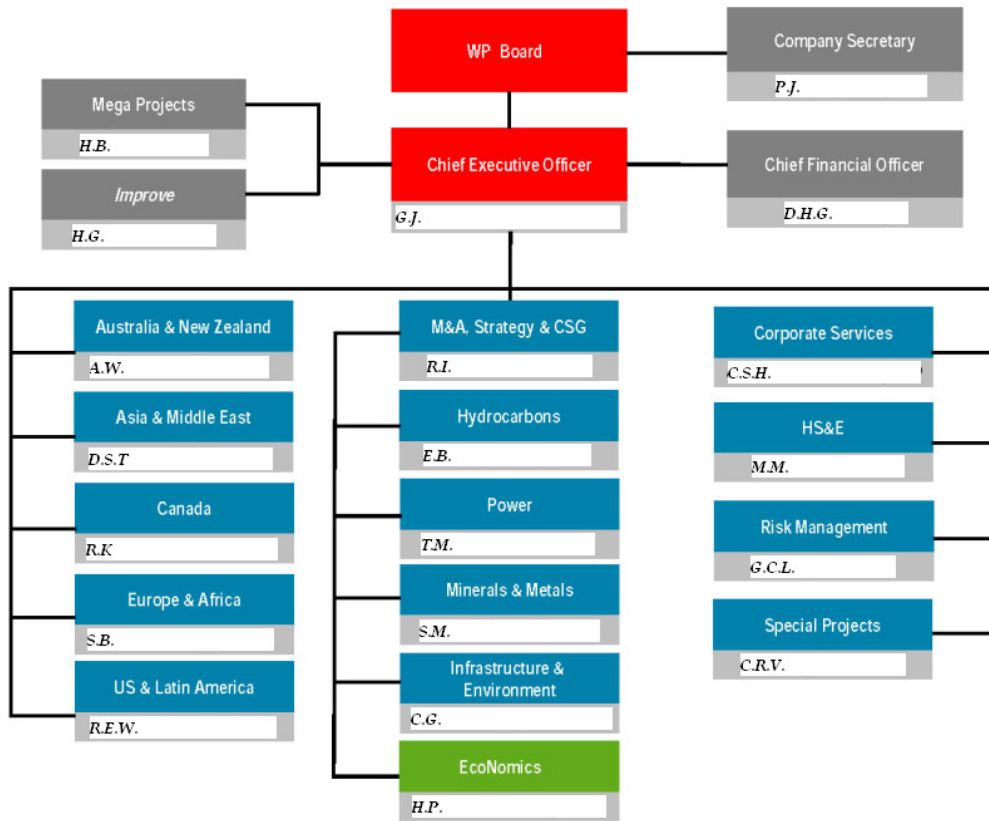


Fig. 72: WP global management structure as per 13th August 2010 (WP Presentation).

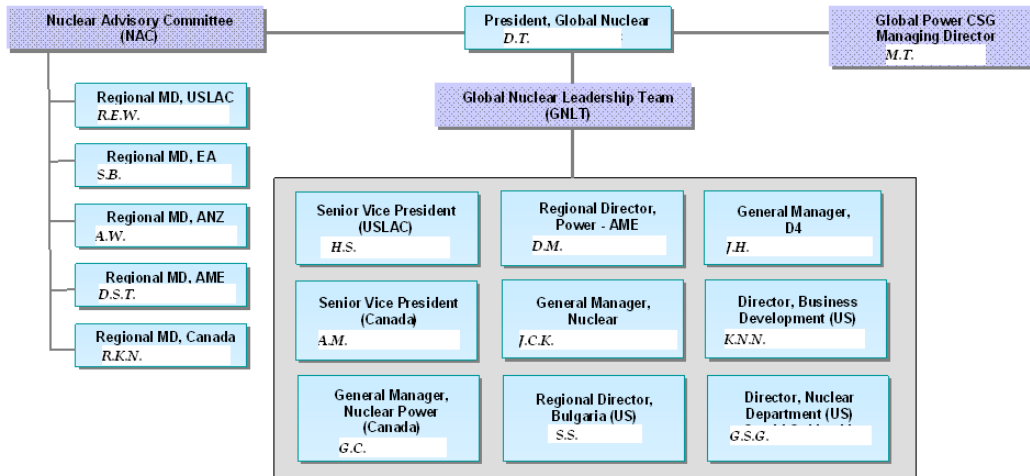


Fig. 73: WP nuclear business management structure as per 13th August 2010 (WP Presentation).

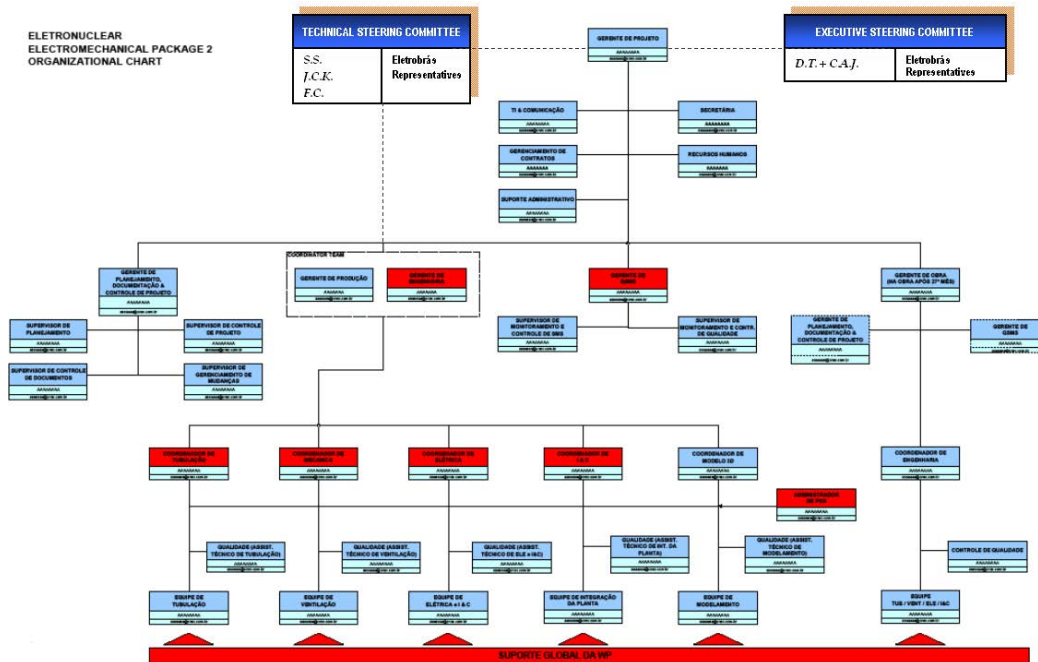


Fig. 74: WP organizational chart for UNA3. Red-box for WP-Reading, blue-box CNC/WP ones (WP Presentation).

On the 13th of August, arrived the news that the deadline of the proposal had changed again to the 9th of September 2010, from the 24th August 2010. Also, key technical documents were sent to WP-Sofia for review and came out with trivial comments, as can be seen next:

Hi All,

I have passed through B15 - KNOWLEDGE OF THE OBJECT and I find it OK.

Just one thing is that on page 13: "...as recognized in the market and can be proven in the curricula presented in Annex YYY."- there is no annex number.

Best regards,

(WP-Sofia) G.G.
Piping Engineer

(E-mail sent on 16^h August 2010 – Exact Transcription)

+++++

Hi Gyus,
Here are my comments

1.5.1.1.1 – Mobilization Phase

It is worthy to add few more sentences of how the "Projectwise" will be used as well as what document control philosophy will be implemented

1.5.1.1.2 - Phase Modeling

Remove the last paragraph of the section, it is repeated twice.

1.5.3- GENERAL ADMINISTRATIVE ASSESSMENT OF CONCEPTS TO BE EMPLOYED

Please describe what PMI is

1.5.3.1- Management and Project Supervision

It is worthy to emphasize the importance of the design review meeting and what is their importance for design development. On the other hand I think that fortnightly design review meeting is too much. Bear in mind that the meeting has to be prepared, conducted, feedback to be collected and implemented. Please bear in mind that the WP procedure requires three stages design review during whole design process at 25/30% at 60/70 % and 90/100%.

1.5.4.1 - Availability of manpower place

Last paragraph. Please do not forget to define the "X%" and "Y years".

1.5.4.2- Recruitment

Last two sentences. "... listed in the table below ..." and "... is shown in the chart below." The table and the chart are missing.

Regards

(WP-Sofia) G.I.
Senior Process Engineer

(E-mail sent on 16^h August 2010 – Exact Transcription)

In the same day, B.M. requested technical information to prepare a short description of the work for the participants of the EPR meeting on the 24th August 2010.

(CNC) L.M.A.,

I am now working on the EPR (Executive Proposal Review) document and would like to include a short description of the work. I remember that you said that in the Methodology you want to include a flow diagram of the processes. If you had a chance to develop it can you send me an editable English version so I can include in the document.

Thanks!

Regards,

(WP-Sofia) B.M.

Hi (WP-Sofia) B.M.,

That's the workflow I did for the executive sequence. Check it out and if its OK I can translate the legend and send you.

Att.

(CNC) L.M.A.
Project Engineer

(E-mail thread on 16^h August 2010 – Exact Transcription)

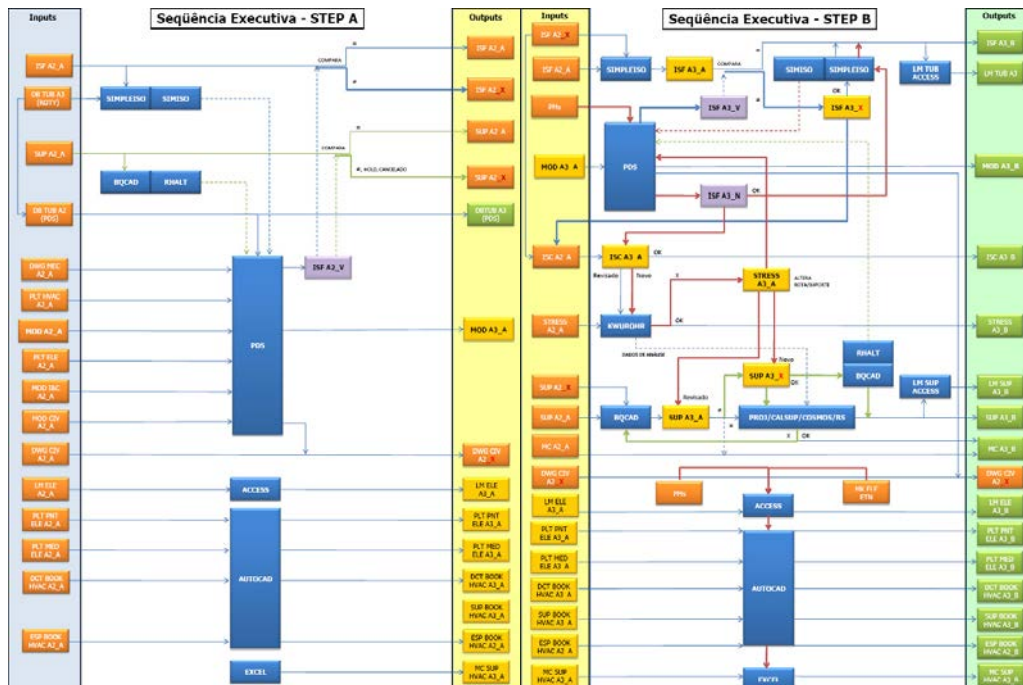


Fig. 75: CNC/WP workflow developed according to UNA 3 bidding instructions.

With man-hours consolidated, it was possible to go ahead with the final risk analysis review. As I came to know, there was intense argument between proposal management and risk analysis personnel. The stressful outcomes of this meeting can be gauged from the field notes below:

When I met F.F.M. later in the afternoon he asked if I knew what have happened in the risk meeting. I said I did not, as I was not required to attend it. So, he told that things “got hot” in there as T.D. fiercely fought over the criteria used for risk assessment, which were imposing a pointless financial burden into the commercial proposal. According to F.F.M. the argument between T.D. and D.B. was so intense that the meeting had to be interrupted several times and end up breaking without a compromise. (...)

After lunch I accidentally met C.L.D. in the elevator and without quoting the source asked what have happened in UNA 3 risk meeting. He showed discontent I said: “*In this company there is people (T.D. and R.M.Z., I suppose) that think they are stars in the constellation...So, you know about risk??.... Then do it yourself!*” Curiously, seconds later T.D. got into the elevator and said hello to us and the conversation broke down. (...) (Field Diary, 19th August 2010). (Field Diary, 19th August 2010).

As I came to know later, T.D. extended the discussion to F.C., M.T.L. (Infrastructure Division Superintendent) and even C.A.J. As I came to know he threatened to quit the proposal if risk assessment criteria that he considered excessive were not revised. His efforts were successful. When I had the opportunity to ask him about what happened he just told me that “Risk people” were crazy. The way they acted we would never be awarded a contract. Few days later there was another risk meeting and this time a compromise was reached towards a more acceptable level of contingencies.

7.5- KNOWLEDGE CHANGE OUTCOMES

On the 20th of August 2010, R.M.Z. forwarded to me and F.F.M., the first visible contribution of WP-Reading to the proposal. A person named B.M.M., sent to a document called “Executive Summary”, alien to the bidding instructions, which were to be added to the proposal as marketing piece to talk about the advantages of hiring WP and introducing the seven engineers to be assigned to the project. The e-mail was sent to C.A.J (CNC/WP President), F.C. (Sales Director), M.T.C. (Infrastructure division superintendent), T.D., R.M.Z., D.T. (President Global Nuclear Division – WP London, formerly from WP-Sofia), H.S. (WP-Houston Regional Director), T.M. (Global Power Managing Director), B.M., L.S.V., S.S. (WP-Sofia Regional Director), and G.J. in that order. The document displayed the logo of both CNC/WP and WP on the header and foothold.

Nuclear Expertise

Eletronuclear inherits well earned experience in choosing WP decisions and planning during the completion of Angra 3. WP to increase confidence in has been continuously involved in the nuclear industry since 1958.

The diverse experience that Eletronuclear could access from our portfolio includes: original design and construction support; full thermal power uprate analysis and modification design; license renewal applications; major equipment replacements for renovation and obsolescence; safety analysis; as well as complete engineering and planning for decommissioning.

16 Nuclear Units A/E of Record

52+ years of commercial experience

Unit	Location	Reactor Type	Start Engineering	Commercial Operation	Operating	Gross Power Output
Sarton Experimental	USA	PWR-Westinghouse	1958	March 1967	No	3 MW
Enrico Fermi Unit 1	USA	Liquid Metal - Fast Breeder	1958	August 1966	No	65 MW
R.E. Ginna	USA	PWR-Westinghouse	1965	December 1969	Yes	668 MW
Mihama Unit 1	Japan	PWR-Westinghouse	1965	August 1970	Yes	340 MW
Mihama Unit 2	Japan	PWR-Westinghouse	1968	April 1972	Yes	500 MW
Takahama Unit 1	Japan	PWR-Westinghouse	1969	March 1974	Yes	850 MW
Three Mile Island	USA	PWR-Babcock Wilcox	1967	June 1974	Yes	837 MW
Takahama Unit 2	Japan	PWR-Westinghouse	1970	January 1975	Yes	626 MW
Crystal River Unit 3	USA	PWR-Babcock Wilcox	1967	January 1977	Yes	260 MW
KG-R Unit 1	South	PWR-Westinghouse	1971	June 1977	Yes	603 MW
Oni Unit 1	Japan	PWR-Westinghouse	1971	December 1977	Yes	1175 MW
Oni Unit 2	Japan	PWR-Westinghouse	1971	October 1978	Yes	1175 MW
Koko	Slovenia	PWR-Westinghouse	1974	October 1981	Yes	730 MW
Virgil C. Summer	USA	PWR-Westinghouse	1971	November 1982	Yes	1003 MW
Perry Unit 1	USA	BWR-General Electric	1973	December 1986	Yes	1303 MW
KG-R Unit 2	South	PWR-Westinghouse	1977	April 1983	Yes	675 MW

The Benefits of Choosing WP

- Eletronuclear Eletronuclear receives a team with worldwide technical support, more than 50 years international nuclear experience, long term involvement with IAEA, and a high level of management support and resource commitment to meet the needs of the multi-national members of the Angra 3 project team.
- World-renowned relevant and certified PDS and nuclear electromechanical design experience with all of the major technology suppliers provides Eletronuclear knowledgeable, professional, and precise design results with the capability to instantly upgrade to SmartPlant 3D upon your request.
- Being instrumental in supplying over 192,000MW of combined generating capacity worldwide including nuclear, hydroelectric, coal, gas turbines, and renewable energy. Eletronuclear receives a veteran team that understands safe fleet operation, sustainability, and efficiency and is capable of providing decisions based on global lessons from a fleet-wide perspective when necessary.
- Eletronuclear receives proven, robust project management and implementation tools, which help harness resources, control costs, and plan efficiently.

We've been passionately engaged in the global nuclear industry for over five decades and have an unparalleled depth of nuclear power experience to draw from. That means we can deliver valuable expertise right now to Eletronuclear's Angra 3 project. Trust and agility are difficult to quantify, but imperative to maintain and build. That's what our long-term customers value the most. Eletronuclear can be assured of nimble and competent performance from a seasoned team whose focus is on excellent project delivery, safe operations, and building a long-term relationship that benefits the people of Brazil.

Fig. 76: List of Questions sent by WP-Sofia engineers on the 22th July 2010.

Later, WP-Sofia commented the two last documents, also with trivial concerns:

Attached are some small comments on Knowledge transfer section. We have just one concern that we are allowed to use up to 15 pages and we used only 7 (or maybe in Portuguese version they are 1 or 2 more pages). Do you think that this will be well accepted by the Client? Should we think of expanding this section? Even with some pictures – diagrams. We can think about this after the EPR rush is over.

Regards,
(WP-Sofia) B.M.

(Subject: UNA3_B16_Work Methodology_20.08.10_Sofia comments...)

Hi All,

Please see the attached file with our comments highlighted by track changing.

Due to google translation it's hard to read and follow them but in general we agree with the text, still more that we had read them before. So the comments shouldn't lead to some significant modifications.

Best regards,

(WP-Sofia) G.G.
Piping Engineer

(E-mail sent on 20th August 2010 – Exact Transcription)

On the 23rd August 2010, B.M. returned to CNC/WP office in São Paulo, to organize the EPR meeting and to follow the last developments of the proposal. In a private conversation she told me more about the EPR meeting:

(...)I saw B.M. quite busy on the phone then it took time to go there and say hello. Then she explained to me that she should make all arrangements prior to the EPR. She had to make sure that all technical and financial information had correctly arrived to each executive members and set up a adequate schedule so that all of them could attend to the meeting. She confessed that it was very hard to arrange a time to get together at once people in such distant offices like Sydney, Houston, São Paulo, Singapore, and Sofia. I took the opportunity to ask her what was EPR meeting for. She explained to me that EPR was a high level committee that would say “yes” or “no” to the proposal. In this meeting C.A.J., CNC/WP president, would officially present the proposal and the other members would check his knowledge about it. However, generally EPR members knew little about the proposal and usually just look at the numbers and taking care about the money and the cash-flow. Therefore, during the presentation, there must not be the signal of minus (-) in any place. She also conceded that schedule planning frequently had to be manipulated to get rid of any (-) which could eventually show up. Even though, she also told me that sometimes the EPR meeting “gets hot”, what I assumed to happen in the form of a political battleground. After all that, the final word would be said by R.E.W, US – Latin America Regional Director.(...) (Field Diary, 23rd August 2010).

On the 24th August EPR meeting took place, and I was allowed to follow in the initial technical discussions, as described in the field notes below:

(...) The EPR meeting was made through conference call. My great expectations to see the proposal debates were broken by the terrible communication resources available, the sound of airplanes on the other side was sensible. Overall the meeting was almost ritualistic in that questions were trivial, like, “Are you confident that all points have been examined”, and the answers limited to “yes” and “no”. When financial discussions began we were asked to go and the meeting continued with R.M.Z., T.D., C.D.L, and A.G.R.(...) (Field Diary, 24th August 2010).

While technical write-ups headed to conclusion, documental work involving certificates and eligibility documents, which were in charge of WP-Reading, (specially G.J.), sparked increasing concerns. B.M. was very worried for the time left for sworn translations of these documents. In a brief conversation, however, we talked about WP and the role of CNC/WP and WP-Sofia:

(...) We suddenly began to talk about differences within WP. According to B.M. the cultures and forms of CNC/WP and WP-Sofia were very different, with CNC/WP very inward-looking and WP-Sofia more forward-looking. B.M. said she was surprising to see that many CNC/WP managers could barely keep a conversation in English, while in WP-Sofia people internally spoke English to one another as a form to train the idiom. As such, she said it was hard to take something out of meetings, and it was better to require and discuss things through e-mail or personal conversations. (...)

(...) When talking about CNC/WP purchase, she said that despite the fact that everybody it was because of its hydropower engineering capability, in fact it was due to nuclear and oil contracts that were on sight of WP. (...) (Field Diary, 26th August 2010).

By the 25th of August 2010, when documents start to arrive by standard mail, and for the first time were seen. Immediately, B.M. and CNC/WP personnel detected several

problems with those few who had arrived. Nuclear project certificates still belonged to Gilbert/Commonwealth, formally linked to WP-NewYork, a branch without employees and revenues (who had been transferred to WP-Reading), which were not entirely absorbed by WP-Reading to reap fiscal benefits in the U.S.

Another key unobserved element was that the official bidder would be WP-International, which also did not possess any revenues or official employees, whereas, technical certificates and financial statements all belonged to WP-Group (WP-Reading controller) which linked to WP-Incorporated (the parent company) and not to WP-International (a ghost entity). Without asking anyone in Brazil or Sofia, WP-Reading only sent an unsigned letter explaining that all these companies belonged to WP-International assuming that it would be just fine. The problem was that WP corporate structure, with several ramifications, cross-controlled companies and ghost entities resembled fraudulent arrangements in Brazilian business, against which competition rules provided several protections, and with certainly would not be met by such letter.

On top of everything, as WP-Group was not a listed company (only the parent company WP-Incorporated was) so it wasn't required by U.S. law to keep audited balance records, required by the eligibility package. As such Ernst & Young a acknowledge auditing company was required to write a virtual balance sheet in the name of WP-International so that it could be presented in the proposal. However, when the audit balance sheet of WP arrived to be attached to the proposal it were detected to be hand signed by "Mr. Ernst & Young", the name of the auditing company, not of its due representatives, a serious and naïve flaw. Even worst, the notary had confirmed and stamped the signature as valid one, what would cast doubts all over the documentation.

Any of these problems would mean immediately disqualification of the proposal, on the 27th of August 2010, as such, F.C. urged for a meeting to discuss the proposal situation, described in the field notes below:

(...) Late in the day, I was urged to follow F.F.M. to a meeting required by T.D. In the room we met C.A.A (CNC lawyer), discussing with F.C. and T.D. As the discussion concerning translation problems of the eligibility documents ended, F.C. told that the technical documents sent to an "insider expert" from Eletrobras Eletronuclear for evaluation returned with a good impression. While there were some comments about the "Knowledge of the Object" and the "Organizational Structure", the "Methodology and Work Plan" impressed to the point that he asked if there were any other person from the Eletrobras Eletronuclear helping us. He congratulated us for the work and asked to speed up the few adjustments.

After that T.D. explained the problem concerning the balance sheets and the ownership of the technical certificates, what angered F.C. He immediately called H.S. (US-Latin America Senior Vice President) and asked for correct documentation. The short time available to correct all these problems brought a great anxiety to the CNC/WP team. There were only 10 days for the bid deadline and only the balance sheet took more than 15 days to be obtained, notary stamped, and sworn translated. Amid the turmoil, several suggestions for correction and speed up measures have been made, however it was Friday and not much could be done. T.D. was very nervous and said that we would call G.J. had urged that he spent the weekend to get everything correctly set.

After the meeting B.M. expressed her worries about how things were handled by WP people in the U.S. (Reading and Houston supposedly). She complained that they simply didn't asked anybody

before doing something, a thing F.F.M had just said before entering the meeting. Moreover, she said she should had already learnt that whenever working with them, she should check things all times, and never forget doing a close follow up. (Field Diary, 27th August 2010).

In the aftermath of this meeting, T.D. traveled to Houston during the weekend to personally oversee the reformulation of the problematic documents and check the other that was still on the go.

With the last corrections made according to “insider expert” comments, on the 30th August I sent the final version of the technical documents to R.M.Z. and my participation on the proposal reached an end, as I travel on the 01st September 2010 an academic meeting in Barcelona.

On the 10th of September 2010, T.D. sent the following message:

Dear Colleagues,

Yesterday we successfully delivered the technical proposal of UNA3.

Our proposal in general was largest and more impressive than of the others.

I would like, in the name of CNC/WP and in my name, thank all those who helped in this endeavor.

After three months of hard work, we delivered a proposal that makes us proud of our quality and competitiveness.

Please extend to our gratefulness to all that directly and indirectly helped in this work.

Abrços,

(CNC) T.D.

Infrastructure – Project Manager

(E-mail sent on 10th September 2010 – Author Translation)

This message has been copied to R.M.Z., M.A.C. (CNC/WP Engineering Director), M.T.C. (Infrastructure Division Superintendent), C.A.A. (CNC/WP lawyer), S.R. (HR Manager), E.D. (Administrative Superintendent) and S.S.H. (Industry Division Superintendent), and copied to F.F.M., A.G.R., D.B., C.D.L., L.M.A., S.P.H., and approximately 20 other people who in one or other way had participated in the proposal, both in what apparently looks like an relevance order.

On the 14th September, back to São Paulo, T.D. told me about the very last days of the proposal.

(...) He T.D. saw me he came to tell about the last days in the proposal. That him, B.M. and F.F.M. spent the last nights and weekends checking each point, correcting, organizing and printing the proposal. He explained that they worked so much that almost lost the last flight to Rio to deliver in the final hours the proposal to Eletrobras Eletronuclear. He said in the end only three competitors presented their bids and that CNC/WP proposal was the largest and most impressive one. He also, told me about the problems that he and B.M. had to make G.J. to get what they asked for. According to his account B.M. had to call to D.T. (President Global Nuclear Division – WP London, formerly from WP-Sofia), which had been his boss in Sofia to intervene and the WP U.S. personnel do what was necessary to finish the proposal. (...) (Field Diary, 14th September 2010).

Few weeks later, on the 29th of September, T.D. has been invited to visit at WP-Reading, probably as recognition of his role in the UNA3 proposal. When he came back he told about the great structure they had with the most modern project tools and skilled personnel.

Several times I asked R.M.Z. and T.D. about the results of the proposal without any direct answer. I was just told that the proposal had problems in the eligibility package with WP documentation and that they were requiring revision. On the 19th November, however, when I passed by T.D. desk, and described the situation as such:

(...) He said me that there were bad news as WP has been disqualified from the competition due to problems in the company documentation. However, for good the other two competitors had been also disqualified by the same reason. Therefore, competition has been canceled and after some time would resume once again. I asked what had happened and he explained that Eletrobras Eletronuclear argued that there were problems in four points of the proposal, particularly in the WP financial statements. Among the other competitors, the Finish company AF Consulting, had three problems, and the Canadian SNC Lavalin, the one that WP feared most, presented only one minor Portuguese mistake but Eletrobras decided disqualify all . Packages containing these two parts of the proposal were returned sealed to the bidders. (...)

(...) Reflecting about the proposal process T.D. conceded that there were difficulties for the WP corporate structure to adapt to the Brazilian business environment. He argued that arrangements to keep technical licenses through companies without employees looked like Brazilian fraudulent arrangements. Therefore, when UNA3 competition were resumed, WP would have to make corporative adjustments or to work on the background to turn new competition rules in their favor. Which strategy would be chosen, he did not know. (...)

(...) In regard to WP U.S., T.D. complained about their careless self-confidence, and "certainty assurance", carrying everything like *"Here it is this way, so it will also kie these there."* He also complained about the difficulty of obtaining information "as it is", and that he had always to guess and check to know how things work in WP. In his opinion nobody can give a direct indication on how to do anything and people were always vague.(...) (Field Diary, 19th November 2010).

On the 8th of December, again I met on the corridors T.D. and he told me that finally WP agreed to make the structural arrangement as he suggested for and WP-New York would be finally incorporated to the WP-Group which would be in charge of the UNA3 bidding as soon as it was resumed. One year later, the bidding process resumed and after several delays and a lengthy process of proposal judgment, a Finnish engineering company unknown to the Brazilian market but assisted by a former CCC director won the bidding process and took over the job.

CHAPTER VIII
BGB PROJECT

8.1- PROJECT OBJECT

BGB was conceived as an integrated oil terminal and storage facility operated by BG, a British oil & gas company, in the future Açu Superport Industrial Complex. The complex is being constructed by LLX, an emergent Brazilian logistics operator, in the municipality of Campos dos Goytacazes (Rio de Janeiro state, Brazil), and according to plans, is expected to handle at least 350 million tons of exports and imports per year, making it the largest industrial port enterprise in Latin America and one of the three largest ports in the world.

The complex has also plans to host two steel mills, two cement factories, a thermoelectric, an automaker, auto parts industries, a metallurgical center, a terminal for the storage and processing of oil, and an offshore support services with an IT complex. According to company's estimates, the whole complex will attract investments of more than US\$ 40 billion and create approximately 50,000 new jobs.



Fig.77: BGB location. (Source: Google Maps)

BGB is a direct consequence of the promulgation of the Oil Law in 1997 (law nº 9.478/1997), which broke up with Petrobras monopoly and implemented the concession system for oil exploration in Brazil. In the concession system, ANP (Brazilian Oil Agency) organize auctions where companies can acquire exclusive exploration rights within determined areas (blocks) for a time period (usually 8 years). Companies are given any oil they produce in return for taking exploratory and operational risks and for paying royalties and other fees to the government. Most of Brazil's oilfields use this system, including about 30 per cent of the pre-salt

region. These were put out in several concessions before the region's potential was understood, mostly to Petrobras, either alone or in partnership with international oil companies (IOCs) such as ExxonMobil, Shell and BG.

In June 2000, took place "Brazil Round 2" ANP auction, where companies spent around US\$292 million to acquire exploration rights on 21 of the 23 offered areas. The consortia led by Petrobras acquired the exploration rights of all Santos basin blocks, paying a particularly high price (US\$ 143 million) for three of these blocks, BM-S-9/10/11. Together with other international oil companies, BG composed a minority share (25% ~ 30%) on these three blocks, what was priced US\$ 42 million at the time.

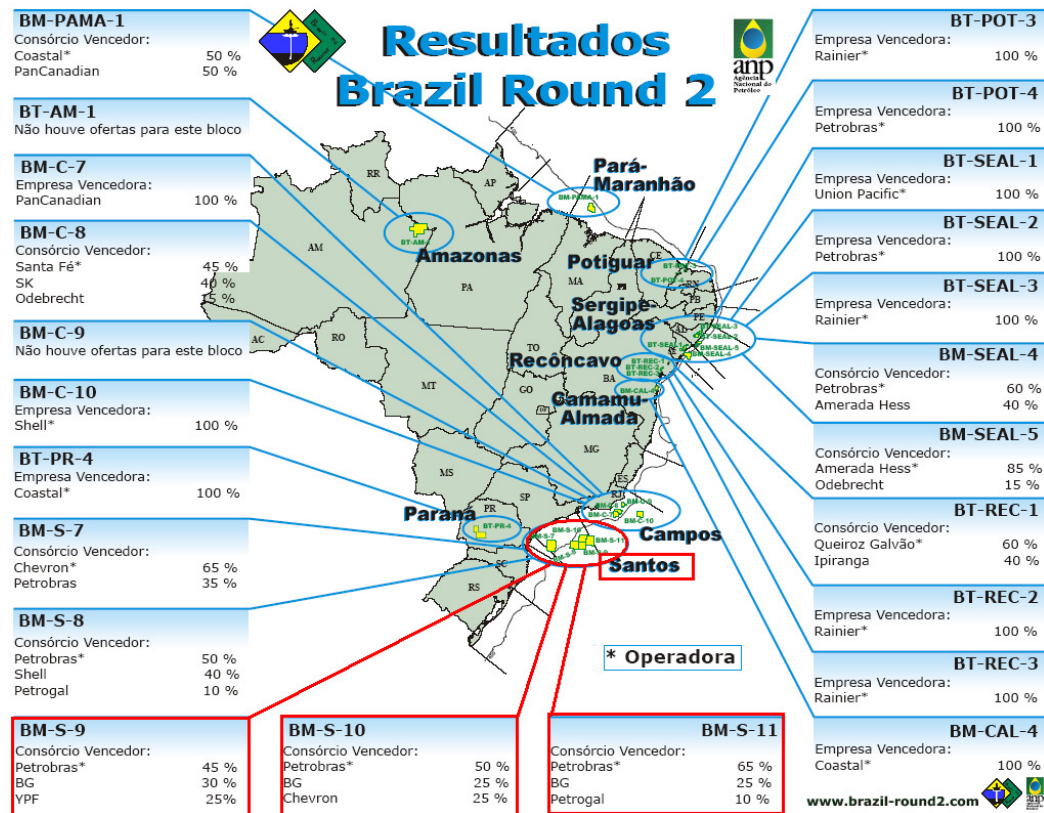


Fig.78: Brazil Round 2 (Source: ANP)

In October 2006, Petrobras, BG and Galp discovered oil in an ultra deep field of the BM-S-11 block, which became known as Tupi. After 2 years and US\$1 billion more on research, Tupi proved to hold a minimum of 8 billion barrels of light crude, the world largest oil discovery in more than 20 years. Tupi revolutionized oil exploration in Brazil as it disclosed the existence of the so-called "pre-salt fields", light oil reservoirs beneath 2,000 meters of water and 5,000 of salt, sand and rocks. After Tupi, several other large oil fields were discovered (Tupi Sul, Iara, Iracema, Jupiter e Carioca) in the Petrobras and BG blocks. Preliminary estimates worth the oil held in the BM-S-9-10/11 fields in US\$ 60billion.

After the pre-salt discoveries, Brazilian government ordered ANP to interrupt further auctions in the Santos basin for further studies. In December 2010, the congress passed a law (12.351/2010) submitting the pre-salt and other strategic areas to the shared production system, where government, instead of fees and royalties, receives a share of the oil extracted by private companies which are forced to accept at least 30% of Petrobras participation. Despite of these changes, the previous concessions were maintained untouched.

In May 2009, the consortium extracted the first oil from the Tupi field and in October 2010, the long lasting tests (TLD) began. With only minor problems affecting Tupi TLD, experimental production is planned to reach 75,000 barrels/day by December 2011, which together with other TLDs on course in the same block, point to an expected production 105,000barrels/day for the consortium by the same date.

In the last quarter of 2010, the fast production ramping up operated by Petrobras began to worry BG management. Different from Petrobras and Galp, the volume of oil soon to be received was incompatible with its logistic structure in Brazil, and shortly a great pressure upon the company's commercialization strategy would build up. With an expectation of reaching 1 million barrel/day by 2014, BG needed viable long-term oil export solution. So forth, three options underwent study by different BG teams:

- Long-haul shipping either direct to market or to a trans-shipment point at an existing facility outside Brazil (such as Aruba in the Caribbean). What would require a large number of ships whose arrival would hardly meet production schedule;
- Shallow water offshore terminal (SWOT) in Brazil. This facility would most likely be a converted tanker and two single buoy moorings (SBM). In Brazil, however, off-shore terminals require hard to get environmental licenses to be constructed, what would also create problems to meet production schedule;

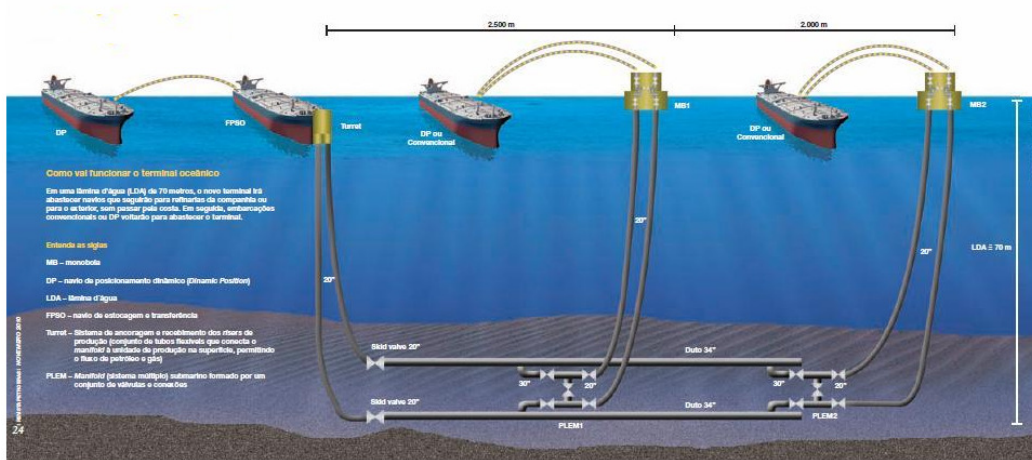


Fig.79: SWOT terminal schematics. (Source: Revista Petrobras)

- Açu Super Port: Port facility being developed by a large Brazilian infrastructure developer, LLX. For a tariff, they would provide basic infrastructure (land, trestle, berths and breakwater). BG would need to build the oil terminal and outfit the trestle and berths, what became known as BGB project.



Fig.80: Açu Superport Industrial Complex as per March 2011. (Source: LLX website)

So forth, CNC/WP was hired to provide owners engineering services and help in the basic definitions and feasibility studies for the BGB option.

8.2- PROJECT STAKEHOLDERS

8.2.1- The Client: BG

In the early 1900s, the gas market in the United Kingdom was mainly run by county councils and small private firms. The Gas Act of 1948, nationalized the UK gas industry and more than one thousand privately owned and municipal gas companies were merged into twelve Area Gas boards, each a separate body with its own management structure. UK gas industry was again restructured by the Gas Act of 1972 which centralized all Area Gas Boards into one single state-owned company, creating the British Gas Corporation.

The Conservative Government led by Prime Minister Margaret Thatcher introduced the Gas Act of 1986, which led to the privatization of the company. On the 8th December 1986, its shares floated on the London stock market in an initial public offering valued at £9 billion (US\$ 18 Billion), the highest equity offering ever at the time.

Ten years later, in preparation for the end of gas monopoly in 1996, British Gas had to go through a major restructuring which separated the company into five divisions: Public Gas Supply, Contract Trading, Transportation and Storage (Transco), Service and Installation, Retail. In 1997, British Gas demerged into two separately listed companies: BG plc in charge of exploration and production and the overseas operations and Centrica plc in charge of the UK retail business. Two years later, after a second demerger, BG plc get rid of the UK transport and distribution business to become fully dedicated international to exploration and production company, BG Group.

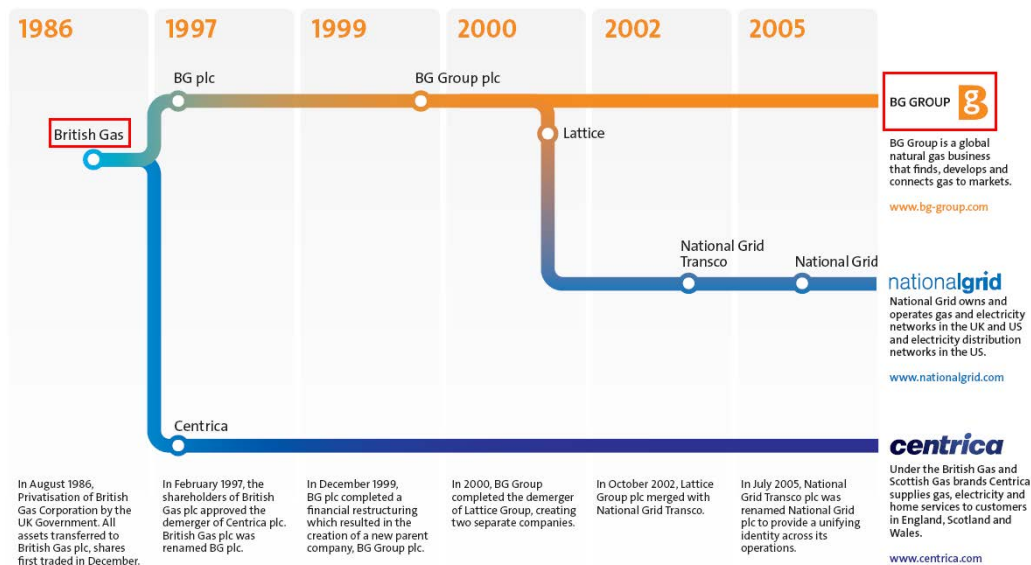


Fig.81: BG Group history. (Source: BG website)

BG Group became a shareholder in the newly restructured Caspian Pipeline Consortium, which planned to build a new pipeline from Kazakhstan to the Black Sea port of Novorossiysk. Under the terms of the agreement, BG Group was entitled to 3 million ton/year of capacity to transport condensate from the Karachaganak gas field in northwest Kazakhstan to markets in the west. The Karachaganak field is one of the largest gas fields in the world, holding according to estimates 9 billion barrels of condensate and 48 trillion cubic feet of gas. Later in the year, BG Group signed gas sales agreement with the Egyptian General Petroleum Company for sales of gas from the Rosetta concession offshore the Nile Delta, to Egypt.

In 1998, BG Group acquired the controlling stake in Metrogas, one of the largest gas distribution companies in the southern cone region, extending BG Group's position in Argentina, where BG Group had been the technical operator since 1992. In November the same year, BG Group announced the discovery of the Margarita field in Bolivia what closed the path to construction of the Bolivia-Brazil pipeline. Two years later, the Presidents of Brazil and Bolivia opened the US\$2 billion pipeline connecting the two countries. The project had been developed by a consortium including BG Group and was the largest gas infrastructure project ever to have been carried out in South America, and supplied gas from Bolivia to consumers in the São Paulo and coastal regions. In April the same year, BG Group acquired a controlling stake in Comgas, a gas transmission and distribution company which today supplies more than 570 000 customers in Brazil. In 2000, BG Group acquired rights to explore for oil and gas in the Santos Basin offshore Brazil with the purchase of a share of exploration rights in the deepwater blocks BM-S-10, BM-S-11 and BM-S-9.

In early 2001, BG Group and partners announced that the Rosetta field had come onstream. The commercialization of the field had been realized in record time, just 45 months after the initial discovery well was drilled. At the same time, BG Group and partners confirmed a successful appraisal well had been drilled on the Sapphire field, in the West Delta Deep Marine (WDDM) area, the sixteenth consecutive successful well that BG Group and partners had drilled on Rosetta and the WDDM over four years. Little later, BG Group and the Government of Egypt signed an LNG Export Agreement for Egyptian gas via an Egyptian LNG plant based in Idku, on the Mediterranean coast. Construction of the first train of Egyptian LNG began in 2001. In June the same year, BG Group announced the discovery of a significant new oil discovery, the Buzzard field, located some 100 km offshore Aberdeen in the Central North Sea. Estimated reserves in the field were estimated to be around 600 million barrels of oil equivalent, which means that Buzzard is one of the largest discoveries in the UK North Sea in ten years.

In 2002, the acquisition of a 30% stake in the Tapti field and the closely related Panna and Mukta fields confirmed BG Group as a key player in the Indian gas production market. BG Group also took over field operation. Following drilling of three appraisal wells from 1997 onwards BG Group confirmed the Hasdrubal discovery offshore Tunisia in 2002, when a third appraisal well tested light oil. In the following years, BG Group took delivery of it's first wholly-owned LNG (Liquid Natural Gas) ship, the Methane Princess and open up purchase process for several more.

In July 2005, BG Group was awarded three concessions in the Santos Basin in Brazil's seventh annual licensing round, this time for blocks BM-S-47, BM-S-50 and BM-S-52. In this later round, BG Group was also awarded one onshore concession BT-SF-2 in the São Francisco Basin. In December the same year BG inaugurated the fourth train of its Atlantic LGN facility in Trinidad & Tobago, reaching total production capacity at Atlantic LNG to approximately 15 million ton/year.

In 2006, BG entered several markets worldwide such as China, Oman, Algeria and Nigeria, started to explore gas fields in the Alaska, realized new discoveries in the North Sea and received three large scale LNG ships from Hyundai heavy industries in Korea, and four more were expected to 2007. In September the same year, BG Group and partner Petrobras announced a light oil discovery in the Tupi field, in the deep water Santos Basin, offshore Brazil. A further discovery, Parati, was also made in Block BM-S-10.

After ten years of growth, by 2008, BG Group confirms leading position in LNG trade. BG Group supplied 55% of US LNG and 50% of all LNG sold from the Atlantic Basin into Pacific basin markets in 2007. BG Group's supply portfolio enabled it to market more than one third of its supply to meet demand in new countries. In total, BG Group supplied nine of the seventeen LNG importing nations.

Through 2009 to 2011, the company kept expanding into new markets and fast growing ones. In 2009, BG Group signed a LNG sales contract with the China National Offshore Oil Corporation, concluding negotiations announced in May 2009, for the supply of 3.6 million ton/year of LNG over a 20-year period. In 2011, BG Group also signed a similar sales agreement with Japan's Tokyo Gas Co., concluding negotiations for the supply of 1.2 million tonnes of liquefied natural gas a year for 20 years from 2015. Both to be supplied with LNG from the Queensland Curtis LNG facility on Curtis Island in Queensland.

In Brazil, BG Group and its partners awarded engineering, procurement and construction contracts worth \$3.5 billion for eight hulls for floating production, storage and offloading vessels to be used in developing blocks in the Santos Basin, offshore Brazil. On completion, each vessel will have production capacity of 150 000 barrels of oil per day and approximately 212 million cubic feet of gas per day. In early 2011, Petrobras filed a "Declaration of Commerciality" with ANP over the Tupi and Cernambi fields in the Santos Basin. The declaration marked the start of the production phase for the fields.

Nowadays, BG Group is a major integrated gas company with a record of delivering strong growth by identifying and focusing on selected high value markets and securing low cost gas for delivery. The cornerstones of the Group's competitive advantage are a deep understanding of gas markets, the skills and experience to invest throughout the chain, and a focus on project delivery. BG has revenues around US\$16 billion and direct employs more than 6000 people (4000 outside UK) from 65 nationalities in 27 countries.

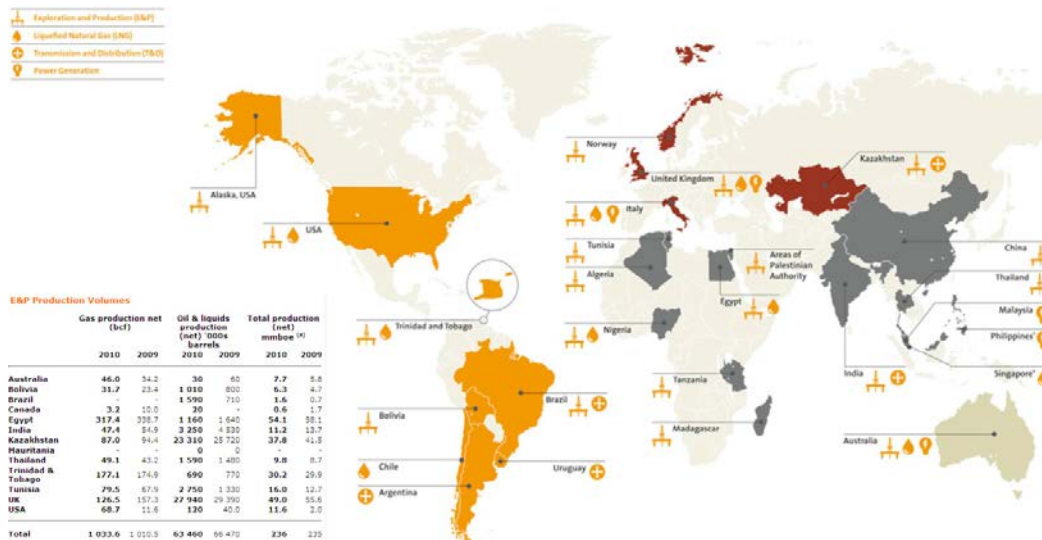


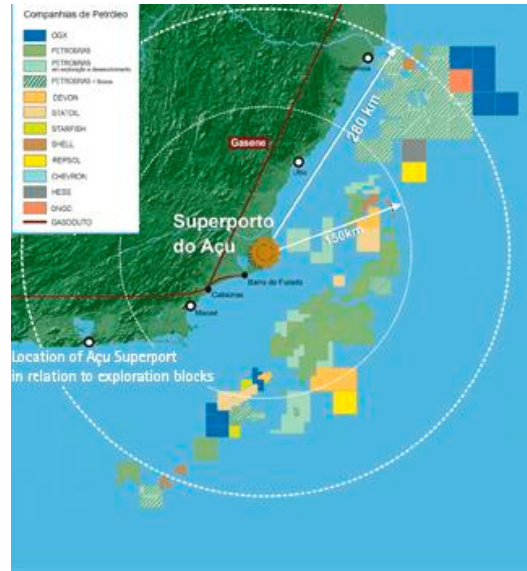
Fig.82: BG geographic diversification. (Source: BG website)

8.2.2- Local Partner: LLX

To understand LLX, first, it is necessary to introduce its founder Eike Batista and the conglomerate that he controls, EBX. Eike Batista is currently the most famous Brazilian entrepreneur, and according to Forbes magazine, is the 8th richest man in the world (March 2011). He is the son of Eliezer Batista da Silva, longtime ministry of Mines and Energy, and head of mining company Vale during the military government, when he became famous for signing contracts to supply iron ore to the Japanese boom. Eike got his start in gold trading and mining. By 1999, its gold mining company TVX still produces around 20 tons of gold per year and employ 2000 people.

His political and high banking friendships eased the path to expand his business through several enterprises, MMX (iron ore), MPX (Energy) and OGX (Oil & Gas), usually in association with large international players. He became famous in the world business as a risk taker, for recruiting and paying huge bonuses for his executives and for the superstition of always using the letter “X” in the name of its companies. Nowadays, through its holding company, EBX, Eike controls businesses spanning mining, shipbuilding, energy, logistics, tourism and entertainment.

Due to chronic Brazilian logistic infrastructure deficiencies, he decided to invest in the concept of integrated industrial port facilities, away from great urbanization centers but close to existing logistic corridors and the oil exploration clusters. Having this in mind, LLX has been created in 2007 in association with the international mining company Anglo American, a Canadian pension fund and the Brazilian Development Bank (BNDES). No surprise that, the initial steps of LLX overlapped with the US\$3,8 billion investments made by Anglo American involving a new iron ore mine in the state of Minas Gerais and a pipeline to transport the ore through the first of LLX ports, the Açú Superport. The port is still under construction and is expected to be ready for the first iron ore shipment by the second semester of 2012.



- | | | |
|---------------------------------|----------------------------------|--------------------------------|
| 1 Iron Ore | 11 Steel Mill 2 | 21 Waste, Pig-iron and Granite |
| 2 Pelletizing plants | 12 Cement Factory 2 | 22 OSX |
| 3 Thermal power plant MPX | 13 Utilities: Water, Gas, Waste | |
| 4 Logistics Yard | 14 Ceramic Industries | |
| 5 Bulk Liquids Terminal | 15 Civil Construction Industries | |
| 6 Oil and Gas E&P Support Areas | 16 Automobile Industry | |
| 7 Administration | 17 Metallurgical Center | |
| 8 Commerce and Leisure | 18 Oil and Gas | |
| 9 Steel Mill 1 | 19 Coal | |
| 10 Cement Factory 1 | 20 Steel Products | |

Fig.83: LLX Açu superport strategic location and overall plan (Source: LLX website)

A second LLX port, planned to be built in the south state of Rio de Janeiro (municipality of Itaguaí) end up being transferred to MMX responsibility to be exclusively operated by EBX subsidiaries, in order to accommodate iron ore exports from MMX Serra Azul mine, allow for the construction of ships in the OSX shipyard and maintenance of oil rigs for OGX.

8.3- CASE CONTEXT

8.3.1- Contractor: CNC/WP

The period between UNA3 and BGB has been marked by the deterioration of CNC/WP project portfolio, what has been particularly felt in the industry division. The constant lay-offs of technical people stimulated the remaining to flee to competition, further weakening company's technical capability. The transition process also struggled into rather discretionary acts that clearly privileged staff personnel, reversing a long tradition of technical sponsorship.

Along the first semester 2010, CNC/WP industry division engaged into several competitions for Petrobras large-scale refining projects, usually in partnership with CCC. However, the duo performed badly in most of them losing projects by a large difference, mostly for non-traditional engineering companies, which were awarded several multi-million dollar contracts. CNC/WP was almost tied to CCC and because of contractual terms could only associate with other construction companies if CCC declined association. Before large projects ran out, the partnership informally broke and CCC, in returning to its traditional partnership with PROMON, was awarded a US\$ 1 billion project for detailing engineering and construction of a distillation unit within the PDY complex.

A sense of insecurity and lack of confidence in the CNC/WP role within WP took over the industry division. In the absence of coherent information, rumors spread that as it was redundant with WP-Houston, it would be slowly demobilized. Despite any practical evidence this story was collaborated by the growing investments in the new mining division in Belo Horizonte and the new oil & gas division in Rio de Janeiro, which were hiring people locally to avoid the transfer costs associated with São Paulo professionals. CNC/WP began to look for increasingly smaller projects on its own and with the help of smaller construction companies. One of this project was PDY2, where Petrobras used a simplified bid process to hire CNC/WP in order to make updates in a specific area of recently delivered PDY project. PDY2 began almost at the same time UNA3 ended, and I was automatically requested by C.C, now project manager. By the end of September, however, the specific unit where was supposed to work was put in hold by Petrobras.

From a privileged engineering company with a solid technical workforce, CNC turned into a financially driven free-rider company. The consequences of this strategy however were quite severe and stretched all over second semester 2010. Contracts decline in value and in schedule what left exposed the heavy and slow structure of the company. In response, however, more staff and management personnel were hired and granted nice brand new positions in the company. Organizational structure at the top suffered at least two large-scale changes to accommodate more and more people always in independent positions to avoid conflict. In the mean time, several initiatives were implemented to convey a feel of normality and open communication within the company.

One of the first of them was the “Bimestrial Strategy Dialogue”, aimed at giving first hand information to CNC/WP employees. In these meetings, M.A.C. (Engineering Director) explained the situation of the company, its prospects and answered questions from randomly selected people who would subsequently meet with their desk neighbours and pass information away, in a sort of institutionalised “whistle blowing”. To kick start, however, people were select by department and discipline managers. With the next participants been indicated by the current participants, cliques end up monopolizing the meeting. Nevertheless, after the first meeting M.A.C. began to be closely followed by the RH manager, which according to a key informant frequently interrupted the conversation to reframe the question in softer terms for M.A.C.

Another initiative was the monthly “Coffee with the President”, which aimed to bring top management closer to CNC/WP employees. However, people attending to these meetings were also selected by discipline and department managers, which clearly privileged its supporters. On the two editions that I followed S.P.H. indicated S.S.S. and A.R.A to participate. Among the phrases about the meeting published in the internal bulletin we find:

“The event gave the feel that I was being heard, by who take the strategic decisions of the company”.
“The invitation for the event made us feel important”.

(Bulletin #*, 19, November 2010 – Anonymous authors)

In the 18th November, were presented the results of the “Cultural Bridge”, a program developed by the HR along 6 months to identify “cultural particularities” between CNC and WP organizational cultures was presented by the RH manager. During this meeting a comparison of the cultural differences between U.S., Brazil and Australia offices in terms of a cultural typology divided into “relational”, “pragmatic” and “conceptual”. According to HR analysis, CNC would be strongly “pragmatic” with a slight “relational” tendency. Compared to the U.S. also highly “pragmatic” and Australia, highly “conceptual”. Overall, however, the meeting felt like “everything is all right”, “there is nothing to worry about”. Lay-offs were credited to a bad business environment caused by the 2010 elections (during which Brazil GDP grew 7.8%).

By the end of November 2010, with lay-offs smashing industry division to only 80 people from 400 one year ago, CNC/WP required WP headquarters help to keep the remaining workforce. Instead of sending work to CNC/WP, WP required clients within international work agreements to use CNC/WP operation to leverage its Brazilian project ambitions. Two of them, Chevron and BG, positively responded to WP pledge and hired CNC/WP to help in the development of their new projects. Chevron, required conceptual studies towards modernization and future expansion for its lubricant mixing unit in Rio de Janeiro, a far less sophisticated job than CNC/WP was used to. BG job, on its turn, was closer to CNC/WP level of specialization, as it required CNC/WP to provide owners engineering services for an oil terminal and storage facilities.

8.3.2- “Fast Track Project” Current State of Knowledge.

As CNC/WP had no expertise in port facilities or oil terminals, it was necessary for part of the project to require the help of WP-Houston which had extensive experience in defining, designing and implementing oil terminal and port facilities. Ran by a completely autonomous team within WP-Houston office, the ports division was one of the most skilled divisions of WP in the U.S. Its engineering manager, W.A., was PhD in port infrastructure and spent more than 30 years designing and overseeing ports around the world.

The participation of WP-Houston in the project was initially seen as a learning opportunity, aligned to what was much said about being part of a global company like WP. Right before the project begins CNC/WP management was buoyant. It was common place for to hear that it was key to learn how to define and design ports and maritime terminals because they would be badly required for Petrobras in a close future, opening great business opportunities to CNC/WP and career venues for those who took place in the project. However, with the terminal part of the job showing complexity and client pressure building up, WP-Houston became increasingly confident in claiming the “lyon’s part” of the contract in order to end a long lasting period of divisional slack. Henceforth, WP-Houston participation in the project became an additional problem to CNC/WP.

As a result of long time practice and considerable success, BG became very confident of its investment appraisal methodology. According to that methodology, the BGB project should go through several phases in his life cycle: Create, Assess, Select, Define, Execute, Operate; which, in fact, were not very different from WP own services methodology.

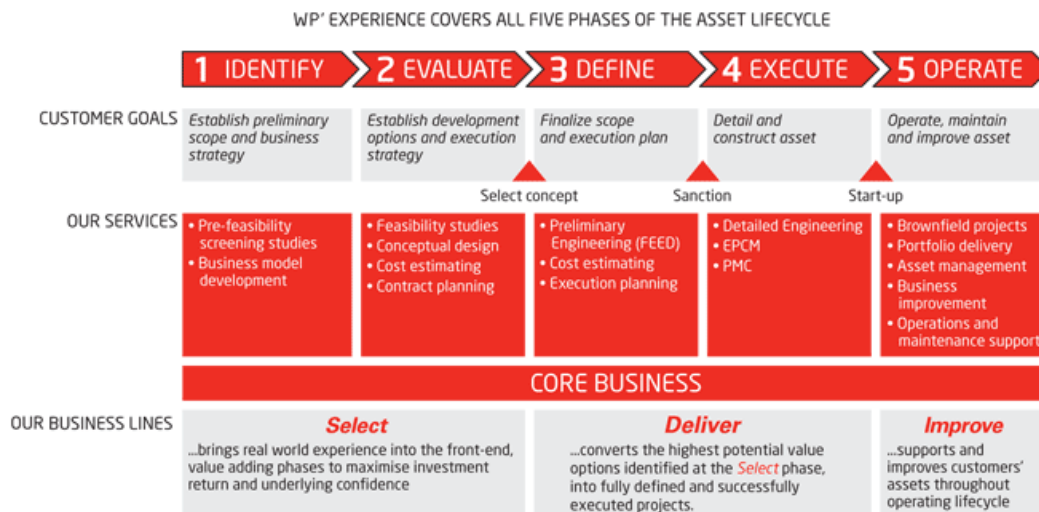


Fig.84: WP Service methodology (Source: WP website)

By January 2011, BGB project was about to enter the so-called “select stage” of this methodology. The primary objective of “select stage” was to evaluate and select a single development concept to take forward into the “Define Stage” (FEED). The concept selection process was expected to yield information enough to develop preliminary cost and schedule estimates (+/- 25% precision).

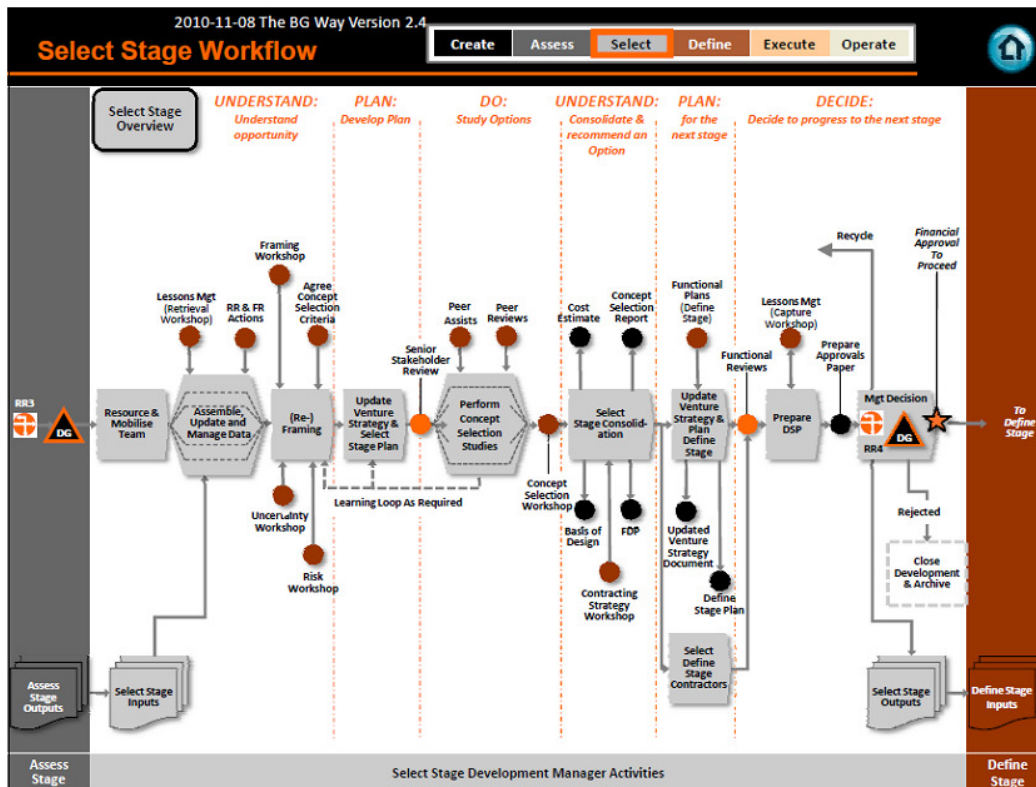


Fig.85: BG investment appraisal methodology – Select Stage (Source: BG presentation)

In this context, CNC/WP was selected to provide “owners engineering”¹⁷ services to BG. Among CNC/WP roles were:

- Review technical data available;
- Assess any environmental constraints embedded into LLX permits;
- Help BG draft a “Statement of Owners Requirements” for the project;
- Develop a “Basis of Design” for the facilities;
- Attend meetings with LLX and BG to clarify interfaces;
- Plan the necessary activities to prepare BG for decision gate in April;
- Draft of the IFB (invitation for bid) for Define Stage;

What was supposed to be a rather trivial job, quickly build up into a dramatic operation. As BG investment appraisal methodology required the accomplishment of clear and well delimited phases, overall schedule compression caused the evenly compression of each individual phase, penalizing those operating the shorter ones.

¹⁷ Under an “owner engineering” contract arrangement an engineering company is sub-contracted to emulate an internal engineering department of the client.

As a result, CNC/WP was pushed into a fast track¹⁸ project approach, under particularly complex scenario, involving scarce resources, information uncertainty and subsidiary rivalry.

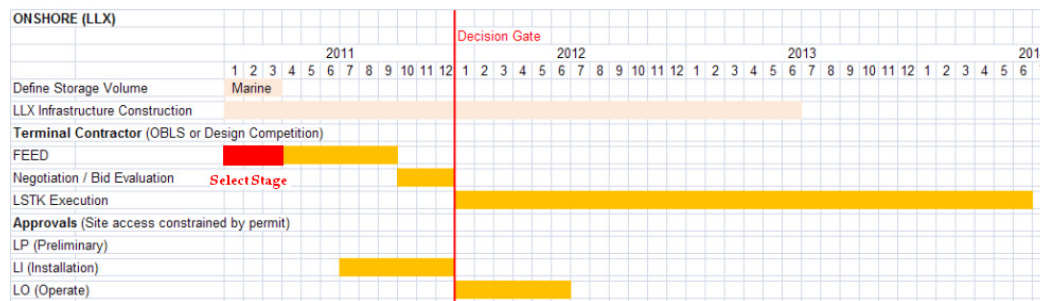


Fig.86: BGB overall schedule.

To overcome this challenge, CNC/WP would have to break up with its traditional way of managing projects and be able to development a fast track approach what would represent an important management innovation process for the company and an additional capability for WP.

8.3.3- Entering the Field

The rumors concerning the BGB project began in early 16th December 2010, with the visit of the first BG executives interested in CNC/WP structure and expertise. The first contact with the project was as described in the field diary notes below:

(...)I perceived a certain movement involving a group of foreigners escorted by S.S.H., P.R.F. (a former CNC/WP project coordinator), and C.C. heading to the meeting room in the end of the floor. At same point, S.S.H. and one of the foreign visitors left the room and looked for A.R.A. apparently to show something about CNC/WP 3D design expertise. The talked for a few minute and then had back to the meeting room.

(...) Right before lunch, with the floor already emptied, C.C. passed by my table and asked if I had a few minutes, and asked one of the foreign executives. He asked me to show some pictures of the PDY tank farm and make a quick explanation about the workshare capability developed for the PDY project. As I explained this work, he made several questions about CNC/WP skills in other plant design systems and collaborative works. Until then, did not know what was it all about.

After lunch, I incidentally met C.C. and asked where those people were from. He told they were from BG and were interested in building an oil storage facility. Then I told him that maybe it would be also interesting for them to see the work we were developing in the PDY2 concerning full facility development in 3D. A little later he brought the executive and we showed this additional work to him. (...) By the end of the day, C.C. told me later that they were impressed by CNC/WP and chances of being winning the project were high. (Field Diary, 12th January 2011).

There was quite a great thrill in the company about this project. Maybe because it was supposed to be the industry division salvation, maybe because it somehow materialized the future role of CNC/WP as an engineering consulting company as

¹⁸ According to the PMBOK (3rd ed., 2004), *fast track approach* refers to a project schedule compression technique aimed at taking an entire project schedule into a smaller period of time than would be done according to standard methods. This project management approach involves conducting project events quicker and overlapped instead of in sequence. Having several teams working on various work packages at the same time can cut schedule times significantly. However, there is a greater chance of errors when scheduled activities are started without previous the necessary information that would have been available if standard project timeline have been followed.

rumors spread. However, in a scenario of imminent massive lay-offs it was probably seen as the last resort.

On the 27th January 2011, a team of BG executives returned to CNC/WP to conduct a due diligence, which comprised of several interviews with key people appointed to project, and to impress the client were selected based on curriculum and English fluency. As such, S.P.H. and I were required to jointly attend one of these interviews on behalf of the piping discipline. The interview conducted in very clear English by M.C., a senior BG executive, was very representative of their view of the project and the problems expected:

(BG) M.C.: What I suggest we do... if you don't mind... I explain to you what the project is, and then, if you don't mind, I would like to speak to each of you separately, OK?!... So you know nothing about this, right?! (...)
So basically what they have done ...they are building a port...and they got a huge piece of land... they got permits to do just about anything on this site. So they have a shipyard in a joint venture, I think with Hyundai, they have a supply base, they have a space for an oil tank farm, they plan to export iron ore from this port. So we say the anchor... you ain't say anchor? ... (...) ...the anchor for this project, the thing that it all comes back to is the iron ore export, OK?!...and these are the iron ore berths here... and Anglo American, which is a big multinational company... will export iron ore from these two berths, through this channel. So, then Petrobras... we think... are going to take these three berths here... and they will transfer oil between the ships, ok?! ... What we want to do is to extend this so that we have space for three ships... and then we will build a tank farm in here...and then we will use their bridge... so, basically they will give us the breakwater, the berths, and the bridge, and the land and everything else we have to do for ourselves. So, what they did, which were not stupid... they to get their permit they had to produce a preliminary design for a terminal... and what they was to assume the biggest terminal they can imagine... with the worst oil they could imagine... so they had oil treatment... we won't need that...So, what we need is a smaller tank farm... and we don't need the treatment...the key... the absolute key to this is understand the interfaces, between us and LLX... and the key to this is the piping discipline... because you guys own the lay-out, all right?! So what we want to do between now and the end of April, is to go and see (...) they have a contractor JPPA who's done the work for them so far...and they also have... a contractor for the bridge, for the breakwaters and everything else...Ok?!... between now and the end of April....

(CNC) S.P.H.: End of April?...

(BG) M.C.: Yeah... we are in a big hurry...

(CNC) S.P.H.: Big challenge.

(BG) M.C.: Yeah...is to understand as much as we can... and there will be holes, obviously...what is exactly what they are giving to us... and where exactly all the interfaces are... (...) it is just a simple project with complicated interfaces...(...) So basically Petrobras have FPSO (large exploration ships) in the Santos basin... and to take the oil from those FPSO, we have to use special tankers with ... Do you understand dynamically positioning? ... we the thrusters underneath ... those ships are special and expensive... so what we want to take those ships, bring the oil to somewhere like this and then unload the oil to a tank farm, and then we will bring in standard ships... fill them up and sent them to probably to China.

(CNC) S.P.H.: High oil, anh?...Oil from Campos?

(BG) M.C.: Santos...

(CNC) S.P.H.: Santos! ... Pre-salt! ...Oh yeah!... Ok! Ok!...Low oil, anh?!(...)

(BG) M.C.: So, they key is to understand what we are getting... let me explain why... LLX are giving us the channel, the wall, the bridge and the land, and then what they call services...and for that they charge us a tariff... the charge so much per barrel... and it is a big number... we pay for the rest... so, it is obvious what is going to happen next. We are going to say, obviously your building that road and that is part of the tariff... and they are going to say "No, no, no... actually you building 25km in the highway...", they are going to say so "we are going to provide the electricity", and we think it is here, we think there is a substation here... and they are thinking we are going totake from the powerstation 50km away... and so on, and so on, and so on... So they key is to understandwhat exactly is in this tariff... because if it is not in the tariff we have to pay for it... (...) So

what we are trying to understand by the end of April is the scope. Does that make sense?(...) You guys are engineer, you know the devil is the details... (...) So if we can get the broad principles by April... then after that we can ... improve the answer overtime... the trick is to understand what the question is...

(CNC) S.P.H.: OK!

(CNC) L.M.A.: *We are used to do this with Petrobras. Petrobras send us big ...how can I say... bid guidelines... we have to break it very very small so we understand all the battery limits, all that services provided, and you have to give a full price for them... so, if you forget something...*

(BG) M.C.: *It is your dollar ... It is your dollar ...Exactly!... And now...this time... you are Petrobras...*

(CNC) S.P.H.: *Oh, so... that's typical Petrobras...*

(BG) M.C.: *That is why you are a team to us... defining the relationship with the other company... (...) And what happens after April?We will decide that between now and April... and it maybe that we run a design competition, ... the definition you will give us... we give it to two contractors, and they produce a design and give us a price... and your duty then is to check their design and to make sure that what they are showing us is correct... (...)for me the most important role on this job is the lay-out guide..... So you guys are busy?*

(CNC) L.M.A.: *We recently have avery similar project from Petrobras ... the "PDY" project... and we had huge tank farms there (...) so we can provide youall this expertise... it is not that difficult.*

(BG) M.C.: *Good!... So you are not doing anything at the moment... right?!*

(CNC) L.M.A.: *Not this big...*

(BG) M.C.: *So Monday you are else... When you will be available...*

(CNC) L.M.A.: *He (S.P.H.) is my boss... he is going to tell you. He says when I am available...*

(Laughs)

(CNC) S.P.H.: *We will decide soon... We will decide soon...*

(BG) M.C.: *Ok! Because we are going to start on Monday...*

(CNC) S.P.H.: *Monday... Next Monday?*

(BG) M.C.: *Yeah!*

(CNC) S.P.H.: *(laughs)...OK!*

(BG) M.C.: *Ok! So you are available to go to Porto Alegre on Monday...did I hear you say yes?*

(CNC) S.P.H.: *I think so...(long breath)... Monday...*

(BG) M.C.: *(Laughs)...you can breathe...mMaybe nothing Monday but very very quickly... next week.*

(CNC) S.P.H.: *Ok!...one weak... ok...we have to plan...(not understandable)...to do this job...*

(...)

(BG) M.C.: *(...) It is slightly different arrangement from what you probably are used to... by my experience is that the guys that do the detail are the best at doing the concept... because thay think about three years down the road...*

(CNC) L.M.A.: *There is something about reverse engineering...you have to think about the ready facility to get back to the principles...*

(BG) M.C.: *Exactly!... If you never do anything other than concept you never really do anything... I'd rather have guys that do the detail doing concepts ... that is why we are here...*

(CNC) S.P.H.: *I see...ok!*

(BG) M.C.: Ok... I think the way it would start ...is probably in Rio... we'll get LLX and its project manager and JPPA in a room... and our project manager and CNC/WP in a table ...and there will be 1 incredible confusing conversation in Portuguese... (laughs) ... and the end of it you will know ... you will be able to tell us, how bad it is.... So what do you think?

(CNC) L.M.A.: The problem gets bigger as much as we know it...

(CNC) S.P.H: I think the only problem is the time... schedule... the only problem is the schedule... in two months...

(BG) M.C.: The reason why we are in a hurry is because we thought Petrobras would do this for us... ok, we thought... Petrobras Would deliver the oil to us in place where we could use ...ordinary ships and taking the stuff away... Petrobras thought that too...they study it and they came back in october and say..." we haven't got enough for us..." (...) to be honest, I dropped this in the shit...and ow we are trying to catch up.(...) the oil is going to come... if we cannot sell it... it is not very clever... I lot people in BG could lose their job... (laughs)...each cargo is worth US\$100 million.

(CNC) L.M.A.: And just a question... When is it expected the oil going to come?

(BG) M.C.: That's a very good question... (start drawing in a paper)... It won't be accurate... just take an idea...this is barrle per day... this is time ... in terms of number of ships that we would need to take the oil to the market... if we would use these dynamically positioned ships... we need one extra ship every six months...ok?! ... to go to the golf of Mexico, we would need something like 20 ships...and to go to China, we would need forty ships... but if we have a terminal, we need something like that, and the most ships we need is 4... so essentially the day we need the terminal its when those 4 ships ... that is the they we need the terminal... and that day is in 2013... but the earliest we think we ca have the terminal is 2014... (...) in BG we say "strecht target" the most aggressively shchedule we can think we must achieve... is the middle of 2014...but you can see that every six months that we are late is another ship... (...) so maybe the answer is as fast as we ca get it. (...) So that is why we are in a hurry... so that is why if can we go start on Monday.

(CNC) L.M.A.: Now I can understand the size of the trouble...

(BG) M.C.: I am a kind of fireman... in Brazil is "bombeiros"? ... I am a kind of "bomberos" for this... (...) And its quite a big fire already.(...) The thing is by April to understand... how real this is ... and if this is real we just keep going...(...) If you out Shell and Chevron they are completely different companies... in terms of the way they think, in terms of the way they think in terms of the way they organize... absolutely... In BG... in some ways we are almost naïve... we tend to start out with the idea that is a contractor says he can do something we will just believe it... we tend to be very few people...so we rely on the people who the work for us far more that probably Petrobras does... So, if you give us rubbish it will probably take us time to realize... because we are assuming that you will not give us rubbish... In fact, you probably has much more responsibility doing work for us than for a company that is much more structured like Petrobras. But on the other side I think we are more fun.

(Recorded Meeting, 27th January 2011 – Exact Translation).

With a clear picture of the service scope it became clear at that moment that the BGB project would be no salvation to the industry division in the short term. Hopes then turned to the RMAN2 project, whose expansion bid would be probably the large Petrobras refining contract for a long time. This project that made part of a long term S.P.H. strategy for climbing up positions in the company. Since the first contacts with the RMAN personnel in September 2009, he did an immense personal effort towards signing and carrying on a money-losing contract just to nurture internal contacts and gain access to privileged information for this bid. As such, different from the other discipline managers who were urged by the production manager to take active part in the BGB project, both to impress the new client and to cover for the lack of senior professional, after initial meetings, S.P.H. turned to the RMAN2 and other proposals.

8.4- THE KNOWLEDGE CHANGE PROCESS

8.4.1- Current Knowledge Resilience

On the 2nd February 2011, C.C. and P.R.F. organized an internal “kick-off” meeting with CNC/WP personnel appointed to the BGB task force. Below follow important notes of this meeting:

(...) P.R.F. started this meeting in a very standard way by telling main contract characteristics. He told that the preliminary service order was signed in 31st January and would be in place until 18th February, so that BG could evaluate the CNC/WP overall mobilization and performance. Thereafter, a second order would be expedited valid until 30th April. He explained project characteristics and main guidelines, highlighting the importance of job that could eventually be extended for a long time. He emphasized that BG was a new client and that if CNC/WP showed good-will it would hold upon us all along this project and future projects. C.C. Highlighted that BG has interested in hiring CNC/WP for other engineering services beyond that one. In this matter even R.F. pronounced that as BG was in Rio de Janeiro, it would be under CNC/WP São Paulo jurisdiction, highlighting it was not Belo Horizonte. C.C. reinforced that it was important to diversify away from Petrobras.

(...) P.R.F. also talk about the people who would make part of the project and the right time for their allocation. R.M.B. expressed his worry about the necessity to have a dedicated professional for the project. He complained that he was short of personnel and that one of its remaining engineers where just about to leave. C.C. intervene to say that although not all personnel would be enrolled all the time, some people were core to the project and thus should be fully mobilized specially, Process, Piping and Civil. P.R.F. insisted that should be make a great effort towards this project because it would be a unique opportunity to learn something nobody at CNC/WP knew. C.C. then argued that schedule was so tight that disciplines should work side to side to respond as quickly as possible. C.C. also demonstrate worry about back office personnel as there had just been an organizational restructuring and their results were restrictive in the sense that BGB would have to use the same personnel which were finalizing PDY2 project.

(...) P.R.F. described the project activities mostly in generic terms of a common project like “scope declaration”, “ project analytic structure”, “list of documents”, and “schedule”. Emphasis was placed on the key meetings to happen in February, while most of the hands on activities like “ consistency analysis”, “basic design complementation”, and ITT (intention to tender) package and associated documents (still undefined) would fall to March. (...) C.C. highlighted that a schedule was soon to be presented as the milestones were better defined. (...) (Field Diary notes, 02nd February 2011)

During this meeting, however, several important questions were overlooked. The inherent complexities in work division due to the unconventional character of the required documents, for example. People left the meeting with deadlines without knowing exactly what should be done and how. Work sequence was also unclear and sparked some unresolved debates as the dialogue below shows:

(CNC) L.M.A.: (...) There will be no drawing production... there will be only reports, project descriptions... only if there is any basic engineering modification... There will be paper only if basic engineering complementation ...

(CNC) S.P.H.: There is preliminary lay-out that must be...

(CNC) L.M.A.: If happens any basic engineering complementation ...

(CNC) C.C.: There will be procurement...if there will be a complementation.... So, we will have to ask them.... we will use the LLX drawing we will change the stamp...

(CNC) S.P.H.: I had already understood like this...then after that meeting I had understood like that... It (BG) has a conceptual design... where there is a lay-out...we are going to get this lay-out... check against 1674 (a Petrobras standard) ... if it is all right...otherwise identify if there is something else to do... we will have to do

that job... it is a drawing... I reutilise all JPPA (LLX) drawings... there is no problem... but I will have to validate...

(CNC) L.M.A.: We will make consistency analysis... if there is ... there will be analysis, is is clear... but if there will be basic engineering modification... then there will be drawings... Consistency check is clear... If there will be drawings ...

(CNC) P.R.F.: It will depend on what BG wants.

(CNC) S.P.H.: In the first contact we had... sorry, I don't understand like this...for me it was already defined... the guy said the following.... He is going to get this lay out and he will want to hear... "It is good if you this, this and that" ... If necessary I will have to redraw...

(CNC) P.R.F.: If necessary so...

(CNC) S.P.H.: Of course I will not start from scratch because I already have one... otherwise... He will not want a small report...

(CNC) L.M.A.: But this is basic engineering complementation... You make an analysis, if the analysis shows a problem... so there is basic engineering complementation...

(CNC) S.P.H.: I know what is basic engineering complementation my dear... what I could get from the guy (M.C.)...was this... it is this that he expect from us... that is what he is contracting... that's because he said "I want someone who can detail doing this..." Basic, already had that was JPPA... "I want a person from detail engineering studying my basic...that is what I want"...

(CNC) P.R.F.: It is true...

(CNC) S.P.H.: Otherwise you won't be doing nothing...

(CNC) C.C.: The basic (engineering) was made before BG... If our consultant ... if we was here... He would have to ask BG, what is your operational strategy? How are you going to operate this? To know how to adequate what is here to BG strategy.... BG can say... "this does not work for me..." (...)

(CNC) R.M.B.: Adequate... We have to adequate the project... to the BG reality... it is not complementation...

(CNC) C.C.: It is not complement... the project exists... adequate...suppose that BG says that it is OK to go with is , then we get back to what you said.. validate...comply with Brazilian norms... comply this, that...(..)

(CNC) P.R.F.: It might be not necessary to redraw the concept...

(CNC) S.P.H.: (...) I will take the editable of this (drawing), do the necessary change and stamp CNC/WP.

(CNC) P.R.F.: It might be he don't need to do that...

(CNC) S.P.H.: And in our drawing theirs come as reference ...

(CNC) L.M.A.: But P.R.F., if it is needed to change the drawings... is it up to us?

(CNC) S.P.H.: We will not change their drawings... their drawings are reference for us...

(CNC) L.M.A.: So we are going to do a new drawing based in theirs...

(CNC) S.P.H.: It might be everything the same...

(CNC) L.M.A.: But it is up to us to do that drawing...

(CNC) C.C.: But then we are going to talk about these details in another meeting...let's go ahead...

(CNC) S.P.H.: (only to me) We never touch in basic or conceptual engineering... we use as reference...even if it is the same...

(Recorded Meeting, 02nd February 2011 – Author Translation).

Curious, is that after all that discussion about engineering terms sparked by S.P.H. and agreed upon many in the room not to apply, the term “basic (conceptual) engineering complementation” (below marked in red) appeared on a slide in the screen. It is also noteworthy the generic terms used for the documentation to be produced which did not corresponded to anything usual.



Projeto NIXXX BG Brazil
NIXXX-0000-COO-AR-0001

► 9 – Cronograma Fase 1 Fast Track (continuação):

- Até 10/03/2011 – Análise de consistência e complementação do Projeto Conceitual LLX/JPPA.
- Até 30/03/2011 – Emissão de documentação técnica para formação dos pacotes de licitação inclusive Edital e seus anexos
- Até 30/04/2011 – Finalização da Fase 1 do projeto, incluindo projeto básico, toda a avaliação técnica de propostas e suporte à BG na escolha do EPEcista.

Fig.87: Initial indications of unusual documentation required for BGB (Source: CNC/WP presentation)

The high level of information uncertainty surrounding the project was also observable. Great emphasis has been given to the meeting with client and LLX, probably because of this. Another problem raised in the final of the meeting touched the infrastructure available for project execution. P.R.F. still did not have an e-mail address and there were no IT link available to exchange documents with BG, so the range of documents available for examination were restricted to those in paper that were at hand. Also noteworthy, the role of C.C. as a part-time project manager surprised and make me wonder how it would be possible to half involved in such a challenging and important entrepreneurship.

As P.R.F. required each discipline to prepare a “wish list” of information to start the project which should be sent to him as soon as possible. I did as required and, later in the afternoon, sent the piping wish list to him. The next day, I met him in the corridors and we had the following conversation as described in the field notes:

(...) I asked him if he had seen the information and if that was what he expected. He thanked for the fast response, and particularly because it was already in English. As I perceived that he was quite busy, I asked if there was anything else I could help. He said that other people were busy doing proposals or else and complained that I was the only one who had already sent to them the wish list and he needed that for today. I said that I could provide some help writing something about process and maybe electrical and instrumentation because I knew some basic information that would be required for these disciplines. He thanked and said that it would help much. (...) I postponed my lunch one hour and went for some help with people I knew around the company that could help. By 2 o'clock I sent a message to P.R.F., copied to R.M.B. and S.P.H. with the a preliminary “wish list” for all disciplines but Civil. (...) Later on the day, R.M.B. made minor comments, mostly rephrasing the questions, which I incorporated and re-send the message. S.P.H. did not answered.(...) (Field Diary notes, 03rd February 2011)

On the 4th February, the first change in BG requirements happened. From the initial requirements of just taking the JPPA basic design and lay-out as a reference, now it was to analyze the extension to what the documents supplied by LLX could be used.

Moreover, P.R.F. asked for the disciplines to create a LD (list of documents) draft based on the one supplied by LLX what clearly demonstrate that not even P.R.F. was aware of the unconventional nature of the project and real client needs.

Ladies and Gentlemen,

Annex follows the preliminary agenda for our meeting with LLX, 15th February 2011, sent by BG Brazil.

Annex also follows our preliminary "wish list" sent yesterday and revised by BG Brazil (comments in red). These topics shall be used in the KOM (kick0oof meeting) of 10th February with BG Brazil.

Yesterday, BG Brazil changed his position in relation to the documentation of LLX, and left it clear that we should analyse with them the extension to which we might use LLX Project. This way I remind you again that schedule is tight what means that we should immediately start a deeper examination of the needs and how we are going to develop this project.

Also ask that all disciplines create a "draft" of how should be the LD (list of documents) of this Project. It might be used, only as reference, the LLX/JPPA LD distributed on the 02nd February meeting.

Att,

(CNC) P.R.F.

(Message sent on the, 4th February 2011 – Author translation and Sender highlights).

8.4.2- Project Organization

CNC/WP project organization was upfront defined and made explicit on the kick-off meeting on the 02nd February. Additional personnel from BG and WP-Houston became known along the following days through the messages and conversations. As such, resulting project organizations was as described in the chart below:

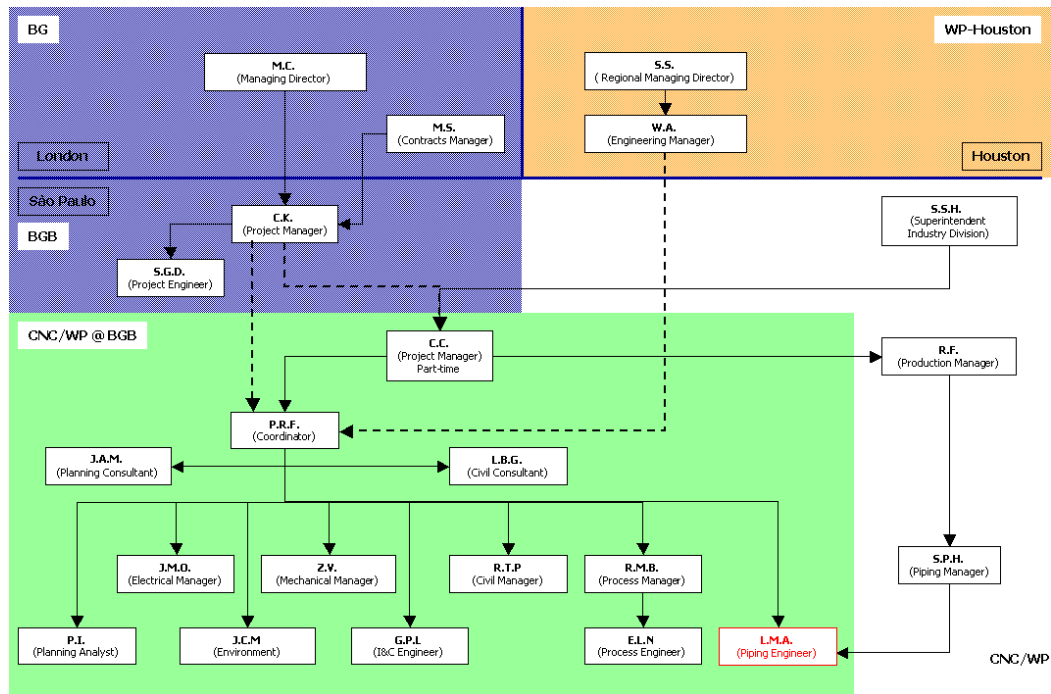


Fig 88: BGB project organization.

The task force involved in the project was supposed to occupy an especially prepared space in the 2nd floor (the same used for the COMOS training) together with BG personnel to be resident. The space, however, until 4th February was almost untouched and only minor preparations had been done. Only after a formal complain of P.R.F. to CNC/WP administrative manager A.M.R., works were accelerated, however, by the 9th of February the situation was as described below:

(...) when I met P.R.F. he urged to me to immediately move downstairs as C.K. was about to arrive the next day and could not get at the project site and realized that no one have yet been mobilized. I said I did not know the place was ready. He said it already was and asked me to rush in. I quickly understood the situation and personally got my stuff (computer, cables, documents) and moved downstairs to the project site. I was the first to arrive downstairs, and the only thing prepared I saw was the drywall separations for the tables of BG personnel (C.K. and S.G.D.) and P.R.F. and the low-separation desks for the task force personnel. The rest was I trip to the past. Almost rotten chairs and old computers with CRT screens instead of the LCD traditionally used all over the company. Phone and network lines were misplaced and still did not work. (...)

(...) In the afternoon, R.T.P. arrived and saw astonished the awful infrastructure provided to the project. She complained about the computer and argued that with that “crap” she would not be able to do not only the BG job but also the other ones she had upstairs. (...) As she was working also in other project and could not move her computer downstairs, IT personnel installed a program that enable she remotely use her computer, however network speed made it unbearable. (...)

(...) By the end of the day, two more people arrived their J.M.O and G.P.L. (Field Diary notes, 09th February 2011)

8.4.3- Current Knowledge Weakening

On the 7th of February 2011 and prior to his arrival in São Paulo, C.K. sent a message to C.C. and P.R.F. to establish the guidelines of the BG-CNC/WP kick-off meeting on the 10th February, as shown below:

(CNC) C.C. and (CNC) P.R.F.,

Herewith the agenda/presentation I have drafted for our kick off meeting on Thursday.

It is not particularly detailed but I hope it starts to facilitate alignment with the team.

I have outlined the main topics to cover, but the format of the meeting shold be opened dialogue and discussion. I do not have all answers but it should be the start of how we are to move forward and to achieve in a short timescale!

We have started some activities already, but please spend some time before Thursday to identify anything else that you or your team want to discuss, particularly if it is not on my agenda.

Could you also start drafting a schedule of CNC/WP activities (to level 1 detail) on Primavera (planning software) of how we are to get to a concept select point. I need to establish soon how long realistically it s going to take. Our target is April, but I have already said internally that this is going to be difficult to achieve. I hope my presentation outlines what we need to achieve by then. (...)

Regards,

(BG) C.K.

(Message sent on the, 7th February 2011 – Exact Transcription).

Right from the start the absence of a consolidated LD elaborated by project management caused a great confusion on what should be done, how and when. Asked to create “drafts” of a LD, discipline heads turn out with standard LD that

were used for the more detailed project to which they were more used. Some of them included documents that were not even possible to be generated with schedule and level of information available, such as drawings and material lists.

On the 10th February, took place the official kick-off meeting with BG and the other project stakeholder, involving BG project manager, C.K., a BG project engineer, S.G.D, all CNC/WP personnel (including S.S.H., industry division superintendent), W.A., WP-Houston ports division engineer manager, and L.B.G., a former CCC manager, now CNC/WP ports consultant appointed by S.S.H. The meeting gave a overall picture of the general guidelines for the project and expectations of BG towards it. Key passages were as described in the field diary notes below:

(...) C.K. opened the meeting with a small discourse telling that despite there was a contract and a client, he saw CNC/WP as an integrated part of BG, as the engineering resource of the company. Therefore we wished CNC/WP to work together with BG as one team only and be pro-active., and different from what CNC/WP would be used with Petrobras this time CNC/WP should not wait for directions. Something that were welcomed by C.C. (...)

(...) In this meeting C.K. and P.R.F. left it clear that despite the delivery date of the documents required by BG was end of April it would be necessary that a technical concept and a +/-25% precision investment estimate for the LLX solution should be available to a go-no-go meeting for this alternative in BG headquarters by the end of March. After that, J.C.M. display his worries concerning the need to revise or apply for new environmental licenses would cause a great impact on the tight schedule proposed. C.K. argued that such issues would be discussed in separate in another meeting however, he agreed that permits would be one of the issues that could make schedule overrun. (...)

(...) When talking about future contracting strategy C.K. told that he got lots of important information from a meeting with F.C., S.S.H., and C.C.. He admitted that BG did not had much knowledge about the construction market in Brazil and the conversation helped to initiated the construction of a contracting strategy as he presented. (...) He also told that preliminary they would conduct a design competition to integrate a ITT (invitation to tender) package and submit it to Brazilian contractors, which according to information he collected with F.C. (CNC/WP sales director), were 3 construction companies capable of running all project phases at most. Contracting strategy was a subject that draw much of CNC/WP management attention, as they wished to extend BG contract, an hourly-fee contract, as much as possible. In this sense L.B.G., argued that the pre-qualification of contractors would last at least 60 days because there were many financial and technical issues to check, and proposed that contractors pre-qualification could run in parallel with the technical evaluation. C.K. replied saying that BG in Rio de Janeiro office already have a contract manager taking care of the pre-qualification issue which would run completely under BG control. Later in the meeting again S.S.H. insisted on the subject by saying that it was important to evaluate the contractor and their process in face of the construction technology used to speed up construction. L.B.G. then begin discussing about the problem of resources competition provided by the construction of Anglo American pier and vented the possibility of taking advantage from the facilities provided after they end their work.

(...) P.R.F. and C.C. explained that despite the project was a task force, not all people involved would be required all time. More probably a core team would be mobilized full time at the second floor together with WP-Houston and BG personnel and auxiliary personnel would be mobilized "as required". What was welcomed by C.K. (...)

(...) Quite interesting along this meeting was the ability of both W.A and particular C.K. of being able to follow the content of discussions running among Brazilians without even speaking a single word of Portuguese. (...)

During this meeting, BG made clear which deliverables it expected to receive and show some examples of their content. Instead of drawings, material lists, and project criteria, BG required a set of conceptual documents whose works were almost

unknown to CNC/WP personnel, more used to engineering executive documentation.

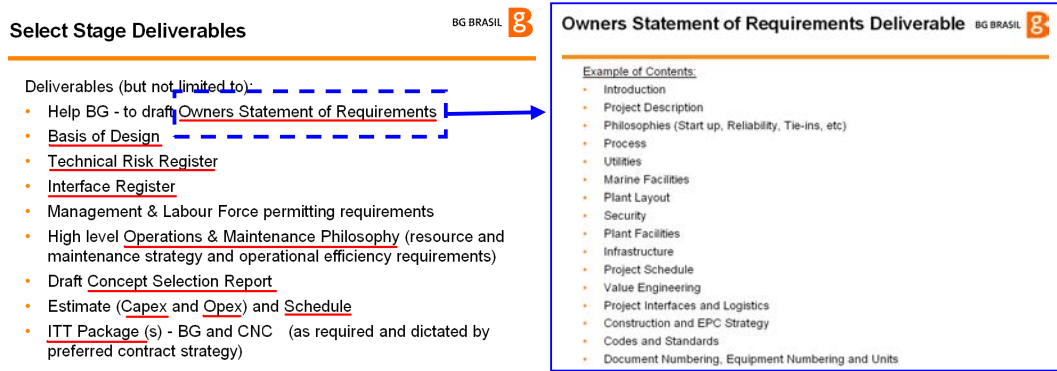


Fig.89: Unusual documentation required for BGB (Source: BG presentation)

The contracting strategy was clearly the subject that attracted most of CNC/WP management attention. During the presentation some initial options for this ongoing evaluation of contract strategy were presented as shown below:

Alternative 1					Alternative 2				
	Tanks	Operating Units	Piping	Auxiliaries/ BERTH		Tanks	Operating Units	Piping	Auxiliaries Berth
Project Planning	BG				Project Planning	BG			
Concept	CNC/WP				Concept/ Owners Engineering	CNC/WP			
FEED					FEED	Parallel FEED			
Contract Management					Contract Management				
Detailed Engineering					Detailed Engineering	EPCI			
Procurement Equipment	Tenderers: 1. Odobrecht 2. Technit/Tenaris 3. CEC 4. ODEBROZ GALVELOS 5. Andrade GUTHERREZ 6. Mowle Jones COST PLUS FIXED FEE				Procurement Equipment	Tenderers: 1. Odobrecht 2. Technit/Tenaris LUMP SUM or COST PLUS FIXED FEE			
Procure Bids									
Out									
Construction					Construction				
Commissioning					Commissioning				
PRE-OPERATION ASSISTANCE	CNC/WP				PRE-OPERATION ASSISTANCE	CNC/WP			

Fig 90: Contracting strategy alternatives (Source: BG presentation)

The meeting continued with less people to discuss cost estimate (CAPEX).

(...) C.L.D. explained C.K. the methodology CNC/WP used for CAPEX estimates, which basically followed AACE (Association for the Advancement of Cost Estimation), a standard bureau on the subject. C.K. asked it could inform on costs per discipline, as piping for example. C.L.D. however, anticipated that for the standards applicable the technique would require number of equipments and everything else would be weighted out of it. This sound strange to me, because it was a very specific project with unusual equipments and wit a very atypical cost distribution than that for a process plant. As such to follow the standard and make an estimate as required, several documents would be need to be created, as for example: Block Diagrams, PFDs, P&IDs (basic process documents)...C.K. reacted and said that he was not sure if they have something like P&IDs ...W.A. laughed and said that without I P&ID nothing could be done... then C.L.D. continued... equipment list, electrical one-line diagram,... Concerning piping, C.L.D. argued that the precision of Piping estimate would be enhanced by the P&ID which would be able to supply the number of valves and other in-line elements. (...)

(...) C.K. questioned if he (P.R.F.) thought it was achievable to get all this informational and documents by the end of April. (...) He explained that the key for the estimate on the level of precision BG wanted would be the civil, the tanks and the piping. S.G.D. questioned about how would be evaluated the costs of the elements to be placed at the berth (...) C.K. interrupted and said that what would be needed at berths would be result of filling the gaps that would appear in the

meeting with LLX (...) S.G.D. then asked if elements to be were defined if WP-Houston would have price list for the estimation of complementary equipment (...)Then W.A. start to talk about the role of WP-Houston ports divisions as a highly specialized division a center of excellence in Marine for the whole world. Then started to raise concerns about the work done for LLX basic project and the simulations they have ran, lay-out, operability...(...) (Field Diary notes, 10th February 2011)

The next day, however, as C.L.D. receive the information that he was supposed only to handle risk analysis and let the Capex work for another professional about to join the company (J.A.M.) he demonstrated irritation and anticipated his withdrawal from the project as can be seen in the meeting notes below:

(...) After the meeting C.L.D. showed up quite disgusted with the news. While talking to P.R.F. he said that people (in directorship) wanted to hire J.A.M. for so long, that this guy was from “their clique” in CCC, and they finally found an opportunity to do that but we would not accept this. He said that if it were to J.A.M. to do the Capex analysis he should also do the risk analysis by himself that he would be involved in helping him in the task nor provided his methodology. (...) P.R.F. showed up uneasiness and asked C.L.D. to reconsider. (...) Later I asked P.R.F. if this guy to join the project was that good to bother C.L.D. P.R.F. did not comment much, just said that there was an internal problem and that this guy was working at CCC and had been hired to provided further help to the economic analysis side of WP (...) Apparently, C.L.D. felt as if his turf have been invaded by someone better connected with the top management. Moreover, C.L.D. team had just been reduced because as she B.D. returned from a period at WP-Houston, the two other junior analysts who C.L.D. have trained while B.D. was out were laid-off when she returned. (...) (Field Diary notes, 11th February 2011)

Also on the 11th February, P.R.F. forwarded a message sent by C.K. with an example of how the documents BG required were to look like.

Gentlemen,

Please find enclosed my first go at drafting a detailed contents list as to what might appear in our Statement of Owners Requirement. I also enclose a template for this document – to be populated.

I am not fixed on the title of main headings or sub-headings or the order in which they appear, but would welcome your comments.

This is an urgent document to get to together and agree for use by the whole team to provide the initial basis to develop the concept.

Regards,

(BG) C.K.

(Message sent on the, 11th February 2011 – Exact Transcription, P.R.F. highlight).

In response P.R.F., forwarded the above message establishing a closer date for the completion of the documents annexed by C.K.

Ladies and Gentleman,

Annex follows the document Statement of Owner’s Requirements so we can complete.

This document shall be complete by 15th February. See C.K. text, in red, in the message below.

Atenc

(CNC) P.R.F.

(Message sent on the, 11th February 2011 – Author translation and highlights).

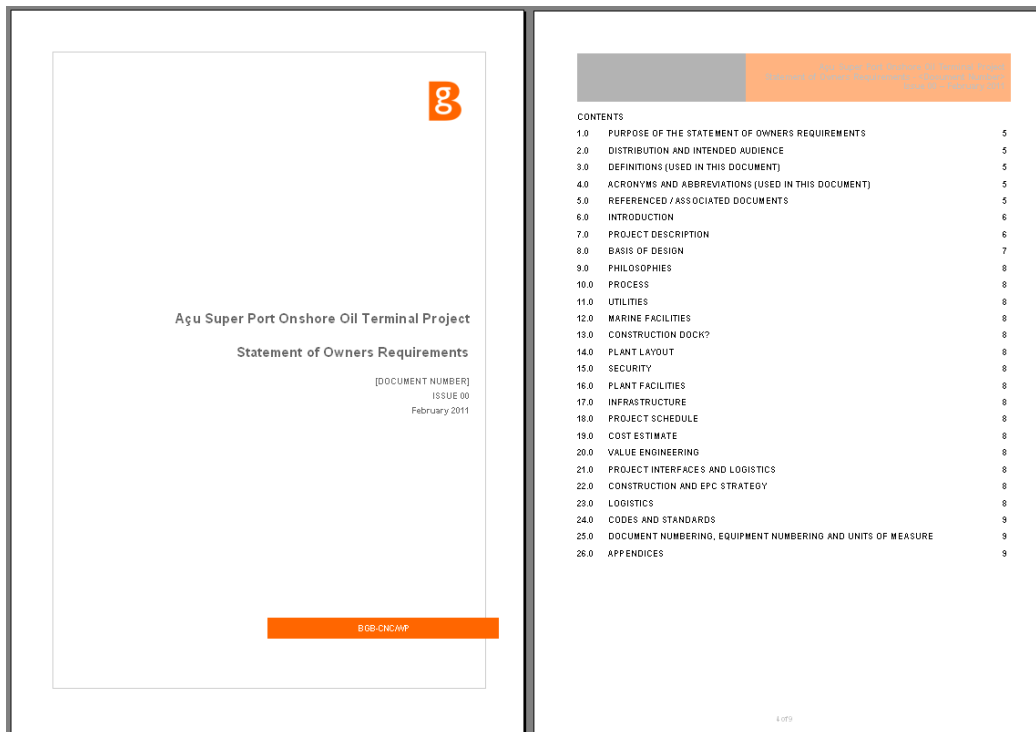


Fig 91: Statement of Owner Requirement front-page and index.

Despite the meeting information and document examples, discipline heads were still uncertain about the works to be done. As C.C. was almost absent from the project taking care of other proposals and P.R.F. spent most of this time, attending to meetings with top management, probably discussing strategies to capitalize on the project, no one was left to establish a clear breakdown and definitions to work. Also troublesome was the lack of physical structure involving phone lines and inadequate hardware which made work sluggish and subject to constant interruptions. Not to mention the parallel activities discipline manager allocated in the task force were constantly submitted to, such as attending to proposal and managerial meetings. So far, work followed in a tentatively and unconnected manner which did not yield any concrete progress.

Parallel, C.K. struggled with the infrastructure provided by CNC/WP. Wireless internet was not working properly and there was no printer available for him to use. As he complained to P.R.F., who has asked several time for IT personnel to arrange that, he personally went to A.M.R., administrative manager, to ask for a quick response in this matter which was supposed to be operational days before. By the end of the day internet connection has been set and a printer has been supplied however no one appeared to set it in C.K. computer.

On the 13th February, C.K. began to demonstrate his uneasiness concerning the speed and direction of CNC/WP work, as can be seen in the message below:

Gentlemen,

Tomorrow is the start of our third week working together for BG Brazil as an integrated project team and clearly work has to start ramping up if we are to maintain what is an aggressive schedule for this

Select Stage. With this foremost in my mind this weekend, I have tried to give a starter on a number of fronts to facilitate the ramping up of work with requesting information from BG (that BG can only provide), providing BG's initial thoughts on the functional operating philosophy for the terminal, commencing the contents list for a Statement of Owners Requirements, the Kick Off Meeting, LLX interface meeting (clearly crucial) and the environmental download later this week.

To add to this list I now provide a starter for the **Process Basis of Design** as the process engineering discipline is key to start the concept development activities and your process engineers clearly need to help develop this document. This document needs further work.

Although this is a BG Brazil provided document to start concept development, we are also an integrated BG/CNC team to act on behalf of BG Brazil working as one team as I mentioned in the Kick Off meeting. Therefore I would like to hand this over (in BG document template format) to CNC to take control of it and its development for BG Brazil and so that its management of change falls within the CNC processes.

The same approach will apply to other BG supplied documents such as (for example) the Statement of Owners Requirements and the full Basis of Design across all the engineering disciplines.

Regards,

(BG) C.K.

(Message sent to (CNC) P.R.F., copied to (CNC) C.C. and P.R.F. (CNC) and (BG) S.G.D., (BG) M.S. and (WP-Houston) W.A. on the 13th February 2011 – Exact Transcription – Author Highlights).

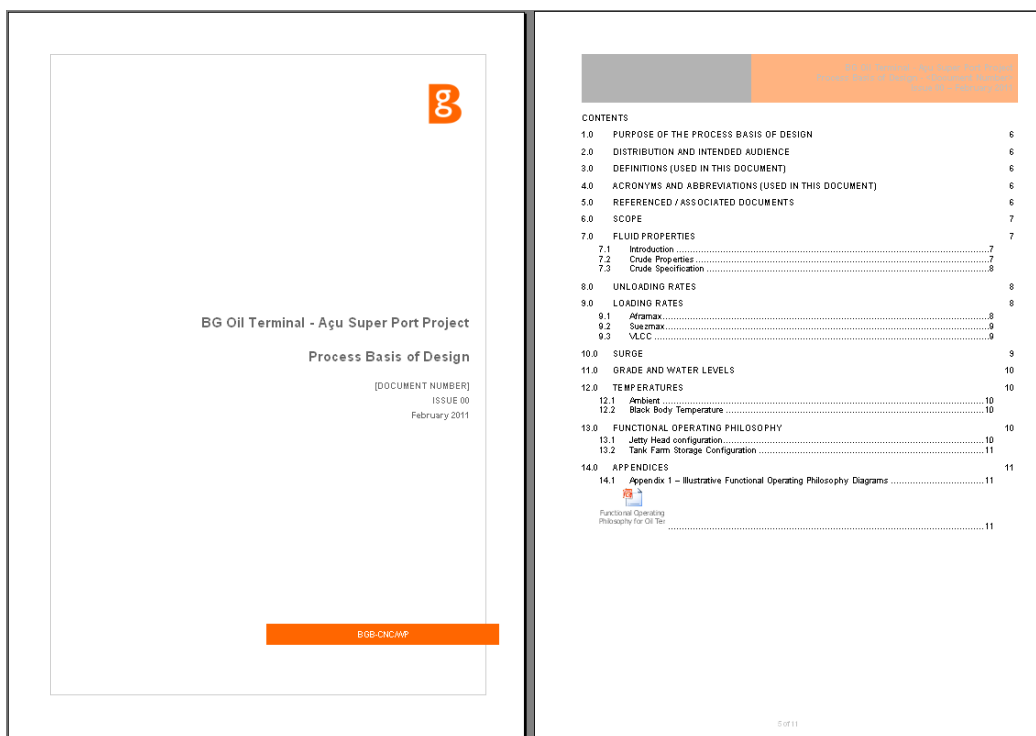


Fig 92: Process Basis of Design front-page and index.

In response P.R.F., forwarded the above message required further attention to the project and fast completion of the documents annexed by C.K to be discussed on a later meeting.

Gentlemen,

Annex follows the documents " Process Basis of Design" and "BG shopping list of Common Oil Terminal Option" to be completed by BG and CNC/WP.

Client awaits fast complementation of the same and I ask you to attend a meeting today at 14:00 to discuss how we will implement or comment them.

I remember again that this Project is different from everything ever done by CNC/WP, because it is a Fast Track with a “Crash” schedule¹⁹.

In the message below it is clear that our answer has to be immediate.

(CNC) P.R.F.

(Message sent on the, 13th February 2011 – Author translation and highlights).

The meeting took place only the next day, as almost there was no one available and even him, P.R.F., was asked to meet S.S.H. to discuss contract issues and WP-Houston participation. Also the 13th February, C.K. sent to C.C., R.F.P. and W.A. a document listing data necessary for the elaboration of the Process Basis of Design which would be completed by BG and a third-party contractor.

Gentlemen,

I have today requested a “shopping list” of data to be provided from BG Brazil to help populate the Basis of Design for this select stage (as attached). Some of it may not be immediately available and will come from a study undertaken by HR Wallingford for BG Brazil. This is not yet completed, so if outstanding, I have asked for a target date for completion.

Please advise if you have any other points as soon as possible.

Regards,

(BG) C.K.

(Message sent to C.C., P.R.F. and W.A. and copied to S.G.D. and M.S. on the, 13th February 2011 – Exact Transcription).

Initial BG Shopping List of Common Data for Onshore Oil Terminal Option

Item No.	Topic	Response	Target date for availability
1.0	Crude Properties (by type)		
1.1	Crude Quality specification/ composition		
1.2	Field Name (by type of crude)		
1.3	Heating requirements for crude (by type of crude)		
1.4	Production profile commencing 2013 (by type of crude)		
1.5	Total Production profile commencing 2013		
2.0	Shipping Details (as applicable)		
2.1	DP2 shuttle tankers to terminal (by range of size and as applicable) <ul style="list-style-type: none"> • Gross cargo capacity (bbls) • Useable cargo capacity (bbls) • Dwt • Draft (loaded and unloaded) (m) • Berth requirements for mooring, layout at berth, ship dimensions, manifold elevations for design, water levels for design, mooring and berthing forces, etc. • Berth facility requirements (electrical power, potable water, plant air, fuel, nitrogen, slop oil, communications, etc) – specifications and quantity as applicable • Unloading arm requirements (size, number, etc.) • Ship pumps capacity and capability, loading/ unloading flow rate, discharge pressure, etc. 		
2.2	Aframax tankers (by range of size and as applicable) <ul style="list-style-type: none"> • Gross cargo capacity (bbls) • Useable cargo capacity (bbls) • Dwt • Draft (loaded and unloaded) (m) • Berth requirements for mooring, layout at berth, ship dimensions, manifold elevations for design, water levels for design, mooring and berthing forces, etc. 		

Fig.93: “Shopping list” of documents example.

¹⁹ According to the PMBOK (3rd ed., 2004), *crashing approach* refers to another particular variety of project schedule compression which is performed for the purposes of decreasing total project schedule duration. This involves weighing the additional costs associated with doing a rush job with the benefits of meeting the newly proposed deadline. The diminishing of the project duration typically take place after a careful and thorough analysis of all possible project duration minimization alternatives in which any and all methods to attain the maximum schedule duration for the least additional cost, and essentially, it boils down to an attempt to get the most productivity out of the least time and expense.

In response, W.A. wrote two times (13th and 14th February 2011) directly to C.K. suggesting that additional information was also important. Noteworthy, however, was that most of this information required extrapolates the WP-Houston scope, which would be of equipping berths for operation, not berth design and construction (LLX responsibility).

(BG) C.K.,

I suggest the following, in addition to the list I sent earlier for discussion with LLX:

Environmental & Geotechnical

Ambient temperatures

Rainfall data

(...)

Facilities:

Design life (years)

Design flow rates - maximum, minimum, expected average

(WP-Houston) W.A.

(Message sent on the, 13th February 2011 – Exact Transcription).

(BG) C.K.,

Please add:

1. Molded depth
2. Number and arrangement of mooring lines (for mooring load calculations)
3. Maximum storm surge height (to determine underside height of the jetty head and trestle).

In addition to winds, waves, and currents for operating and maximum conditions (directionality extremely important).

Regards,

(WP-Houston) W.A.

(Message sent on the, 14th February 2011 – Exact Transcription).

As the amount of information handed over by BG increased so lag time within CNC/WP also increased. While the “Statement of Owners Design” was distributed the same day it arrived, the “Process Design Basis” and Shopping List of Common Data” took one day to be distributed and the “Functional Operation Philosophy” two days. The information flow between BG and CNC/WP also became highly dynamic. On the 12th of February 2011 C.K. sent the first draft on the “Functional Operation Philosophy” of the terminal.

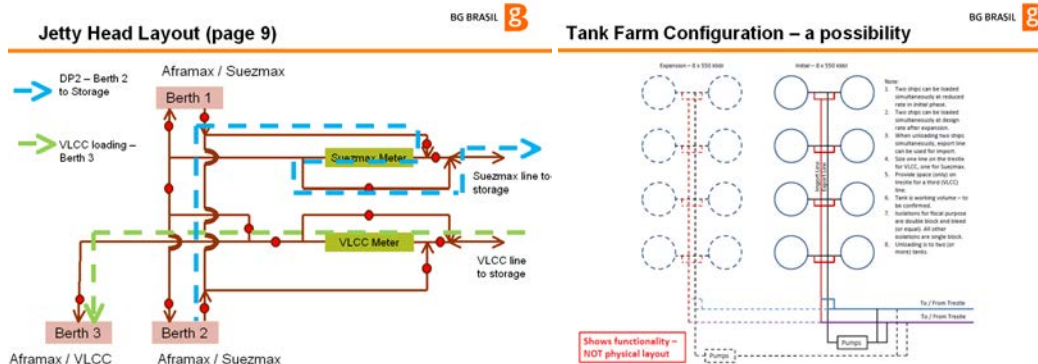


Fig.94: BGB basic design alternatives (Source: BG presentation)

This document was only distributed by P.R.F. two days later on the 14th February 2011, almost at the same time that C.K. sent additional comments upon:

Gentlemen,

On Monday 14 Feb I presented BG initial thoughts on the operating functionality to CNEC for this terminal (as attached). As discussed then, I can now provide our additional remaining requirements on the functionality for the concept Select Stage with some refinement to the previous information. By tomorrow morning I will also provide the crude quality data as also discussed. There will be five (5) crude qualities to consider to represent cargo quality in shuttle tankers from the five offshore fields (namely Iara, Iracema, Tupi, Guara and Carioca). These will be the assumptions on crude quality valid for this Select Stage of the concept.

All together this will provide all BG required information for BG/CNC to finalise the **process** basis of design and begin the concept development for the process engineering function in earnest. Please proceed with finalising this document for this Select Stage. It also provides part of the input to the Statement of Owners Requirements.

The additional functionality requirements are as follows:

Marine Side at Berths:

- Berth 1 nearest trestle and on seaward side to accommodate DP2 shuttle tanker, Aframax and Suezmax (as before);
- Berth 2 nearest trestle and on coastal side to accommodate DP2 shuttle tanker, Aframax and Suezmax. Also in case of mishap at Berth 3 to accommodate VLCC it shall be assumed that seabed shall be dredged to accommodate VLCC as well at Berth 2. Therefore piping layout and unloading/ loading arms location shall match this possible circumstance, however arm sizes and piping sizes will only be for DP2 shuttles tankers, Aframax and Suezmax. VLCC will have to load at a reduced rate at Berth 2 (if needed);
- Berth 3 furthest from trestle to accommodate Aframax, Suezmax and VLCC (as before);
- We still require 3 berths not 4 berths in total (even though LLX plans/design can accommodate 4 berths);
- Provision only for a third fiscal meter (sized for VLCC loading duty) shall be assumed, but not installed initially at the jetty head. So not to be included in the Capex estimate other than any pre-investment needed to install in the future (e.g. tie-ins, space allocation in layout, etc)
- Two simultaneous loading/ unloading operation at the berths is still valid. We do not require 3 simultaneous operations.

BG will provide shipping data for mooring layouts, etc shortly.

Trestle/ Bridge/ Pier Bi-directional loading/ unloading lines:

- We require two bi-directional loading/ unloading lines to storage to be installed, one sized for DP2 unloading, Aframax and Suezmax loading and one sized to accommodate VLCC loading (as before)
- Provision only for a third bi-directional unloading/ loading line sized for VLCC loading, but not installed initially along the pier to storage. So not to be included in the Capex estimate other than any pre-investment needed to install in the future (e.g. spacing requirement and pipe supports design so that we can retrofit for a future operational date).
- All pipes and equipment to be designed for fluid of specific gravity = 1.0

Tanks and Tank Storage Area:

- Previously we advised that Base Case total useable volume was 4 million bbls. We need to match useable volume delivered by DP2 shuttle tankers of 1.1 million bbls in each and every delivered cargo. So requirement is now for eight (8) tanks of 550,000 bbls useable capacity - ground conditions prevailing (equating to 4.4 million bbls total useable volume);
- Provision for future expansion case of another eight (8) tanks similarly remains (e.g. total 8.8 million bbls). Any pre-investment requirements for future expansion should be included in Capex estimate.
- Provision of a second set of pumps to accommodate the future expansion storage should also be made, but not installed. Any pre-investment requirements for future pumps should be included in Capex estimate.
- Transfer capability of crude from tank to tank shall be required, but not blending capability. It is envisaged that the loading pumps could accommodate this with some flow control, but CNEC to confirm or otherwise advise through conceptual design.
- BG will require segregated storage for certain crude products, but this should be possible through the conceptual design of the facilities anyway. CNEC to confirm or otherwise advise through conceptual design

*It is assumed that all crude types (5 off) will be capable of being stored.
I hope this is clear. I am willing to go over this again with you and the process engineers in a meeting if there are any queries. Please advise.*

Regards,

(BG) C.K.,

(Message sent on the, 16th February 2011 – Exact Transcription – F.P.R. highlights in red).

This comments were distributed only on the 16th February 2011 but were further complemented on the 17th February 2011:

Gentlemen,

Apologies, but a small refinement to the requirements stated below on functionality of this oil terminal as follows:

Where I had stated (highlight below) that no blending facilities were required in storage, this is not true;

BG will require stirrers in the bottom of each tank as this will enable a homogenous solution in a tank should we mix cargo quality types in any given tank;

BG require a facility to 'spike' crude quality from storage to that of incoming crude quality to the terminal from the FPSO's/shuttle tankers to create blend.

BG should be able to monitor flow rate delivered from any tank. This may have an impact on the layout of the suction pipework from each tank to the pumping area. CNC/WP to optimize piping configuration layout.

Regards

(BG) C.K.,

(Message sent on the, 17th February 2011 – Exact Transcription).

Noteworthy, along this process is the fact that WP-Houston was cut-off from direct communications with BG as can be see below in the information regarding "Marine Side / Shipping Assumptions for Concept Select Stage" which directly interested to WP-Houston however first passed through CNC/WP hands, demonstrating an attempt to control the information flow:

Gentlemen,

I now provide further BG supplied data/ assumptions for Marine side and shipping details for use by CNC in this Select Stage for concept definition activities. As you have advised me you may need to share some of this data with your WP colleagues in Houston.

1) Data/ assumptions related to the Crude Quality parameters (ref. Section 1 of the attached document) was sent to CNEC by separate email today - completed.

2) Data/ assumptions related to BG operating functionality requirements for the Terminal (ref. Section 3 of the attached document) was sent to CNEC on Monday and Wednesday this week and today – completed.

3) Data/ assumption related to Marine side and shipping details is provided in Section 2 of the attached document and is the subject of this email

In addition:

(...)

Regards,

(BG) C.K.,

(Message sent on the, 14th February 2011 – Exact Transcription).

The highly dynamic character of the information and the increasing lag time took the CNC/WP into some confusing situations, as for example, when two different “Functional Operation Philosophy” documents (the one sent on the 14th Feb. and the other one sent on the 16th Feb.) circulated simultaneously among technical personnel. Also, most of the interdisciplinary work depended on definitions developed by the Process discipline, which until then were busy with other jobs in the company. To the point that these problems added to the already existing ones, CNC/WP progress almost stalled. To revert this situation, on the 14th February, P.R.F. requested a meeting with all discipline heads, to discuss technical issues, particularly process ones, with the help of W.A and C.K. The overall content of this meeting was as described below:

(...) C.K. began the meeting by reviewing the project concepts. He spent quite some time presenting the “Functional Operation Philosophy”(…) it was observable that still there was great uncertainty regarding, oil properties, flows and necessary facilities, as C.K. told there were more information to arrive by the end of the week.

(...) R.M.B. remembered that a “flush line” would probably necessary to avoid contamination of different products during loading and unloading. (...) C.K. however interrupted the discussion to say that all this debate depended on the types of cargo that BG might want segregate, what still was under definition, what might even develop into using different berths for different types of oil (...) In the same line W.A. reminded about heating requirements which would be necessary depending also on the type of oil. C.K. said that there were ongoing tests on the oil quality and that it would take time for a final word on the issue. Because of this we would have to work with an assumption for the select phase.

(...) There was agreement that few could be done without oil compositions, flows and segregation strategy. However, in the end it fall upon R.M.B. to specify which exact oil properties were needed so that the Process discipline could go ahead into its definitions, which was set to be sent tomorrow. (...)

(...) P.R.F. told that he had already received the BG standards to be used in the work and that they would soon be uploaded in the PW (document management system) so that everybody could access. (Field Diary notes, 14th February 2011)

As C.K. left the room, C.C. and P.R.F. required the others to stay for an internal meeting. In face of the client expectations and the tight schedule, W.A. pushed for a wider participation of WP-Houston, as can be seen in the dialogue below:

(CNC) P.R.F.: What is concerning me in this project is the speed of this project. We normally don't see this kind of speed in Brazil, first... second, I only know of Shell and Exxon doing project in a situation of crash schedule as you said... and what C.K... BG is expecting when they make “ping” we do the “pong”...(...)... in half an hour more. And sometimes it is not possible... we are still getting data... without this data we are not going to get...

(WP-Houston) W.A.: The problem is that... we... as a team... are not telling the client BG the fact. It is too fast we cannot met... or we can met... they still are under the impression that it can be done. We are not telling... C.K...The other thing is that we are still missing some basic data ... don't have!... I mean unless you do just sketches, just like what he did... those scenarios (...)... it's kind of very schematic...it is not difficult to do something like that. (...) We don't have complex process... very simple (...) In Houston mechanical engineering do all that... (...) The other thing we have to talk is how can we support you?... and let the client agree too. We can really speed up... specially now if a change my flight for returning tomorrow... so I will be Wednesday morning in Houston... I can do, and help and support you if we have the green light... we can work on these blocks, in scenarios, we can do things... I try to get more people you know and put under crashing...and come up with some sketches and some diagrams... but we need the green light... because it is important that we try to meet their expectations... we are one team...

(CNC) C.C.: Let me ask now the Process team here... but first in Portuguese then P.R.F. will translate to be easy to understand... (Turn to R.M.B. and E.L.N. in Portuguese) You are getting into now and this is the first time you are seeing this, but...what would be the “battery-limit” (work division) between us and WP

effective?... for example, he has just offered to do the block diagram, and this and that... Can we do this with them? Is it possible for us?... Because it looks like to me...

(CNC) R.M.B.: We don't have resources to do this... with this Friday dead-line for example... it made it quite hard... Wednesday and Thursday I will be in Rio... Chevron... E.L.N. is busy in RNEST, a bush of VDF fall upon her...

(CNC) E.L.N.: A bunch... and the other person that is with me is going away (leaving CNC/WP)...

(CNC) R.M.B.: We are losing an engineer...

(CNC) E.L.N.: We are losing an engineer and we have a pile of things, people is upon me...

(CNC) R.M.B.: If Houston could go ahead with this initial diagrams and so forth... (...)

(CNC) C.C.: This block diagram, as you said... these scenarios... it is not included in the proposal you sent me tomorrow? ...

(WP-Houston) W.A.: Yeah... but considering that it has to be done by the end of the week I don't have the paperwork... the authorization... I did get in touch with Houston to prepare a process engineer and ask go ahead and get a visa... and keep him ready... but visa takes a week... so we have issues.

(CNC) C.C.: Because we have a problem with resources... this scenarios could be studied here... because after his presentation, what we are going to need from WP is very clear to me is the port area... (...) What do you think (to CNC/WP personnel)? ...(...) let's discuss this a little bit more...(...) he has the project for two ships...so somebody has already studied how does this ship arrive through the channel ...(...), then BG is requiring a third berth...(...) so for this third ship, in case LLX agrees, all portuary infrastructure must be confirmed... so we will discover tomorrow who will do this job...

(CNC) P.R.F.: (...) It will completely change the third pier... BG... all the berths will change... (...) It will be necessary to duplicate the Petrobras berth...

(...)

(WP-Houston) W.A.: We can see tomorrow if LLX is flexible, if we can rearrange the berth... we have flexibility to do the image of what Petrobras has... (...) We will see tomorrow what we can do or cannot do...

(...)

(CNC) C.C.: But whatever is the status that is where we are going to need your support.

(WP-Houston) W.A.: We can do complete layout, do all the studies, we can do all the design ... even the "top-side", the mechanical, the process, everything... the electrical, the instrumentation, the loading arms, all the equipment that goes with it, resting, mooring, the whole work, that is no problem...

(CNC) C.C.: And returning to the first question, about the process itself... the scenarios...the conceptual analysis, since we do not the resources over here, then I think it could be done there from Houston...

(WP-Houston) W.A.: That what I was to say, we can really support you with this crash thing... if getting people here, as you know is a problem, the cost and also the rates are too high... it is a lot cheaper to do that in Houston... but we don't want to tell the client that we are doing too much... ok... but somehow we can find some arrangement ...

(CNC) C.C.: As you said, only this conceptual split of work...

(WP-Houston) W.A.: I have to get the green light before I leave... because tomorrow evening I am leaving...

(CNC) C.C.: We have another problem... it's a commercial one... they have an trade agreement with WP-Europe... not with WP-U.S....

(WP-Houston) W.A.: I raised the question already with Houston... If we can we work under that agreement... (...) they know...

(CNC) P.R.F.: F.C ask you (C.C.) to get in contact with G.F. to use this table and it's over...

(CNC) C.C.: It is not possible... it is in Euros...

(WP-Houston) W.A.: But that is what C.K. told me ... initially what he told me, before lunch, is that they are going to do that in Europe...Initially, then they were told that they have to do it in Brazil... (...) this need to be resolved as soon as possible... and tomorrow... we don't have time because the meeting is going to ...

C.C.: Then you return to Houston...and we going to address...

(WP-Houston) W.A.: Nothing can be done in Houston until we get the green light ...

(CNC) C.C.: I know... Even been here... (laughs)

(Recorded Meeting, 14th February 2011 – Exact Transcription).

8.4.4- Innovation Attempt

Over the next day, 15th February 2011, the alignment meeting between LLX/BG/CNC/WP took place. Attended to meeting LLX commercial and project managers, JPPA personnel who had developed the preliminary port and oil storage concept, C.K., S.G.D, all CNC/WP task force personnel, and W.A, which were required to stay for the whole week in order to also participated in that meeting. It was a very cordial meeting and most of the discussions were dedicated at confirming information provided by LLX, clarifying the interface limits to be provided by the port facilities and go through an information check list elaborated by BG and CNC/WP elaborated from the “wish list” and “shopping list of data” previously developed.

INTERFACE AND DATA GATHERING MEETING AGENDA – BG/ CNC/ LLX/ JPPA Tuesday 15 February – CNC Offices Sao Pualo

Purpose of Meeting:

The primary objective of this meeting is to review i) engineering data and design information that is available from LLX/ JPPA and ii) identify and clarify the scope demarcation of technical interfaces to assist with the development of the concept definition and scope of work for an onshore oil terminal at the Açu Super Port Site. Size, functional requirements and operating philosophy to BG requirements.

Key Topics for Discussion are:

- 1). **Overall**
 - 1.1 Port location coordinates
 - 1.2 Port limits (landside and marine)
 - 1.3 General port development plans including future expansion/ phasing and timing (e.g. other third party stakeholder plans for construction in the area for the oil terminal)
 - 1.4 Port access (e.g. comments on existing operations/ access/ downtime due to wind, waves and visibility)
 - 1.5 List of LLX and International Standards utilised in port design
 - 1.6 Shared facilities philosophy

Fig.95: Interface and data gathering question list.

Overall, LLX showed great interest in doing business with BG and very flexible in changing its project, provided that BG paid the due costs. The meeting enabled an interface clarification document, which established LLX duties and delivery dates as well as some BG comments on how it views some of the project constrains on LLX schedule.

LLX / BG INTERFACE CLARIFICATION AND ASSUMPTIONS FOR SELECT STAGE

INTERFACE AND DATA GATHERING MEETING – BG/ CNC/WP/ LLX/ JPPA - Tuesday 15 February – CNC/WP Offices Sao Paulo

Purpose of Meeting:

The primary objective of this meeting was to review i) engineering data and design information that is available from LLX/ JPPA and ii) identify and clarify the scope demarcation of technical interfaces to assist with the development of the concept definition and scope of work for an onshore oil terminal at the ACU Super Port Site. Size, functional requirements and operating philosophy to BG requirements. The following summarises the discussion and concludes a clear basis for interface assumption for the Select Stage.

Item No.	Topic / Engineering Data Item	LLX Initial Comment (prior to meeting)	BG/CNC/WP/LLX Interface Meeting Discussion Comment	Select Stage Interface Assumption (as applicable)
1.0	Overall			
1.1	Port location coordinates	see the drawing nº ACU-9.DES-0.0000-01-LLX-003	Clear data provided on reference drawing	
1.2	Port limits (landside and marine) general port development plans including future expansion/ phasing and timing (e.g. other third party stakeholder plans for construction in the area for the oil terminal)	The expansions at the ACU Port are planned for the offshore terminal-TX2	Notionally assigned berths for BG won't be complete (basic infrastructure) until mid 2013. Could be earlier, but assume 16 to 18 months from when BG provides it assumptions for shipping and berth requirements to accommodate.	This is late for BG if we want early operational capability at berths for STS transfer by mid 2013
			Dredging by LLX to accommodate 25m draft assumed to be completed by mid 2012 based upon completion of negotiations with PB by June 2011.	
			Breakwater completion assumption – mid 2012	
			LLX currently not talking to any other stakeholder for use of tank storage area.	BG can assume total occupation of designated site for tank storage, construction, operations and accommodation for Select Stage

Fig.96: Interface and data gathering responses.

Later in the day, two situations attracted my attention and were captured through the field notes below:

(...) before leaving, W.A. and P.R.F. engaged a meaningful conversation. W.A. thanked very much P.R.F. and his wife for receiving him so well and being so friendly and said that anytime P.R.F. traveled to Houston to tell him so that he could return the kindness. (...) Then W.A. told that he recognized that there was a fear in CNC/WP of work being transferred between U.S. and Brazil. He said we would never think in “packing things and take out”. He said we should not fear them and that he wanted just to help.(...) certainly WP-Houston was eager to raise its share on the project, however apparently it face resistance from BG in face of raising cost concerning. (...)

(...) later I the day and for the first time I saw, S.S.H. (CNC industry division superintendent) showed up to see how was set the infrastructure available for the BGB task force. The floor was empty and he called me by my name to ask for P.R.F. I thought that was kind of strange because in more than 4 years working there I had never had the opportunity to talk to him and did not even know he knew my name. He inspected the structure, now more acceptable, and showed surprised that I was still working. (...) (Field Diary notes, 15th February 2011)

With more information consolidated and released for CNC/WP work, BG pressure intensified. Perceiving a certain hesitation of CNC/WP in creating a schedule and showing progress, C.K. required documents to be released in preliminary versions at a shorter date. In this context, on the 17th of February, C.C. required a meeting to discuss strategies to unravel the work. Key points discussed follow below:

(CNC) C.C.: (...) The inputs we have are here. (...) What do we have to do, in this project... let's recapitulate... We have to produce deliverables... with a certain coverage... that allow for a cost estimate with this precision here... (...) we have to do this “guy” here... he first campaign of all... we have to populate this document ... “Statement of Owners Requirement”... we have to do the “Process Design Basis”... the “Full Design Basis” which in fact is a general “Project Criteria”... in a sole document he embraces electrical, piping, mechanical... and then we have to do the “Interface Matrix”... between the LLX and BG ... (...) this thing here, if I am not mistaken, is up to the next week... 25th of February.

(CNC) P.R.F.: These documents are more descriptive than any other thing... they do not have a calculation or any deep technique...

(CNC) C.C.: How are we structuring it, to try to attend ... the entire conceptual process project ... based on the operational philosophy that he (C.K.) gave us... with operational data... will be done by WP (Houston)... people is negotiating with them... to close deal as fast as possible... the guy there are going to get all this conditions (...) will estimate dimensions for the tanks, in function of the types of oils, of the blending that will be necessary... will create a preliminary lay-out both for the on-shore and the port...so he (WP-Houston) will have to give this picture to us ... that is what guy are going to get... and from this point and on we will have to complete our part. (...) independent of it, one cannot say " there is no work for me now"...yes there is a lot of work ... This guy here, "JPPA" did a complete basic project (...) he designed for the worst case assumption... (...) I want to say the following... there... inside the documents they sent to us... there is a kind of general descriptive project that in fact is this document here... this "Full Design Basis" where all is written somehow for that project...nothing prevent us to go there and take things out to populate ours... (...) Tomorrow the guy will make a Capex... my friend... if there is no time to do a "one-line diagram" ... you will not tell the guy that is doing it here... he is not here now, he will begin on Monday... my friend call to ABB and ask how much does it cost a substation like (...) to use the LLX documentation as reference... it is not for you to tell our inspector (C.K.) (...) So, with all this information we can have an idea (...) and beyond this there is the project as we know it... (...)this initiates with WP-Houston and finalize here in CNC/WP... but this here... has begin, middle and end here... beyond the JPPA documentation, yesterday in the meeting they gave a lot of information... about the site, gave many important documents... (...) these documents here have to be populated... is the extract of all that has to be done... (...) So, I suggest we should print ... To make the text of this guy here... we may talk later about the structure we are thinking... there will be a person that will be the owner of this... he will compile all this information... we will write... a scribe... a tough guy... but each one of you will have ... when it is up to talk about "automation system"... G.P.L. has to go there and tell the philosophy, what to consider... Guys, independent what they are producing there (Houston) because no one will do this for us... (...) Another thing, we are talking about a terminal... pump, tank and piping... only that... (...) it is a simple thing. (...) The shock here is the schedule ... this phase here... that has to be overcome... so, this guy here, and this guy here... he already filled in some parts... so this information that arrived today... he (C.K.) does not want the document all completed, typed, to be issued... nothing like this... he wants the document completed by us, where there is missing data... with premises... (...) but he wants this thing for the next week! Because he needs this... "how they are going to do the project if they don't have that" ...this is the project criteria... everybody also does... here we have a model... multidisciplinary... we can use it.

(...)

(CNC) J.M.O.: Who will be the father of this deliverable?

(CNC) C.C.: This guy here will be a person from the infra (infrastructure division), his name is F.M.C. (the same who left UINA3 project when his workload surged)...and his mission... how it will operate... there will be P.R.F.... and F.M.C...and there will be one more guy... J.A.M....(...) this guy here (F.M.C.) will have this Statement (Statement of Owners Design) here... his mission will be ... come back with this ready...

(CNC) P.R.F.: (...) You will have to do your part and he will compile...and improve...

(CNC) C.C.: This guy here (J.A.M.), will take care of Capex... Now, in the first days... he will begin on Monday... he will have nothing to ask to you... but little later, he will begin to walk on the alley... (...) he will go for... no, price no!... maybe you know the guy from Siemens... only if there is a in-house database... if there is not, has to get with an acquaintance... "please, give me a price..."

(CNC) J.M.O.: We are going to do this or there will be someone responsible...

(CNC) R.T.P.: This person... J.A.M....

(CNC) P.R.F.: J.A.M. will not quote prices! ... he will just compile...

(Technical people demonstrate concern about the additional activity)

(CNC) C.C.: Calm... (...)we have to get at this level (+/-25%)...it is not 10% nor 5%... so far we go... the rest is index... (...) I was looking at the documentation, of the methodology... to get to this level ... we don't need to make layout plans... it's by an index... (...) This guy here (J.A.M.) will give the methodology...to get here what do we have to feedback... the rest is index... (...) To succeed it has to get ready by 30th March...face it like it was a traditional proposal... for those who had the opportunity to do all that fast... you have to imagine something... here we have to imagine more because theoretically there we have better information ...(...)

(CNC) P.I.: Capex on the 25th (February), no?...

(CNC) P.R.F.: No...far ahead... 30th March.

(CNC) R.T.P.: Is it not April?

(CNC) P.R.F.: No...April is the end of the project...

(CNC) P.I.: They (technical personnel) are questioning because they think it is 30th April...

(CNC) C.C.: He (C.K.) he began with 30th April and ended with 30th March... He knows it is extremely difficult... we have to do our obligation... (...) our mission... CNC/WP is used to do FEED and detailing ... it is not used to do that... so this is a great challenge...our mission, despite all daily hardships, is to "die shooting"(...)

(CNC) E.L.N.: By what I talked with R.M.B.... we are waiting that Houston go ahead with a process concept, (...) this conceptual will come?

(CNC) C.C.: It will...

(CNC) E.L.N.: And when it is expected? Does it have already been traced with Houston...When is it expected?

(CNC) C.C.: It has been promised before the 9th March...(...) they are there... negotiating...

(CNC) E.L.N.: (...) And we would have to deliver all these basic data before the 30th March...and we would do a PFD, a line list, a P&ID, the basic documents (...) But we this conceptual to know what to do (...)

(CNC) C.C.: What you can do in parallel...find out a datasheet... "tropicalize" all in their... or check against standards... (...) it is something simple... it is not an executive project ...(...) just to enable someone to quote...(...)

(CNC) P.R.F.: Take a look at what LLX did as a reference...

(...)

(CNC) L.M.A.: But C.C., what worries me is that, ok this is a simple project, but on the other side the only thing we asked in that meeting that arrived until now is the oil composition but it did not come the flow nor the operational philosophy... the operational philosophy he sent is loading and unloading... will he made it automatic, or manual...

(CNC) P.F.R.: We... We have to study that...

(CNC) C.C.: We are the engineering... "owners-engineering"...

(CNC) L.M.A.: Ok, but what about the flow?

(CNC) C.C.: The flow he has to tell...if it is missing...

(CNC) L.M.A.: Without the flow I will choose a pipe of 50" or 10"? ...The tank will be...

(CNC) E.L.N.: But I think the conceptual will come soon...(...) Because you have to unload the ship... How long to unload the ship?...

(CNC) L.M.A.: OK, if a define that the tank is 80,000... I am defining!...

(CNC) E.L.N.: If we have the size of each ship and the time it takes to unload the ship we can have the flow...(...) and the size of the ship Houston will have to supply...

(CNC) L.M.A.: The ships we have the sizes, the problem is not the size of the ships is the flow...flow at the terminal... (...)

(CNC) E.L.N.: The flow it is probably Houston... its conceptual... its basic... (...)

(CNC) C.C.: If it missing... ask the guy (C.K.)...

(CNC) P.R.F.: If you are going direct at the guy... read the documents (...)

(CNC) C.C.: We are going to do as much meetings as necessary to align this understanding. ... if we are going to talk to the guy he will say "you are my engineering".

(CNC) L.M.A.: All right C.C., but there is information that is not ours...I can define whatever I want but...(...)

(CNC) E.L.N.: To define storage volume and define equipment someone has to know the flow.

(CNC) C.C.: No doubt ... if it did not come, we have to ask... Houston is not in yet... W.A. opened his luggage yesterday... we have to read it here ...

(CNC) L.M.A.: But who will make this question... me?... E.L.N.?... because it interest both...

(CNC) J.M.O.: Centralize in P.R.F...

(CNC) P.R.F.: I centralize...

(CNC) L.M.A.: This P.R.F. does not have to centralize...it's her question...

(CNC) C.C.: In fact... this question is Process...let the Process begin... because the project begins at Process. In this case... If she is not available, and you evaluate the documents... you can ask...

(CNC) L.M.A.: C.C. if the information has to come from her and she did not do it so I will have to do my calculations and go ahead...

(CNC) E.L.N.: No... it is not like this... it is not like this... (...) the flow is an important information that must go to Houston so they can delineate all storage, flow, how many pumps...

(CNC) C.C.: These guys (WP-Houston) ... they still did not make a deal...

(After people left the meeting I asked to talk to C.C. and P.R.F.)

(CNC) L.M.A.: (...) I see various common mistakes that we did in UNA3, and that ... First... F.M.C. will not do this job...Who did it for UNA3 was me and F.F.M...we worked through several night to do this job... He will not do...

(CNC) P.R.F.: It has been defined by the Directors...

(CNC) L.M.A.: When the eleventh hour arrives, and you realize that he had not done that...you will need someone to work through the night to do it...he will not do that...

(CNC) P.R.F.: But it is hard to believe...(...)

(CNC) L.M.A.: Let C.C. come back then we make a resume...and another thing that still is not clear... not clear to me and I don't believe that it is clear to the others, is a link between what everyone has to do, to what has to be delivered ...

(CNC) P.R.F.: We have to do that table...

(CNC) L.M.A.: It is not clear... there is 4 generic documents but where is my exact duty ... where I am going to place my information...

(CNC) P.R.F.: It is inside the index of the documents ... It is just to open the document and read, man! It is just to complete a description...there is no calculation in these documents...

(C.C. approaches the conversation with P.R.F.)

(CNC) L.M.A.: But when you begin to assemble that it is going to be tough... (...) UNA3 was a technical proposal, where we had to deliver something like this ... We would win the bid not based on price but based on what we would do...this was the proposal, they put F.M.C. to compile... he did not do that...(...) he accumulate the job and when it was close to the deadline he jump out... Then I and F.F.M. we worked through the night for weeks to compile and get document together... to make a product... the product was a book...(...) Second, while we did not atomised item by item ... man!... it did not go ahead ... because two people did the

same job... another one nobody did... (...) my worry is this... I am downstairs helping P.R.F... we are as much as we can... but if we do not separate... "this is your box, fill it!" .. it won't go... and if we left in F.M.C's hands... nothing against him...it a huge stuff for him and he don't hold ...don't hold...

(CNC) P.R.F.: It's important to know...

(CNC) C.C.: OK! We have to get this index...we sit together and take the index... identify who are people...

(CNC) L.M.A.: I begin to do something yesterday, more or less like this...(.) each of these items are the finished products... each of them unfold in several items...(.) there is things that we can take out of LLX documents...There is things that became clear during the meeting with LLX... (...) Getting data from JPPA and LLX we can fill in some of these spaces... (...) so each space either has to be done or has to have an owner, to deliver this on a due date...otherwise it is not possible to assemble a complete documents...(.) Some things are mine, some others are E.M.S and others are G.P.L.... but we must pay attention that is mine but before passes through E.L.N...(.) so each item has to have a owner... somebody that comes and write something...(.) if we don't do that we won't end in a document, we end with a patchwork full of holes... As such, something I think is important to be done before set people for working is to give this orientation...(.)

(CNC) C.C.: Wait a minute.... (...) We are going to do the following... until 25th... F.M.C....because it is a fight to get the guy... he is into three proposals.... until 25th...am I going to ask you to coordinate this for me...

(Recorded Meeting, 17th February 2011 – Author translation).

On the 18th of February, P.R.F. finally sent the meeting notes of BG/LLX/CNC meeting settling down the important point discussed. He also highlighted to all in the team the pressure exerted by BG manager, C.K.

Gentlemen,

Annex follows the meeting notes with LLX, in 17/02/2011, and the new version of LLX/BG Interface Assumptions Engineering Data Gathering.

The data of this meeting, which you all participated, and the respective meeting notes contain directives necessary to complete the documents required for this project:

- *Statement of Owner's Requirement*
- *Process Design Basis*
- *Full Design Basis*

BG requires that these documents shall be completed until 21st February the latest, even if a preliminary status.

This way I insist, again, that all make efforts to read the documentation priorly received.

Client is not satisfied with our response time and I foresee strong problems beginning on Monday, 21st February, if we are not fast enough in the execution and complementation of the documents above.

IMPORTANT: From 21st February and on, we will have weekly Project Review meeting in the presence of the client. The first meeting will be 22th February at 14:00, Block A, 3rd floor. All of you are required to go.

Att,

(CNC) P.R.F.

(Message sent on the, 18th February 2011 – Author translation and sender highlights).

By then, several annoying situation start to affect the perception of BG manager C.K., towards CNC/WP, what can see in the field notes below:

(...) Again C.K. struggled to use the printer recently set. As he tried to print a document and it did not work, he showed nervous and after several trials, and P.R.F. was not at his table, he decided to go upstairs probably to complain to C.C. or S.S.H. because no one at the IT desk in front of our desks spoke English (...)

(...) Later in the day, P.R.F. commented with me that C.K. complained about the time people arrive at the office at CNC/WP and their dedication to the project as several times he saw the desks empty. As we discussed about the issue, P.R.F. said that we had already told that people followed company schedule, and although they arrived later (9:00AM) they also left later (at 7:00PM), different from C.K. who arrived around 7:00AM and left 5:00PM at most. (...) (Field Diary notes, 18th February 2011)

In order to intensify the pressure towards result, C.K. sent the following message, where he established several intermediate targets to CNC/WP pursue although work was still under organizations.

(CNC) C.C. and (CNC) P.R.F.,

Next week is week 4 of CNC / BG working together out of a potential total of only 10 weeks for this Select Stage activities for concept development.

Therefore I expect to have received or have completed the following as a minimum by the time I leave for UK on 24 Feb:

- I should be receiving time sheets today for review of actual hours worked by CNC on this project as agreed last week;*
- The WP proposal for additional resources as required by CNC; together with CV's and CTR's to underpin the proposal;*
- The revised Level 3 Schedule of CNC/ BG activities as discussed yesterday to end of this Select Stage;*
- The CTR catalogue for CNC resources to underpin the schedule to end of Select Stage (i.e. the estimate of man-hours);*
- The final version of the **Process Basis of Design** document as per the draft and BG template I sent you last weekend;*
- An **essentially complete draft** of the **full Basis of Design** document (for all disciplines);*
- An essentially complete draft of the **Statement of Owners Requirements** document (lets discuss today if there are still queries as to what this is);*
- The **translation of the Cost estimating** sheet as discussed at the Kick Off meeting.*

No pressure eh!

Best Regards,

(BG) C.K.

(Message sent on the, 18th February 2011 – Exact Transcription - sender highlights).

As expected, on the 21st February, J.A.M. arrived at CNC/WP to provide support to the Capex estimation. Along the days I gathered several impressions over him which can be gauged from the field diary notes.

(...) J.A.M. arrived while everybody was in a rush to read the documentation and begin to generate some output. As he engaged into several conversations trying to gather more information about the project, I noticed that all the time he kept flattering itself. Sometimes about the great projects he had participated before, the role of manager he had in some company, or his links with CCC (...) In the end of the day as I did not joined the conversations he start asking questions about my role in the project, my rank and tell I was too young to such important position. I said that despite I was young I had participated in several projects and had learnt a lot (...) As instead of looking for something to help he kept on bolstering his curriculum I realized why C.L.D. did not liked him. (...) (Field Diary notes, 21th February 2011)

After lunch, I and P.R.F. looked for C.K. to show how we were thinking in organizing this work in order to consolidate concepts and get more information to help team to elaborate the unusual documents required. The dialogue was as follows:

(CNC) L.M.A.: This is a sort of split of work we did based on the documents you sent us and essentially, in orange we have the main documents (...)

(P.R.F. interrupt to talk about internet connection problems experienced by C.K and promised he would go "upstairs" to require immediate solution)

(BG) C.K.: Let me just say what I just said (...) ... so the "Basis of Design" is what BG says what we can rely on... for the concept select... the "Statement of Requirements" is what we do with the "Basis of Design" to develop the concept... but it is not the concept... the "Conceptual Design Report", at the end ... early April... is the key deliverable which has a lot of things that support such as equipment lists, PFDs, etcetera, etcetera... Around the preferred concept...

(CNC) L.M.A.: Is this the hard core document so?...

(BG) C.K.: That is the main ... and then we have an estimate that comes with it...

(CNC) P.R.F.: Here he has what it is, how long and how much it is going to cost...it is really the main document... (Portuguese)

(BG) C.K.: Ok, just to say to be clear the standard...

(CNC) L.M.A.: Ok... For example, for the "State of Owners Requirement" we have just to describe what we are about to do, in the "Concept Design Report"...

(BG) C.K.: Yeah...using the Basis of Design ...on reliable information...

(CNC) L.M.A.: It is all about telling how we are going to work with this to get to here...

(BG) C.K.: Yeah...correct...so it says, and a key example is we will produce an estimate to +/-25% equity... that's all we need to say against the estimate... and also the methodology about by which we get to that...

(CNC) L.M.A.: But the consideration that we will be using for this estimate... we placed them in the "Statement of Owners Requirement" or we wait to show them in the "Conceptual Design Report"? ... For example we are assuming there will be an heliport...

(CNC) P.R.F.: That should be in the "Statement of Owners Requirement"

(CNC) L.M.A.: So every consideration I do for the "Concept Design Report" for the Capex estimation, should be in the "Statement of Owners Requirement"?

(CNC) P.R.F.: Because on the "statement" we should write what is going to ...

(CNC) L.M.A.: Because am I handling those documents right now and what I feel is that something that is not completely...decided, (...) so in this text ("Statement of Owners Requirement"), I must tell I am considering, I am not considering...

(CNC) P.R.F.: In this document you just tell what you are considering... (...)

(CNC) L.M.A.: The description will be in "Concept Design Report" but the assumptions will be in the "Statement of Owners Requirement"...(...)

(CNC) P.R.F.: Right...

(CNC) L.M.A.: That is something very important to us...

(BG) C.K.: The "Statement of Owners Requirement" says we don't need to provide accommodation for operate, but we should consider it to constructions...

(CNC) P.R.F.: Period...just clear....

(BG) C.K.: He does not say the nature of the campus... that is the work, that's done.

(CNC) L.M.A.: Ahead of concept selection report...(...) What we should require from every discipline leader is to provide assumptions that will be used at this point...

(CNC) P.R.F.: Just described it...You don't have to calculate anything...

(BG) C.K.: Shouldn't take a long time to produce it...

(...)

(BG) C.K.... (laughs nervously)...I want to see I first draft...because we are working together...I don't mind in editing it... but it gives me opportunity to share it back in my office in the UK... and particularly my venture manager... to double check ... if we are going the right way... that is why it is important to do it... well I said this week...as soon as possible ... before I very go to marching on there...

(CNC) P.R.F.: We will not issue anything before you have a look at that...

(BG) C.K.: Like with the schedule... if we get a long time to get the first draft... because I think C.C. is trying to perfect it... and then I have comments, and then it takes even longer... so I don't mind what status it is in... as long as you think you've done a first reasonable draft...then give it me... it does not have to be perfection... (...) we all are working in one team ...that would normally be BG document to give to a contractor... but because, you know, we have late started now part of the plan is to have CNC/WP to be part of the BG team to help to develop this and then do the work... (...)

(Recorded Meeting, 21th February 2011 – Exact transcription).

On the same day, C.K. finally provided the flow information, and now it was possible to calculate how many oil pipelines would be necessary and thus start to work with the tank farm and pipeway arrangements.

(CNC) P.R.F.

I enclosed our assumptions related to the type of tankers that we shall be accommodating at the oil terminal, their offloading and loading assumptions (as applicable) and slopl produced water to be returned to shore assumptions.

Please use these assumptions in the conceptual design of the facilities for this Select Stage.

Regards,

(BG) C.K.

(Message sent on the, 21th February 2011 – Exact Transcription).

Later in the day, P.R.F. managed to organize a clear input/output and a draft of the responsibility matrix concerning the outputs, as can be seen below:

	A	B	C	D
1	INPUTS			
2	DOCUMENT	RESPONSIBLE	ISSUE DATE	NOTE
3	BG Standards and Info	BG	10-fev	CD TO DISCIPLINES
4	Draft Statement of Owners Requirements	BG	11-fev	
5	Functional and Operating Philosophy	BG	12-fev	
6	BG Shopping List of Common Data for Onshore Oil Terminal	BG	13-fev	
7	Draft Process Basis of Design	BG	13-fev	
8	Additional Functional and Operating Philosophy I	BG	16-fev	
9	Additional Functional and Operating Philosophy II	BG	17-fev	
10	Crude Oil Quality Assumptions	BG	17-fev	
11	Marine Side / Shipping Assumptions	BG	17-fev	
12	Dados Básicos do Porto de Açu - LD	LLX	10-fev	
13	Conceptual Design JPPA & Technoil	LLX	11 e 14-fev	
14	Meeting 15/02/2011 - BG/LLX/CNEC	LLX	15-fev	
15	Meeting Notes 15/02/2011 - BG/LLX/CNEC	LLX	16-fev	
16	Reference Document - Automotive Manufact. Plant	LLX	16-fev	
17				
18	DELIVERABLES			
19	DOCUMENT	RESPONSIBLE	ISSUE DATE	NOTE
20	Statement of Owners Report	All Disciplines	25-fev	
21	Process Design Basis	PROCESS	25-fev	
22	Full Design Basis (Critério de Projeto)	All Disciplines	25-fev	
23	Matriz de Interfaces (LLX-BG)	F.R.P.+Disciplines	25-fev	
24	Capex +- 25%	J.A.M	30-mar	
25				
26	OBS:			
27	ISBL WP-Houston (develop) -----> CNC/WP (final issuing)			
28	OSBL CNCWP - Development and Issuing			

Fig.97: BGB preliminary inputs and outputs.

In the sequence, Process discipline manager, R.M.B., replayed the message rebuffing the schedule and turning over the scope for WP-Houston.

(CNC) P.R.F.,

In relation to the schedule to the "Process Design basis", it was compromised as WP-Houston scope, Am I right? Otherwise, the date 21th February is not viable.

Sds

(Message sent on the, 21st February 2011 – Author translation).

Later, I finished and sent the work breakdown with items that could be individually assigned to professionals and have their accomplishment monitored.

Gentleman,

Annex follows the spreadsheet to be considered as responsibility matrix. In their it is described the relation item versus responsible for each document to be delivered.

Texts in English corresponding to each item shall be sent to me for final document assembly. There will not be any verification on my part.

This matrix is still under construction and therefore might be modified at any time. Use always the last version received.

Few minutes ago, in a meeting with P.R.F. and C.K., it has been clarified that to the Statement of Owners Requirement we shall supply only the ASSUMPTIONS and EXCLUSION to the items ranked. Therefore, this document is equivalent to our "declaration of scope".

Any doubt please get in contact.

(CNC) L.M.A.

(Message sent on the, 21st February 2011 – Author translation).

	A	B	C	D	E	F	G
1	ITEM	TITLE	PAGE	REQUEST	DISCIPLINE	RESP	STATUS
2							
3	1.0	INTRODUCTION		CLIENT	BG	C.K.	NI
4							
5	2.0	PROJECT DESCRIPTION		CLIENT	TUB	L.M.A.	NI
6							
7	3.0	DEFINITIONS		CLIENT	?	?	NI
8							
9	4.0	ACRONYMS AND ABBREVIATIONS		CLIENT	?	?	NI
10							
11	5.0	REFERENCED / ASSOCIATED DOCUMENTS		CLIENT	?	?	NI
12							
13	6.0	BASIS OF DESIGN		CLIENT	-	-	OK
14							
15	7.0	PHILOSOPHIES (Start-up, Reliability, Tie-ins, etc.)					
16							
17	7.1	Operating Philosophy at Berths (Jetty Head)		CLIENT	BG	C.K.	NI
18	7.2	Operating Philosophy for Tank Farm		CLIENT	BG	C.K.	NI
19	7.3	Reliability Philosophy		CLIENT	VP-HOUSTON	?	HOLD
20	7.4	Tie-In		CLIENT	PRO	R.M.B.	NI
21							
22	8.0	PROCESS					
23							
24	8.1	Liquid Receptions Facilities					
25	8.1.1	Manifold Dimensions and Unloading Rates		CLIENT	PRO	R.M.B.	NI
26							
27	8.2	Vapour Recovery Unit at Jetty Head		CLIENT	PRO	R.M.B.	NI
28							
29	8.3	Crude Oil Storage					
30	8.3.1	Number of Tanks and Design Capacity		CLIENT	PRO	R.M.B.	NI
31	8.3.2	Design Pressure		CLIENT	PRO	R.M.B.	NI
32	8.3.3	Fluid Density		CLIENT	PRO	R.M.B.	NI
33	8.3.4	Liquid Overfill		CLIENT	PRO	R.M.B.	NI
34	8.3.5	Loss Prevention		CLIENT	PRO	R.M.B.	NI
35	8.3.6	Mechanical Handling Devices		CLIENT	PRO	R.M.B.	NI
36	8.3.7	Provision for Future Storage Expansion		CLIENT	PRO	R.M.B.	NI
37							
38	8.4	Piping Runs					
39	8.4.1	Pipe Racks and Pipe Tracks		CLIENT	TUB	L.M.A.	NI
40	8.4.2	Pipeline Corridor		CLIENT	TUB	L.M.A.	NI

Fig.98: Project team responsibility matrix.

On the 22nd February, based on the information regarding flow sent by C.K., L.M.A., R.M.B. and E.L.N. agreed to be considering in our studies three pipelines (two 42 inch and one 48 inch) from terminal to storage, what would be considered by the piping discipline to develop the overall layout of the project and to feed the Capex estimate.

The visit to the Açú Superport site happened on the 23rd of February. Some impressions of the trip can be taken from the field diary notes below:

(...) As we waited for R.T.P. in the hotel lobby, I, P.R.F. and C.C. engaged with a series of conversations talking about oil projects and characteristics of Petrobras. When R.T.P. arrived, we headed to a nice restaurant in Rio, however, C.K. seemed a little uncomfortable. Along the diner he also talked little and as such we all end up speaking more Portuguese among us. A rather unkind situation however, happened when C.C. asked for the bill and in checking it, C.K. saw and showed surprise with the price, R\$ 600 (US\$ 400). When C.C. said that it would be upon CNC/WP, C.K. said it did not matter because in the end it was up for him to pay.(...)

(...) While waiting in the tiny waiting room for the private jet that would take us to Açú, S.G.D. and I engaged into a conversation about the good and the bad things about Rio. The conversation extended and he told about his life, how he learned to speak Portuguese in Angola and this skill helped him to get this job in Rio. Told that he had married a Brazilian and had two children. (...) as C.K. sat down and start to talk with S.G.D. about the hotel accommodation in São Paulo, I was looking at a magazine when I saw an Aston Martin on a publicity page. I showed the photo to C.K., and trying to engage into an informal conversation said that I really liked British cars. Almost informally, he replied that this one was quite hard to see even there... and added he had a BMW. I showed my amusement for a British having a BMW. He told it was just fine. (...) I asked where he worked in England and he explained that he lived in a nearby city and commuted every day to London for almost an hour. (...) Although not enthusiastically, it was the first time we talked informally during all his time in Brazil. The conversation, however, ended when we were required to go to the airplane. (...)

(...) Along the visit, I only talk to S.G.D. once. He asked about my impressions on the visit and about my formation and specialization. The conversation this time felt a little more like an inquiring, as if he wanted to check my credentials. (...) Along the visit, C.K. made many questions and talked a lot with P.R.F. about many things from the cities around the port to the operational details of the construction (...) During the lunch, however, despite we sat all together and enjoyed a incredible meal, both S.G.D. and C.K. barely spoke. Just like in our return to Rio. (...) (Field Diary notes, 14th February 2011)

Technical impressions on the visit can be taken from the message sent on the 24th February 2011 to keep S.P.H. informed:

(CNC) S.P.H.,

Yesterday (23rd February 2011) we visited the Açú portuary complex, which is under construction. Through the visit we realized that the LLX entrepreneurship is still more incipient than we thought. The land is still covered with vegetation and without due preparation. Land is still subject to hydraulic landfill and soil preparation. There is no electricity or water supply. Roads are not paved and there is no rainwater drainage. In construction phase only the pier and the berths for Anglo America and part of iron ore slurry settling, however, nothing complete or operational. In the maritime part there is still 500m of berths to be constructed. Breakwater still awaits construction.

He identified at least one key problem that affects the piping discipline on the off-shore part. Apparently there is no space in the bridge to the passage of the pipeway. There is only two lanes on the bridge one for the conveyor belt of Anglo American and other for vehicles. Initially we thought about locating the pipeway right to the belts (...) however, the presence of heavy trucks around and the constant belt maintenance would represent a constant risk to that. On the left side, there is also problems particularly with the rainwater channel which is 2 m wide and 2,5m deep, and stretches all over the bridge.

He will need to get a cross section drawing of the bridge in order to analyse which is the current space availability and think about alternatives, however, a final solution shall be agreed upon LLX and environment personnel because it will certainly require changes in the bridge project and probably in the environmental permits. The on-shore part apparently presents no problem, because the land is completely straight and there is no relevant crossings. Along this branch, piping shall be supported by sleepers.

Att,

(CNC) L.M.A.

(Message sent to S.P.H. and copied to P.R.F., on the, 24th February 2011 – Author translation).

Back to the office, I could see that the work breakdown suggested found a good reception and start to yield results. I received several e-mail with the individual parts from each task-force member and after some suggestions gradually this parts were dynamically added to the documents BG required. In the end of the day I sent the a preliminary version of the “Full Design Basis”, “Interface Matrix” and of the “Statement of Owners Requirement” so that P.R.F. could check the progress and also made some comments.

GOOD WORK!!!

I will start today the verification and also on the weekend and on Monday, 28th February we talk by the morning.

THANK YOU ALL THE EFFORT AND DEDICATION!

LET'S SHOW THE CLIENT THAT WE DESERVE ALSO THE BASIC AND EXECUTIVE PROJECT IN THE SEQUENCE!

(CNC) P.R.F.

Gentlemen,

Added to the documents all material sent me to the date. Annex follows the responsibility matrix and the documents as they are at the moment (except for the Process Design Basis)

Any comment Just look for me so that we can make the adjustments.

Please, pay attention to the changes in the responsibility matrix, and to what has been left.

Att,

(CNC) L.M.A.

(Message sent to P.R.F. and team members and copied to C.C., on the, 24th February 2011 – Author translation).

Despite the work ramping up and further extension for draft delivery, P.R.F. looked increasingly tenser. After the port visit his relationship with C.K. had visible deteriorated. Apparently, C.K. questioned expenses and hours charged on the project, leaving P.R.F. in the troublesome position to give explanations to the CNC/WP management. In at least one occasion it was visible P.R.F. irritation with C.K. constant demands. By this time, P.R.F. looked quite stressed and meetings with the CNC/WP top management became constant. He almost did not had time to coordinate the efforts of the task force, and in the absence of any other leadership the team was running almost on its own.

Also on the 25th February 2011, a preliminary schedule was released, evidencing the fast-track characteristic of many sequential activities running almost simultaneously.

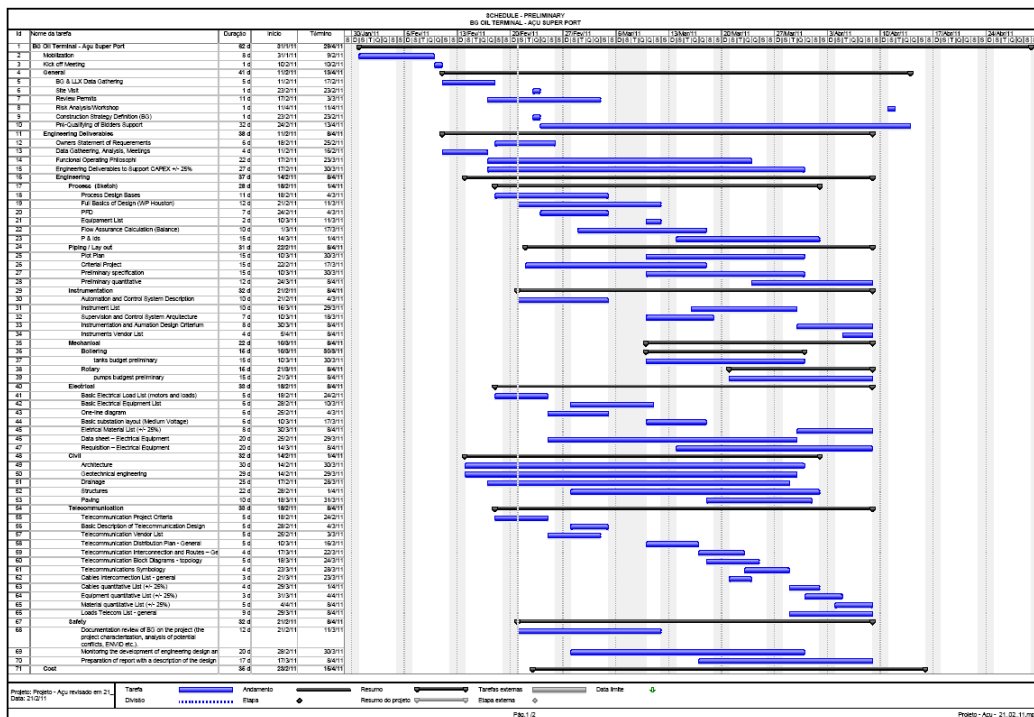


Fig.99: BGB fast-track project/crash schedule.

8.4.5- Innovation Break-up

Later in the day S.G.D., which would be replacing C.K. for a week (2nd to 4th of March), sent a message requiring P.R.F. to speak in private with each discipline head in order to get more information on project progress. P.R.F. considered that a vote of distrust, however, did not react against. P.R.F. was worried because as C.K. was not satisfied with CNC/WP mobilization and results he was delaying to sign the definitive service order until 30th April. On his account the order was waiting to be signed in for days at C.K.'s desk.

On the 28th February 2011, finally CNC/WP and WP-Houston reached a cooperation agreement, as can see in the message below:

Ladies and Gentlemen,

Split of work between CNC/WP and WP Houston as follows:

Activity	WP- Houston	CNC/WP
Process Design Basis	Only inputs	X
Compile Design Basis/Concept Definition	X	
Develop Block Diagrams	X	All CADD work
Develop PFDs	Only sketches	Complete + CADD work
Mass Balance	X	
Flow assurance	X	
Equipment List	X	Complementary list for on shore
Preliminary Data Sheets	X (Port – main equipment)	X (on shore)
Tank Farm, Utilities, etc		X
Port – develop and evaluate alternative layouts and concepts	X	
Develop Jetty head layout	X	
Conceptual design of Jetty head including piping configuration for loading and unloading	X	
Conceptual design of connecting bridges	X	
General		
Review available data and information	Only inputs	X
Identify gaps and recommendations	Only inputs	X
Statement of Owner's Requirements	Only inputs	X

Atenc

(CNC) P.R.F.

(Message sent on the, 28st February 2011 – Exact Transcription).

Despite of the agreement, almost no information produced at WP-Houston arrived and CNC/WP in time for the elaboration of the draft documents required by C.K. and therefore it was expected to impact only the final documents to be delivered in the end of April.

A curious situation happened when in the rush to completed the documents, P.R.F. asked J.A.M. to take care of some parts and he almost immediately passed them over to me, as can be seen in the message below:

(CNC) L.M.A.

Follows the descriptive for item 1 (annex).

For item 2 (keep).

For item 3 ask you to add (UNDER DEVELOPMENT)

Item 4 – You are elaborating, Am I right?

Item 5 – Document List of the Excel file (annex)

Any doubt, just get in contact.

Sds

(CNC) J.A.M.

(CNC) J.A.M.

Annex LLX LD (List of Documents) to complete the item “ Documents associated”, which we spoke today.

Ask for you help to develop the following topics:

- 1- Purpose of basis design*
- 2- Distribution and intended audience*
- 3- Definitions*
- 4- Acronym and abreviations*
- 5- Referenced and associated documents*

Atenc

(CNC) P.R.F.

(Thread sent on the, 28th February 2011 – Author Translation).

In the afternoon, P.R.F. gathered discipline heads for a fast meeting, in order to prepare them for S.G.D inquire the next day. The content of the meeting was the following:

(CNC) C.C.: S.G.D. that some of you knew, that is the manager responsible in BG Brazil for this project too... C.K. is by BG UK... and S.G.D. is for BG Brazil. (...) He will want to talk to each one of you ... 10, 15 minutes... whatever... and then he will want to check that talk with me. So I requested this conversation here, so that we could align... as far as possible... I know there is a lot of people with a question mark this size, in some areas of the project, but this is to align what we are going to tell.... First, that date on the 30th, we have to let it clear to S.G.D. that we cannot met. I received now a call from C.K. that his director ...a way to say... punched the table... I want everything on the 30th...of March...He called me and I said “ It does not work you to ask for the 30th March because this is unreal...I will give you what I can on the 30th of March, and the rest goes to the 15th April in accordance with our schedule” ... The guy already got nervous on the phone... It does not work if I do cuddles... So, until 30th March let’s produce what is possible (...) but this date 15th April I need you to real hold to it... (...) because in the beginning it was on the 30th March, but we all arrived at the conclusion that it was not possible. I debated with him, asked for three weeks and he gave me

two. But looks like that when he get in London he was forced to retreat. So we have to show our position (...) So this is the first alignment I want to do... I think S.G.D. will go for the schedule...

(...)

(CNC) R.M.B.: And Houston?

(CNC) P.R.F.: Houston is beginning to check the documents today. Why/ because it has only been signed by BG, on Friday in the end of the afternoon... and by us to... so Houston did nothing till now... (...) S.G.D. will probably ask about Houston... please... answer, " You BG, inclusive, signed the proposal on Friday 25th in the afternoon... so today 28th I have no information... and probably throughout the week...()"

(CNC) R.M.B.: What is up to Houston?

(CNC) P.R.F.: It is up to Houston, only the maritime terminal! And there is more... Beyond process that would be the basis, I had asked support for tank dimensioning, something like this... C.K. cut this all ...and told " If you ask for this I will cut more than the half of your CNC/WP hours" ... because you are transferring CNC/WP responsibility to WP-Houston...so it is kind a complicated... don't count on Tank dimensioning, piping dimensioning... (...)(Field Diary notes, 28th February 2011)

In the beginning of the night, counting almost 4 days of delay, we sent the drafts to P.R.F. in editable format with his comments incorporated. He worked through the night to check the documents, included additional information and forwarded the documents to C.K. so that he could show the progress of the work in an important meeting to happen in BG office in London. After that point, I suspended my collaboration with the project organization and required P.R.F. to ask J.A.M. to keep on organizing the conceptual documents because it was time to dedicate to the piping technical documents.

8.5- OLD KNOWLEDGE COLLAPSES

On the 2nd of March 2011, C.K. sent a harsh comment on the "Design Basis" document drafts sent by CNC/WP team.

(CNC) P.R.F.,

I have enclosed my initial marked up comments of your first draft of this General Basis of Design document.

I have struggled with this document draft!

The purpose of this document is to provide rely on information for our project team to go away and do a conceptual design for the onshore oil terminal for the Select Stage.

My general observations are:

- *Some sections are still to be completed*
- *The BG Standards to which we agreed three weeks ago are not listed or referenced*
- *A lot of the sections detail design basis that would be more appropriate to FEED or even detailed design engineering and I question whether they are needed for conceptual design (e.g. why do I need to know that all rotating equipment shall have guards for conceptual design?)*
- *There are no sections on Environmental conditions (e.g wave data, temperature data, marine growth, wind data, topography, geotech, soil conditions, bathymetry, seismic, etc) – other than perhaps by reference to LLX supplied data*
- *There is no Reliability, Availability and Maintainability criteria*
- *There is no project location data or coordinates for the Project and Port Site areas – other than perhaps by reference to LLX supplied data*
- *There should be a general Units of Measure section (rather than just covered in the Instrumentation Section)*

· There is nothing on HSSE – at the very least project activities should be in accordance with BG HSSE Policy and Standards – not mentioned I look forward to receiving a revised version as soon as possible.

Regards,

(BG) C.K.

(Message sent on the, 2nd March 2011 – Exact Transcription - sender highlights).

Later in the day, C.K. sent an even harsher comments about the Statement of Owners Requirement, as can be seen below:

(CNC) P.R.F. and (CNC) C.C.,

I enclose my initial marked up comments on CNC very early draft of the Statement of Owners Requirements.

Again I have struggled with this document! I am now very concerned:

· The performance of CNC is not good enough to meet the schedule that we agreed and that you recently realistically said you could achieve;

· This schedule shows completion of most of the activities for Select at the end of March;

· Next week is not going to be that productive due to the 2.5 public/ bridging holidays in Sao Paulo, which only leaves 3 full weeks to end of March thereafter;

· CNC team members demonstrate a lack of understanding of what is required for conceptual design in this Select Stage;

· This document should not take days to complete – it is relatively simple and states what we are going to do with the 'rely upon' information that is in the Basis of Design documentation. It is not intended to be the summary of the conceptual design output – that is the Conceptual Design Report;

· CNC team members have a tendency in this document and in the General Basis of Design document to focus on more FEED and/ or detailed design criteria/ assumptions rather than conceptual design. They seem to have problem in developing from a blank sheet of paper to develop the concept. I was at pains to stress the differences at the KO meeting, but the message does not seem to have got through.

We have a conference call tomorrow and I ask you to think beforehand how we improve performance.

Regards,

(BG) C.K.

(Message sent on the, 2nd March 2011 – Exact Transcription - sender highlights).

During the afternoon, after a tense conference call with C.K., P.R.F. sent an urgent message to all in the team:

Ladies and Gentleman,

After the project meeting, day 28th February, I require each discipline to develop a urgent strategic plan, so that we know which "deliverable" it is possible to issue until 30th March, and what is necessary for this to happen.

I suggest that you do this study. "forward back", because the date is already defined and as kept on the 30th March, that is, what are the information, documents and actions needed to be taken to accomplish this schedule.

I remind you that the creation of a LD is extremely urgent.

C.K. informed that the closing meeting - Integrated Function Review (IFR) – will be on the 4th April, here in CNC/WP with all disciplines and coordination.

We will have until 10th April to finalize and issue all documents after the IFR meeting.

C.J.B. is responsible for collecting the most data from each discipline to build the Capex and compile the documentation for the BG ITT.

Atenc

P.R.F. (Message sent on the, 2nd March 2011 – Author Translation - sender highlights).

On the rush to go ahead with the technical documents, I asked for the help of R.T.P and Z.V. to provided the calculation over building, dikes and tank sizes so that we could model these elements it in the 3D environment and start working with the layout.

On the 3rd March, to speed up the process I ask some colleagues which have worked with me in the PDY project to help in the layout work. A.R.A. helped copy some common elements from the PDY project and through the day we began working in the layout. In the end of the day we were able to tell J.A.M. the amount of pipe so that he could work on the Capex.

On the 4th March, I created a document list for the piping discipline to serve as a reference to what CNC/WP would deliver at the date required and sent it to P.R.F.

DOCUMENTS LIST - PIPING

Customer: British Gas
Project: BG Oil Terminal - Agü Super Port Project

Item	Description	Note	Form	Sh	Issue Date	Required Documents
B1	Plot Plan		A4	√	See schedule	Basic criteria from BG, design criteria, list and dimension of mechanical equipments, architectural documents of buildings, P&IDs (or PFD), bridge project section
B2	Preliminary Specification		A4		See schedule	Basic criteria from BG, fluid processes information (e.g. fluids service, pressure classes, temperature, allowable corrosion)
B3	Preliminary Quantitative	Only piping and valve quantitative Purpose: +/- 25% accuracy cost	A4	√	See schedule	Basic criteria from BG, F&ID, Plot Plan, Preliminary Specification.
B4	Preliminary Scope of Work of the Piping Systems (part of the document for EPC contracting)	Purpose: shall be included in document for the bidding process for EPC contracting	A4	√	See schedule	Basic criteria from BG, documents of basic design process criteria

Fig.100: Piping document list – Return to old knowledge.

It was a turbulent day for P.R.F. and the following dramatic situation happened:

(...) Early in the morning P.R.F. asked me if I had something like a document or a layout so that he could show at a crucial teleconference that would happen after lunch time. I said we were working very hard to finish the layout in the 3D and I would tell A.R.A and C.L.S, who were helping me, to speed up so that it was ready by 14:00. He thanked and left in a rush to a meeting with directors. Then I went upstairs and explained the situation to A.R.A. and C.L.S. who immediately decided to work until we finish the layout. (...) As the meeting hour approached I began to press C.L.S. to avoid being too detailing and speed up work. We were both tired and hungry but we keep on working to finish the layout to hand it to P.R.F.(...)

(...) By 15:00, C.L.S. finished the last details and we could generate several images and I rushed to sent them to P.R.F. before the meeting began. We also printed some large versions and handed them to him as he headed to the meeting. (...) (Field Diary notes, 04th March 2011)

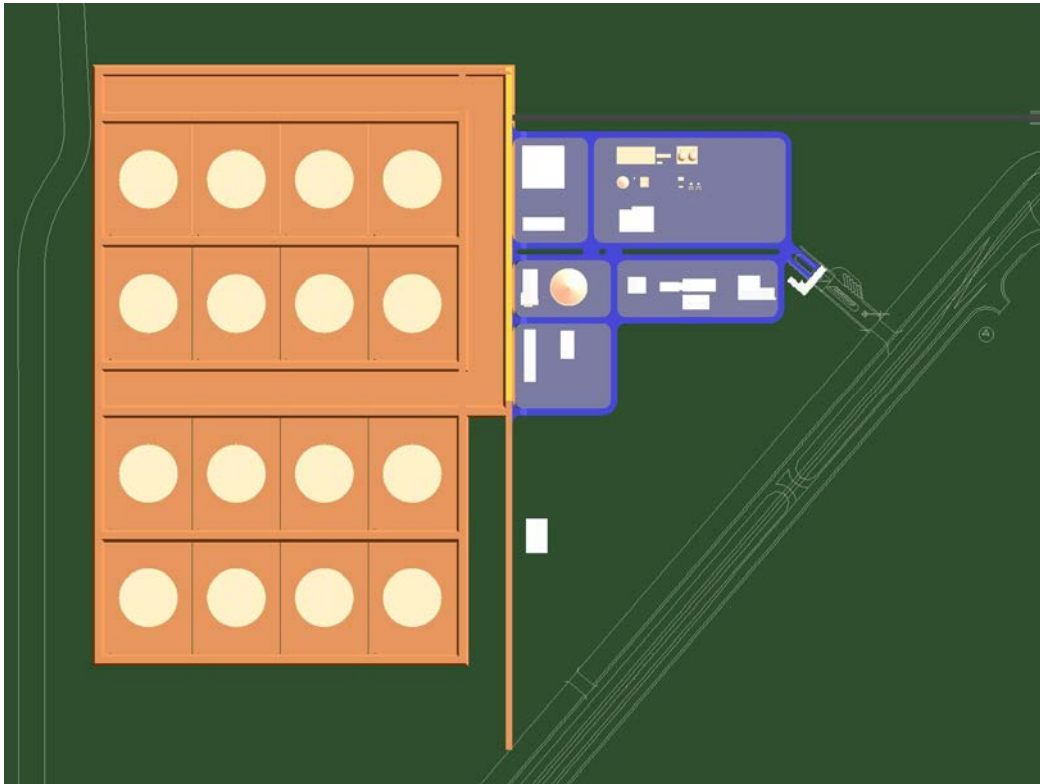


Fig.101: BGB preliminary lay-out plan view.

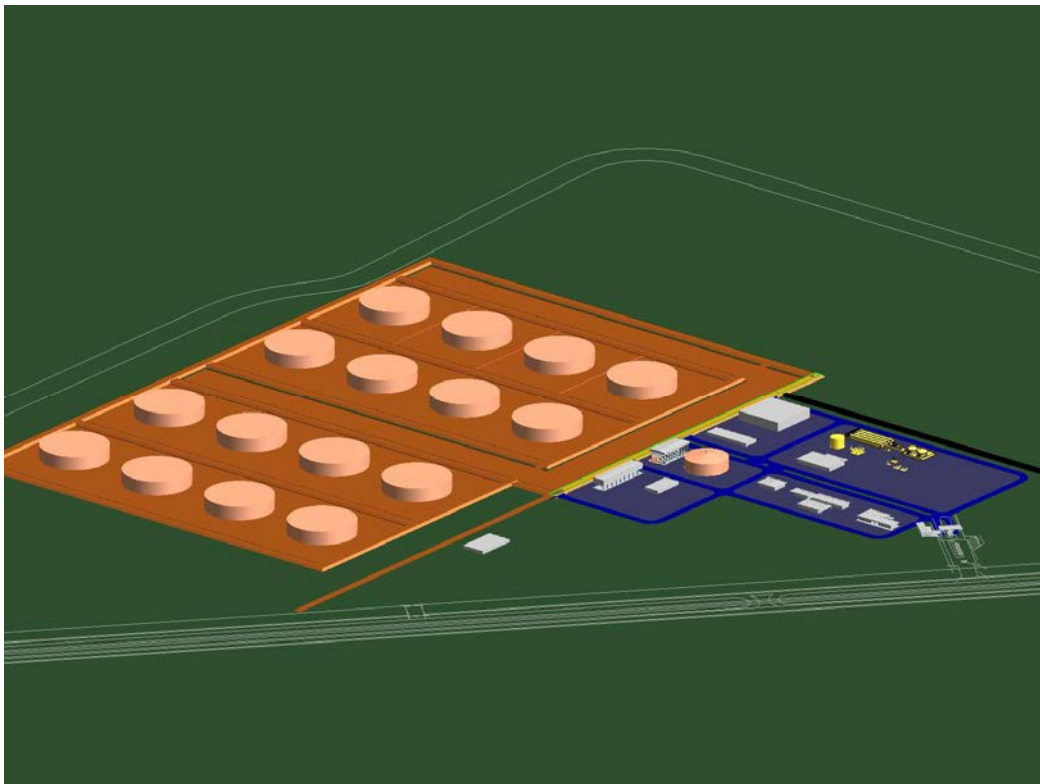


Fig.102: BGB preliminary lay-out isometric view.

On the 14th March 2011, after the Carnival break (7th to 10th of March), the BGB project has been abruptly interrupted as BG was greatly disappointed with CNC/WP and decided to give up the LLX option and join Petrobras in the expansion of its oil storage facilities.

Appalled with the results of the BGB project, P.R.F. quit WP and returned to its independent engineering consulting business. With the almost simultaneously failure of the RMAN2 bid, personnel recently hired and allocated in the BGB project such as G.P.L., Z.V., and J.A.M. were immediately laid-off. The end of the third study case also marked the finish of the data collection for this investigation. As such, I left WP and resumed my engineering consulting works elsewhere.

CHAPTER IX

DATA ANALYSIS

9.1- DATA INTERPRETATION

9.1.1- PDY Case

In the beginning of PDY, power asymmetry between WP and CNC was considerable. Not only WP was the contract owner but it was also overly confident in its methods and capabilities even in face of a new and unknown client like Petrobras. As a result, WP socialized CNC on how workshare was to be conducted, what CNC personnel accepted based on the assumption that WP international experience provided superior project management knowledge compared to CNC. The limited scope of interaction further reinforced the sensation that the knowledge provided by WP worked fine and that should be institutionalized.

As conflicts intensified due to the inability of WP in managing the strict contract requirements and in meeting Petrobras demands, WP has seen itself in the need to ask for CNC advice on how to handle as increasing number of project issues. Although this process led to a decrease in the power asymmetry, CNC socialization was already extensive and the belief that WP was right in its workshare approach undermined any possibility of questioning the *institutional knowledge* transmitted. As a result, even experiencing a favorable situation in terms of gaining an increasingly important role on the project, CNC personnel remained passive knowledge replicators for quite a long time, what helped to WP knowledge to gain density and further institutionalize.

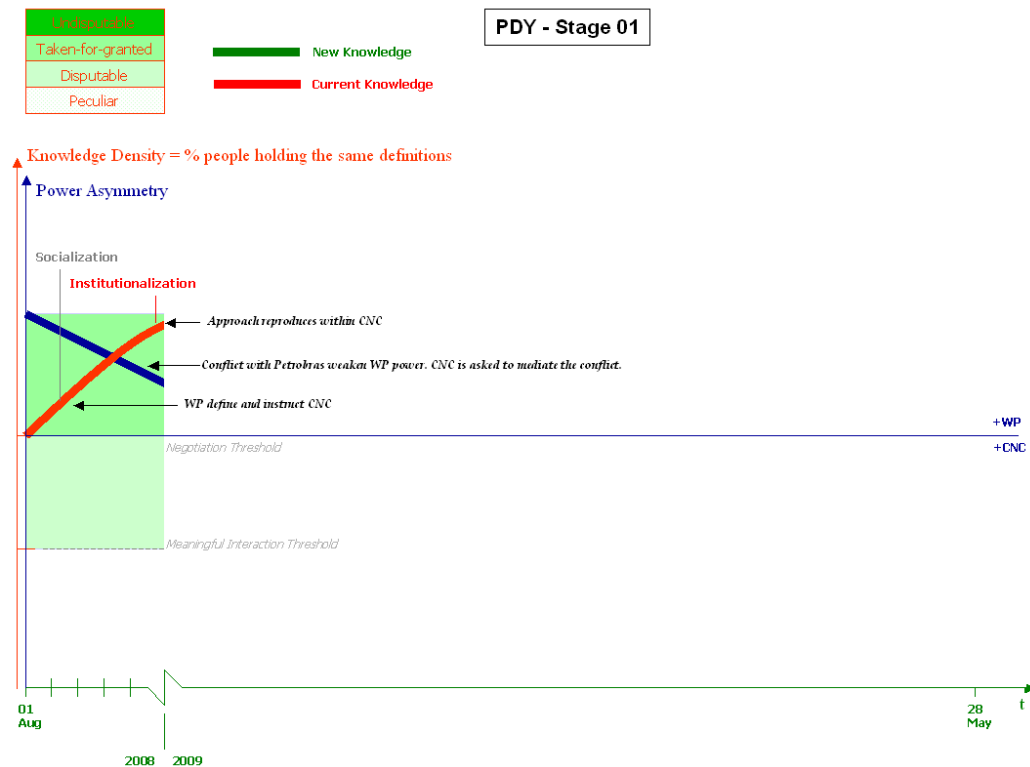


Fig. 103: PDY international workshare knowledge change stage 01.

As the project advanced and interaction intensified, workshare coordination became increasingly difficult bringing a sense of uneasiness to the partnership. Even though initial dimensional inputs for calculation and detailed design should come from WP, CNC was constantly accused of lagging behind the partnership for not being capable of designing directly into the 3D environment (PDMS). Though this diagnostic reflected a rather superficial analysis of the workshare problem, it has been acknowledged and internalized by CNC project management to the point of becoming a sort of a self-recognized handicap.

Parallel, CNC was already addressing project issues directly to Petrobras without WP mediation, what alleviated client pressure over WP but resulted in additional reduction of the power asymmetry. Under these circumstances, tension has been introduced in the relationship. If on the one hand WP kept on blaming CNC for project delays, on the other hand it kept on benefiting from its participation on the work process. As a result, pressure for change started to accumulate on WP side.

Apart from most people at CNC which self-blamed their lack of experience in conducting the workshare appropriately, a few people (i.e.: K.G., D.C.C, A.R.A) start to wonder what could possibly be wrong with CNC that prevented an experienced company (to the point of being appointed by Petrobras) from living up to its expectations. This self-evaluation moment represented a shift in the mainstream project mentality as it marked the point where the search for alternatives began. As a consequence the workshare knowledge provided by WP began to lose density and head towards initial questionings.

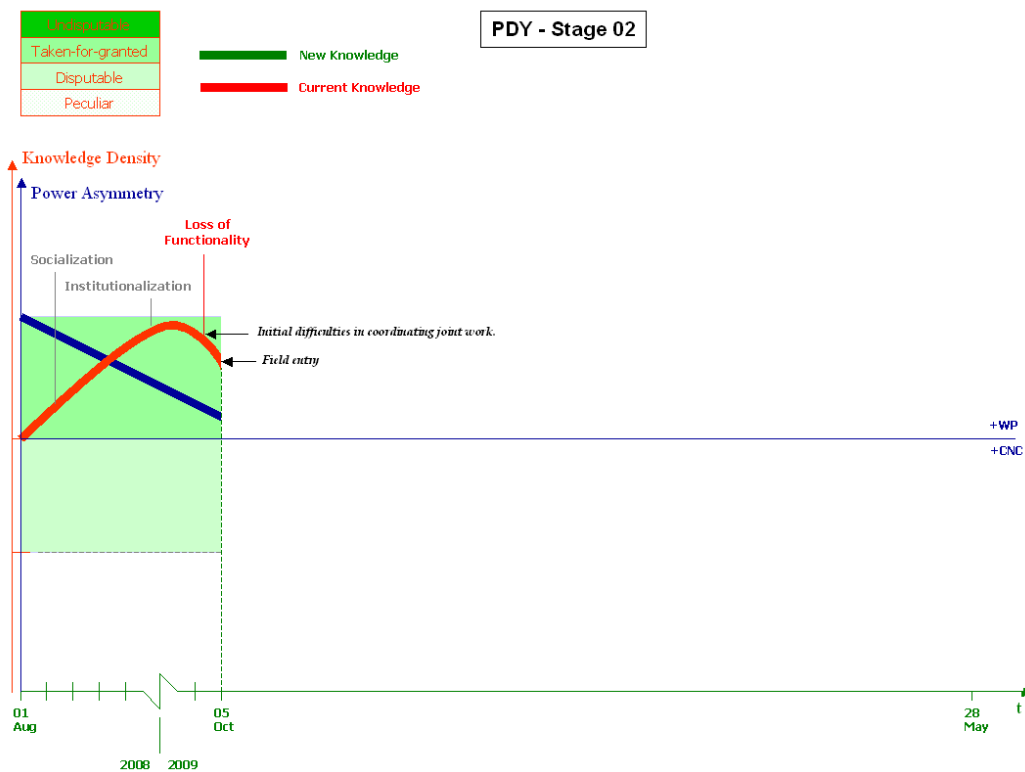


Fig. 104: PDY international workshare knowledge change stage 02.

With this self-evaluation moment, came up for the very first time the possibility that instead of having internal (CNC) causes, workshare problems could result from external (non-CNC) ones, WP knowledge inclusive. Argued about its confidence on the approached, WP rebuffed the possibility of being wrong and once again accused CNC Civil team of being incompetent in handling the joint work in the 3D environment. Pressure reached its maximum when WP threatened to send personnel to CNC to handle the problem, what has been taking as a direct threat to CNC project manager's (K.G.) autonomy and as a challenge to the company.

With WP being emphatic on the effectiveness of the knowledge supplied and with pressure building up for results, a period of radicalization in the use of the older approach took place (i.e.: more database filters, more spreadsheets, more people involved). Nevertheless, the more effort and resources were directed to the task of making the knowledge supplied to fit into the situation, the more it seemed inappropriate. Along informal and frank conversations important typifications that latter would help in the knowledge change process emerged (i.e.: "freezing").

At this point, differently from the initial moment in which self-evaluation ruled out the possibility of an internal (CNC) cause for the workshare problems, the radicalization in the use of the traditional approach made evident that the ultimate cause for the workshare problems was the knowledge provided by WP. Henceforth, certainty about the knowledge in use was suspended and its density fell below institutional level. As a result, internal questionings to the way WP handover work to CNC were voiced for the first time along team meetings.

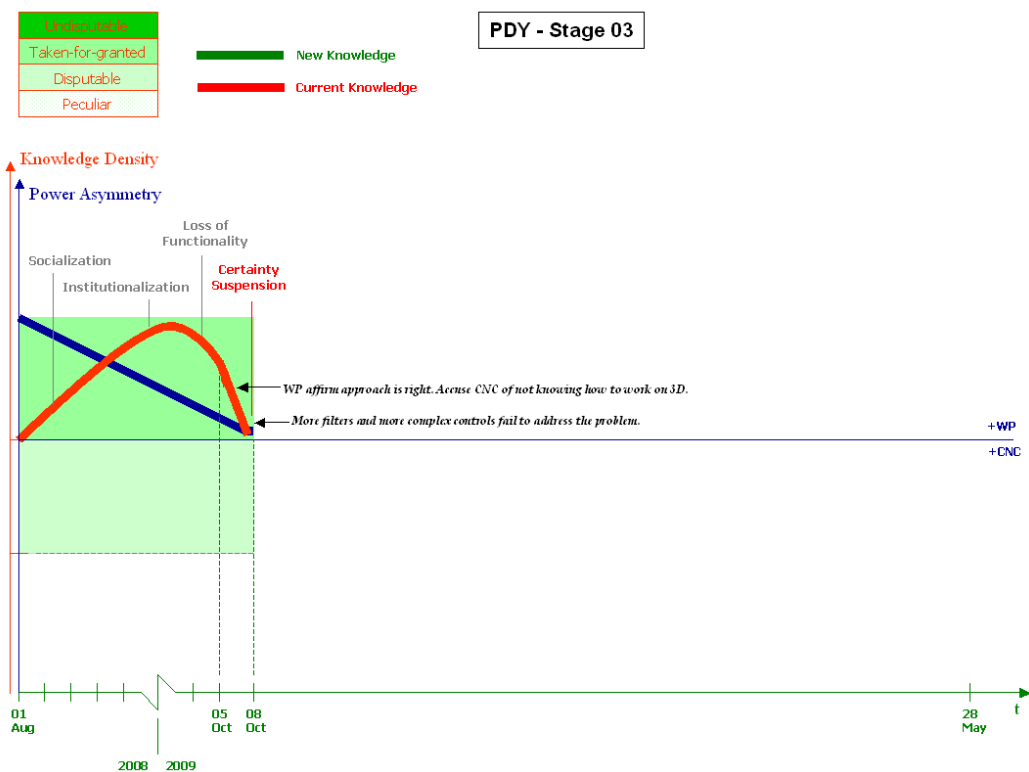


Fig. 105: PDY international workshare knowledge change stage 03.

After certainty suspension, underlying concepts regarding the workshare in the 3D environment underwent a detailed review by the personnel in charge of solving the problem. Knowledge elements previously taken-for-granted were thoroughly examined providing a more robust case against the way WP designed the workshare process. At the same time that faulty elements in the knowledge were ranked, additional typifications (i.e.: “marking”, “coping”) regarding what should change to make the workshare more effective kept on emerging as a result of informal conversations and debates involving key project personnel.

A collateral effect of this open examination process was that the density of the knowledge regarding how to manage the workshare fell down quickly. With problematic elements in the WP workshare knowledge being exposed along informal conversations and in meetings, key project members started to openly question it. Nevertheless, more important than finger pointing at WP was to spot the necessary changes to be made. As agreement within CNC was thin at the time, a first moment of political action involved “selling” the necessary changes first at upper level to K.G. what as been facilitated by the crisis moment the project experienced.

As debates advanced and a clear proposition on what would be required from WP crystallized, a strategy to approach WP and ask for changes in the handover process has been designed and involved the support of K.G., as strong resistance was expected. In a direct e-mail sent to WP project manager (G.F.), K.G. exposed WP missteps, required work responsibilities to be clearly marked and asked for a meeting to discuss the issue. This mounted to be a second moment of political action.

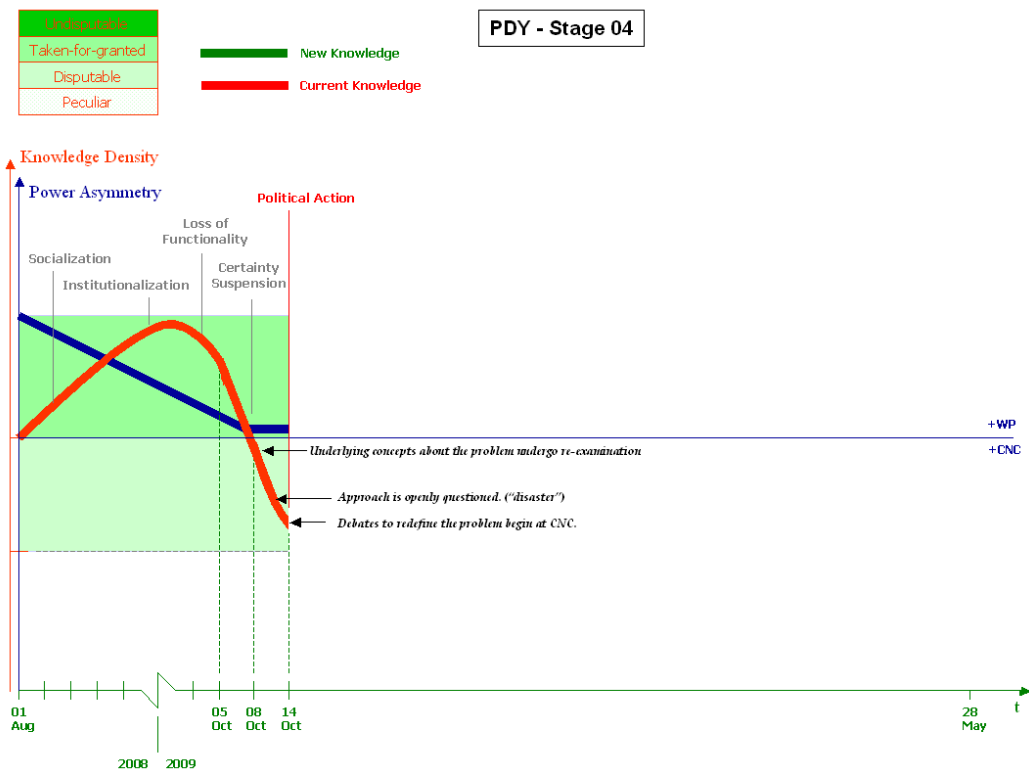


Fig. 106: PDY international workshare knowledge change stage 04.

A third moment of political action happened during a teleconference involving CNC and WP teams, having at the forefront of WP team S.B.D. (WP engineering manager). In the beginning of the meeting, WP personnel insisted that there were already in place many forms of identifying CNC scope, however, with S.B.D. adopting the certainty suspension position transmitted by K.G., they were far less emphatic. As discussion progressed and S.B.D. position remained one of suspended certainty, WP team also start to put on hold their certainties and asked for examples of handover problems. Quickly, debates moved to WP personnel having one side sensitive to the problem (i.e.: S.B.D.), and other more resistant to change (i.e.: H.L.). Faced with a robust questioning, current knowledge defenders brought up additional elements to keep it afloat (i.e.: "That's on the P&ID", H.L.). At this point, however, it became clear that the changes were necessary, and resistance to change quickly faded away.

With WP agreement, a new definition of the workshare problem emerged making up for a turning point for the workshare knowledge in use, and thus made up for the very moment of innovation. In the same day, e-mail was sent to K.G. settling down the new marking system to be implemented by WP. As new knowledge start taking place of the older one, workshare knowledge density stabilized, though, at a very low level. More elements needed to be added (i.e.: "coping", "naming", "deleting", "SIC".) to make up for a whole new workshare knowledge to be tested and transmitted. Now enjoying a higher status as accredited "knowers"²⁰, CNC was in charge to develop it. Few days after, the initial draft of a new procedure guiding how workshare was to be done has been sent to WP for comments.

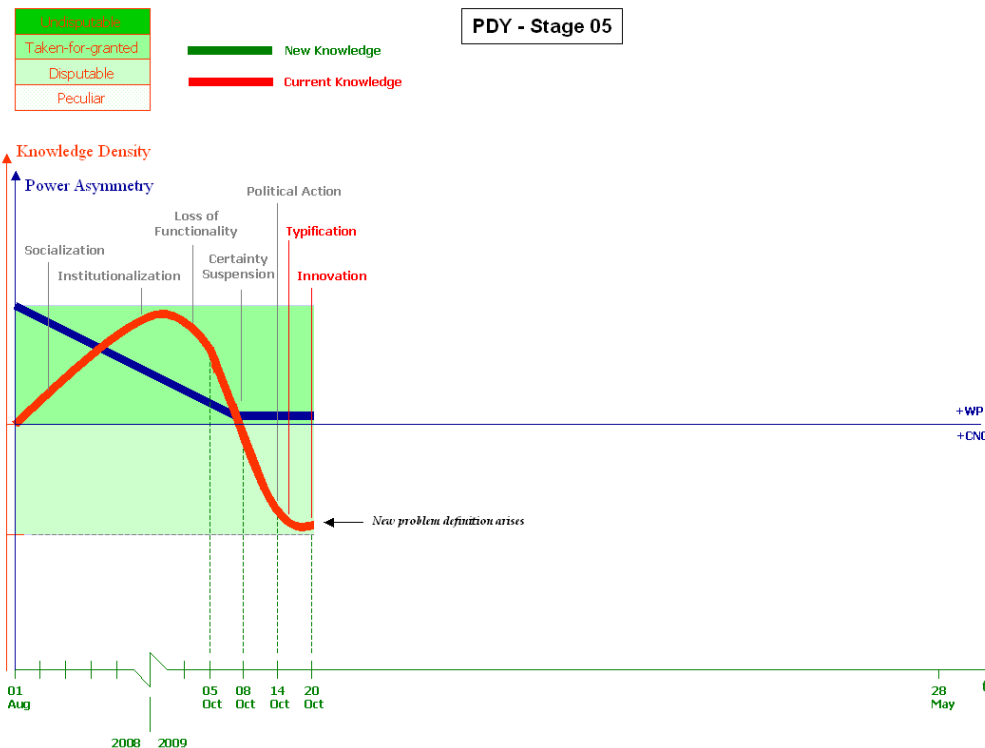


Fig. 107: PDY international workshare knowledge change stage 05.

²⁰ Berger & Luckmann, 1966, p.71

As the implementation began more people were told informally on how workshare was to be held and the impact of the changes in their work. As many details concerning the new knowledge were still under development and test this has been a gradual but straightforward process. With the early basic elements of the changed knowledge already accepted, the sequential ones found little opposition. As the new knowledge kept on being developed and been increasingly accepted it entered a zone of quasi-institutional equilibrium, where knowledge is dense enough to be transmitted but still remains subject to retrenchment or further change.

The creation of the SIC control is a landmark in the knowledge process as it represents a moment where the changed knowledge materialized beyond its typifications (i.e.: “filtering”, “coping”, “naming”, “registering”, “deleting”, “freezing”, “associating”, “tracking”). Once objectivated, the new workshare knowledge could be more easily explained and submitted to a wider audience. The stage for a successful legitimation and socialization was already set.

With the formal presentation of the detailed procedure first to K.G. and then to S.B.D. the workshare knowledge, now embodied in the “SIC control”, has been legitimized, and thus, gained density enough to be socialized at large. Alongside, the arrival of WP personnel to closely follow/support CNC work marked a rare moment of face-to-face interaction between international team members. Despite initial lecturing on WP part, the relationship quickly evolved into one of trust and even friendship, resulting in further confidence in CNC work and recognition of CNC personnel as “knowers” just like them.

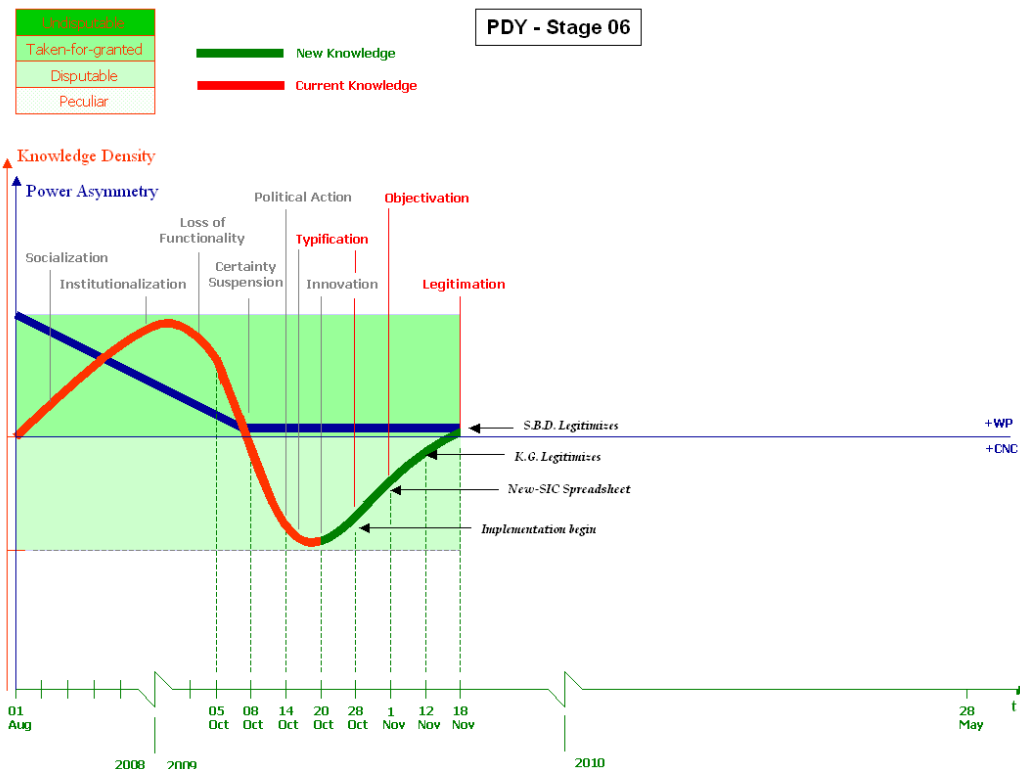


Fig. 108: PDY international workshare knowledge change stage 06.

Being legitimized by both project managers, the new knowledge found little if any opposition. For WP, socialization proceeded quite smoothly, as few reinforcements and back-checks were necessary with most of them happening through a fast sequence of exchanged e-mails. For CNC, however, the larger impact and number of people involved turned new knowledge socialization lengthy and more problematic. CNC supervisors had their work backlog exposed and partially lost their scrutiny over work planning. As a result, they resisted using the SIC control as a work release tool and kept asking WP to release element by other means, though unsuccessfully.

“Area 8000” development represented a turning point in the power relation between WP and CNC. For the first time CNC lead the project and had WP under a dependent position. The new workshare knowledge and tools (SIC control) played a key role in the successful accomplishment of this task and set the landmark for an “almost equals” relationship between WP and CNC. As a result, the socialization has been fully accomplished at WP where it became institutionalized at project level.

Alongside, the new workshare knowledge went through further refinements to become more consistent and to provide further managerial information regarding CNC work progress. Despite the underlying aim of reinforcing to WP that CNC had everything under control, D.C.C. blocked to disclose the progress graphic to WP arguing that it would attract too much attention what could backfire. As a result, new knowledge institutionalization at WP has been restricted to the project interface. Combined with the partial institutionalization at CNC, the overall new knowledge institutionalization end up losing thrust and remained quite tenuous.

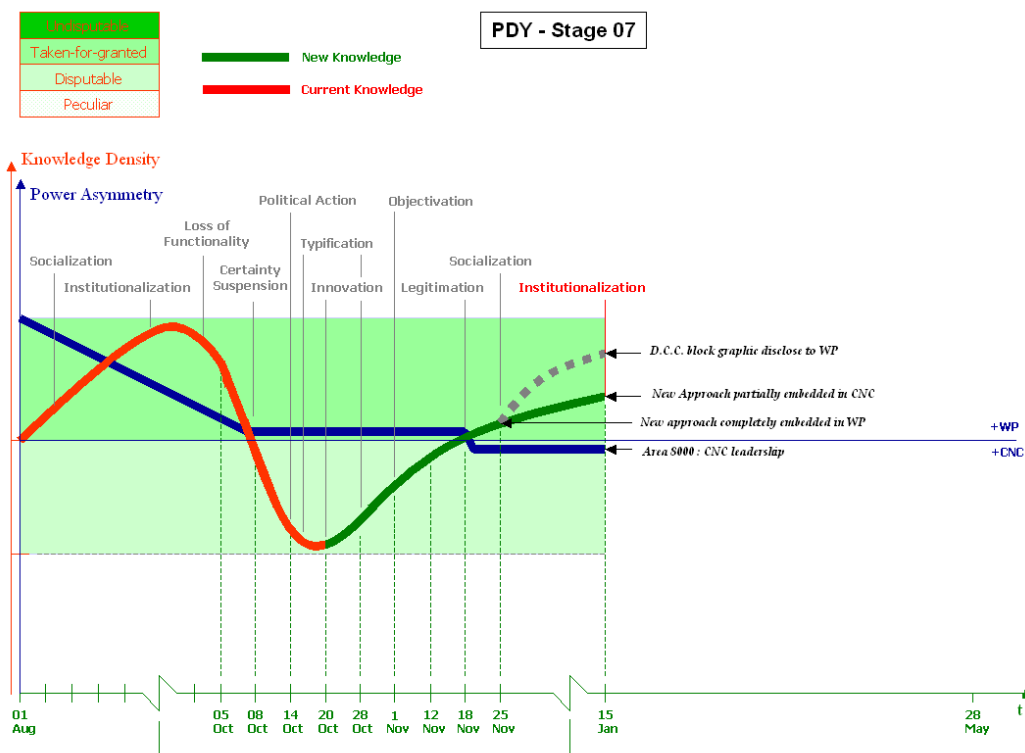


Fig. 109: PDY international workshare knowledge change stage 07.

After WP acquisition a period of political turmoil took place at CNC where project and technical managers rushed to show up their best works to WP in order to improve (or keep) their positions. Ahead in this race K.G., who already enjoyed considerable reputation at WP, found in the new workshare knowledge a showcase. During the first international visit of a key WP project manager (A.J.S.), K.G. tried to lift the new workshare knowledge to a “CNC capability” status. As PDY headed towards a close end, K.G. aim was to join A.J.S. project (a multibillion dollar mining entrepreneurship for VALE) in similar conditions it had now with PDY. Day long presentations and meetings brought company wide attention and A.J.S. keen interest.

Nevertheless, this attempt of increasing knowledge density (and acquire prestige) by promoting its reproduction also attracted the opposition of the Industry Division Superintendent (S.S.H.) and its Engineering Manager (R.F). Exerting their prerogative of assigning personnel to firm tasks, S.S.H. and R.F. took over control of direct contact with A.J.S. With this boundary spanning monopoly in place, no contact regarding the potential partnership could go ahead without consent of S.S.H. and R.F. CNC feedback to WP-Edmonton inquires became protracted to the point that A.J.S. interest in the partnership quickly faded away.

As such, the second attempt of increasing knowledge density by promoting non-identical reproduction beyond PDY and CNC boundaries failed as a result of strategic action of S.S.H. and R.F. who feared K.G. strengthening. Further, attempts to sell CNC expertise abroad failed as Brazilian professionals were not WP wide recognized as “knowers”, mainly due to a lack of contact among peers.

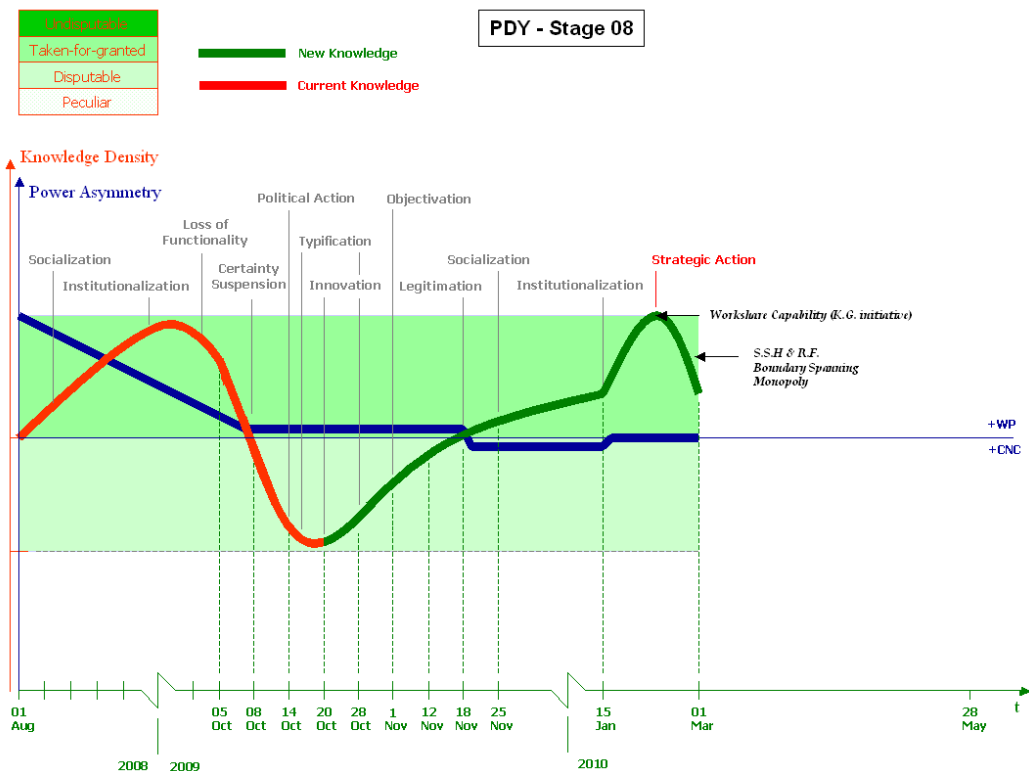


Fig. 110: PDY international workshare knowledge change stage 08.

In a third attempt, K.G. asked S.P.H. to implement a similar 3D model control similar to that of PDY at the RMAN project. S.P.H., however, did not make great efforts to extend the use of the new knowledge, as it would expose his schedule overrun and compromise his autonomy. Even though, two people have been indicated by K.G. to reproduce the SIC Control methodology in RMAN, however, without S.P.H. support both of them left the project without making any progress in this direction.

Alongside, the tenuous institutionalization of the new workshare knowledge within CNC made its socialization to go unfinished as the “look-at-the-model” approach persisted in supervisors’ minds. Counting with K.G. support, D.C.C. urged a meeting with coordinators in order to clarify and reinforce the use of the SIC control as a tool to release work to supervisors. It was up to the coordinators now to enforce the full application of the new knowledge what helped to further extend its internal density.

Also under D.C.C. initiative and K.G. support, a “3D project management seminar”, has been promoted in order to “sell” internally at CNC parts of the new workshare knowledge (i.e.: SIC control and 3D progress measurement). Again the move has been blocked by R.F. who rescheduled several times the seminar and in the end emptied the room by making himself absent. S.P.H., who had long held the monopoly over 3D works, attended to one of the seminars and actively downplayed the usefulness and novelty of the new workshare knowledge. He also pushed debates to such a complex point that the subject became almost hermetic to the rest of the audience. As a result, another attempt of non-identical reproduction failed and new knowledge institutionalization though effective remained tenuous.

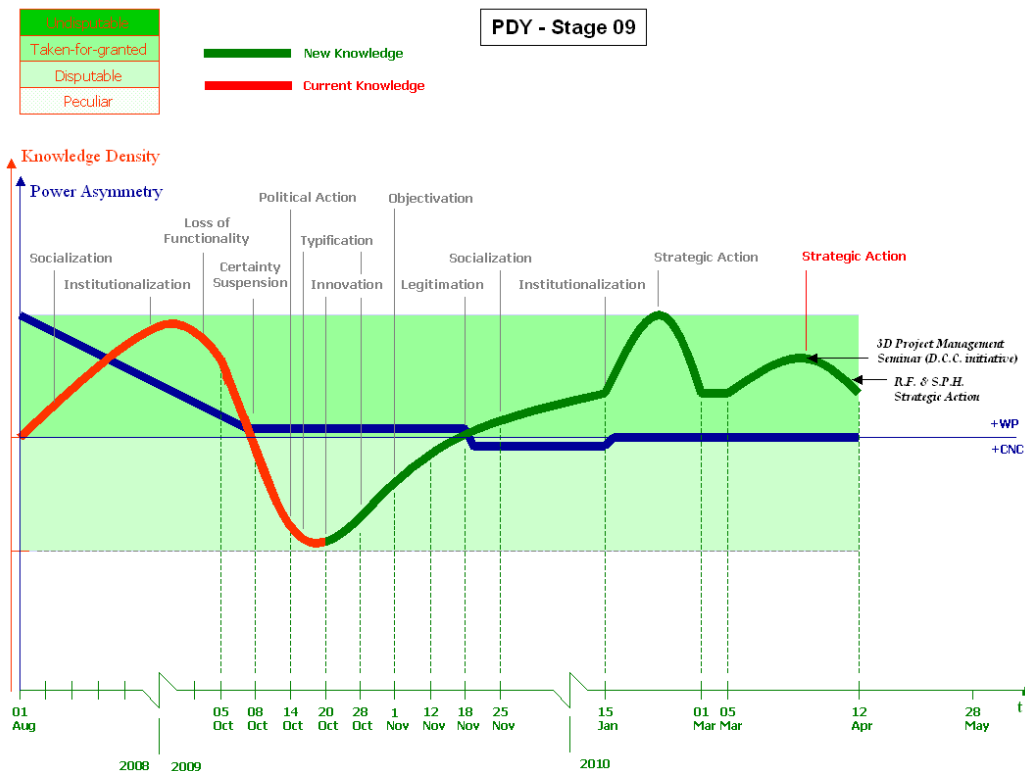


Fig. 111: PDY international workshare knowledge change stage 09.

Though workshare knowledge has actually changed both at CNC and WP and the net result of the change process has been positive (workshare process improved), overall impact on companies' knowledge has been limited as the new knowledge (or parts of it) did not stretched much further than PDY limits. On the WP side, knowledge change impact has been higher in intensity (more institutionalized) but shorter in range (less people affected). At CNC impact has been less intensive (less institutionalized) however implications have been almost companywide (more people affected).

New knowledge expansion has been limited on the WP side both by CNC lack of self-confidence and by the internal power struggle which hampered its reproductive strength. Even though, the good performance in PDY (enabled by the new workshare knowledge) reflected in an improved corporative image of CNC. Within CNC, knowledge expansion has been clearly limited by the internal power struggle among managers. Nevertheless, spun off effects of the new knowledge could be felt over several other areas such as planning (i.e.: model progress), engineering (i.e.: work organization), and project management (i.e.: 3D coordinator as key project position) as well as through different projects (i.e. UNA3, BGB).

As soon as PDY ended and the new knowledge lost its direct utility, it retrenched back to a personal knowledge possessed by the strict circle of professionals who directly worked on it. Once again it entered a debatable state were CNC personnel held disparate opinions about the pros and cons of its definitions and on how workshare should be held and 3D work progress should be measured.

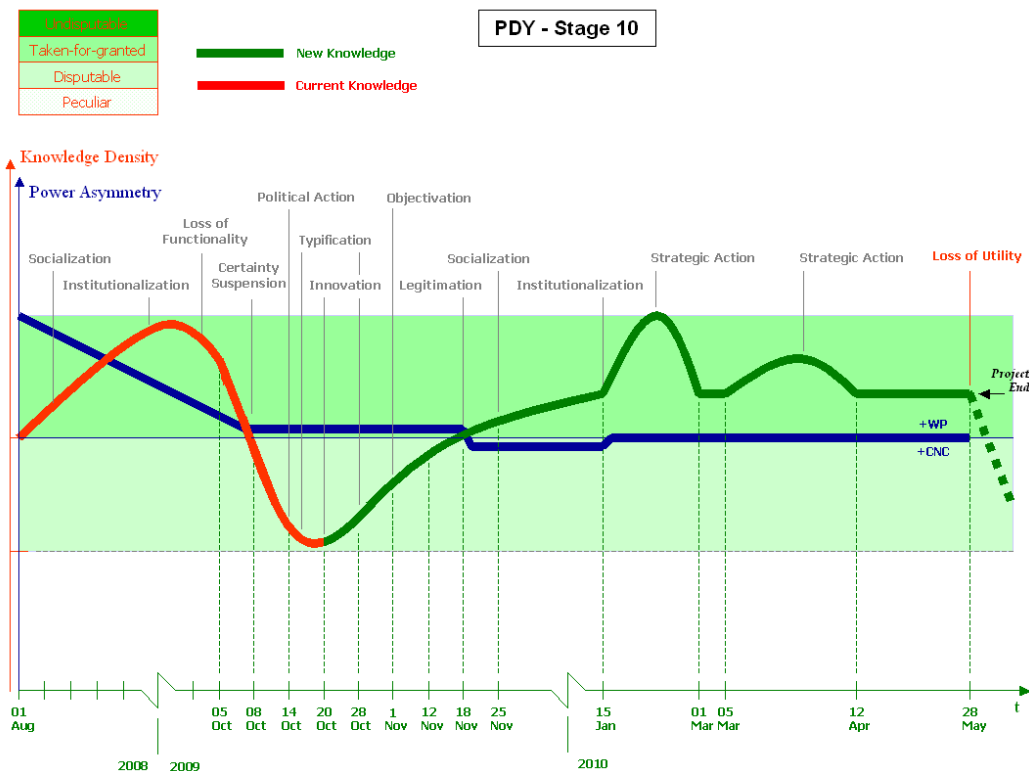


Fig. 112: PDY international workshare knowledge change stage 10.

9.1.2- UNA3 Case

UNA3 bid represents the first international project of CNC as a formal WP subsidiary (thus CNC/WP). It is also representative of the initial strategy WP designed to tap into Brazil sizzling economy. Despite the official discourse in which WP would empower CNC/WP to become a fully capable subsidiary, initial movements went in the direction of using CNC/WP as a local post to have access to stated-owned companies' mega-projects to be further redirected to other well established subsidiaries abroad. Within that logic, UNA3 bid participation came up as a WP-Reading (U.S.) initiative channeled through the good relations CNC/WP had with Eletrobras, a long time hydropower client.

In the beginning, power asymmetry was high, with WP-Reading holding a “knower” status and CNC/WP holding a support status. The points of interest checked by G.L.G (WP nuclear division vice-president) during his visit at CNC/WP demonstrate that expectations were low about CNC/WP with questions mostly directed to CNC/WP 3D design capability and how to transfer part of the job overseas (mainly to WP-China). The unconventional activities disclosed in men-hour (MH) spreadsheet puzzled WP-Reading making it less certain on how bid was to be held. The request to CNC/WP to fill in the MH estimate represents the weakening of WP knowledge on how to bid under such circumstances. This uncertainty intensified with the release of the bid instructions which brought current estimation methods under deeper scrutiny.

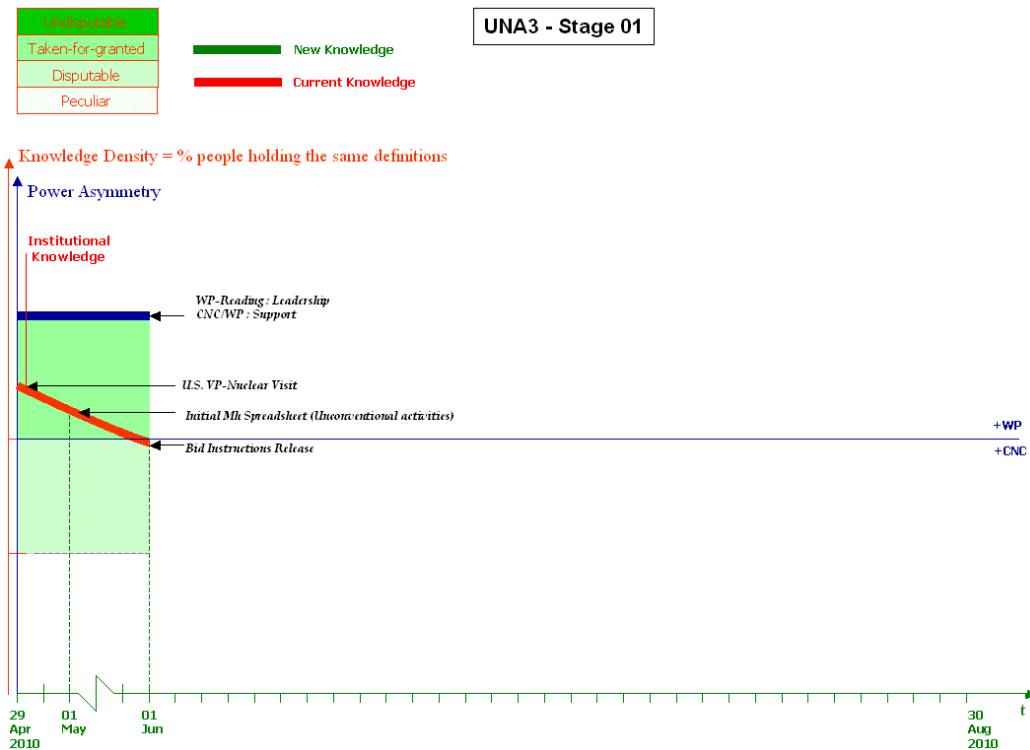


Fig. 113: UNA3 global price contracting knowledge change stage 01.

The uncertainty regarding the scope of activities (to which WP-reading was not familiar) together with the requirement that at least 80% of the job should be held locally and there should be technology transfer with local entities turned upside-down the initial power distribution. Faced with a marginal role in the future project and the prospect of creating a local competitor, WP-Reading reduced its participation in the bidding to a minimum. Even though empowered, CNC/WP still depended on the nuclear certificates that only WP-Reading could provide, ultimately leveling the power asymmetry between WP-Reading and CNC/WP.

Despite its lack of nuclear expertise, CNC/WP applied knowledge from other bids for stated-owned companies and went ahead with the estimation. CNC/WP also cross-checked information within bid instructions to ensure its estimations, however, uncertainty on the tasks to be held clearly unsettled WP and CNC/WP executives. Even though, CNC/WP still trusted that WP know what it was doing and thus should follow its lead. To enforce his control over the process, WP headquarters urged WP-Sofia (Bulgaria) to join the bidding team.

Initially, WP-Sofia role was to provide a checking stance for CNC/WP estimation and technical doubts, however, almost without examining the bid instructions, WP-Sofia straightforwardly applied the standard estimation methods originally developed by WP-Reading (its parent office). As a result, WP-Sofia questioned estimations weakening again CNC/WP position in the bidding. The enrollment of WP-Sofia also represented a less careful socialization of the current knowledge and thus the return of its density and taken-for-granted status.

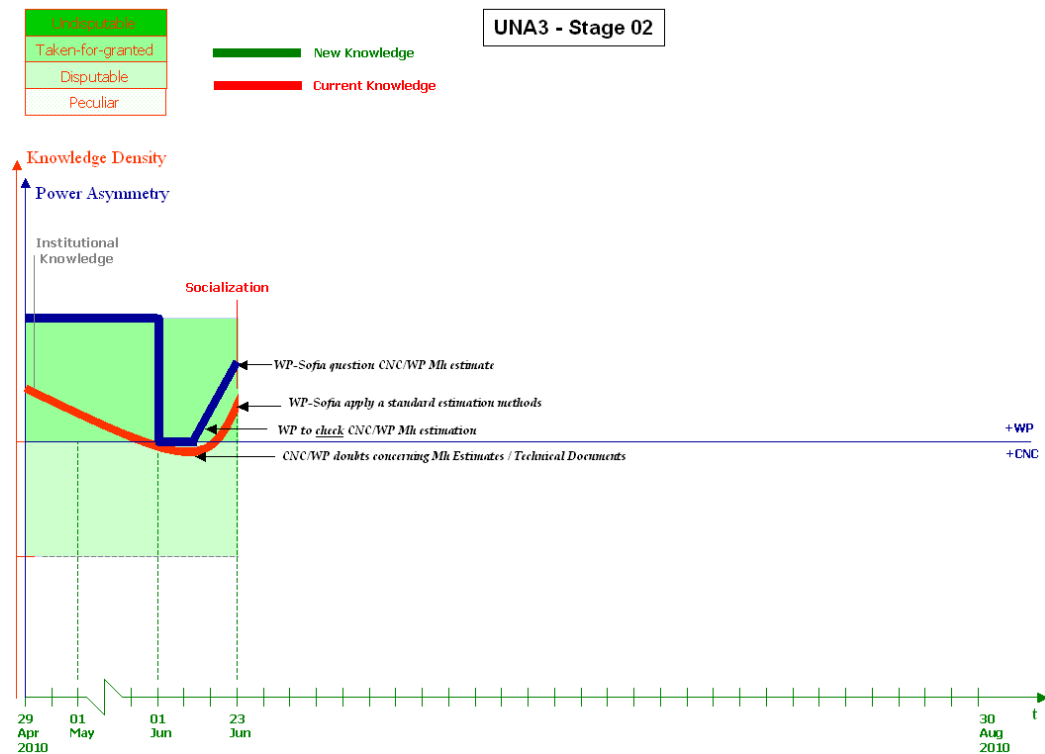


Fig. 114: UNA3 global price contracting knowledge change stage 02.

Alongside WP-Sofia questionings, WP-Reading interest in the bid returned with a strategy to gain further influence and secure a privileged place in a future project. Drawing on the strict personnel qualification requirements, WP-Reading claimed key positions in the future project further weakening CNC/WP stance. To make sure that it had updated information and its interests preserved, WP-Reading sent G.J. to CNC/WP to closely follow proposal developments. G.J. focus on contract pricing and job posts as well as its disregard for the technical documents and certificates, which were decisive bid parameters, evidence the stance adopted by WP-Reading.

The lack of understanding of the bid instructions by its partners has been noted by CNC/WP which fiercely debate with WP-Sofia to defend its estimations. To rebuff critics of a poor examination of the bid instructions WP-Sofia sent standard estimation forms and statistic tables as a way to legitimize its approach. These documents, however, made little sense in the context of the UNA3 bidding which was very strict and clear about activities to be carried, which had no correspondence to what was considered in these documents. Nevertheless, as they represented the materialization of WP current knowledge on how to bid such projects, they were forcefully socialized at CNC/WP as the ones to be universally followed.

As a complement in its strategy to occupy future key posts, WP-Reading also required the final word on the technical documents to be attached to the proposal. Event though, responsibility over initial drafts fell upon CNC/WP which was at great time pressure to hand them to WP-Reading to be “verified” and “enhanced”. This work division put CNC/WP under a disproportionate pressure of time.

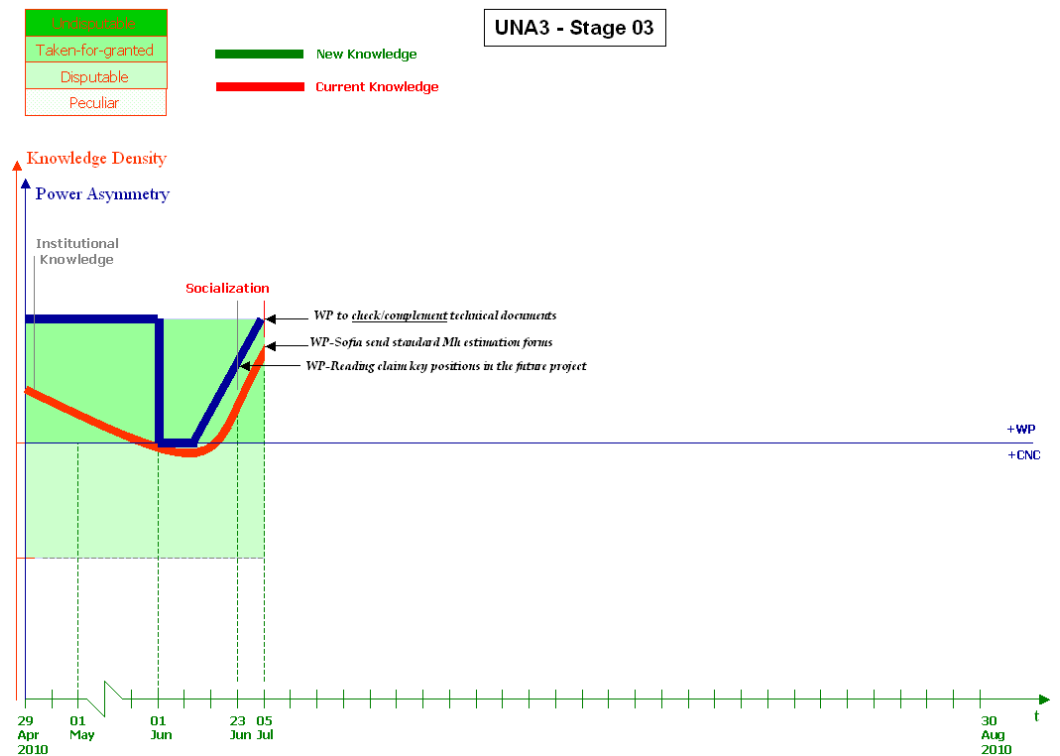


Fig. 115: UNA3 global price contracting knowledge change stage 03.

Two events marked a turning point where CNC/WP realized that WP knowledge no longer could be held credible: the debates about the use of another engineering design system (SmartPlant 3D instead of PDS), and the standard technical procedures sent by WP-Sofia. In the first case, the idea has been aired by G.J. despite clear bid instructions about using PDS. He believed that Eletrobras could be dissuaded out of this requirement what beyond impractical as it would mean full revision of a public bid instructions in favor of a proponent, was also largely illegal. In the second one, WP-Sofia sent work procedures describing how to roll a brand new project while bid instructions clearly emphasized that UNA3 was to be an exact clone of UNA2, what required a completely different approach.

As a result of the enrollment of WP-Sofia (and WP-Reading come back), power asymmetry grew up again, leaving little space for CNC/WP to voice its questionings over the highly institutionalized approach. Current knowledge density increased steeply and mounted to an almost oversocialization of the current knowledge on how to bid large-scale projects. All this in behalf of more power for WP-Reading in the future project, and more prestige for WP-Sofia as a “procedure champion”.

The uneven distribution of power and responsibilities brought the proposal work to a sudden halt. At the same time WP-Reading and WP-Sofia successfully enforced their highly institutionalized knowledge, more responsibility was being transferred to CNC/WP. Once WP knowledge demonstrated being non-functional to the proposal work but no other party listened to it, no other option was left to CNC/WP than to let WP knowledge fell for itself.

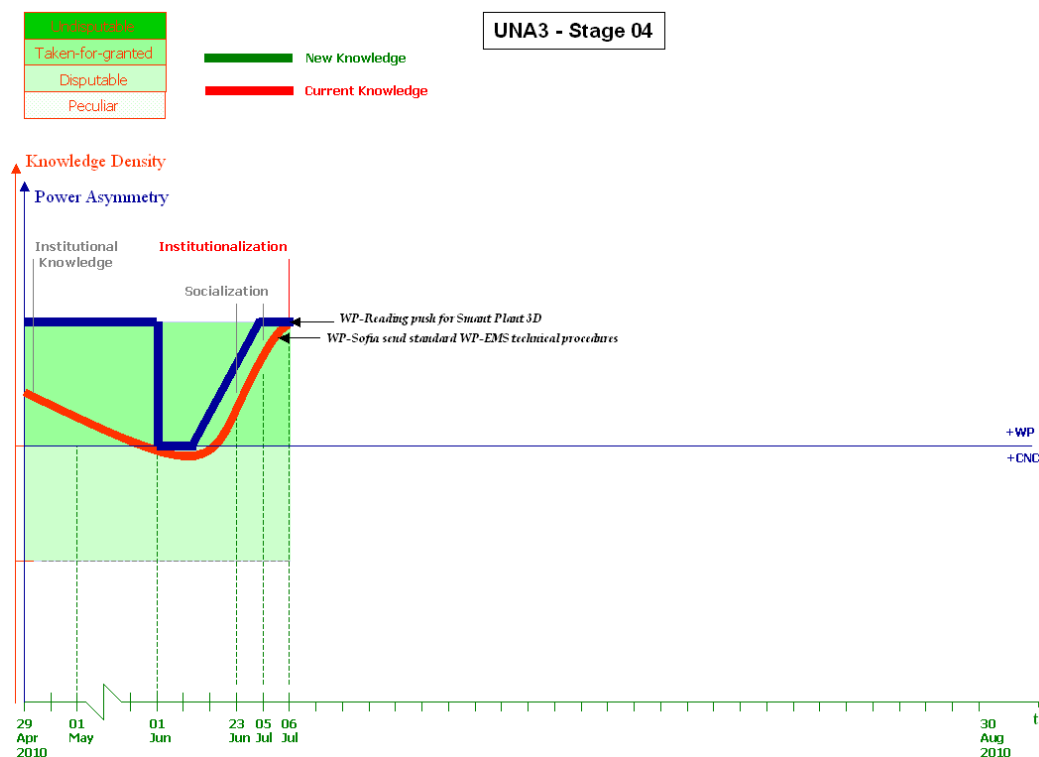


Fig. 116: UNA3 global price contracting knowledge change stage 04.

Quickly, however, current knowledge proved highly inadequate guidance the UNA3 bidding process. The arrival of technical procedures which completely missed the point or ignored bid requirements, set off a dismal reaction on the part of CNC/WP. As a result of the dissonance between the WP knowledge and proposal needs, a parallel line of work has been established with approval of R.M.Z. in which CNC/WP took over responsibility over most of the write-up's required, inclusive those planned to be held by WP-reading and WP-Sofia. This was seen as a safeguard against their inability in providing reliable knowledge regarding the accomplishment of the write-up's which suddenly became the focus of CNC/WP.

In opposition, however, G.J. focus was still to make changes on the bid process and proposal on WP-Reading behalf. G.J. insistence in using SmartPlant 3D instead of PDS (required in the bid) ignored the many arguments provided by CNC/WP for moving on the debates to more important and practical proposal subjects, such as the certificates and technical write-up's, which were far more decisive in the bid.

As a consequence of this process, vast time has been wasted discussing how to change clearly defined bid requirements (i.e. engineering systems and work methodology), showing a lack of self-evaluation on the part of both WP-Reading and WP-Sofia. With the time running out fast pressure mounted for clear and precise directions not only regarding what to do but also who would hold responsibility. In the lack of practical guidance on how to deal with real proposal tasks current knowledge begin to show signs of losing any functionality.

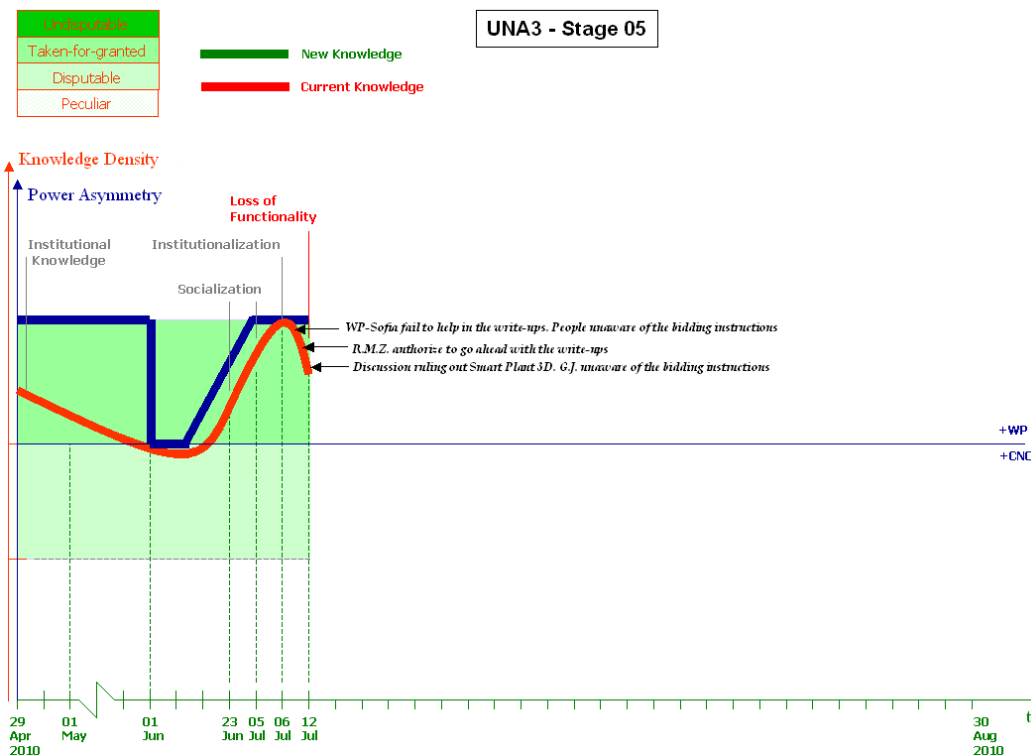


Fig. 117: UNA3 global price contracting knowledge change stage 05.

Despite the parallel work line established by CNC/WP in relation to the write-up's, uncertainty spread over other areas of the proposal work. The persistent discussion regarding the engineering systems and future project positions promoted by G.J. distracted other team leaders from smaller but fundamental decisions, regarding, for example, the idiom in which proposal documents were to be written and who were to be in charge of each document.

Another reversal happened when WP-Reading realized that not even its senior specialists fit into the qualification requirements asked by Eletronuclear. As WP-Reading began to falter in this subject they were urged to present alternatives which further exposed their lack of knowledge for this specific sort of proposal. An unfolding problem then became the limits between WP-Reading and CNC/WP identities. As G.J. insisted that both were the same company and thus could assign personnel to the key positions, CNC/WP personnel argued that WP-Reading and CNC/WP were legally different companies and thus CNC/WP could not have their personnel listed in a proposal officially led by WP-Reading. The confusion regarding company identity quickly spread into the certificates and eligibility documents further jeopardizing the process and dragging down knowledge density.

Although at this point WP current knowledge went under certainty suspension at CNC/WP opening room for deeper questioning, this far it has been restricted to the CNC/WP corridors. Nevertheless, power asymmetry was still too high for this questionings to spark any change. As such, knowledge density kept falling as a result of the work increasingly become uncertain and misguided.

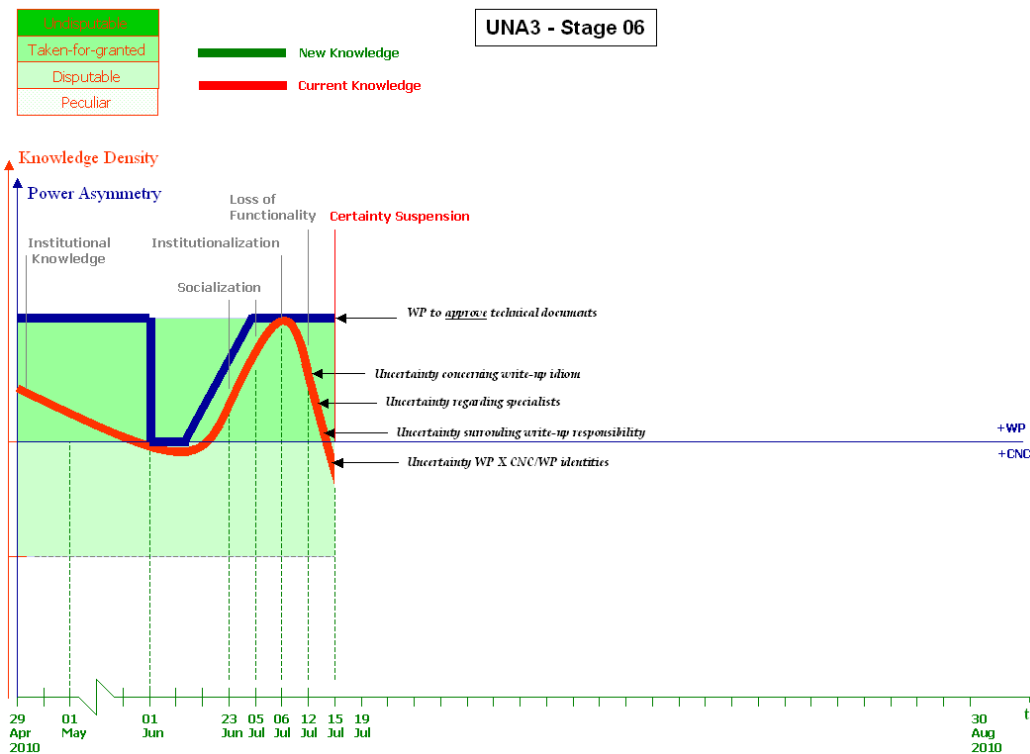


Fig. 118: UNA3 global price contracting knowledge change stage 06.

Even though technical proposal work was running adrift, WP-Reading turned its focus to the financial questions and used its “knower” prerogative to claim the final word on the commercial proposal terms. Even in a scenario where its leadership and knowledge proved highly dysfunctional, the legitimation position WP-Reading held within the corporation provided the means to keep power asymmetry untouched.

As it would be the first corporate risk analysis CNC/WP would participate in, risk personnel decided to run a preliminary analysis, using its own methodology, to set a good impression at the official meeting. Several key CNC/WP executives have been invited to contribute to this preliminary analysis however, the exercise has been emptied by an internal event promoted by CNC/WP president despite the importance of the proposal for the company as a whole. During official risk analysis, however, divergences on how contingencies should apply demonstrated that WP contracting knowledge was strongly biased towards “reimbursable costs contracts”, and thus, was highly inadequate for “global pricing contracts” such as UNA3. Overall, the use of the current contracting knowledge in the Brazilian market would result either in non-competitive prices or bid withdrawal due to unacceptable risk.

The arrival of B.M. (WP-Sofia) to assist G.J. in the proposal organization unintentionally marked the beginning of a change in direction in the whole proposal process. B.M. not only improved communications with WP-Sofia, but also established an independent assessment of the current knowledge on the WP side. As such, her stance contrasted with G.J., which saw CNC/WP remarks as linked to its under-socialization on WP contracting knowledge.

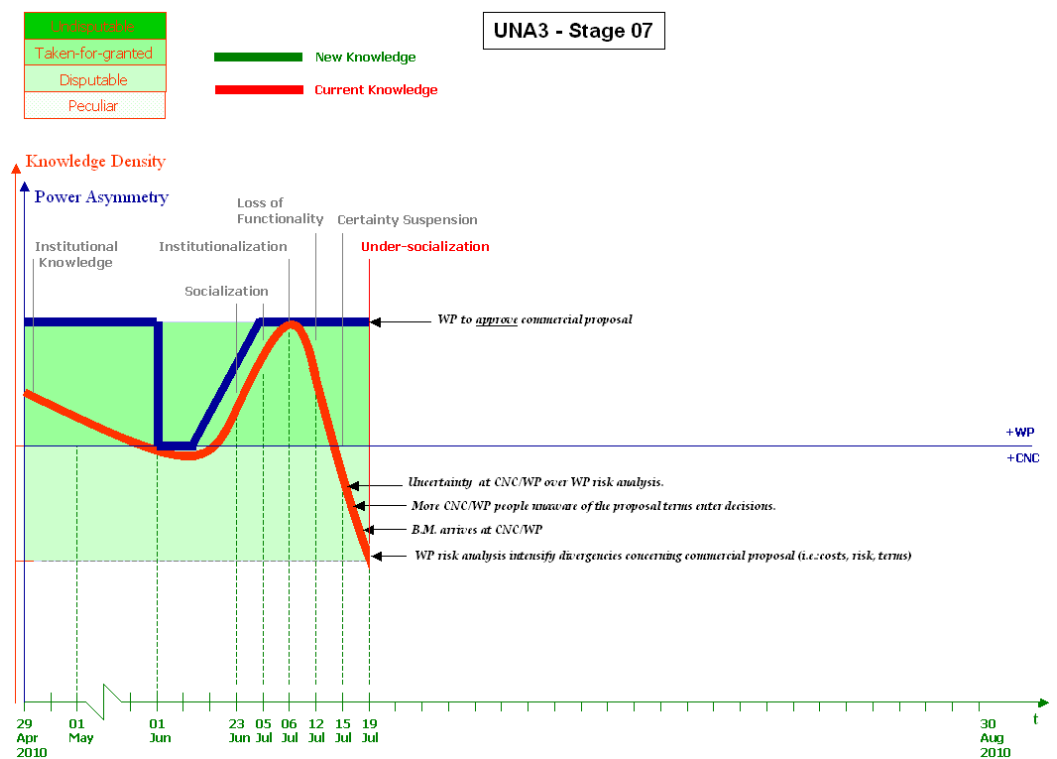


Fig. 119: UNA3 global price contracting knowledge change stage 07.

Initially, B.M. work focused on establishing a bridge between CNC/WP and assist G.J. in disentangling UNA3 eligibility requirements and access WP resources to get them. Regarding the first task, B.M. participation has been decisive. Despite initial rivalry, the extenuating work journeys and face-to-face interaction created a trustworthiness bond between her and the CNC/WP personnel, which was passed on to WP-Sofia office and facilitated exchanges between the two offices. On the other hand, divergences between B.M. and G.J. increased on daily basis, as her focus was to fit the WP approach to CNC/WP and UNA3 needs while his was to fit CNC/WP and UNA3 needs into WP approach.

Even though feedback time improved, remarks over CNC/WP papers still demonstrated a lack of proposal understanding on the part of WP-Sofia. This problem also affected new CNC/WP additions to the proposal team. Particularly remarkable was the fact that the absence of a thorough analysis of the bid instructions did not prevented people from joining discussions and make disconcerting suggestions, some of them questioning explicit client requirements and scope definitions. Overall, this can be taken as an indicator of loss of meaning regarding the current contracting knowledge as it became so rarefied that stopped to provide a common ground for team members' interaction, opening space for meaningless ideas.

At this point, a state of almost paralysis took over team activities. Key meetings to approve the technical and commercial proposal had to be postponed due to a lack of common ground in which debates could proceed and decisions could be made.

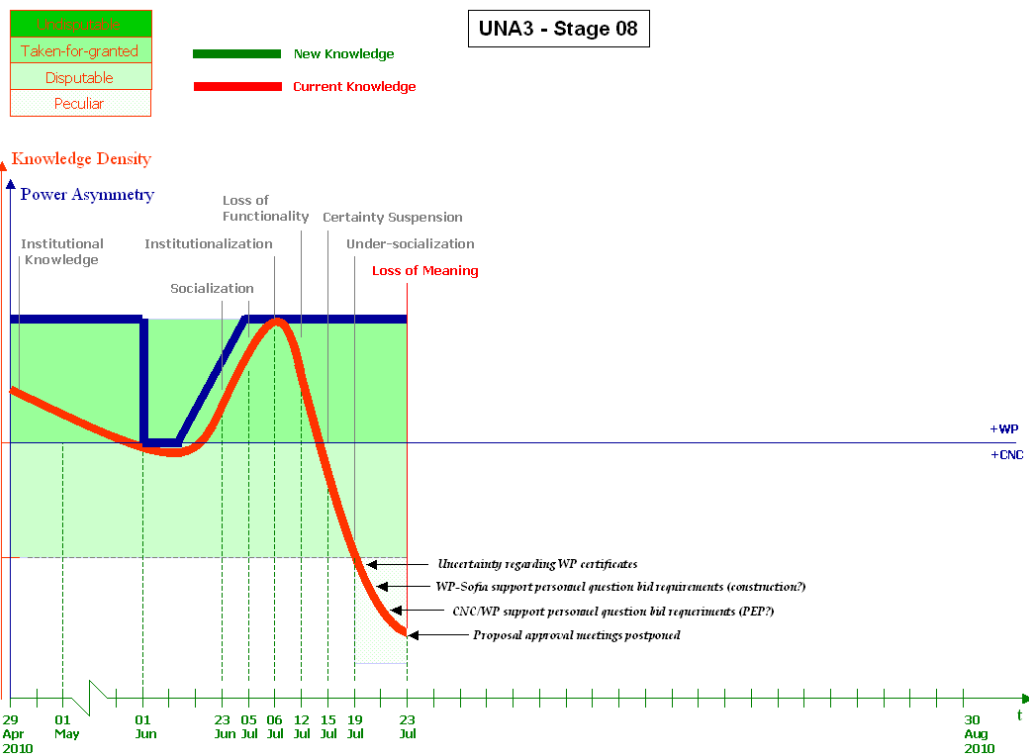


Fig. 120: UNA3 global price contracting knowledge change stage 08.

The site visit and the technical seminars represented a key moment in the proposal work. The materialization of all elements mentioned in the bid instructions in front of team members left no space for doubts or second thoughts. At this point current contracting knowledge looked completely out of place, and both G.J. and WP-Sofia engineers had to completely review their approaches. For CNC/WP, which have been questioning WP approach for several weeks without results, the information gathered came to confirm several points it had brought to WP-Reading and WP-Sofia attention.

As a result of the visit, new common typifications replaced the almost individual ones that existed just before the visit establishing a new common ground on which communication and understanding could be once again rebuilt. Moreover, face-to-face interaction between CNC/WP and WP-Sofia engineers (i.e.: G.G. and S.T.V.) solidified the incipient trustworthiness bonds and resulted in CNC/WP personnel being granted a “knower” status. Out of these two processes, new typifications involving roles and responsibilities emerged bringing order and direction to the joint work of CNC/WP and WP-Sofia regarding the write-up’s.

Overall, the visit redefined the problem to all team members and created the conditions by which old knowledge could not block new understandings and courses of action. As a result, a completely new knowledge progressively gained density and re-entered a quasi-institutional zone. Now team members could interact to improve these definitions towards more effective joint work, and back to their home offices, further spread these typifications to overseas professionals enrolled.

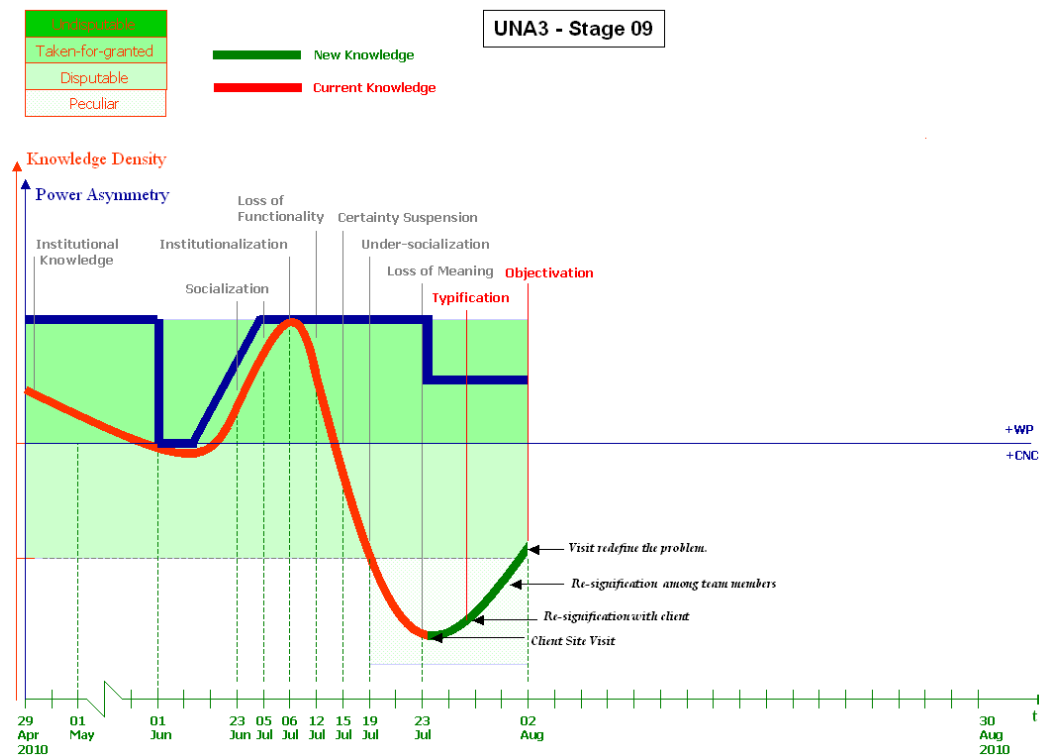


Fig. 121: UNA3 global price contracting knowledge change stage 09.

Back from the visit, CNC/WP personnel quickly updated the MH estimation and began to revise the documents for the technical proposal. With the help of two junior engineers, which substituted F.M.C. and P.D.J. (two proposal experts which brought no contribution to UNA3 at all), the write-up work gained great speed. T.D. and R.M.Z. also helped revising and writing entire sections. As a result of this effort and of having most of its concerns confirmed by the client site visit, CNC/WP has seen itself in position to make demands against WP-Sofia and WP-Reading regarding their responsibilities in the joint project. WP-Reading has been urged to deliver the eligibility documents while WP-Sofia to quickly review the revised write-up's.

With WP-Sofia sending now "just suggestions", the review work has been quite fast and CNC/WP technical write-up's were quickly legitimized almost without remarks. With WP-Sofia on his side, CNC/WP buildup pressure upon G.J. and WP-Reading regarding the certificates for the eligibility package. In a situation that can be understood as a first moment of political action, T.D. urged F.C. to ask top WP US management to put further pressure on WP-Reading. B.M. also added to this pressure enrolling the participation of D.T. her former boss and now WP Nuclear Division Managing Director.

As a result of having WP-Sofia and top WP management at his side, the power asymmetry between WP-Reading and CNC/WP reduced significantly. This reduction in power asymmetry also opened room for further questionings from CNC/WP, which now were carefully listened by WP Nuclear division executives at large. As such, the new contracting knowledge upon development gained further density.

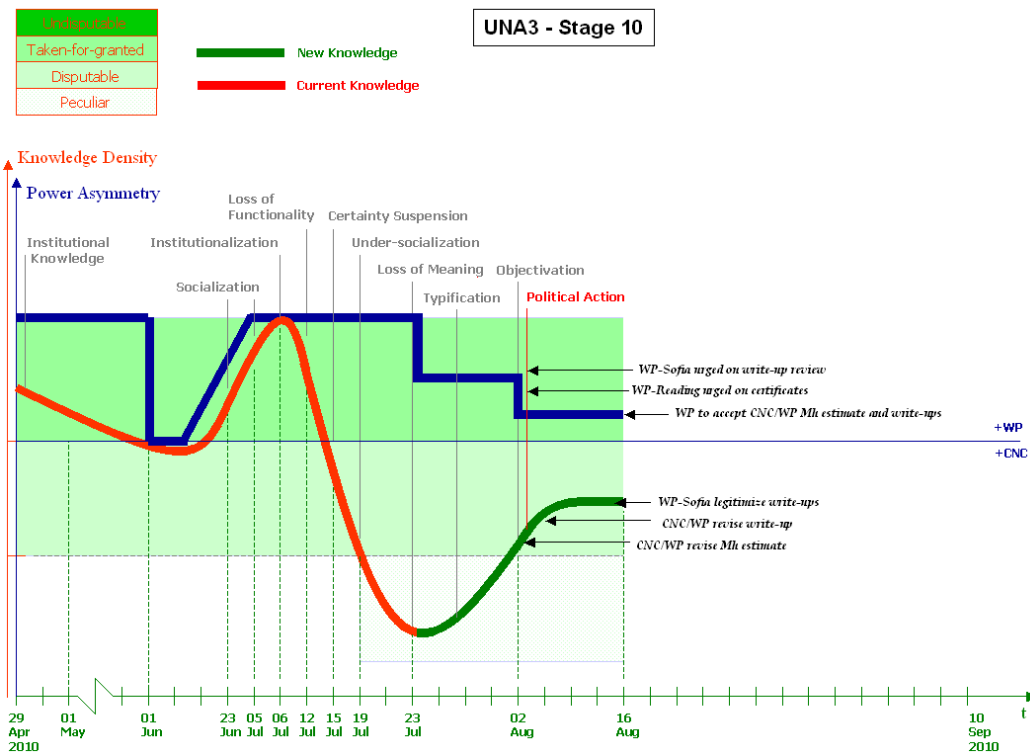


Fig. 122: UNA3 global price contracting knowledge change stage 10.

With the MH estimation approach legitimized, the next challenge for the proposal was the risk methodologies both CNC/WP and WP-Reading used. On the CNC/WP side, the amount added for contingency was so high that final price would extrapolate client top estimations (presented in the bid instructions) meaning immediate disqualification. On the WP side, due to the amount of money involved and to its global price features, UNA3 proposal ranked at an unacceptable level and thus would need approval of WP CEO before going ahead.

To overcome these two barriers, T.D. engaged into intense debates with CNC/WP risk personnel and actively questioned in the risk meetings contingency values and criteria. Under the threat of T.D. quitting the proposal if risk criteria were not reviewed to bring proposal price close to bid instruction values, C.A.J. (CNC/WP President) had no other option than to legitimize T.D. risk view. Afterwards, T.D. engaged into intense political action for WP to accept CNC/WP analysis which brought risk levels back to acceptable ones. Operated in his favor CNC/WP efforts, mobilization of WP top executives (T.D.; S.C., S.H.) and the project attractiveness, which would open up a unique market for WP. Despite its tradition, faced with such pressure, WP-Reading end up having its power leveled with CNC/WP one.

After that, the focus also turned to the EPR meeting which would give the proposal final approval. B.M. personally dedicated to the task of preparing CNC/WP to make a successful presentation. Though almost ritualistic, in the sense that no debates and questionings were made during the meeting, EPR approval gave further density to the new contracting knowledge as more and more people agreed with its definitions.

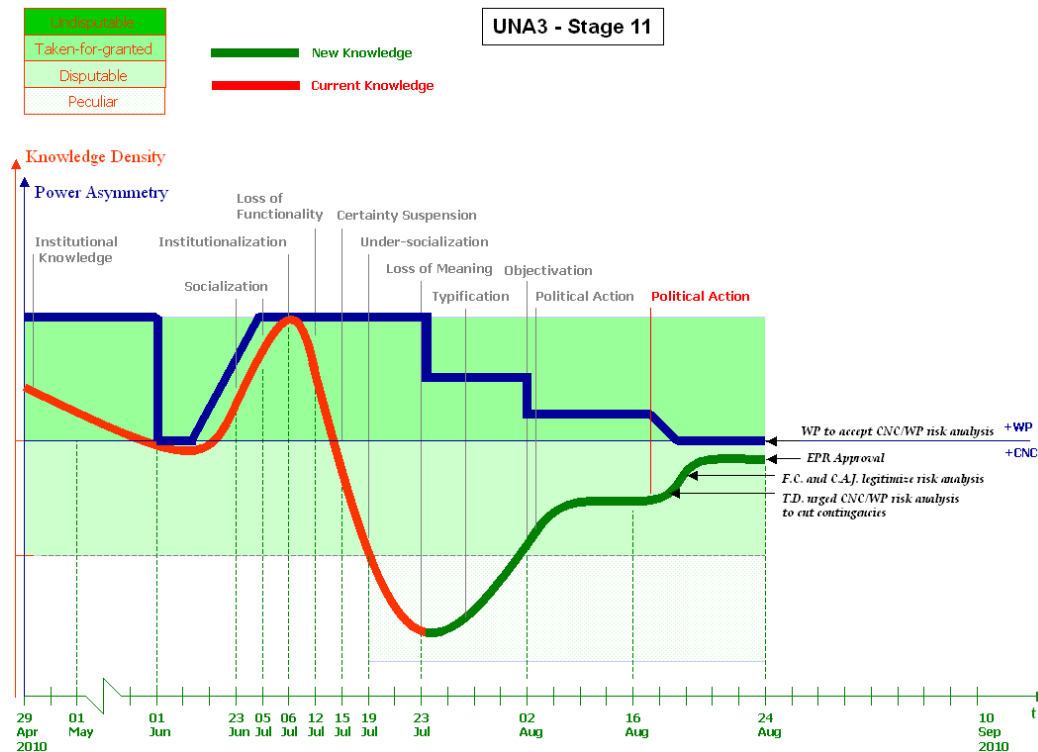


Fig. 123: UNA3 global price contracting knowledge change stage 11.

Despite the massive work done by CNC/WP and WP-Sofia towards proposal paperwork, in attempt to standout, WP-Reading launched its first material contribution to the proposal, a 5 page marketing piece called “executive summary” (not required by the bid instructions) with great publicity to all WP top managers involved in the proposal before submitting it to the other partners. However, when long waited eligibility documents from WP-Reading started to arrive at CNC/WP. In a preliminary check, B.M., T.D. and F.F.M. realized that have been issued following U.S. legal standards, and not Brazilian ones (far more strict) and therefore were not acceptable according to bid instructions. Moreover, only at this point details regarding WP corporative arrangement that would be unacceptable according to client terms only then were brought to partners' attention. The fact that WP-Reading had hold these problems for so long is elusive of the pervasive influence of and longstanding power asymmetry, particularly reflected as excessive self-assurance.

In a third moment of intense political action, F.C. directly called U.S. top management and urged immediate action to correct and re-issue the documents. B.M. also used its links with D.T. to urge a critical intervention in the WP-Reading work. Also, T.D. immediately departed to the U.S. to follow up corrections and make sure no other document would be sent with problems alike. UNA3 proposal was finished at the very last minute and has been delivered on due time thanks to the efforts of CNC/WP personnel and WP-Sofia. Months later when proposal resumed after a short cancellation, WP agreed to make changes to its corporate structure in order to avoid problems in future proposals for Brazilian state-controlled companies.

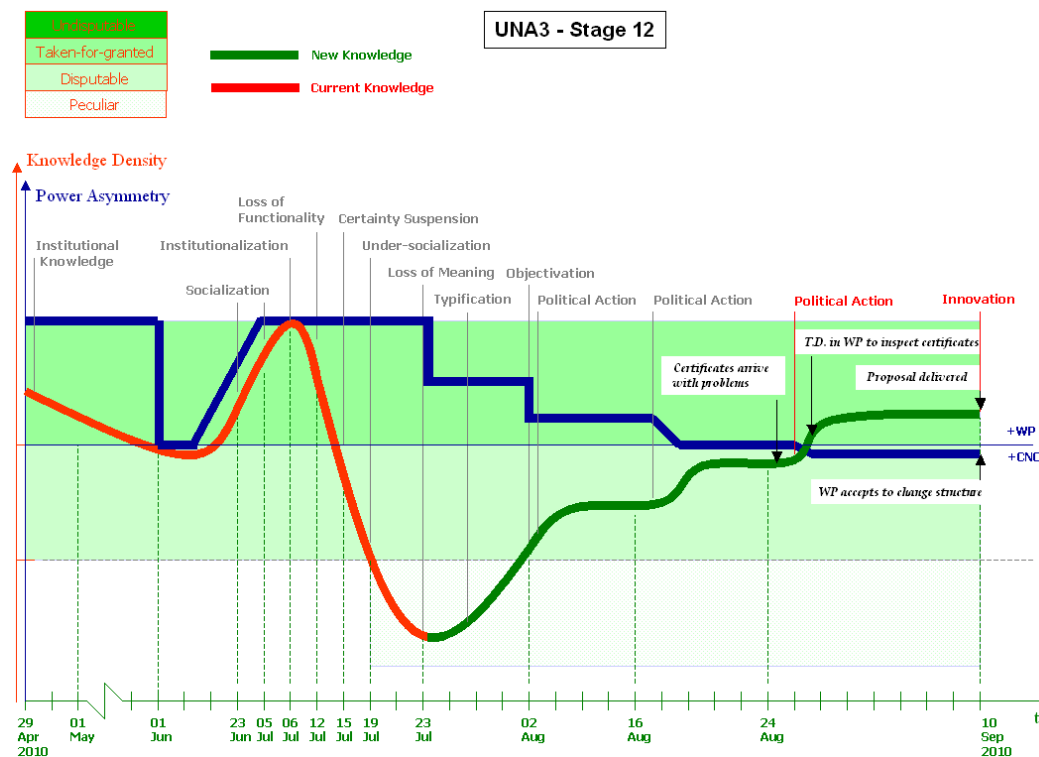


Fig. 124: UNA3 global price contracting knowledge change stage 12.

9.1.3 – BGB Case

Despite the lack of expertise in designing oil terminals and being completely inexperienced in rolling out fast-track projects, BGB contract and project leadership has been assigned to CNC/WP. The reasoning behind client’s decision was that experience regarding the local business environment would be more important than technical expertise, and WP could be able to offer them both. As such, CNC/WP would be responsible by project management and tank facilities while WP-Houston would provide support for it on the ports and terminals. This way, project started with power asymmetry favoring CNC/WP, differently from recent past experiences.

Right from the internal kick-off meeting, however, the approach adopted by CNC/WP was that of a standard project. Even recognizing the challenging outlook, project management almost unconsciously relied on the same path used for traditional projects. Even in face of a quite unconventional project scope, initial directions for team members were to develop traditional documents, which represented the materialization of the current *institutional knowledge* on how to develop projects. The taken-for-granted belief in the current approach made project management and key leaders to downplay the few questionings raised and disregard the composing effects a fast-track schedule would bring upon initial project uncertainties.

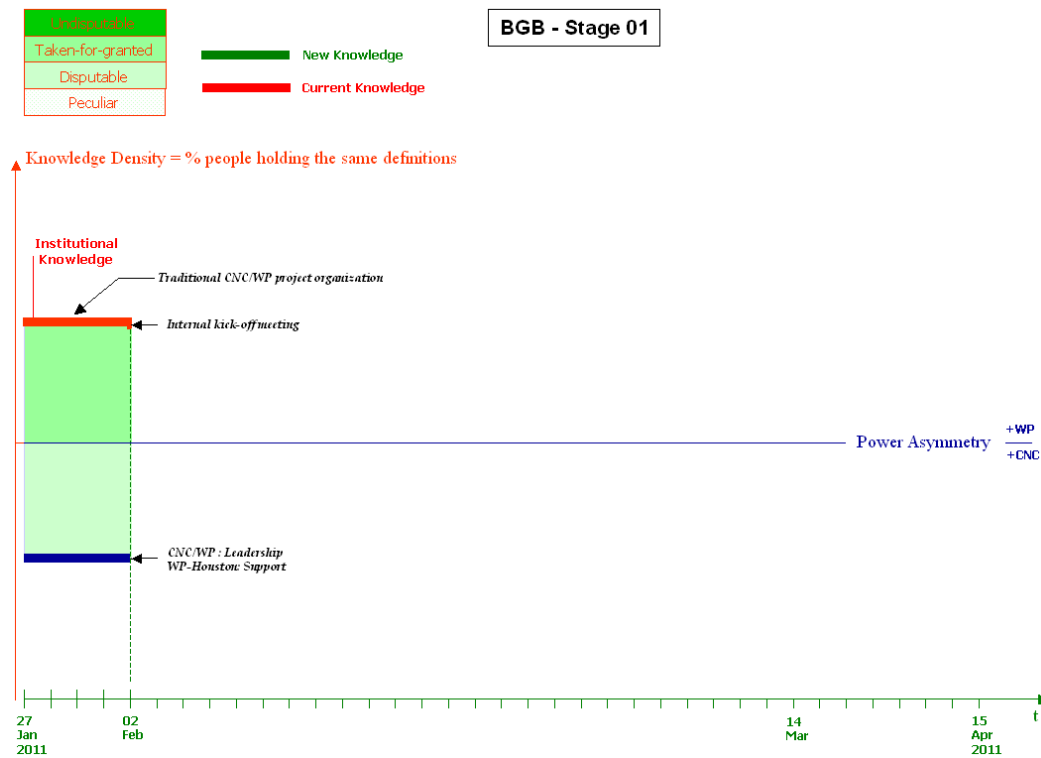


Fig. 125: BGB fast-track project knowledge change stage 01.

Following the traditional project organization, F.R.P asked for a “list of documents” (LD). Due to the unconventional character of the project, however, this requirement generated great uncertainty as project scope fit awkwardly on a traditional LD. With unconventional client requirements such as “information wish-lists” and constant direction changes on how to consider customer-supplied data, traditional project organization knowledge steeply lost its functionality. Working under increasingly uncertain conditions and with a pressing schedule, some supervisors added to their lists documents that mismatched project stage and available level of information. As uncertainty surged knowledge density plummeted.

In the official kick-off meeting, C.K. provided current knowledge a further downward push as he presented a far from conventional set of documents expected to be developed by CNC/WP. In face of these explicit requirements, team members suspended their certainty on how to handle project activities, making current knowledge lose its take-for-granted status and enter a debatable zone. Even with knowledge plummeting and schedule tightening, contracting strategy was the only matter that attracted full project management attention.

To make things worse, company support for the project, neither reflected the importance of the project for CNC/WP nor its detached position in the partnership. With project infrastructure on the verge of improvisation, and discipline leaders delaying project assignments, CNC/WP responsiveness to client requirements has been severely hampered. CNC/WP lack of direction in the initial weeks undermined client’s confidence, weakening its power stance against WP-Houston influence.

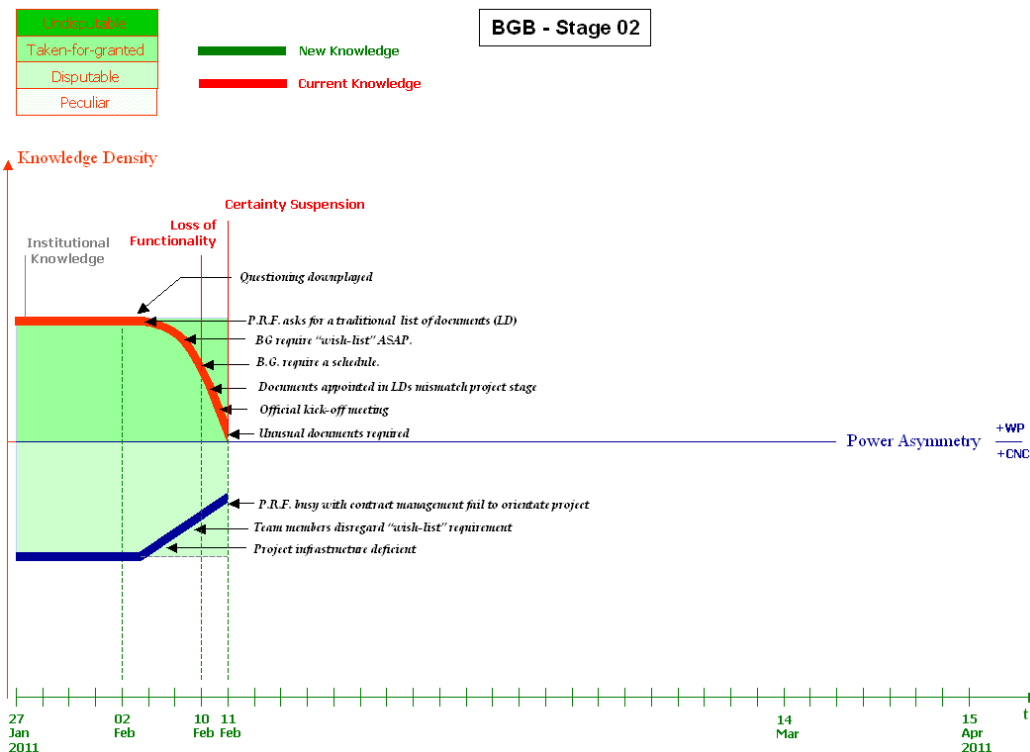


Fig. 126: BGB fast-track project knowledge change stage 02.

The unconventional set of documents required by the client extended uncertainty from “how to organize” into “how to do”. Even though documentation examples (materialization of client fast-track project knowledge) were provided, in the absence a legitimation instance to “explain” them through socialization or guide disparate interpretations towards a new consensus, they were of little use. Moreover, enrolled in parallel tasks and submitted to a tight schedule, team members also did not gather the conditions to come up with new typifications and objectivations required for a knowledge change. As a result, current knowledge density kept on plunging and started to provided less and less guidance even to face-to-face interaction among local team members.

Parallel, WP-Houston increasingly demanded higher project participation. CNC/WP strategy devised by H.S.S., however, was to get the most of WP-Houston technical expertise in exchange for the least possible stake in the project. Unexpectedly, however, WP-Houston by-passed CNC/WP and opened its way direct to the client. This act of rebellion further weakened CNC/WP leadership in front of the client and thus its power stance in the project.

Suddenly the client flooded CNC/WP with information and scope changes. As the amount of information increased so did the lag time between its arrival and distribution within CNC/WP. As a result, uncertainty further extended towards “what to do”. Disciplines began to work on different client requirements dragging down communications and the rest of common understanding. The hope to bring the team back on track was the interface and data-gathering meeting with LLX.

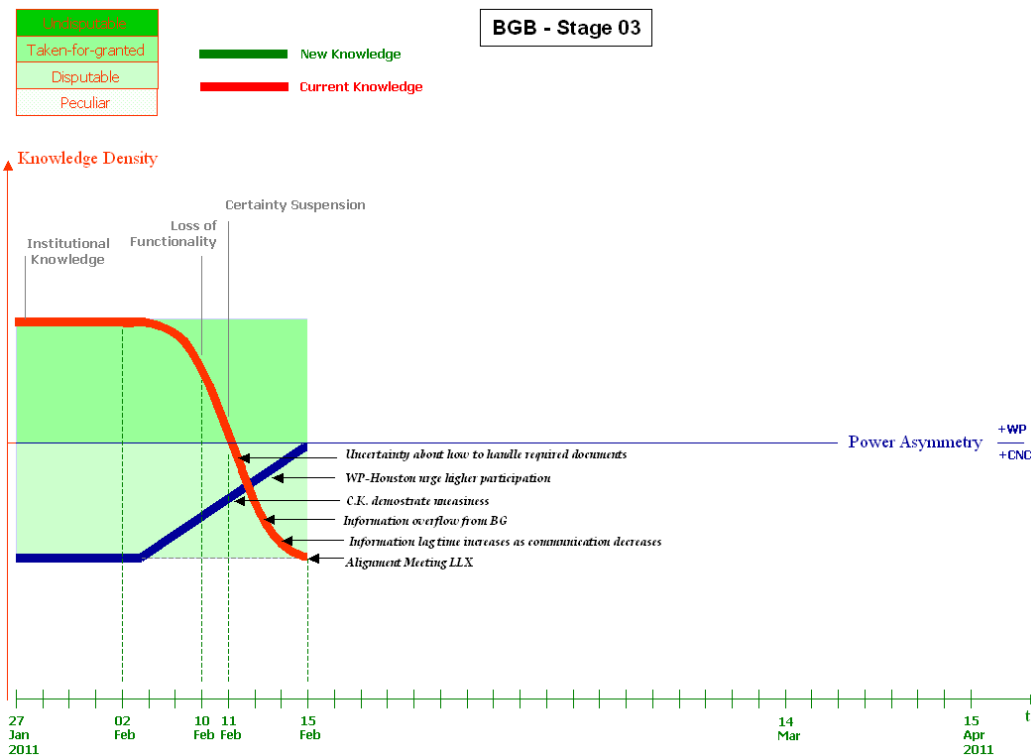


Fig. 127: BGB fast-track project knowledge change stage 03.

Indeed, the interface meeting with LLX helped the team to arrive at some new typifications as well as it highlighted that key client information was missing. After this meeting, W.A., in a first moment of public political action, made project management realize that it would be impossible to cope with client requirements without increasing WP-Houston share. As such, power asymmetry has been leveled between partners opening room for more knowledge exchange. Notwithstanding, BG quickly turned-over the information required and intensified the pressure upon CNC/WP demanding for document drafts.

In order to respond to this pressure an internal meeting was set to discuss ways to unravel the work. Despite arriving at key typifications and close addressing real work issues, project management came up with the proposal that team personnel should focus on the technical work while document organization work would be assigned outside the team, a very similar approach to the one that failed at UNA3.

In a second moment of intense political action an alternative compromise has been reached with project management in that both tasks would remain within the team organized by a clear “work breakdown” with responsibilities assigned according to a “responsibility matrix”. This agreement represented a shift in the way projects were organized within CNC/WP, and thus, a truly innovation moment. As C.K. legitimized the “work breakdown” and P.R.F. the “responsibility matrix”, this new knowledge gained density enough to be transmitted within the team though it still remained debatable and subject to further change.

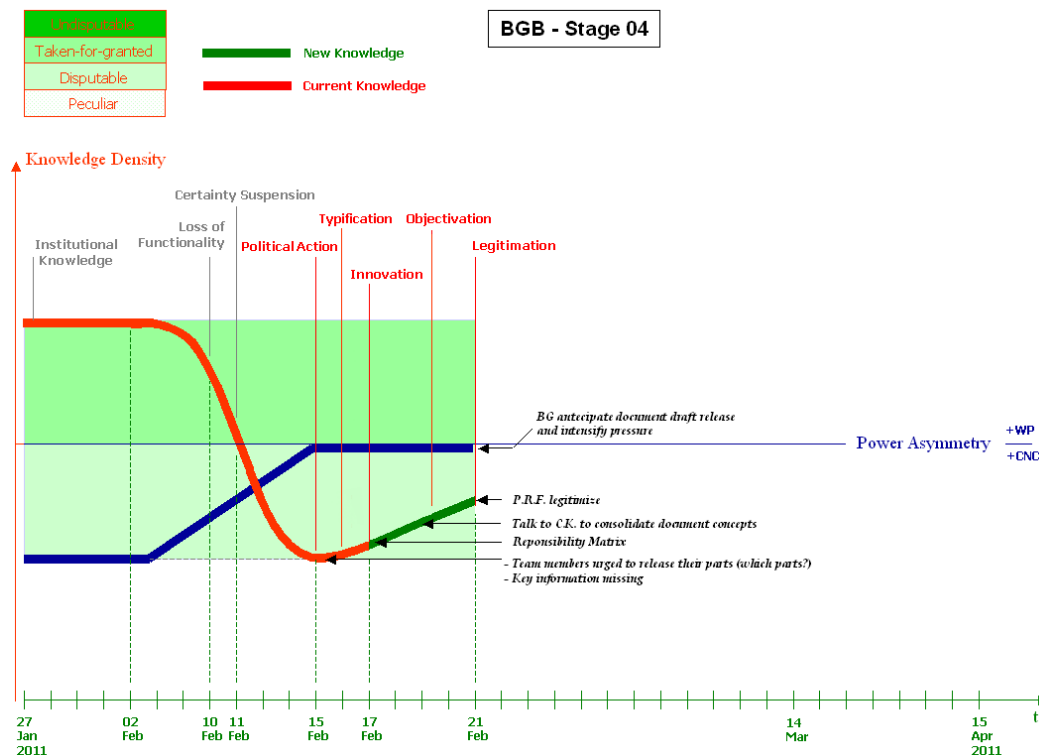


Fig. 128: BGB fast-track project knowledge change stage 04.

The new approach caught on quickly among team members and considerably improved work organization, however, it apparently arrived too late. With tasks defined and responsibilities clearly assigned work ramped up and the initial drafts start being assembled. A preliminary scheduled has also been developed evidencing an extreme “fast-track” characteristic with almost all activities running in parallel.

Nevertheless credibility with the client was already damaged and P.R.F. and C.K. relationship worsened on a daily basis. During the one-day site visit client discontent with overall CNC/WP performance was visible. Even though, CNC/WP top management increasingly required P.R.F. presence to discuss contract management approaches and problems such as C.K. reluctance in signing the additional work orders. On its turn, P.R.F. constant project absence left team members again struggling for definitions and feedback and made the relationship with C.K. to further deteriorate, what reached a maximum with S.G.D. (C.K. assistant) requesting to talk in private with team members. Contracting management priorities also prevented P.R.F. from following draft progress through the new organization tools what made the new knowledge slowly losing its initial impetus.

After a long negotiation the split of work between CNC/WP and WP-Houston has been defined and the IEWO (internal exchange work order) prepared to be issued. When their schedule arrived, however, it became clear that WP-Houston support would not come on time to help in the draft preparation as expected. With four days of delay the drafts and the preliminary schedule were released to client comments.

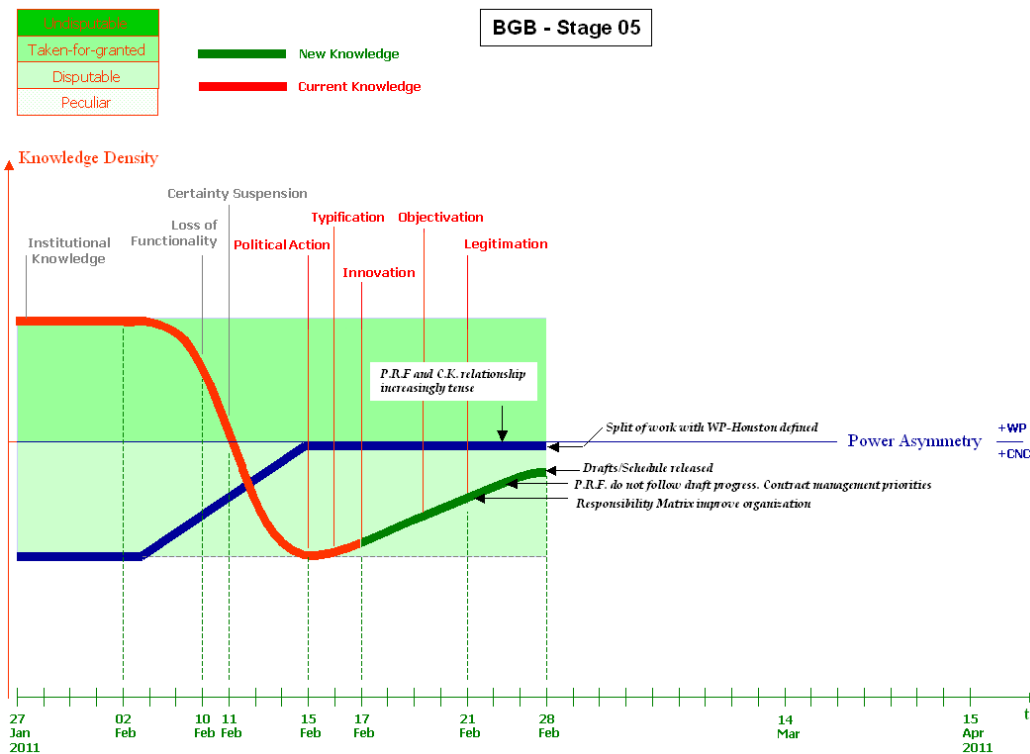


Fig. 129: BGB fast-track project knowledge change stage 05.

The arrival of early C.K. comments over the drafts caused great consternation within team, as they were unusually harsh and expressed a long time frustration with CNC/WP work. His observations and remarks were interpreted as vague and contradictory and instead of setting CNC/WP work into a desired path resulted in great uncertainty on what the client wanted at all.

With the organization work in the hands of J.A.M. the new knowledge stopped been harnessed and to the point that it did not followed further project developments has seen its practicality severely reduced. As a result of this continued under-socialization, new knowledge lost density and quickly stopped providing guidance to the teamwork. In a conference call with P.R.F. to discuss an action plan C.K. request a LD and a preliminary capital expenditure (CAPEX) estimation as traditionally developed for standard projects what puzzled team members and represented a return to former project approach. In this process, a sense of loss of meaning took over team members as they no longer knew what should be done to match client expectations.

In a last attempt to save the project, P.R.F. urged for any documents that could show project progress. Even though a great effort involving many people has been done to generate evidences that the project though was not set as the client expected it was indeed progressing. The attempt failed as the client did not accept the evidences presented and decided to cancel the project. At this point knowledge on how to carry on a "fast-track" project headed towards anomie where team members no longer could tell even what has happened at all.

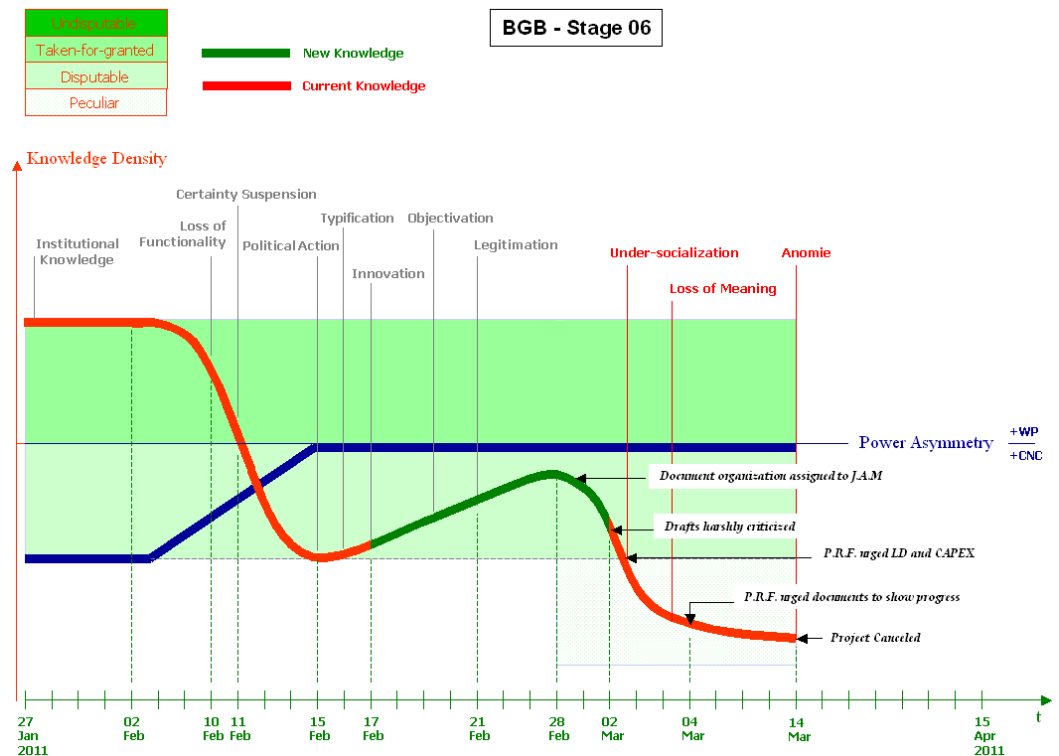


Fig. 130: BGB fast-track project knowledge change stage 06.

9.2- CASE INSIGHTS

9.2.1- PDY Case Insights

A first insight arising from PDY data is that power asymmetries have a persistent effect on knowledge density. In PDY, even with a decrease in power asymmetry, current knowledge kept its momentum towards increasing institutionalization. A possible explanation relies on the fact that long-standing power asymmetries allow socialization processes to be far-reaching and gain a momentum on their own detached from increasing returns or efficiency concerns. In this framework, *inertial institutionalization* persists until conditions change to make current knowledge lose density faster than it gains on being socialized (what happened in PDY).

Long-standing power asymmetries also undermine self-assurance and capacity of questioning, thus reducing the prospects of endogenous knowledge change. On the weaker side, subjects tend to associate problems not to the knowledge itself but to its understanding or application. On the stronger one, knowledge creators tend to stand for a dysfunctional knowledge in order to keep their status and power position. As a result, socialization is further strengthened, leading to a radicalization in the knowledge application and the accruing of related problems. Along such *evaluative blind spots*, internal pressure can build up for quite a long time without yielding any endogenous change movement. In PDY, despite the crisis situation, result of 14 months of poor results, exogenous third-party pressures were responsible for initial change movements.

A key insight arising from the PDY case is that *self-criticism* represents a fundamental moment in the whole process of knowledge change. *Self-criticism* takes place when the question “why is it not working?” comes to the mind of personnel deeply involved in knowledge application. This was an essential moment where some subjects tried to figure out their responsibility in making current knowledge effective or not. Only after ruling out their own failure in understanding and applying it is that they can turn attention to knowledge functionality itself. In PDY, this self-evaluation process represented a point in which a few team members (i.e.: D.C.C. and A.R.A.) detached from mainstream project mentality (i.e.: CNC Civil does not know to work on 3D) and begin to search for alternative explanations.

Once problems with current knowledge were exposed, what was taken for granted became openly criticized and certainty about it suspended. After this point, knowledge density fell sharply and great uncertainty started to surround the work. Under great time pressure, some team members engaged into open and direct debates (under ideal speech conditions) to identify faulty elements in the current knowledge and gradually develop new typifications towards a more functional one. *Internal political action*, thus, was a key mechanism to redirect knowledge from a downward trajectory. *Internal political action* was also fundamental to “sell the idea” and enlist the support of key project members for the initial set of typifications and propositions.

Though *innovation* is commonly approached as a moment of ingenuity of few enlightened ones (Govindarajan & Trimble, 2010), in PDY it came up as a calculated strategic path composed of a compelling argument, a consistent proposition and a political backing path. A weak argument, a loose proposition, or a poorly chosen political backing path would certainly have undermined the chances of *innovation* to come about. Moreover, *innovation* came out not as a finished idea to be straightforwardly implemented but rather as a new problem definition built around several newly developed typifications. Nevertheless, it marked a turning point in the knowledge change process as it opened the path for a new more functional knowledge to emerge and keep on being improved.

Another key insight brought about by PDY points to the key role played by project managers in the knowledge change process. In PDY, although project managers did not take part in the ideational part of the knowledge change process, they actively participated in the structuring one, as they contributed for new typifications to be voiced, debated and objectivated. In this frame, at least three essential roles were played by project managers: knowledge state transmittal, communication/framing, and arbitration.

In the first place, project managers usually assume that if an issue has been brought to discussion by a peer then it is worth attention. On the background of this sort of class courtesy is the perception that one manager can induce its lower level knowledge state into others. In PDY, for example, the certainty suspension state of K.G. has been transmitted to S.B.D. who, even standing where current knowledge was held highly institutionalized, agreed to bring the subject into discussion by also temporarily suspending his certainty. The same did not happen at lower ranks which categorically rebuffed the complaints in prior meetings. In this sense, *knowledge state transmittal* is a key role played by managers that enables issues to be bridged along groups enjoying different knowledge states.

Next, in the whereabouts of decisive meetings, communication and framing difficulties were overcome through project managers' effort in continuously back checking and aligning meanings along with discussion participants. As a result, communication did not get jammed by language differences as well as problems and propositions were not framed differently on each side of the discussion due to cultural differences. In PDY, S.B.D. participation in the meeting of 20th October 2009 is a perfect example of the *communication/framing* role project managers possess in international project teams, and how it is important not only to knowledge change processes but also to international joint work at large.

Finally, project managers also arbitrate team member's discussions in order to check for argumentation consistency and strength. This task requires great sensibility on the part of project managers who must go beyond entrenched positions and vested interests to determine the rationale underlying each argumentation. In PDY, S.B.D. sensibility in arbitrating discussions was key to break into the defensive position of WP-Houston and bringing them also into certainty suspension. In this sense, *arbitration* is a key role that project managers have in knowledge change processes

which enables them to explore and balance arguments in order to determine which one shall win and receive further support.

As a result of new typifications being declared winners of the debate, its creators were granted "*knower*" status within the team, meaning that they were henceforth "holders of qualified opinions" and thus "worth to be listened". In PDY, the "*knower*" status was essential for further knowledge development as it shifted the efforts of change advocates from winning support towards perfecting the new knowledge. In this sense, the "*knower*" status allowed complementary typifications to be developed more quickly and under less scrutiny than the initial ones supporting the subsequent objectivation process.

Along PDY, the *objectivation* process proved to be a very iterative one. The very first attempts of *objectivation* prompted for the need of additional typifications to complement and perfect the initial ones. As additional typifications were developed and complementarity among them grew, *objectivation* advanced. With the perfecting process underway, new knowledge gained density and its first objective elements started to materialize (i.e.: "WORKRESP" attribute, "Extraction" spreadsheet, "transfer/deleting" procedure). In PDY, however, the "SIC spreadsheet" represented the core materialization of the new knowledge and the ultimate result of the *objectivation* process. Once objectivated, new knowledge could be more easily explained and submitted to a wider audience thus making it gain further density.

The objectivation process enabled the new knowledge to be once again submitted to managerial attention, this time in search for *legitimation*. The advancements made from initial typifications towards objectified products yielded a more clear appreciation of and also more mature knowledge. As a result, the "vote of confidence" given by project managers to initial typifications has been transformed into a "certainty of course" in face of the resulting objectivations. With the new knowledge legitimized by both project managers what was thus far a "proposition of few" became a "managerial decision" with due coercive implications.

In PDY, *legitimation* has proved to be a fundamental process in the knowledge change process as it embedded the new knowledge with a power component beyond the political one it held so far. The power component added to the new knowledge gave it an important initial socialization impetus which speeded up and facilitated the transmission process. The recent recollection of old knowledge collapse also contributed to new knowledge socialization by exempting it from any conceptual competition.

Once legitimized, the new knowledge could then be socialized with other project members at large. In PDY, however, the socialization process followed quite distinct paths along the different partners. In WP-Houston, socialization has been fast and strong but short in range, which has been quite limited to those directly involved with the workshare problem. In CNC, socialization was been quite sluggish and tenuous, however, it has been far reaching, affecting not only the entire Brazilian project members but also stretching to other parts of the local organization and even

into the corporate level. Such difference can be explained in several ways and unveils important insights, particularly those regarding the role of power and politics in *knowledge latency* and *penetration*.

A first explanation is a structural one. At WP there was less people directly involved in the knowledge change process (about 5) compared to CNC (at least 18). On the one hand, the smaller number of people involved allowed new knowledge to gain density much faster at WP than at CNC. On the other one, the reduced number of people affected by change in WP provided fewer links by which socialization could propagate. Further contributed to narrow the socialization channels the fact that roles were much more well-defined at WP (specialist/short-term worker profile) than at CNC (generalist/long-term worker profile). Under tighter roles, new knowledge usefulness remained limited to WP personnel directly involved with the workshare problem, thus imposing an additional limitation for its socialization impetus.

A second explanation is a contextual one. The impact of knowledge change has been much more extensive at CNC than at WP. As a result, new knowledge socialization at CNC required a more careful process of explanation and justification to proceed. In that sense it can be argued that although debates slowed new knowledge socialization and made its institutionalization more tenuous they also made its main typifications and objectivations more widely known and debated. Alternatively, however, new knowledge impact (and thus socialization) at WP has also been limited by CNC action, which decided not to disclose the new knowledge in full. If more elements of the new knowledge had been disclosed (i.e.: progress graphics) it could have brought a deeper impact on the way WP carried their work and thus to the extent it had been socialized and institutionalized.

The higher internal power asymmetry within WP and the lengthy process of deconstruction of the old knowledge also left few room for questioning once new knowledge has been legitimized by top management, what certainly translated into a more straightforward socialization at WP. If on the WP side it was necessary only a first legitimization thrust provided by project management for the new knowledge to settle down, at CNC, a more diffuse power allocation allowed room for a more discretionary action (especially on the part of supervisors) thus making necessary several management interventions to reinforce socialization whenever explanation and justification proven not effective.

This last explanation can be complemented by a cultural component. As suggest by DaMatta (1979), rules in Brazilian society are taken as guidelines for action rather than coercive elements of social order. Therefore, Brazilians (CNC team members included) tend to reinterpret or selectively apply rules and hierarchical decisions taking in consideration broader contextual factors. According to the author, the same does not apply to the U.S. culture (predominant at WP-Houston) to which a rule is an element to be applied equally to all individuals beyond contextual considerations.

Overall it can be said that socialization in WP has been more “power-led” while in CNC it has been more “politically-led”. An evidence supporting this argument is the

fact that once PDY project has finished, and its power relations ended, the new knowledge quickly lost density and completely vanished from WP, while in CNC it kept on being debated and had parts of it applied on other projects. Another evidence supporting this claim is that in CNC the new knowledge remained tenuous for quite a long time only breaking this tendency after “power-led” attempts of non-identical reproduction. Overall, it can be argued that “politically-led” socialization takes longer however its impact on the overall stock of knowledge is more extensive both in time and space. Where socialization is more “power-led”, knowledge changes faster but its influence remains restricted to its direct application point.

Another important insight from PDY is that face-to-face interaction in multicultural work environments (i.e.: international project teams) through short-term assignments can be more conducive to mutual understanding than to misunderstanding. Although in a first moment cultural differences indeed set a stage for rivalry and misunderstanding, given appropriate conditions, these shortcomings tend to be gradually replaced by better communication and collaboration. Several mechanisms linked to the use of international project teams contribute to this process of *cultural distention*.

First, face-to-face interaction through short-term assignments helps team members to acquire first-hand contextual information regarding the conditions under which common work takes place in its different locations. Not only the lived experience helps to demystify prejudices and overcome second-hand impressions but also offer opportunity for engagement on other locations realities allowing for qualified contributions that ultimately improve project team relations. With more information regarding each other contexts available through face-to-face interaction the ground for better mutual judgment and conduct adjustment is already set.

Second, short-term assignments help team member’s communications beyond the acquisition/improvement of language skills. Actions, reactions, behaviors, demeanors, and other non-verbal forms of interaction gradually became unspoken/unwritten elements of language which help improving communication or at least the expectations framework. Face-to-face interaction also provides direct feedback on minor cultural differences further improving communications. To the extent that new information channels are added and meanings are adjusted, it can be argued that communications are “reframed”, that is, adjusted to multicultural face-to-face interaction conditions.

Finally, once contextualization took place and communications were reframed information flew more easily and precisely between team members allowing for the mutual recognition under “knowers” status. Back to their offices, the “knower” status was passed on to other team members further improving the overall project communication. *Cultural distension*, however, can be influenced by a myriad of factors ranging from social to individual. Although it is not the focus of this analysis to point all these factors, some noteworthy features of PDY context have been identified as contributed to a notable *cultural distension*. Among them were

noteworthy the clear goal setting for the team, the receptive stance on the Brazilian team part, and the clear and straightforward pragmatism of the American team.

Another key insight arising from PDY case is that the personal power of a project manager is closely linked to the knowledge resources he has at his disposal both formally and informally. Usually, non-institutionalized knowledge resources are embedded with key people who may develop allegiance links with project managers and favor them in exchange for better project posts or employment stability. Less usual, however, is a project manager to prop up the knowledge resources of his team members in order to enhance his power stance. In PDY, K.G. consistently tried to leverage the knowledge resource he had at hand in order to gain wider visibility in the corporate structure and reinforce his company position compared to his peers. If he had succeeded he would have struck a deal to join another major international project (i.e.: VALE project) almost effortlessly.

In the same way knowledge resources can leverage personal power, power struggle can be transmitted to knowledge processes. As K.G. tried to leverage his position company and corporate wide by propping up the new workshare knowledge, his move has been strategically counteracted by his peers who used their privileged positions to block direct access to other potential users. Manipulating the socialization channels, corporate managers prevented the new knowledge to institutionalize beyond project limits, what would reinforce its density and revert into additional influence for K.G. and his project members. So far, it can be argued that in PDY, the power struggle involving K.G., S.S.H., R.F., S.P.H., D.C.C. and other team members end up limiting the extent by which the knowledge change influenced the company despite its pragmatic implications.

This struggle is representative of how project-led firms are kept under a constant tension. On the one hand, project managers depend on resources provided by corporate managers to accomplish their tasks. However, once engaged into the project with financial resources under his control they can leverage their position almost unconstrained. By controlling determined clients or knowledge resources, project managers can extract power enough to challenge company's hierarchical structure and influence company's ways. Corporate managers, however, are always in a delicate position to provide enough resources for projects to be successful but not enough to be challenged ahead. Overall, power struggle can make knowledge change more unpredictable as it becomes subject to non-pragmatic concerns.

A final insight provided by the PDY case is that even if a new knowledge do not propagate and institutionalize to the point of becoming a widespread practice, it still can influence several areas of the company beyond project boundaries. When a certain knowledge stop being understood as an institutionally coherent piece due to the end of its direct pragmatic application, or because it fail to break resistance of company sectors, it end up retrenching back to a quasi-institutional state (held by few individuals). This way it can be kept alive in a less structured format and propagate through "*project stories*". Eventually it can also be spun off into its objectivations to be selectively applied somewhere else in the company.

9.2.2- UNA3 Case Insights

A first important insight brought about by UNA3 case regards *socialization intensity*. Along this case it was possible to see that socialization intensity increases with subsequent socializations. Those who are socialized under certain knowledge tend to further socialize it with much more intensity. Overtime, however, socialization may intensify to the point of becoming an *over-socialization*. It was noteworthy in UNA3 how the traditional knowledge was much more emphatically enforced by WP-Sofia (who was socialized on it) than by WP-Reading itself (who created it). As a consequence, no method is better at pushing certain knowledge ahead than let somebody who received it already institutionalized to propagate it.

Another important insight from UNA3 is that power asymmetries also make debates to *shift focus* and thus become inefficient knowledge change mechanisms. Along UNA3 it was possible to see several situations where the power prerogative has been used to direct attention away from problematic items or reinterpret them as non-problematic ones. Several knowledge maintaining mechanisms operates in that direction. First, once knowledge is institutionalized (and thus taken-for-granted) analytic focus automatically shifts from core elements towards peripheral ones. Away from the core, relatedness is subject to discretionary criteria which not rarely is guided by non-pragmatic concerns. Second, *institutional knowledge* filters actor's perceptions in a way that they cannot perceive non-covered items as potentially problematic ones. As such, problems that do not fit into the *institutional knowledge* definitions are deemed irrelevant. Finally, to acknowledge that *institutional knowledge* might be faulty or wrong is by definition unacceptable. A power position simply allows actors to disregard evidences that contradict their convictions (institutional ones).

Thin problem analysis is another knowledge maintaining mechanism that can put knowledge change at bay for a long time. *Thin analysis* is frequently used to direct discussions towards elements of the traditional knowledge that still hold for the situation under examination, letting other non-compliant elements hidden and unobserved. In other words, it is an attempt to legitimize a certain knowledge by hiding its faulty parts while highlighting it's still functional ones. Is a deliberate attempt to influence interpretations and manipulating meaning towards a favorable stance regarding the current knowledge. *Thin analysis*, though do not directly deviate focus from problematic knowledge elements, act to make change arguments look less compelling.

Together, *oversocialization*, *shifted focus* and *thin analysis* contributed to a state of blindness among team members where even confronted with mounting evidence against traditional knowledge made them unable to develop a critical assessment or envisage the need for change. Along UNA3 this situation lasted for a considerable time mainly due to a power concentration in the hands of WP-Reading who discretionarily used its leading position to set priorities and drive debates towards its interests. In that sense, it can be argued that in asymmetric partnerships self-interest and strategic intent frequently overcome collective interests and practical intent.

The extent to which WP-Reading used its privileged position to protect its knowledge and interests at UNA3 made *loss of meaning* a phenomenon quite visible. The disconnection between WP-Reading and WP-Sofia situation assessments and pragmatic project needs made current knowledge to lose density for a considerable amount of time. In that sense, *loss of meaning* could be clearly identified in the moments where ungrounded debates involving disconnected ideas become common place. An important insight, then, is that under *loss of meaning*, debates no longer help to redefine problems because common knowledge is so rarefied that it stops providing a common discussion ground. Remaining typifications though existed where scattered and held almost at individual level.

Under these circumstances, it was necessary an exogenous shock (i.e.: client visit) to break with the blindness state in which team members found themselves and to realign typifications and make meaningful debates among team members possible once again. Along this realigning movement it has also been important the participation of B.M. who provided a first critical stance on WP side to alert on the mismatch between situation assessment and project reality. B.M. also promoted *cultural distension* by enacting a boundary-spanning role between CNC/WP and WP-Sofia, which helped communications to improve, and a trustworthiness bond to rise. As a result WP-Sofia changed side and began to support the new contracting knowledge pushed forward by CNC/WP.

Another key insight from UNA3 regards the use of *personal ties* to enfranchise external support and overcome internal resistances for knowledge change. Although WP-reading mismanagement became evident after client visit, it still kept a privileged power position due to the possession of key bid assets (i.e.: certificates, key personnel). To hold control over project, WP-Reading exited joint work and held tight its legitimation role, thus placing necessary knowledge changes at bay. To bring power asymmetry down and move on with necessary changes, both T.D. and B.M. had to use their personal ties to circumvent project structure and indirectly press WP-Reading to loosen its grip over project control. Through *external political action* they enlisted the support of WP managers from other offices and at key corporate positions (i.e.: WP-Houston, WP-London), which could provide alternative legitimation means and thus weaken WP-Reading resistance towards necessary knowledge changes.

Also, a credible mix of threats and trust helped to enfranchise the support of reluctant company executives towards the necessary knowledge changes. By threatening to drop proposal, T.D. forced C.A.J. (i.e.: CNC/WP president) to join ranks and lift the pressure over WP-Reading. Had not T.D. being a long time and respected project manager within the company, and project deadlines looming too close, this strategy would have certainly backfired. In that sense, additional power can be extracted from *momentary opportunities* and *reputational background* at a price that must be weighed against its risks. Overall, a thorough situation assessment and sense of opportunity were found to be key elements supporting *external political action*.

Another strategy adopted by CNC/WP and WP-Sofia to bring power asymmetry down was to swiftly comply with its duties in order to expose WP-Reading misconduct in theirs. This can be quite visible after client site visit when CNC/WP and WP-Sofia joined forces to speed up write-up and man-hour estimation revision, which have been accomplished and approved almost the same time. WP-Sofia has also provided full support to CNC/WP risk analysis virtually without comments. As a result, work activities under WP-Reading visibly became bottlenecking points providing arguments for a more emphatic external political action. Overall, the combination of these two strategies (external political action and careful “housekeeping”) consistently eroded the existing power asymmetry, allowing room for the necessary knowledge changes.

A final but relevant insight from UNA3 is the pervasive influence of long-standing power asymmetries, particularly reflected on an *institutional knowledge* over-reliance. At some moments of UNA3 reliance on the current knowledge was so intense that it prevented team members from even reading the bidding instructions before presenting their contributions and opinions. As a result considerable time has been wasted convincing people of the appropriateness of direction given by the client itself. Over-reliance on *institutional knowledge* also caused activities to go on for a long time without proper feedback. As a result, feedback has been pushed downstream making misunderstandings and misalignments going undetected for a long time.

9.2.3- BGB Case Insights

A first insight arising from BGB case refers to the extent that simultaneously *divergent interest* weakens current knowledge and also the prospects of knowledge change. As debates dispersed around several issues, ground for common understanding diminished, what quickly dragged down the density of current knowledge. Dispersed debates also tend to yield feeble and disconnected typifications that have little chance to evolve into coherent objectivations and contribute to project main goals and to a wider knowledge change. Therefore, just as intense power asymmetry can make debates to *shift focus*, the coexistence of simultaneously *divergent interests* make debates to *lose focus* and also become inefficient inductors of change.

Along BGB, at least three competing poles of interest could be detected. First, CNC/WP interest in acquiring ports and terminals knowledge from WP-Houston. Second, WP-Houston interest in keeping its large specialized structure afloat in a uncertain economic environment. Third, CNC/WP interest in extending its participation and leadership through the whole entrepreneurship. With these three parallel issues competing for team members’ attention, debates have been scattered thus yielding few and weak typifications regarding how to conduct a “fast-track” project that could hardly represent an alternative path to current knowledge. Furthermore, such lack of focus kept management attention away from project main problems, and unable to detect and support new typifications that could have contributed to the necessary knowledge change.

In this line, BGB case provides additional insights that complement the arguments developed along PDY examination regarding the role that management plays in knowledge change process. A first insight points to the important *screening* role played by project managers, which must pay attention to the rising of new typifications among team members and select the most promising ones to receive support towards further developments. By providing the necessary stimulus by which new typifications can emerge and be further developed, managers can both keep knowledge alternatives at hand, and signal team members the direction of change when necessary.

Along BGB, this role has been only partially played by P.R.F. because only through *internal political action* he was able to recognize the need of change and become aware of alternative, more functional ways of managing a “fast-track” project. Even though P.R.F. supported initial typifications and opened an opportunity window towards knowledge change, this happened in a reactive rather than active fashion way. As a result, the impetus provided for knowledge change has been way below the necessary one to foster wider debates and eventually yield a more robust knowledge alternative. As such, although initial typifications materialized into new objectivations (i.e.: responsibility matrix, work breakdown), legitimation has been almost rhetoric resulting in a limited stimulus for new knowledge *socialization*.

This argument also brings to light the role played by *internal political action* in creating the necessary conditions for knowledge change. Along BGB the skillful political action of some team members helped to attract management attention to the need of knowledge change. While W.A. has made a compelling argument regarding the need for more power sharing between partners and a truly workshare arrangement, L.M.A made an emphatic recall of recent company mistakes that should be avoided within BGB, such as sharing project responsibilities with people outside the team. Overall, these two political interventions made management sensible to the need of change and attentive to alternative more functional ways of carrying a “fast-track” project.

Unfolding from these observations, another important insight brought by BGB is that although knowledge materialization helps to increment knowledge density, by no means it supersedes *socialization* and the time component it involves. In other words, knowledge does not acquire an institutional status for the sake of being materialized into objective media but rather by being subjectively introduced in the consciousness of individuals along time. In BGB, although new knowledge has been quickly objectified, the lack of socialization impetus and the assignment of socialization task to someone unfamiliar to its development (J.A.M.), turned knowledge change a short-lived experience. Therefore, a second key role managers play in knowledge change processes is the *sponsorship* one. After legitimizing a new body of knowledge, managers must provide enough socialization stimuli (politically or coercively) so that *socialization* becomes a self-sustaining process.

Overall, BGB case provide compelling evidence that if managers fail to bring into balance this dual role (*screening* and *sponsorship*) under low power asymmetry, knowledge invariably loses density due to a continuous loss of functionality and lack of viable alternatives. Along BGB, knowledge deterioration was almost palpable with uncertainty gradually expanding from “when to do”, into “how to do” and finally arriving at the most basic question: “what to do”. Although, team members may always arrive at new knowledge consensus and endogenously generate the conditions by which socialization becomes a self-sustaining process, under the pressure of time and without leadership more probably they won’t. This happens because for knowledge change to gain momentum, typifications must come up and develop around a certain gravitating point, what requires a certain level of intentionality, certainly an attribute of individuals and well-delimited groups.

A final insight arising from BGB case is that, in case internal team conditions do not favor debates involving current knowledge problems and they produce only feeble and disconnected typifications, knowledge change can always rely on *externally developed typifications*. These are usually brought from prior work experiences on which team members may have participated. Nevertheless, bringing typifications from the outset, break up with collective creation character they are supposed to hold and link them to the specific individual that brought them about, what may eventually generate resistance and weaken its knowledge change potential.

9.3- CROSS CASE ANALYSIS

9.3.1- Cases Similarities

A first noteworthy similarity touches the fact that all three cases began with a considerable power asymmetry, which invariably evolved into a certain degree of power equilibrium. In a broad sense it can be argued that as projects involve non-redundant resources, each participant is expected to provide a unique, and thus powerful, contribution towards project goals. Though at the beginning of the project some tasks are deemed more important than others, overtime their relative contributions are rebalanced in the light of project developments or unplanned events. This explanation support the common theoretical argument that projects teams are by definition zero-sum games composed of interdependent parts whose individual powers naturally neutralizes one another.

A closer look at the cases, however, shows that rather than any natural tendency towards equilibrium it was the active agency of disadvantaged actors that brought down initial power asymmetries. Quite often, power asymmetry translates into knowledge socialization from the stronger partner to the weaker ones. However, any socialization attempt across different situations brings the prospect of dysfunctional outcomes, which are met by weaker partners with opposition and a consequent power struggle. Data collected suggests that disadvantage actors actively seek to rewrite the power balance in better terms not only as a reaction of self-interest but also as a protection against unfair partnership conditions, and they do this by questioning the power distribution basis from which knowledge is a key component.

Evidences that disadvantaged actors carefully explore project contingencies to put forth their power rebalancing strategies abound in the cases examined. Deliberate *rebalancing acts* happened several times along the cases and were particularly salient during “area 8000 design” in PDY, in the “write-up fast delivery” in UNA3, and through W.A. speech in BGB. In common these *rebalancing acts* share intentionality, sense of opportunity, and a great deal of political action, which is essential to expose knowledge (or partnership) dysfunctionalities, align interests and mobilize pro-reform groups. The main goal of *rebalancing acts* is to level down existing power asymmetries in order gain further status in the eyes of corporate managers or to correct for unfair partnership conditions.

Hardly, however, can *rebalancing acts* happen without the sanction and support of management, and their effectiveness is directly linked with the intensity of such participation. In PDY, where *management agency* has been more incisive (K.G., D.C.C), power asymmetry dropped quickly allowing room for a more consistent knowledge change process. In UNA3, *management agency* has been more reluctant (T.D., R.M.Z.), and thus power asymmetry remained high for a considerably longer time putting at risk the prospects of successful knowledge change. In BGB, it is possible to identify two moments with quite different outcomes. A first one, where power asymmetry dropped quickly thanks to active agency of W.A., which opened room for a initial knowledge change movement, and a second one, with the project already running under low power asymmetry, which weakened/scattered change propositions fostering the return of traditional knowledge, and subsequent anomie.

If at the forefront of knowledge change is *management agency*, at the background is the role of “change agents” or *innovators*. In all three cases were detected the presence of “change agents”, who are the first ones to devised a gap between traditional knowledge and project goals, and actively engaged into *political action*, not only to expose those gaps but also to propose new directions. Along the three cases “change agents” can be easily identified as those who first questioned *institutional knowledge* in the light of current situations to unravel dysfunctional typifications from functional ones. “Change agents” were also responsible for assessing and organizing key variables affecting the problematic situations to frame it to a wider audience, thus providing a reference background to further debates.

Can be pointed as “change agents” or *innovators* along the three cases examined A.R.A, L.M.A., B.M., F.F.M., and W.A. In common these “change agents” shared the following characteristics: outstanding academic formation, inquisitiveness, critic view, investigative mindset, open mindedness, strong orientation towards project/corporate goals, group detachment, and framing skills. If their individual characteristics were rather predictable, their emergence proved subtler. If under high power asymmetries to be a “change agent” is a rather unwanted status, under power equilibrium conditions it happens so unconstrained that consensus and a consistent direction of change result attainable. In that sense, data collection indicates that *moderate power asymmetries* not only trigger but also organize agency, and thus foster the emergence of “change agents” in the number and quality necessary to set in motion the change process.

Power rebalancing developments set out another commonality among the three cases. Despite abounding literature pointing to “cultural clashes” as a common outcome of international work settings, data collection points to a much more dynamic and complex picture of these multicultural encounters. Differently from the ubiquitous cultural rifts found in most international business literature, the three cases showed that multicultural relationships evolve overtime, and given certain conditions, do this in a way that improve mutual understanding and allow for groundbreaking political compromises with substantial knowledge change consequences.

On the side of the time, all three cases began surrounded by intense power asymmetries what set the stage for mutual distrust and open rivalries. Under such tense environment, disagreements and broken expectations tend to be blamed on easier to spot dissimilarities, from which cultural differences are a rich and unavoidable source. Moreover the extensive use of lower richness media (i.e.: e-mail, instant messages, phoneconference) for communication in early project phases as well as the absence of social bonds linking project members can be easily associated to the bulk of reported “cultural clashes”. Where project members met earlier in the project development and made use of richer media to communicate, “cultural clashes” have been considerably reduced, as both UNA3 and BGB cases demonstrate.

Whenever power was rebalanced and tensions eased, cultural differences no longer represented valid elements of contention but rather different perspectives over the same subject. Along the cases it was particularly visible that initial rivalries and cultural misunderstandings evolved into quite friendly collaboration once face-to-face interaction began. As previously discussed, face-to-face interaction enables contextualization, improve communications and create social bonds. In that sense, the recognition of each other knowledge as different yet equivalent through the concession of the “knower status” represented the point where mutual understanding was reached and political compromises turn out viable, thus opening an essential path by which multicultural environments can yield groundbreaking knowledge change.

On the side of the conditions, data collection shows that when team members from the weaker partner are assigned to the stronger partner they become mere spectators of the process led by them. Overtime, the weaker partner expatriates are either socialized into stronger partner views, ways and approaches or fell compelled to support them to be accepted in the new environment. To bring about any questioning or resist socialization not only is met with incredulity and disappointment but may ultimately be labeled as assignment failure. As an example, both P.D.J in PDY and T.D. in UNA3 returned from their overseas assignments convinced that stronger partners (WP-Houston and WP-Reading, respectively) held everything under control to few months later realize the knowledge supplied by them provided poor support to project needs.

In the opposite direction, when stronger partner team members are assigned to go to the weaker partner, they are confronted with situations where their knowledge fits awkwardly and thus becomes subject to questioning. Away from the main power source, such questionings must be met with new arguments that require a critical inspection of what has already been institutionalized. Such critical inspection not only softens existing convictions but also opens space for political action and knowledge revision. Moreover, the need to be accepted in the new environment opens room for concessions on the part of stronger partner expatriates, what involves at least listening to what weaker partners have to say. As an example, G.A. in PDY and B.M. in UNA3, arrived at the weaker partner (CNC) convinced that they were underperforming its tasks to later realize that several issues (among them the *institutional knowledge* imposed) prevented them from performing properly.

Therefore, data collection points that moving personnel internationally from the stronger partner for temporary assignments on the weaker partner proved more relevant to overall knowledge change than the opposite move. Such *“bridging” assignments* represent a channel by which power can be rebalanced and *institutional knowledge* resistance be breached. Along *“bridging” assignments* change is key for acceptance and a successful assignment, while in *“socialization” assignments* (from the weaker partner to the stronger one) conformity usually is the awarded outcome. In that sense, moving team members from the stronger partner to the weaker ones help creating the conditions by knowledge change can be triggered.

Even though assignment direction represents an important enabling factor in international project teams, its effects seem to be composed by other elements, what would help to explain some noteworthy deviations. For example, though C.K. (BGB) and G.J. (UNA3) moved from the stronger to the weaker partner, they negatively contributed to the establishment of an enabling multicultural environment. On the other hand, W.A. (BGB), though moving from the weaker to the stronger partner, contributed to establishment of a constructive multicultural environment and to trigger the knowledge change process. In this line, data collection indicates that *cultural interest* and *proximity* are mediating factors affecting the performance of *“bridging” assignments*.

The three cases offer contrasting examples on how different personal approaches towards the host culture affected teamwork integration and knowledge change outcomes. G.A. (PDY), B.M. (UNA3), and W.A. (BGB), for example, demonstrated great *cultural interest*²¹ in interacting and understanding the surrounding cultural environment and therefore represented successful integration examples. Not by coincidence they became active participants of knowledge change processes. In the opposite field, E.R.K. (PDY), G.J. (UNA3) and, C.K. (BGB) provided examples that range from disinterest to negative stance towards the host culture. Overall, they showed little interest in understanding or participating in the surrounding cultural environment and are directly associated to change resistance or negative project outcomes.

²¹ Correlate yet distinct concept from “learning orientation” (Porter & Tansky, 1999) and “willingness to adapt” (Selmer, 2001b).

At the root of *cultural interest* is the individual predisposition to overcome language, meaning and background differences and engage into an exchange relationship with people from different cultures. Expatriation literature (Mendenhall & Odou, 1985; Aycan, 1997; Black, 1988) points that such individual predisposition can be fostered by a myriad of factors. *Prior international experience* (work/travel), for example, has been positively associated to positive expatriation outcomes (Takeuchi et Al., 2005). In this line, though younger and less technically inexperienced, B.M. was already a globetrotter executive while G.J., despite older and more technically experienced, was in its first international assignment. Prior international assignments B.M. may have provided her with the necessary skills to disentangle the uncertainty surrounding international mobility and enable her to overcome cultural differences more easily than G.J.

Another predisposition factor ranked by expatriate literature is *ethnocentric behavior*, which lies in the assumption that home country culture is more important or superior to that of other countries. Ethnocentric behavior is commonly associated to negative expatriation outcomes (Hall & Gudykunst, 1989) and according to Clark et al. (1999) is more often found in central economies like U.S and U.K. In this line, confronted with a mild but increasingly assertive societal environment like the Brazilian one, it would be naturally expected that W.A., which comes from a less assertive societal background (Libya), would present a considerably more perceptive stance when compared to C.K., which comes from an more assertive and rather ethnocentric societal background like the U.K. The same argument may be used to compare the intercultural predispositions displayed by B.M (Bulgaria) and G.J. (U.S.) in UNA3, and G.A. (Colombia) and E.R.K. (U.S.) in PDY.

Cultural interest can also be harnessed by a *welcoming stance* from the host culture (Florkowski & Fogel, 1999), and therefore be externally induced. In all three cases, Brazilian team members displayed a noteworthy *welcoming stance* towards overseas colleagues. International team members were supported in their adaptation needs and receive direct information and feedback regarding their adaptation needs (i.e.: language, location, local habits, and behaviors). Moreover, they were frequently stimulated to join conversations, lunches, and social events. Nevertheless, the effects of a *welcoming stance* seem to be limited to the intensification of already existing predispositions in the sense that no conversion from a culturally disinterested to a culturally interested one has been identified along the cases. Even though, except for G.J. and C.K., at the end of the assignments it was visible the creation of social bonds among local and international team members, what could become visible in the farewell events, personal compliments and post-assignment contacts.

Along data collection *proximity* emerged as an important factor of integration for international team members. *Proximity* can be understood as any condition that creates close contact and direct exposition of international team members to the host context and its actors. Close and direct contact between project members and the host environment require differences (i.e.: idiom, technical terminology, discursive approach, habits) to be worked out in order to make joint work tenable. *Proximity* also prevents cultural segregation and the formation of cliques and the consequent

accruing of culturally-based disagreements. Overall, *proximity* creates structural conditions by which interaction among team members of different cultures becomes unavoidable and at the same time clashes undesirable.

Along the three cases, *proximity* has been achieved by making international team-members to sit side by side with their local counterparts and to be treated as equals and under the same conditions along meetings and team events in relation to its counterparts. Such equality among team members set a level playing field where differences had to be sorted out among counterparts directly with minimum external interference. Moreover, project colleagues become to each other the main point of reference to assess the local context and the expectations and feedbacks of the international partner. By channeling a great deal of information exchange on a limited range of connection points (represented by face to face interaction among counterparts) *proximity* puts a great pressure over actor's ability to streamline communication and arrive at common ground. In that sense, *proximity* almost certainly contributed to sort out differences at a faster pace and in better terms than would be achieved in alternative arrangements.

Nevertheless, data collection shows that *proximity* is not a trouble free integration inductor and under certain conditions has show to induce the opposite reaction. In BGB, *proximity* ended up exposing project contradictions (client interests x management interests) to C.K. so emphatically that his natural distrust has been reinforced to the point of evolving into heavy critics and ultimately causing project rupture. In UNA3, *proximity* ended up taking G.J. into the opposite direction of integration. As he remained resolute to its convictions, several times he decided to detached from the core team to work at the hotel and ultimately retrench back to his office in the U.S.. Such reaction has been identified by Richards (1996) as "exclusion paranoia", where unable to cope with the host environment, the individual is overtaken by the impression that the host community is loaded with threats and is plotting against him/her. Therefore, the use of *proximity* as a mechanism to foster integration in international project team requires careful attention on the part of management, particularly when actors show signs of uneasiness and withdrawal.

9.3.2- Cases Differences

A first dissimilarity involving the three cases regards current knowledge initial density. Data collection indicates that initial *knowledge density* and unfolding *power dynamics* have a direct influence over the prospects of knowledge change. In PDY, where knowledge had been more recently institutionalized and power dynamics showed quite simple, knowledge change has been a straightforward process. Along UNA3, with a moderately institutionalized knowledge and a more intricate power dynamics, knowledge change struggled to happen. In BGB, under a highly institutionalized knowledge and a complex power dynamics, knowledge change showed unattainable. Data indicates that the way *knowledge density* and *power dynamics* interrelate to allow for knowledge change is mediated by a myriad of contextual factors out of which *socialization length*, *actors' self-confidence*, and *leadership behavior* have shown to be important ones.

Data collection shows that under a low-density initial current knowledge, power asymmetry unleashes socialization forces that set in place for a long period of time create self-reinforcing mechanisms that provide a great momentum for knowledge institutionalization. In PDY this process has been aggravated by the fact that current knowledge has been functional for quite some time, what further reinforced its socialization thrust. As a result of such a lengthy socialization, current knowledge density strengthened overtime even though power asymmetry weakened. When dysfunctionalities emerged current knowledge had already attained institutional level, nonetheless power asymmetry was already low enough to encourage political action to start up knowledge change.

In the other two cases, projects began with current knowledge considerably more institutionalized. However, even though socialization impetus was stronger, current knowledge dysfunctionalities emerged soon enough to prevent them from acquiring a self-reinforcing dynamic. In such downward knowledge density scenario two situations took place. In a first moment, under a declining power asymmetry, BGB team members have been able to engage some level of political action towards initial knowledge change movements. In UNA3, however, power asymmetry resisted for a long time even faced with a declining knowledge density. In the absence of political debates that could yield new typifications and reset problem definitions, current knowledge density plummeted bringing the risk of anomie.

Under a knowledge density upward scenario, with new knowledge already underway, the role of power asymmetry in knowledge change seems to reverse. From knowledge change deterrent, power asymmetry became a knowledge change inductor. As an example, in PDY, a moderate level of power asymmetry helped knowledge to gain density enough to cross the institutionalization threshold and becomes self-reinforcing through socialization. In a second moment of BGB, the lack of power asymmetry deprived new knowledge from the necessary support for its further development and initial socialization, and as a result new knowledge density scaled back. At that point, the absence of some power asymmetry to qualify and direct debates, also let team members with no other option than retrench back to old knowledge shortly before falling into anomie.

Overall, data indicates that to spark political action and allow room for knowledge change, declining current knowledge density must be met by a moderate or declining power asymmetry. Great power asymmetries discourage political action and thus hinder the reaction capacity of team members to a decline in current knowledge density. On the other hand, some level of power asymmetry is necessary to make new knowledge gain density prior to socialization gain momentum and becomes self-reinforcing. In the absence of some power asymmetry, new knowledge may take too long to gain density by its own functional merits and fall prey to underdeveloped objectivations or the strategic action of disadvantaged actors. Data also indicates that a scenario of power equilibrium and low knowledge density (for both current and new knowledge) is highly conducive to a state of anomie, and thus interaction paralysis, what invariably translates into project failure.

In that framework, it can be argued that *socialization length* affects knowledge density upward responses to changes in power dynamics. The longer the socialization processes are in place the less dependent upward knowledge density becomes from power asymmetry. Decoupling initial knowledge density from power asymmetries creates a favorable environment to knowledge change processes. Such favorable environment is further encouraged under simpler power dynamics (i.e.: horizontally organized actors, single/aligned interests), which are expected to react more quickly to changes in knowledge density. The shorter the socialization processes, and the more attached initial knowledge density becomes from power asymmetries, the harder is to promote knowledge change without power rebalancing. Under a complex power landscape (i.e. vertically integrated actors, multiple/concurrent interests) power rebalancing can be a lengthy process and make knowledge lose too much density before change comes within reach.

The following diagrams represent the proposed socialization length role over upward knowledge density movements in relation to power asymmetry developments:

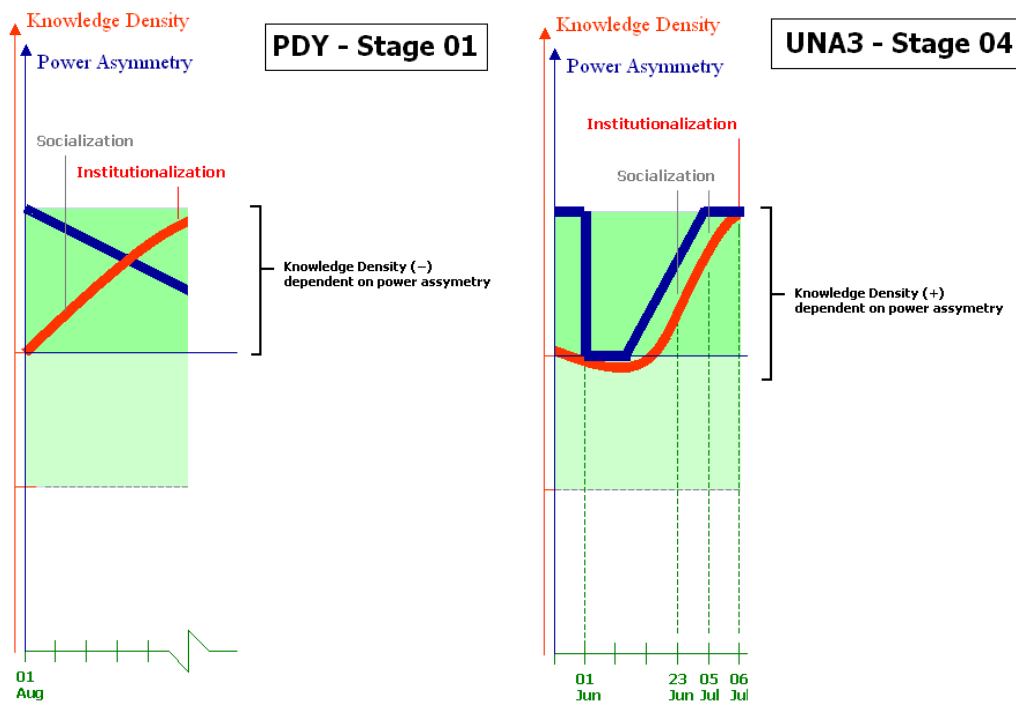


Fig. 131: Socialization length influence on upward knowledge density and power asymmetry developments.

Another contextual factor that has shown to influence knowledge density and power dynamics developments was *actors' self-confidence*. Self-confidence allow actors to question current knowledge dysfunctionalities earlier in time and under less favorable conditions than less confident ones. Such influence operates two-fold. First, lack of confidence makes current knowledge go unchecked and uncontested for a longer period of time allowing for a deeper socialization and a consequent gain in knowledge density that becomes harder to revert. Second, confident actors are able

to question knowledge dysfunctionalities at higher levels of power asymmetries than less confident ones, thus anticipating power dynamics developments that might allow room for knowledge change to happen.

Along data collection CNC and WP followed partially divergent paths regarding self-confidence. Thanks to the worsening Brazilian engineering business scenario (between 2009-2011) and ownership transition developments, CNC personnel self-confidence scaled back from a very confident stance at PDY, to an hesitant one at UNA3 and finally to a rather unconfident stance during BGB. This partially explains why current knowledge has been more emphatically debated and criticized at all levels along PDY (though it was embraced in the beginning under the expectation of a “superior knowledge”), criticized but with more restricted debates at UNA3, and nor debated neither criticized at BGB.

WP personnel self-confidence also underwent considerable transformation along this investigation, however, data collection indicates that it has been far more complex and multifaceted process. As WP moved from a multi-domestic company made out of acquisitions towards a full-fledged transnational company, some offices acquired the status of “excellence centers” whose knowledge has been legitimized at some extent by top WP management. Such legitimization did not happen formally through charter assignment, however, WP “excellence centers” were automatically enrolled in projects involving their engineering specialties. In a first moment, “excellence center” personnel have been empowered and became quite confident of their “superior knowledge”. In a second moment, however, with this “superior knowledge” brought to novel situations, submitted to deeper scrutiny, and confronted with local alternatives, a sense of uneasiness quickly superseded any confidence gains at the “excellence centers”. As such, apart from the intensification in the use of international project teams, data collection shows little influence of this transformation over WP personnel self-confidence across the three cases examined.

Overall, it can be argued that *actor’s self-confidence* affects knowledge density downward response to changes in power dynamics. The more self-confident actors are the less dependent downward knowledge density response becomes from power asymmetry (TYPE1). By exposing current knowledge inconsistencies and dragging knowledge density down, earlier questionings create a favorable environment for knowledge change to happen if power dynamics shown responsive. Also, the more self-confident actors are the less institutionalized current knowledge becomes and the easier to promote knowledge change in face of favorable power dynamics (TYPE2). Again, decoupling initial knowledge density from power asymmetries creates a favorable environment to knowledge change processes, which is further encouraged under more flexible power dynamics and hindered under more rigid ones. The following diagrams represent the proposed role of actor’s self-confidence over downward knowledge density movements in relation to power asymmetry developments:

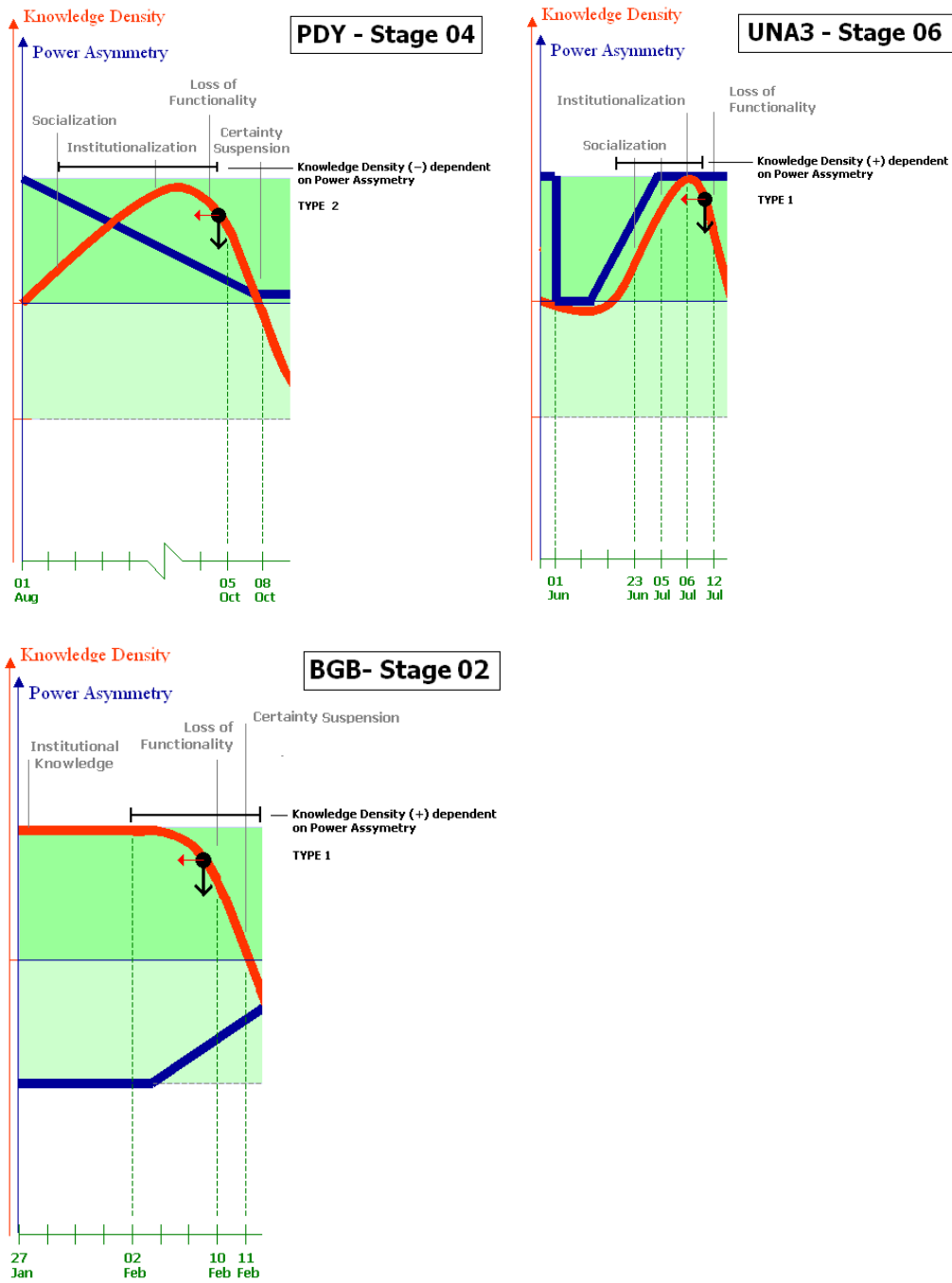


Fig. 132: Actor's self-confidence influence on downward knowledge density and power asymmetry developments.

A last relevant contextual factor that has shown to influence knowledge density and power dynamics relationship was *leadership behavior*. Differently from socialization length, which influences upward knowledge density, and actor's self-confidence, which is linked to downward knowledge density, *leadership behavior* has shown to affect power asymmetry responses to changes in knowledge density in both ways. By paying close attention to knowledge density variations, project managers are in position to actively influence power dynamics to facilitate knowledge change developments.

Project managers shall be able to perceive a steep fall on knowledge density and act to timely countervail power asymmetries in order to stimulate debates towards new typifications, and facilitate the emergence of alternative directions. This way, project managers can prevent knowledge from losing too much density before a viable knowledge option emerges, what can drive project teams into ineffectiveness and even paralysis. Also, project managers shall be able to look through a myriad of new typifications and incipient objectivations and spot a promising collection of them to receive support towards further developments, and eventual legitimization and socialization. Acting like this, project managers organize knowledge change efforts and prevent the search for alternatives from taking too long or losing focus. Once spotted a new viable knowledge option, project managers are in position to lift power asymmetry back to help new knowledge to consolidate and gain density.

Along data collection three quite distinct *leadership behaviors* can be identified. In PDY, project leaders (i.e.: K.G., V.S., S.B.D., C.C., D.C.C., L.S.J.) timely recognized the steep fall in knowledge density and quickly reacted to turn power dynamics in favor of knowledge change. When a viable knowledge option emerged, once again power dynamics moved to support new knowledge development and consolidation. As a result of such attentive leadership behavior, PDY knowledge change process happened in an opportune and confident manner. Even though the window of change brought some disturbances into project daily activities, the amplitude of such disturbances have been relatively small, and thus, well assimilated without major impact in project team effectiveness.

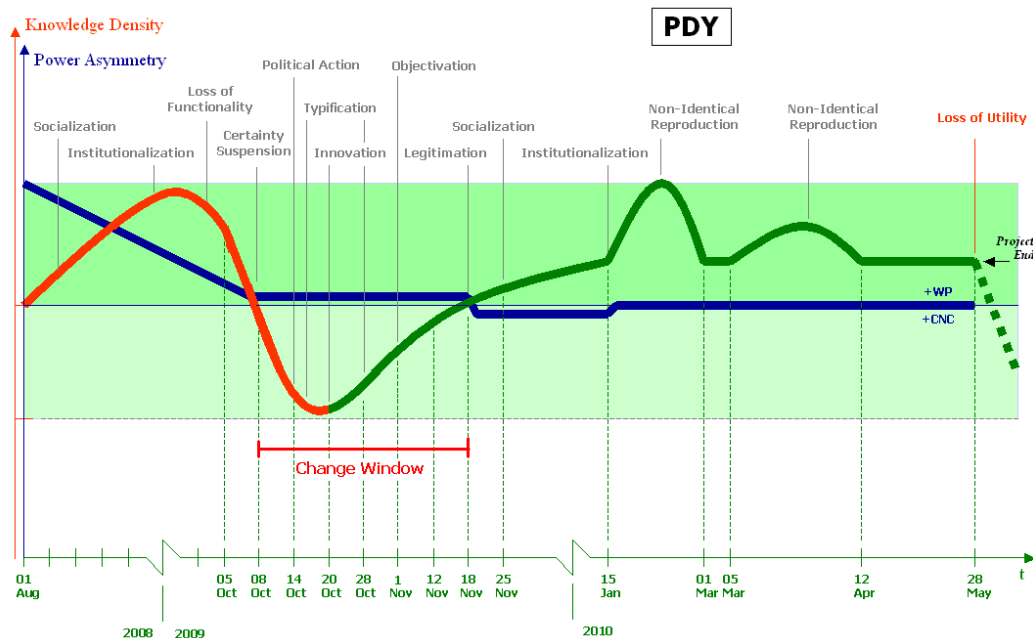


Fig. 133: PDY knowledge change window.

Along UNA3, project leaders (i.e.: T.D., R.M.Z., G.J., L.S.V., B.M.) either took too long to recognize knowledge dysfunctions or did not put the necessary effort to timely get power dynamics in line with necessary change. Consequently, knowledge

density fell sharply and project went on the verge of anomie. Power dynamics only began to move favorably towards knowledge change thanks to an indirect client intervention, which made knowledge dysfunctionalities blatant. Such late political action required several vigorous interventions from T.D. and B.M. to revert power asymmetries, thus slowing new knowledge development and consolidation. As a result of such hesitant leadership behavior, UNA3 knowledge change process struggled to happen and got too close to failure. Its window of change stretched too long causing great disturbances, taking a toll on project team effectiveness.

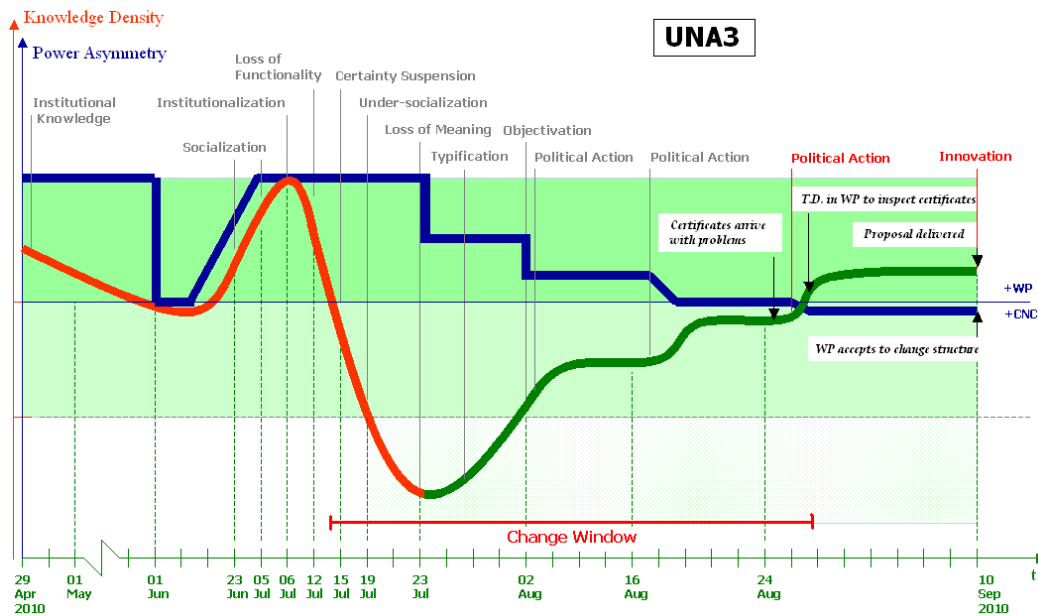


Fig. 134: UNA3 knowledge change window.

In BGB, project leaders (P.R.F., C.C., S.S.H., W.A.) were so abstracted with present and future contract management that they became completely unaware of upfront knowledge dysfunctionalities and the consequent knowledge density freefall. Parallel, power asymmetry has been leveled not as a result of a deliberate strategy to allow for organized knowledge change but rather as a disorganized response to unfolding events. When a viable knowledge option came by, project leadership had already lost control over power dynamics, and thus, has been unable to provide a favorable environment for its development and consolidation. As a result of such inattentive leadership, BGB knowledge change process failed, throwing the whole undertaking into irreversible anomie. The available time for a window of change has been severely restricted by the time-compressed nature of the project what put great pressure over leadership ability to drive power dynamics favorable to knowledge change.

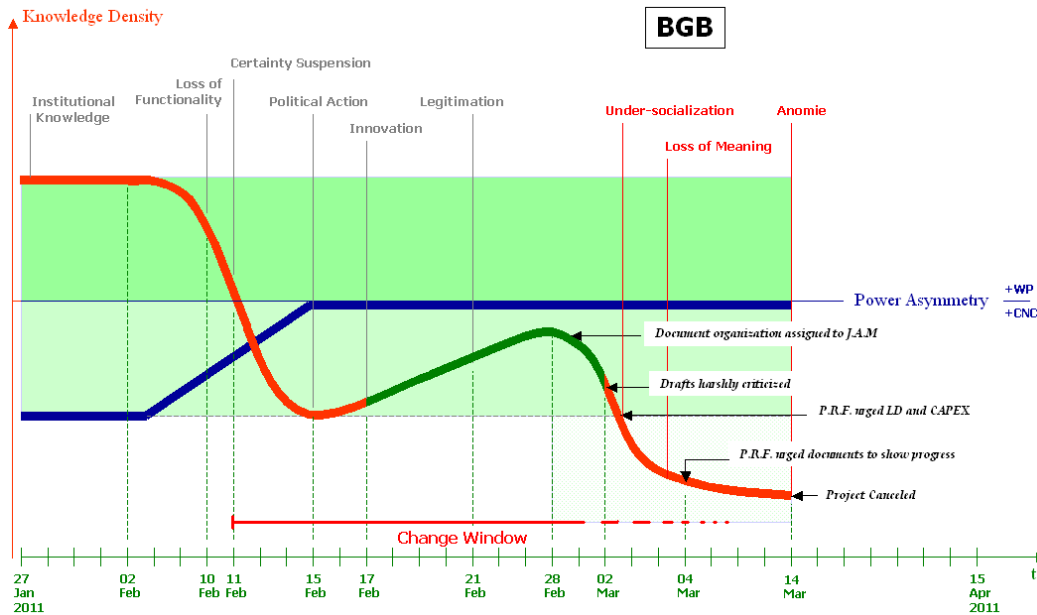


Fig. 135: BGB knowledge change window.

Overall, *leadership behavior* has shown to affect power dynamics responsiveness to changes in knowledge density. An attentive leadership is better positioned to gauge exploitation and exploration gains and thus anticipate the necessary interventions in power domain. In this line, data collection indicates that project leadership sets the pace of knowledge change by opening and closing the opportunity window by which team members can contribute towards more functional outcomes. Therefore, even though project leaders may not take direct part in the elaboration of new typifications or objectivations they actively participate in the change process by providing a favorable environment in which knowledge change can take place.

Another dissimilarity involving the three cases refers to the nature of the knowledge under examination. PDY case involved a strictly technical subject, whereas UNA3 a commercial one and BGB a management issue. Data collection indicates that beyond *knowledge density*, which is a function of the number of people attached to the same definitions, another less variable knowledge property that affects the prospects of change is *knowledge nature*. Technical knowledge whose debates can be brought closer to objective/rational terms proved easier to change. On the opposite corner is management knowledge whose debates mostly happen in a highly subjective/emotional ground and proved very resilient. In a middle position, commercial knowledge displayed a dual character, ranging from a strict rational logic when dealing with financial subjects, to a completely subjective one when dealing with strategic issues.

Along data collection, technical knowledge (PDY/UNA3) has been *widely debated* by all ranks of team members who from several different perspectives contributed in many different ways to stimulate and enrich debates. Team members directly involved in debates frequently had to use *objective evidences* (i.e.: images, graphs,

numbers, tables) to prove their point and were frequently submitted to refutation tests that further extend changes of reinforced prior conclusions. Additionally, team members involved in technical debates displayed the *clear goal* of arriving at better project outcomes based on the objective premise that less cost/better process (as project products are mostly specified upfront) should be met. Even though, the prospects of carving out a promotion or solely shy away work could be sensed along some debates, they still laid behind the less-cost/better process argument.

Management knowledge debates (UNA3/BGB), on the other hand, have been mostly conducted in '*petit-comité*' by top management personnel who mostly relied on *subjective evidences* (i.e.: past experiences, third-party stories, impressions, empirical observations) or *second-hand objective* ones provided by middle management to prove their points. Great secrecy covered ongoing discussions, leaving even middle management at the margins, and thus blocking any chance of external influences to penetrate debates. It can be argued that the reduced number of perspectives as well as the use of intrinsically weaker evidence, and the hierarchical relations involved in such "*petit-comités*" most certainly induced a sense of collinearity among participants curbing drastically the prospects of change. Also, not rarely top management displayed to be moved by *multiple and conflicting goals*. If on the one side such lack of direction scattered debates, on the other one, the sensitive character of underlying interests restricted debates or made them very subtle, further limiting the prospects of change.

Overall, data collection indicates that the *subjective level* of debated issues, and the *underlying motivations* behind actor's actions are two important factors affecting the prospects of knowledge change. The more subjective the issues under examination the less grounded debates becomes and the harder it is to arrive at noticeable knowledge change. The more objective the problems under examination the more likely debates can yield a substantive knowledge change. Also, the more straightforward actor's interests the easier to arrive at a common ground and thus to some level of knowledge change. The more furtive and subtle actor's interests the harder for common ground to be reached, and thus, to yield any knowledge change. In that sense, knowledge change is not only function of current knowledge state but also function of intrinsic knowledge characteristics that affect team members' ability/predisposition to move in direction of change.

Together, *knowledge density* dynamics and *knowledge nature* constrains help to explain other dissimilarities observed along the cases. A key dissimilarity explained by this combination is the reach of knowledge change outcomes. Although the three pieces of knowledge analyzed were corporate wide relevant, the reach of knowledge change varies along each case. In PDY, knowledge change has been restricted to the project, while in BGB it somehow got lost at firm level, and only at UNA3 it acquired wider corporate implications. Data indicates that the reach of knowledge change outcomes is linked to the *managerial strength* placed to make it happen and to the extent that knowledge nature is transformed along this process.

As previously discussed, data indicates that the more material/objective and the less dense current knowledge is, the easier to promote change. Conversely, the more ideational/subjective and dense knowledge is, the harder to promote change. The combined action of these two knowledge features would explain why in PDY knowledge change has been successful, while in BGB it failed, as well as why UNA3 fits a in between position. Nevertheless, extending analysis beyond the change process itself into the reach of its implications, it is possible to go deeper in this interplay to argue that *knowledge density* and *knowledge nature* have a relationship on their own. The examination of the opposing knowledge expansion paths followed through PDY and UNA3 can provide closer details of this relationship and the elements involved.

In PDY, although the knowledge under examination involved a managerial/subjective component, all along the change process it has been handled in a technical/objective way. However, as new knowledge began to cross project boundaries towards further reach and deeper institutionalization (K.G. initiative) it has been immediately counteracted by the *strategic action* of other firm ranks. Three venues of *strategic action* have been used to weaken new knowledge: containment, delegitimation and discredit. By taking control of boundary-spanning positions, S.S.H. and R.F. blocked the communication channels by which new knowledge could expand beyond firm boundaries (i.e.: WP-Edmonton workshare). Next, delegitimation took place in the form of an subtle downplay of new knowledge relevance within firm, particularly on the part R.F. (i.e.: seminar delays and absence). Finally, new knowledge has been submitted to direct subjective inquire by an internal oppositional stance (i.e.: S.P.H, who has always lead 3D design) in order to cast doubts over its functionality. Together, these three *strategic action* mechanisms blocked new knowledge expansion, limiting its reach to project boundaries.

Theory shows that differently from *political action*, which has the aim to transform knowledge in objective grounds through open and direct debates, *strategic action* has the aim to transform knowledge in subjective grounds through subtle and furtive moves. In that sense, *strategic action* works in the opposite direction of socialization. While socialization tries to build up knowledge density by progressively establishing a subjective complementarity between objective practical implications, *strategic action* deliberately works to deconstruct knowledge by exposing structural flaws in this subjective complementarity and extending them to the objective results of its practical implications. Although, disadvantaged actors can also make use of *strategic action* to resist socialization, it is by excellence a tool of the powerful. While low ranks lack resources to trade and a central network position to manipulate communications, top ranks have all what they need to make use of *strategic action* as tool to block change.

The undercover character of *strategic action* is a necessary one both to exchange refutation for validation and to avoid direct confrontation. Discretion helps throwing the proof of validity to those promoting knowledge, exempting opposing actors from elaborating and submitting a refutation test, what beyond time-consuming may end up promoting or perfecting what was supposed to be weakened. In addition, to bring

objective evidence to a subjective discussion is always a problematic situation because, given a sufficiently biased or uninformed audience, even objective proofs may be dragged into doubt. As such, *strategic action* intrinsically depends on furtive methods to avoid confrontations that could ignite open debates and settle discussions into more objective grounds.

The use of *strategic action* to curb new knowledge expansion along PDY indicates that in its expansion path new knowledge objectivity has been progressively confronted in more subjective terms. As previously discussed, although new knowledge can gradually gain density and expand through socialization this process can be further accelerated by the use of power. Data indicates, however, that if on more objective grounds power can act as an inductor of knowledge change, in more subjective ones it may become a deterrent. First, in more subjective grounds the additional strength provided to new knowledge can be seen as a threat to firm's internal power balance and thus trigger oppositional stances. Second, because a "power-led" socialization induces a premature transformation of new knowledge objective nature into a subjective one, thus making it easier for disadvantaged actors to oppose it. Consequently, as new knowledge expands through the use of power it is confronted with an increasingly less friendly environment what happened to limit the spread of PDY new knowledge to the neighborhoods of its practical application.

In a certain sense, UNA3 represents a diametrically opposing situation both in terms of context and results. In UNA3, although the knowledge under examination involved a objective/technical component, right from the start it has been handled in a highly managerial/subjective way, with a particular emphasis on strategic interests. In a framework of intense power asymmetry and project management reluctance in confronting it, change come up as a result of indirect client intervention. Taking advantage of a complete re-shift in problem definitions that disorganized WP-Reading hegemony, T.D., on the part of CNC/WP, and B.M., on the part of WP-Sofia, joined efforts towards the necessary knowledge changes. Due to a number of corporate concessions necessary to make the proposal viable, knowledge change expansion was fundamental for the accomplishment of project goals. Instead of using power to prop up the new knowledge T.D. and B.M. successively push the threshold of political action upwards. Every time, T.D. and B.M. faced *strategic action* on the part of WP-Reading they responded pushing objectivity upwards attracting the support of high ranks around corporation linked to project goals. As a result new knowledge expanded by progressively pushing the objective character of its implications into subjective grounds.

Overall, it can be argued that the use of power to prop up new knowledge density has intrinsic limitations. Assuming that *political action* gain strength on material/objective grounds and *strategic action* gain strength on ideational/subjective grounds, the more power is used to boost new knowledge initial density the more opposition it is expected to attract as it moves from objective to subjective grounds. Data collection suggests that power alters the perception of knowledge density and knowledge nature, making denser knowledge also look more subjective and thus subject to strategic action. Therefore, the only way to extend the

reach of knowledge change beyond the neighborhood of its practical implications is to enfranchise the support of higher ranks through open and direct debates, thus extending upwards the threshold of political action.

Conversely, although some level of knowledge change has been achieved in all three cases, it can be argued that only at PDY it acquired a perennial status. Although, strategic action prevented PDY new workshare knowledge to expand corporate-wide, some of its key elements (i.e.. SIC spreadsheet, fig. 42) manage to spread within CNC/WP limits inclusive to UNA3 (i.e.: proposal completion control, fig. 70) and BGB (i.e.: responsibility matrix, fig. 99). If on the one hand it can be argued that as PDY has been the first case to be approached then it stands in a privileged analytic position, on the other hand, data collection suggests that several other factors may have also contributed to differentiate the depth of knowledge penetration of this case in relation to the other ones.

First, PDY new knowledge higher penetration can be explained by the "politically-led" character of its socialization within CNC/WP. As previously discussed, due to local cultural features new knowledge socialization had to be perfected and carried on for a longer period of time what made it to acquire a comparatively stronger self-reinforcing character within firm limits. A second explanation touches the fact that faced with opposition, socialization becomes imperfect and thus knowledge reproduction more subject to variation. While weaker objectivations and typifications may fall apart, core ones are likely to remain compelling and become more easily transmitted to niche audiences. In this sense, it can be argued that although strategic action can limit the reach of knowledge, *non-identical reproduction* can further strength its penetration. Finally, moving people across projects is also an objective way to spread *quasi-institutional knowledge* across the company. Although individuals are unable to embody *institutional knowledge* and carry on socialization on their own, they are still capable of carrying a considerable amount of typifications/objectivations elsewhere, thus promoting new knowledge penetration.

Another noteworthy dissimilarity among the three cases touches the *innovation timing*. Data collection shows that whereas for PDY and BGB *innovation* represented a key step in a wider knowledge change process, for UNA3 it looked more like the ultimate product of the knowledge change process itself. Deeper analysis involving the broader context, however, reveals that this process/product paradox can be explained if one takes in consideration the dimension of the knowledge change process in relation to a single observer's perspective. In PDY and BGB, for example, the scope of knowledge change has been relatively contained to project/firm boundaries. So far, knowledge change depended on a singular problem redefinition involving a limited number of people and a relatively simple set of typifications and objectivations, elements that were gathered around a visible boundary and developed along a clearly delimited timeframe.

For UNA3, however, the scope of knowledge change has been considerable wider as it involved a key business knowledge and several corporate entities. Thus, knowledge change required the redefinition of a multifaceted problem involving an

undefined number of people and a complex set of typifications and objectifications. While in PDY and BGB the knowledge change process could be apprehended by a individual observer as whole (first image, fig. 136), in UNA3 it became too large to be captured in detail without allowing for temporal distortions (second image, fig. 136).

Distortions in the perception of time have been long described by authors in the field psychology like Ornstein (1975), Hicks et al., 1976), Fraisse (1984), Taylor (2005), Grondin (2010), and Le Poidevin (2011). In common these authors argue that the perception of time is influenced by the amount of information absorbed by the observer. The more information is absorbed, faster is the perception of time, and thus, greater the difference between actual and perceived timeframe. In that sense, as complex processes overwhelm individual observers with data, they tend to believe that they have ended while they are still unfolding. Along knowledge change process, a truncated time perception makes innovation look closer to the end, and thus a product rather than a process.

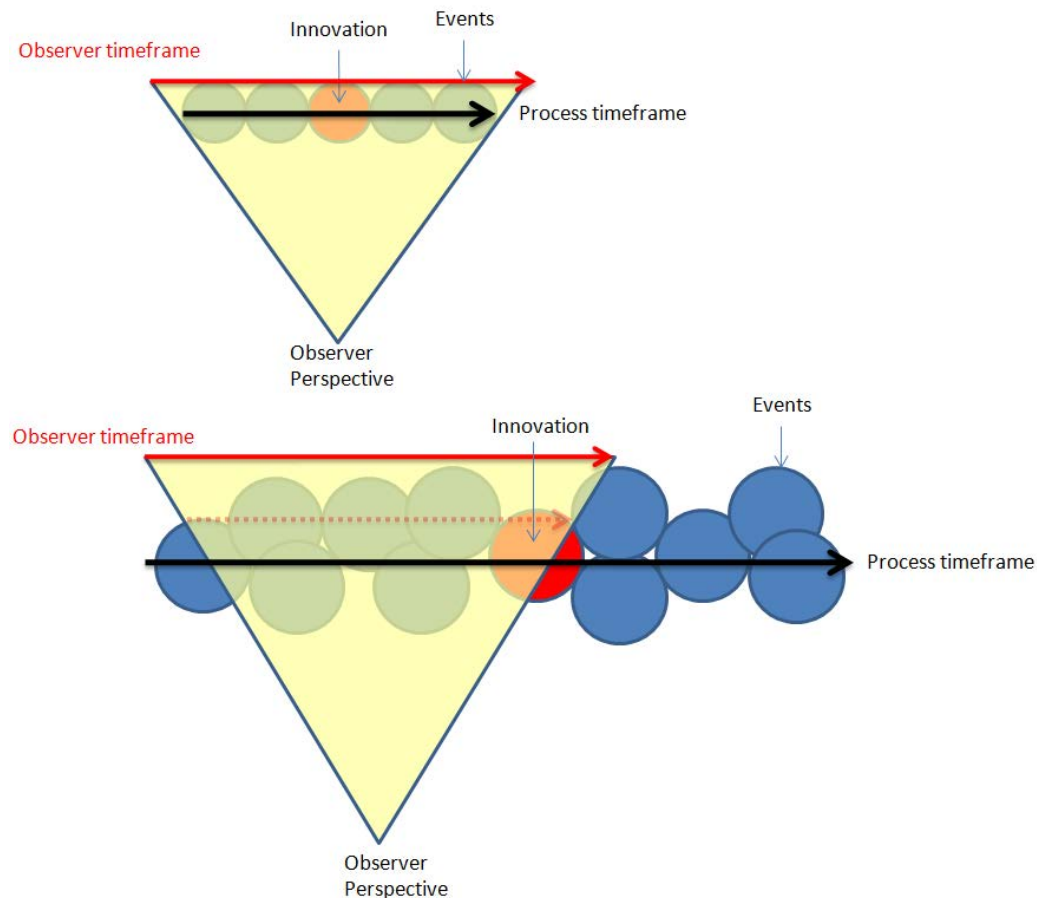


Fig. 136: Process/product paradox applied to the knowledge change process.

Further complement the prior argument the notion of *analytic myopia* found in works as diverse as Levitt's (1960) on marketing, Porter's (1992) on strategy, and Stein's (1998), Larwood & Whittaker's (1977), Miller's (2002) on managerial decision. In common these authors identify actor's tendency to focus on a rather restricted frame of analysis at the expense of a more encompassing one. In practical terms,

analytic myopia translates into the inability to see problems and processes in their due perspective, therefore distorting cause-effect relationships. Drawing on this concept, it can be argued that if from a more restricted perspective and a compressed timeframe innovation looks like a product, seen from a wider perspective and through an expand timeframe, it once again looks like a process (see fig. 137). This observation further contributes to the argument that innovation is a fundamental step within a larger process of knowledge change rather than a product in itself.

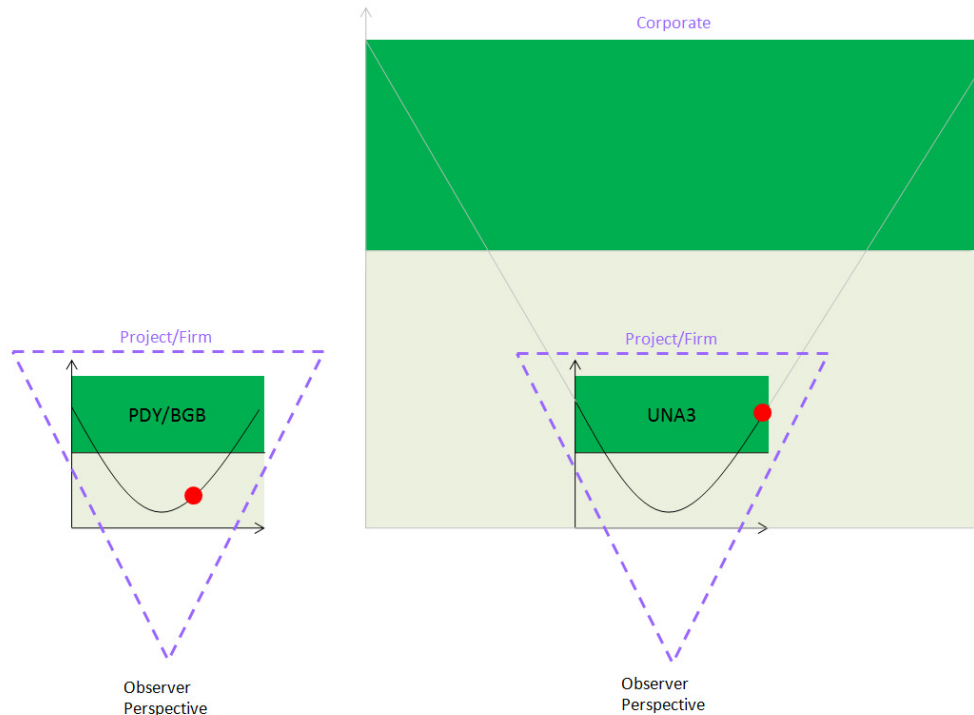


Fig. 137: Process/product paradox applied to PDY/BGB in comparison to UNA3.

Beyond intrinsic knowledge features and situational factors, broad contextual differences have also contributed to the observed outcomes. *Client participation*, for example, clearly distinguishes the three cases, with BGB enjoying direct participation, UNA3 indirect participation, and PDY in a midterm position with client operating at arm's length. Along PDY and BGB, power asymmetry quickly responded to the loss of knowledge density whereas at UNA3, it resisted quite long time, particularly due to the absence of a countervailing force to disrupt existing power asymmetries. In that sense, data indicates that the closer is client participation, the faster tends to be internal power rebalance in face of a dysfunctional knowledge. Nevertheless, in PDY client pressure had been positively channeled towards knowledge change while at BGB it has been so intense that became disruptive to the knowledge change process, suggesting that there is a limit on how much client participation can contribute to knowledge change. Overall, clients represent a key source of both power and legitimation and to the extent they influence intra-company power balances they can decisively influence the outcomes of knowledge change processes.

Also, the *level of international interaction* have been quite different across cases, with PDY involving a more limited interface interaction, while UNA3 and BGB involved a broader and more direct one. The *level of international interaction* is a measure of the number of different cultural backgrounds team members were exposed to while interacting within international project teams. In PDY, only two different cultural backgrounds were in play and at a moderate distance, what despite allowing for a certain rivalry contributed to a simpler compromise and more straightforward change process. In UNA3 and BGB, however, the number of different cultural backgrounds was considerable higher and their interaction much closer. If on the one hand such background dispersion made polarization more difficult, on the other hand it also made a compromise less likely. In UNA3, a great deal of political skill has been necessary to set a level playing field for debates stripped out of cultural biases, a situation rendered almost impossible in BGB due to the conflictive character client-management relationship acquired along project. Overall, data indicates that the higher the *level of international interaction* the easier to move towards change however harder is to reach at common ground, thus requiring great political skills on the part of change incumbents.

9.4- KEY STUDY FINDINGS

9.4.1- Analytic Backdrop

In the first place, data examination indicates a considerable correlation between the theoretical framework used to approach knowledge change and the investigated phenomena. Data shows clear signals of theoretically expected processes, such as typification, objectivation, and institutionalization.

Overall, *typification* could be identified as the process by which individual concepts regarding reality emerge out of individuals' direct interaction. In that sense, *typifications* are incipient and unstructured attempts to approach reality at the level of individual interaction. Typifications are very subtle cognitive and discursive entities that can be detected in speeches at near subliminal level, and which progressively grow from recurrent thematic, to metaphors, and then to ad-hoc concepts. The intersubjective negotiations that create typifications runs almost unnoticed along interactions and follows a path of interactively testing "tags" and "meanings". At a certain point a "tag/meaning" pair (i.e.: "freezing"/"make things stop changing for a while") is formed and increasingly used to recall a determined aspect of reality in further interactions.

Along data collection, *typification* was particularly salient in PDY. A great effort to grasp the overall situation and provide a backdrop for debates, what can be detected along recorded meetings, especially those from 5th Oct. 2009 to 14th Oct. 2009. For UNA3 and BGB, however, typification have been far less salient thanks to diametrically opposing reasons. In UNA3, persistent power asymmetry left almost no space for typification to take place. Rather than interactively generated, typifications emerged almost ready to use out of client visit. In BGB, the lack of direction dispersed debates what resulted in fewer and weaker typifications. As a

result, key typifications had to be "imported" from the outset rather than interactively generated.

Objectivation, on its turn, could be identified as the process by which typifications were refined and interconnected along multiple interactions. *Objectivations* provide a more structured and encompassing interaction frame which enhance mutual understanding and enable further advances in reality definition. Objectivations rise up as new understandings/reality propositions, as well as proposed courses of action, to be submitted to a wider audience. As such, they can be detected in the form of incipient discourses or even materialized into objects such as studies and prototypes. Even though objectivations already present a certain level of structuring, the typifications that compose them and their links remain relatively feeble and are still subject to negotiation. In that sense, typifications may be added, changed, and subtracted in order to enhance new knowledge functionality and endorsement. Along successive rounds of interaction reality definitions gain a well-defined shape so that concerted social action turns viable in determined directions.

Data collection shows that *objectivation* manifested both in discursive and material terms across all cases. Along PDY, new knowledge has been objectified by the urge "to control model handover and execution" discourse, which materialized in the form of "WORKRESP" attribute, extraction, SIC spreadsheet, and weekly progress curves. In UNA3, new knowledge has been objectified by the "that's how business is done in Brazil" and materialized in the "proposal completion spreadsheet" and in the proposal "write-ups" and "man-hour estimations". Finally, in BGB, new knowledge has been objectified by the "this is a unusual job and needs unusual tools" discourse and materialized in the form of a "work breakdown plan" and a "responsibility matrix". As transmittable and testable propositions, objectivations are far more observable than the typifications that compose them, however, objectivation still is a highly interactive process that requires a great deal of attention from change incumbents.

Finally, *institutionalization* came up as the process where objectivations consolidated into an encompassing system of roles and representations, which enabled actors to cope with a determined reality definition. *Institutional knowledge*, therefore, embodies a concrete reality definition and a concerted guide for action to be transmitted and abided by. As a complex system that intersubjectively link actors at several levels and across different timeframes, *institutional knowledge* is not readily observable as an ensemble. At moderate levels of institutionalization, part of its constituents become salient along socialization processes. When highly institutionalized, however, *institutional knowledge* becomes partially visible through widespread assumptions that end up constraining actor's perceptions of a changing or different reality, and taken for granted courses of action, that pay little attention to environmental circumstances or unexpected outcomes.

Along the three cases, only at PDY new "workshare" knowledge attained institutional level within project boundaries. In UNA3, new "global-pricing contracting" knowledge objectivation has been fully accomplished and it managed to cross the institutionalization threshold, however, there is not enough data available

to confirm if it has indeed attained institutional level at corporate level. In BGB, new "fast-track project management" knowledge change retrenched back before crossing the institutional threshold. Nevertheless, in the beginning of each project, the strength of current *institutional knowledge* could be felt at rather different levels. In PDY, *institutional knowledge* presented itself through the "look at the model" approach, in UNA3 through the "reimbursable-costs contracting" mindset, and in BGB as the traditional "detailed engineering" project management approach.

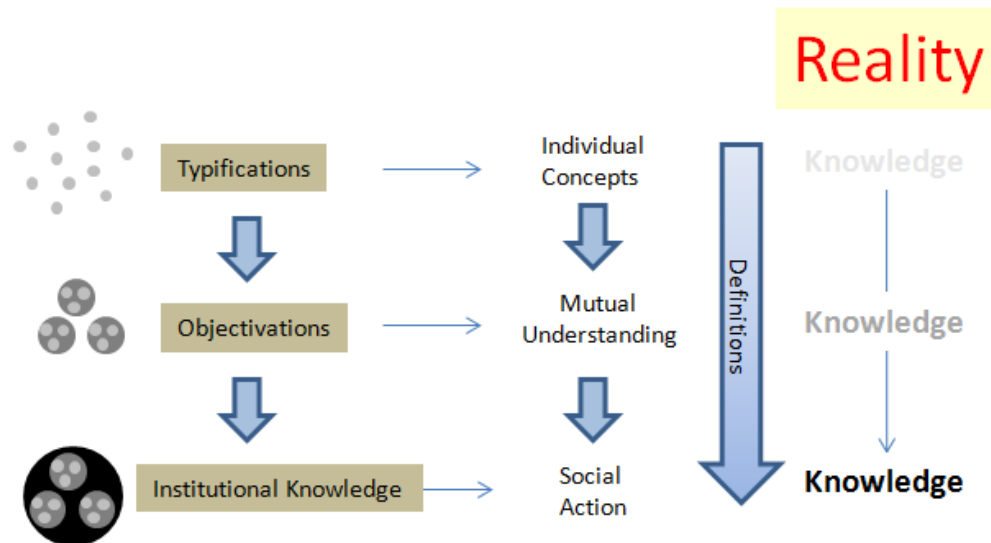


Fig. 138: Simplified framework of the knowledge creation process from a social-constructionist perspective.

9.4.2- Knowledge Change Framework

Next, in line with extant theory, data collection shows that apart from extreme situations (i.e.: reification), knowledge is not a stable product and its integrity is subject to the action of simultaneously countervailing forces. The balance among these forces not only continuously affect *institutional knowledge* "density", that is, its ability to engender concerted action, but also controls the prospects of knowledge change. To single out these forces it is necessary to take a closer look to the parallel processes that set knowledge in motion along its three basic states and how these forces may compose to produce the observable outcomes.

While in an ordinary situation powerful actors tend to impose their reality definitions over others, within a situation of weakened definitions (e.g.: crisis, current knowledge demise) hardly there is something that can be imposed, and as a result, power stop making sense from a coercive point of view. Insofar, a scenario of low knowledge density almost invariably contributes to lower power asymmetries, what makes all reality grasping attempts to be deemed equal and typification process to flourish. Overtime, some propositions will look more appealing than others, and as interactions proceed, some of them will invariably acquire a typification status.

Along data collection, such sense of uncertainty can be clearly captured in PDY recorded meetings from 05th October 2009 to 14th October 2009, particularly through D.C.C, P.R.W. and K.G. speeches. In UNA3, uncertainty began on the 5th July 2010, with the first WP-Sofia misplaced contribution, and reached a maximum in 23rd July 2010, when proposal approval meetings were canceled due to a complete lack of common definitions. In BGB, uncertainty took time to manifest but emerged strongly when the client asked for completely unknown documents on the 02th February 2011 and peaked on the 17th February 2011 under the pressure for document draft delivery. Though at different moments, in all three cases uncertainties lowered power asymmetries narrowing hierarchical distances among team members, and encouraging particular views to be externalized and debated.

In PDY, uncertainty and power distension set off strong typification processes, with initial typifications emerging out of informal meetings like those involving D.C.C., P.R.W., and A.R.A. Some appeared first like "tracking", "extracting", "filtering", "naming", "registering" and "freezing", while other only later on like "marking", "coping", and "deleting". In BGB, strong *institutional knowledge* delayed uncertainty perception and so power distension, what resulted in late and messy typification processes yielding few hardly connecting typifications like "unusual", "drafts", and "speed". In UNA3, power asymmetry was held for so long that uncertainty has been completely overlooked and typification process did not happen for most of current knowledge decay. Basic definitions had to be provided by the client during site visit once typifications were unable to be created interactively within project team.

A dispersed collection of typifications, however, does not automatically translates into mutual understanding nor provide enough definitions to be imposed. Although typifications may be associated by chance and allow for some level of mutual understanding, more likely it will happen in a lengthy and highly unpredictable way. Data collection suggests that the primary force that set actors towards timely and objective mutual understanding is political action. *Political action* has been identified as the process by which actors deliberately try to build mutually shared understanding out of the myriad of existing typifications. In this framework, politically-driven actors try to identify, settle and interrelate existing typifications in order to organize and broaden the scope of intersubjective interaction.

In its essence, *political action* creates "density" by tying together closely-occurring or clearly-related typifications (i.e.: clustering, fig. 138), by weaving complementarities among apparently disconnected typifications (i.e.: binding, fig. 138), or by fostering new typifications that create complementarity between existing ones (i.e.: bridging, fig. 138). Such associative work, however, is built on the free agreement of other actors what depends on "open and direct" debates to happen. By "open" it shall be understood that participation must be granted to all actors that actively manipulate the reality aspect under examination, and thus, can contribute to the reality definition task. By "direct" it means that particular and collective interests must be clearly stated in order to allow political action to efficiently work towards an encompassing compromise. Therefore, moving individual concepts to mutually shared ones is a process that involves intensive intersubjective negotiation.

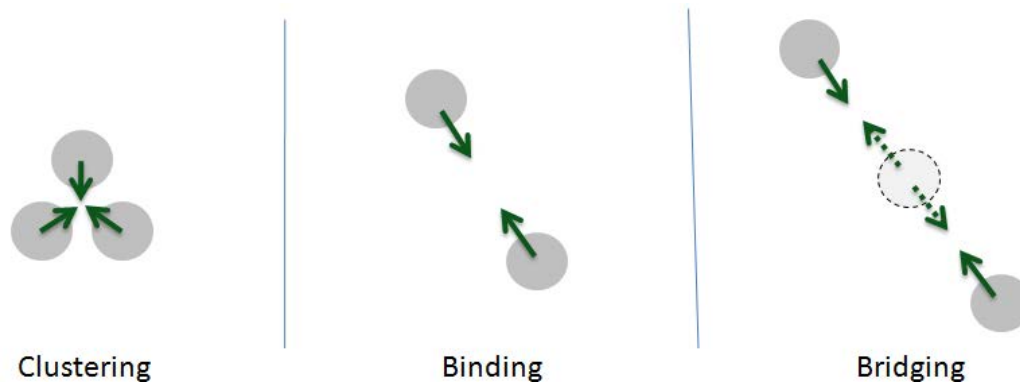


Fig. 139: Different forms of political action.

Several moments of political action were captured along data collection. In PDY, political action majorly happened from 14th October 2009 to 20th October 2009 and involved increasingly larger interaction circles. First, D.C.C., A.R.A., and L.M.A., then K.G., P.R.W., and C.L.E., and finally S.B.D., H.L., and K.D.H. Along these debates, *clustering* involved typifications like "tracking"- "extracting"- "filtering", while *binding* ones like "naming"- "registering", and "registering"- "issuing". *Bridging* happened with the creation of new typifications like "coping" (e.g.: "filtering"- "coping"- "naming") and "deleting" (e.g.: "registering"- "deleting"- "freezing"). Also, along political processes some typifications were rejected (e.g.: "tracking" X "marking"), while others were reframed (e.g.: "naming" for "tracking" -> "naming" for "registering"). Overall, PDY relatively intense political process provided the basis for a radical change in the way reality was approached and a solid landmark towards a new reality definition.

In BGB, political action involved a rather limited number of people (markedly F.R.P., C.C., W.A., and L.M.A.) and took place in the form of one-off events. To unleash political processes and bring complementarity to a poor set of typifications it was necessary to bring additional ones from the outset (i.e.: client, past projects) like "sharing" (by W.A.), "assigning" (by J.M.O.), and "internalizing" (by L.M.A.). In that case, *bridging* has been the main form of political action used to create complementarities like "unusual"- "sharing"- "speed", and "draft"- "assigning"- "internalizing"- "speed". The limited scope of political action in BGB resulted in a minor change in the way reality was approached, basically pointing to an adaptation of definitions from similar situations to the current one.

In UNA3, specific circumstances made political action acquire a quite distinct dynamic. The closed set of complementary typifications provided by the client sparked a late round of typification dedicated at project organization which lasted from 30th July 2010 to 2nd August 2010, and directly involved T.D., R.M.Z., B.M., L.M.A. and F.F.M. In this process new typifications such as "breaking", "assigning", "evaluating", and "consolidating" emerged enabling political action to take place in a sequential way and involve a large set of actors, mostly in its *binding* form. In UNA3, a late and prolonged political process, resulted in a relatively moderate change in the way reality was approached, one that fit well enough for the current situation, however, did not established a rupture with the previous one.

Increasingly complementary typifications provide a preliminary interaction background to all those involved in the reality definition task. However, while some reality spots become more or less defined, great uncertainty still covers most of interaction landscape. Nevertheless, such preliminary background provides a departure point from which further typifications and associations can be built upon, and overtime, continued political action engender increasingly broader reality propositions. At a certain point, such political activity arrives at propositions that markedly imply in a groundbreaking approach to reality, one that may establish a complete rupture with previous ones, and that's when *innovation* takes place.

In this line, data collection suggests that *innovation* can be understood as a sudden change in the way reality is approached sparked by a cumulative process of interaction background reorganization. Far from the traditional image of a "luminous" well-defined idea, innovation would represent a turning point in the knowledge change process, a collective reflection moment which breaks up with past references to embrace new ones. Data shows innovation as a moment where uncertainty gave room to a subtle sense of direction, as if a new path towards a more encompassing reality definition had been suddenly unveiled. In PDY, this innovation moment took place during the 20th October 2009 meeting, while for BGB it happened during the 17th February 2011 meeting. In UNA3, due to the extent of the knowledge change involved, innovation came up in corporate terms as proposal delivery. Overall, considering that such change process is sparked by balanced arguments, shared propositions and an initial set of supporters, it can be argued that political action always set the stage for innovation.

Though innovation foretells a new reality definition by no means this is a warranted or a straightforward path. While this upcoming reality proposition remains supported only by a tentative association of typifications, it represents a rather delicate framework that can be rapidly dismantled by a single strategic move. To gain density and better support the reality definition work, such complementary typifications must be submitted to a larger set of actors for appraisal, improvement and support. These actors, however, either are experiencing great uncertainty and must be introduced to such new reality developments, or are still rooted in the older definitions, and thus, must be convinced to leave it. The challenge, therefore, is to move ahead with the reality definition task not only in an organized fashion way, but also in a way that do not jeopardize the political compromises so far harnessed.

The solution for this conundrum is to embed typifications and their associations into a manageable support so that they can be scrutinized towards advancement but not obliterated. As previously seen, objectivation is the process by which complementary typifications acquire materiality and thus can be more easily explained and securely debated. The objectivation focus is to enroll a larger set of actors to look for a increasingly broader picture based on the proposed interaction background, rather than to rediscuss the typifications and associations develop so far. Even though changes in the proposed interaction background can be expected as a result of wider exposure, this is not supposed to happen directly but rather within a larger and more subtle process.

Data indicates that materialization triggers a reflexivity process by which typifications and their associations are progressively enhanced towards the objectivation status (see Fig. 139). In a first reflexive moment, initial actors put themselves in the position of the intended audience and, based on their assessment of audience focus, critically gauge if a determined material representation is compelling enough to promote mutual understanding and grab support for the associations made so far. If not, such material representation goes into change until this critical assessment is satisfied and it is considered ready to be disclosed. In a second reflexive moment, initial actors evaluate audience feedback, and if necessary make improvements or a complete redesign. As objectivations are submitted to diverse audiences they are perfected and increasingly serve as a base for mutual understanding across actors approaching reality from different perspectives. As the interaction base expands supported by these objectivations, the new reality definition is enhanced and gains strength.

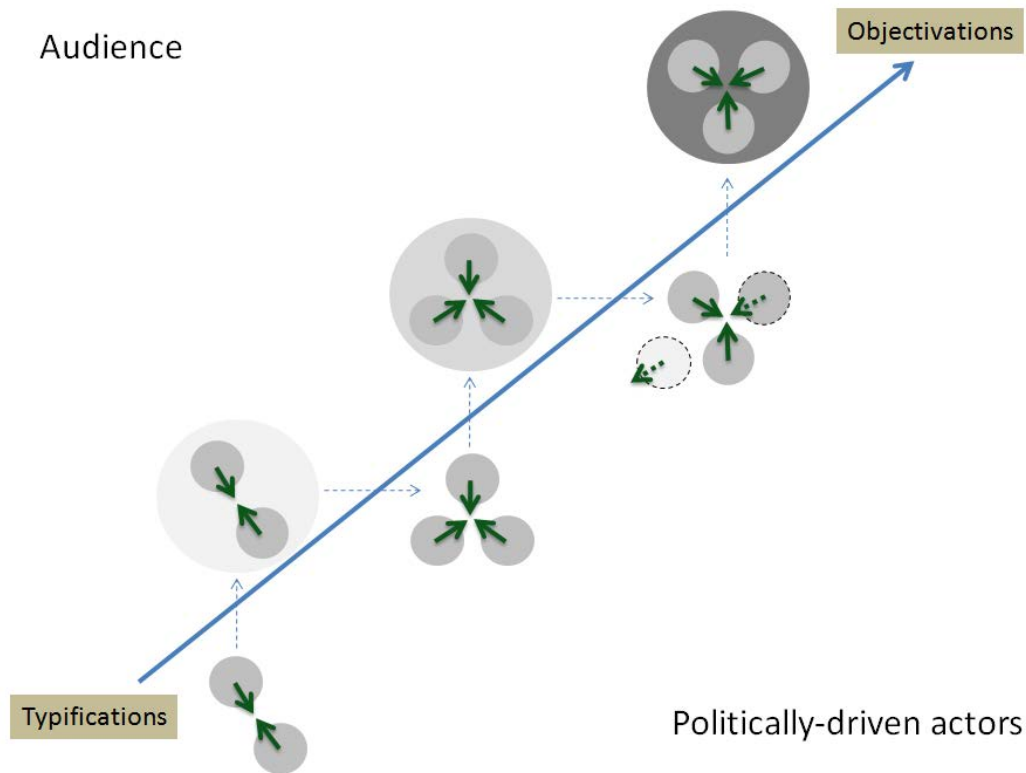


Fig. 140: Objectivation as a reflexive process.

Objectivations, therefore, are designed to attract the attention and grab support of a specific audience, what according to data collection obey some basic principles: they must be simple and actionable. Simple in the sense that they must be easily captured by an audience troubled by uncertainty. Actionable in the sense that they must establish a clear way to handle reality as proposed. The more complex and the less actionable an objectivation is the less likely it will provide a basis for mutual understanding and receive enough support from the intended audience.

The transformation of the "marking" typification into the "WORKRESP" attribute, and the materialization of the "freezing" typification into the "transfer/deleting" procedure represent two key examples of how objectivation happened at PDY in a very basic level. Also in PDY, the "SOW" and the "summary spreadsheets" (Figs. 35 & 36) represent examples of failed objectivation attempts due to their complexity and poor actionable character. Lately, the whole new workshare knowledge materialized in the form of the "new-SIC spreadsheet". In BGB, document "work breakdown" and "responsibility matrix" also represent objectivations derived from typifications such as "unconventional" and "document father". For UNA3, client typifications materialized in the form of "man-hour-estimate", through the "write-ups" and in the "risk analysis" report, while project organization typifications developed interactively materialized in the "document completion spreadsheet". Also lately, the whole new global-pricing contract knowledge materialized in the form of the "delivered proposal". Insofar, objectivations usually develop from discourses, to tools, then to procedures, and eventually into prototypes.

Overall, objectivation creates "density" by embedding complementary typifications into a web of signs, thus creating a protection layer that exposes their actionable character but hide their conceptual ones. In other words, the audience is submitted to what objectivations are up to in terms of organizing the proposed reality (e.g.: classify, relate, assign, control, inform) rather than to inspect what is conceptually behind them. At this stage, it is essential to protect typifications and their associations from wider scrutiny, otherwise political processes would run indefinitely, as increasing the number of actors, political processes would turn exponentially complex and far-reaching compromises virtually impossible to reach. Objectivations, thus, represent a cognitive artifice to convey complex and subtle ideas in a simple and direct manner so that dissent and uncertain actors are attracted towards the new reality proposition, and more, engage into its development.

Therefore, objectivation marks a change in the reality definition task from a ideational phase into a structuring one. While in the ideational phase typification links are spontaneously created through interaction and compromise, in the structuring phase, objectivation layers are deliberately "designed". Though such design task still involves interaction and compromise, objectivations are also subject to choice what allows room for power to manifest. As such, if initial objectivations can be deemed political, as they become more complex and capable of directing action they are increasingly accompanied by some level of "sanctioning". As data collection shows, "sanctioning" has the aim to control the unfolding consequences of the knowledge change process in ways that benefit, or at least do not jeopardize, particular interests. In PDY, progress graphic (Figs. 47 & 48) concealing by D.C.C. represents an event where an objectivation has been discretionarily blocked from being disclosed under the argument that it could backfire planning, a audience reaction that could affect his personal power. "Sanctioning", therefore, is the primary channel by which a power component is gradually introduced in the knowledge change equation.

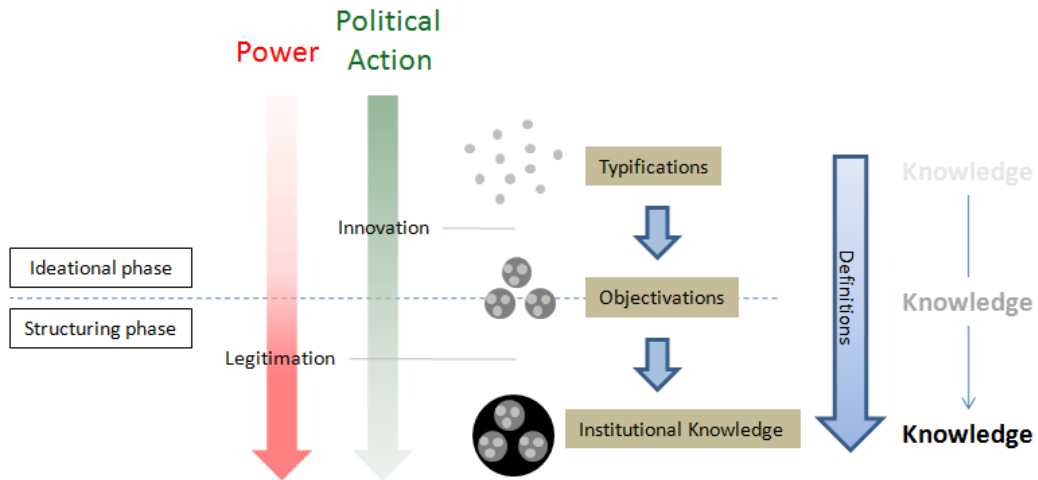


Fig. 141: Shifting forces along objectivation.

What determines the end of the objectivation process is *legitimation*. By definition, legitimation is the ultimate introduction of power in the reality definition task done by a sanctioned authority, one that settles what is to be considered "the" reality and shall be transmitted as such. Once legitimized, room for negotiation narrows drastically and the incipient knowledge is ready to be socialized. As data collection shows, legitimation usually takes place when the new reality proposition is supported by objectivations that are robust enough to hold some level of concerted action and to elicit the support of key constituency. In PDY, new knowledge has been legitimized first by K.G. (CNC project manager) in the 12th November 2009 and then by S.B.D. (WP project manager) during the 18th November 2009 meeting. In BGB, new knowledge has been legitimized by P.R.F. (BGB project manager) on the 21st February 2011. In UNA3, due to the considerably larger scope of the knowledge change process, legitimation body rested on a corporate stance, which has only opened the way for proposal delivery on the 10th September 2010.

Even though legitimation powerfully constrains the reality definition task, the collection of actionable objectivations that supports it still has a long way to go before being able to promote concerted action. The mechanism by which this incipient knowledge is transmitted and thus consolidates is *socialization*. Data collection confirms that socialization creates "density" by reproducing knowledge, that is, by expanding its base of supporters and transmitters. Socialization usually materializes through a series of mechanisms such as lecturing, training, and supervising, and is enforced either through monitoring or symbolic rewards. Socialization also plays a key role in determining group faultlines, what constitutes a further venue of enforcement. Given certain conditions, this base of supporters and transmitters can increase to point of making socialization self-reinforcing. Before acquiring a self-reinforcing character, however, socialization depends on a driver to be sustainable. Data collection shows, that socialization can be powered by two distinct drivers, resulting in two completely different outcomes in terms of knowledge development.

Under a "*power-led*" *socialization* knowledge is rapidly socialized, usually along a structured impersonal program or direct coercive supervision, and as such, it remains only at a superficial level of consciousness, almost amounting to a form of social performance. "Power-led" socialization creates a knowledge that is *extrinsically* strong, or in other words, a knowledge that is pervasive while external stimuli (e.g.: coercion, reward) is in place. Provided the end of these external stimuli, socialization loses strength and the new knowledge density tumbles quite rapidly. Provided enough power, however, this external stimuli can perfect socialization to the point of inducing *identical reproduction*, what not only promotes a fast gain of density but also provides enough energy to create strong self-reinforcement dynamics along new knowledge socialization. This way, "power-led" socialization allows room for abrupt changes in the knowledge dynamics.

On the other hand, under "*politically-led*" *socialization* knowledge is gradually socialized on a peer-to-peer basis, and as such, goes deep into consciousness to the point of being internalized as a belief. As such, actors are convinced to embrace new knowledge based on a critical assessment of efficiency and fairness. Furthermore, in the same way that "politically-led" socialization may allow for some level of resistance it also invite actors to take part in new knowledge consolidation, therefore opening room for additional enhancements, more encompassing compromises, and further acceptance. Insofar, "politically-led" socialization creates a knowledge that is *intrinsically* strong, that is, a knowledge whose pervasiveness is independent of external stimuli, as long as its strength is internally generated through a gradual process of persuasion. This way, "politically-led" socialization allows room for *non-identical reproduction* as a way to accommodate some change and alleviate tension generated along new knowledge socialization.

These two socialization drivers could are visible along data collection through PDY case, with WP-Houston running under "power-led" socialization, and CNC running under "politically-led" socialization. In the first case, the reduced number of actors to be socialized as well as the coercive possibilities of being fired or sent into a dreadful assignment (e.g.: Middle-East) in retaliation for opposing a management decision made its part in enlisting new knowledge compliance in WP-Houston in a quite fast manner. In CNC, the lack of coercive instruments (i.e.: hot engineering market) as well as the local tradition of selectively applying rules and directions made socialization more dependent on a gradual and negotiated approach. In BGB, a tepid legitimation unleashed a feeble socialization process were the power driver was almost absent and the political one has been overwhelmed by a tight scheduled. In UNA3, data collection does not allow many inferences about socialization process that might have happened as a result of proposal delivery.

After successive rounds of socialization, new knowledge density increases to the point of becoming self-sustainable, and as a new reality definition finally settles in the collectivity, concerted action around clear roles and expectations turns viable. At this point it can be said that knowledge reached institutional level, that is, acquired firmness in actors consciousness that goes beyond direct forms of manipulation. The so-called *institutional knowledge* not only provides clear courses of action but also

shapes actors perception of reality. Confronted with a different situation, actors tend to see it in the same terms as the original one upon which *institutional knowledge* has been developed. Overtime, *institutional knowledge* creates complex self-maintenance apparatus which can take the form of procedures, norms or even artifacts (e.g.: machines, softwares). Not rarely, however, *institutional knowledge* can materialize as whole bodies of compliance and enforcement which are governed by specialized personnel called *institutions* (e.g.: universities, companies, societies).

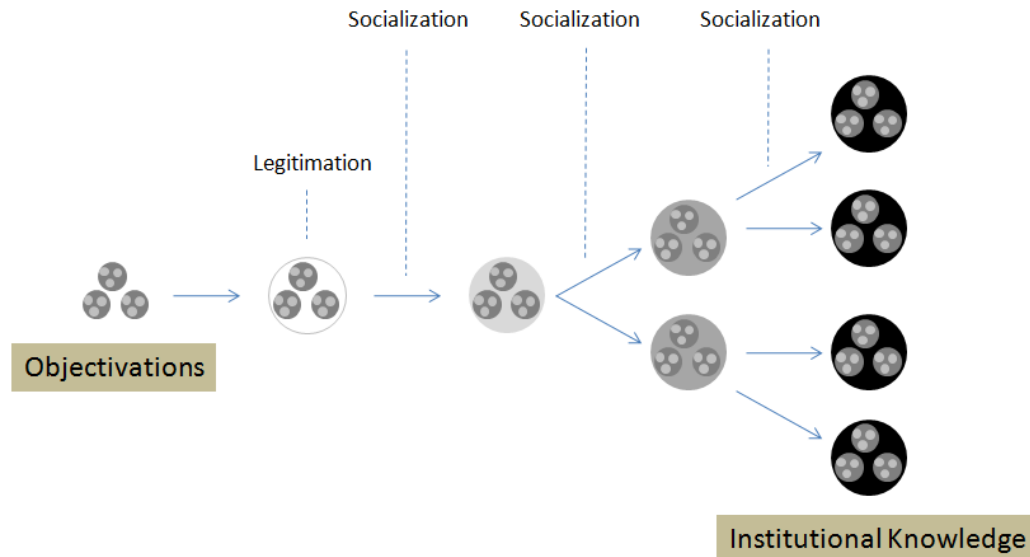


Fig. 142: Institutionalization as a distributive process.

Along all three cases, only at PDY data collection provides solid evidence that new knowledge has attained institutional level within project boundaries. In PDY, the new workshare knowledge became fully institutionalized at WP-Houston by 11th January 2010 when it played a key role in the accomplishment of a key milestone, the "area 8000" joint design task. At CNC, the "politically-led" character of socialization kept it developing until 12th February 2010, when L.Y.L., the last supervisor to fully embrace the new workshare knowledge, finally complied with its procedures. In BGB, as a result of a lack of socialization drivers, new knowledge failed to reach institutional level, and a return to old knowledge paved the way towards anomie. In UNA3, although data collection provides little evidence that new knowledge attained institutionalization, there is an indication that as a result of UNA3 proposal, changes happened in the corporate structure so that records would be concentrated in key offices in order to enhance corporate ability to handle similarly strict bidding rules.

Even after institutionalizing at project level new knowledge behavior still reflects choices made along its development path. "Power-led" socialization consolidates a sort of knowledge that carries internal tensions, and thus can be kept stable only under constant monitoring and enforcement. "Politically-led" socialization consolidates a sort of knowledge that is relatively tension-free and thus capable of self-sustaining, and eventually expanding beyond project boundaries. New knowledge expansion is an important outcome as long as it provides a venue to

tackle correlate situations in other settings, what may eventually revert into more influence and power to its proponents. However, let socialization alone, this expansion rate is too slow to boost new knowledge into higher institutional levels before project ends and its density declines. In that sense, data collection shows that to promote new knowledge beyond project boundaries, at a faster rate, it is necessary to use additional amounts of power. In that framework, new knowledge expansion turns into an investment of power, that is, power is used to generate more power.

This strategy, however, is not a risk-free one as long as compliance problem arises when new knowledge is socialized beyond project boundaries. First, as a determined reality definition expands it starts to confront other reality definitions which have supporters on their own. Second, this strategy may threaten long standing power balances, and thus, spark oppositional stances. Finally, this additional power can build up internal oppositional stances, particularly when "power-led" socialization has been used to consolidate new knowledge. Therefore, the more power is used to prop up knowledge density, the more *strategic action* is expected to take place, as a result latent opposition or challenged interests. In its essence, *strategic action* is no different in nature and in mechanisms from political action, yet it is still distinct due to the undercover character and non-aggregative goals, in contrast with political action which displays a public character and an aggregative impetus.

As strategic action success depends on its ability to develop furtively for a long time, it poses a challenge to the investigation to capture it full detail. Nevertheless, along data collection several strategic action moves could be identified. In PDY, where "politically-led" socialization took place, strategic action was predominantly external to project and involved company high-ranks which saw in new knowledge expansion a threat to current power balance. First, S.S.H. and R.F. used their organizational prerogatives to seize the communication channels by which new knowledge could expand towards the VALE project, leveraging K.G. influence within the company. Second, R.F. downplayed new knowledge relevance within firm, by delaying and emptying the seminar which intended to expand the new knowledge internally. Finally, new knowledge has been strategically exposed to direct subjective inquire by S.P.H, who has always lead 3D design within company, and casted doubts over its functionality, further weakening company's interest on it.

Along UNA3 and BGB, where new knowledge socialization was more "power-led", some signals of internal opposition could be identified, and serve as an example on how strategic action can operate from within projects. In the final UNA3 run, WP-Reading launched the "executive summary", a document not required in the bid instructions, with great publicity to all WP top managers in an attempt to standout as a key participant in the project and blur CNC/WP and WP-Sofia outstanding work. In BGB, the fact that J.A.M. has not taken part on new knowledge development and legitimation, may have probably influenced him in not putting much effort in further socializing or developing it properly. Overall, strategic action can be associated to several blocking or disruptive practices that lead to new knowledge containment, delegitimation, and discredit, elements that have been traditionally reported in business literature as features of "politicized organizations" (Mintzberg, 1985).

At this stage of new knowledge development, strategic action becomes a countervailing force against further institutionalization, one that can only be efficiently offset by reinforcing socialization or by moving upwards the threshold of political action what invariably depends on the use of more power. Let alone, political action hardly can offset the effects of strategic action, basically because the undercover character of strategic action make it difficult for new knowledge proponents to detect and counteract it in a timely manner. Furthermore, counteracting strategic action is an exasperating task as long as boosting up new knowledge consumes disproportionate more time and effort than detracting it. Finally, strategic action narrows the room for new knowledge to gain further density before environmental changes take place and re-unsettle the original situation which gives it essential pragmatic support. As such, the more time strategic action is capable of holding back new knowledge expansion the easier it becomes to reverse it. Data collection shows that as a result of strategic action and early environmental changes, new knowledge invariably retreats back into a quasi-institutional state where its density lowers but some of its structuring remains.

Such *quasi-institutional knowledge* differs from new knowledge at its early stages because differently from the later its base of supporters becomes spatially dispersed and linked only through common history and long-range bonds. In that sense, although it is still held in some actors' consciousness it is hardly actionable in practical terms. Most likely is that *quasi-institutional knowledge* can decisively influence current objectivation processes and thus recycle part of its core objectivations into newer knowledge under development. One that although resembles features from previous ones, is yet quite distinct. Overall, quasi-institutional knowledge plays a key role in the knowledge change process by enriching the medium on which knowledge change occurs and by turning knowledge cycling less abrupt and therefore less risky. At this point, it can be argued that it is the accumulation of quasi-institutional knowledge what makes social ensembles able to pursuit incremental learning strategies.

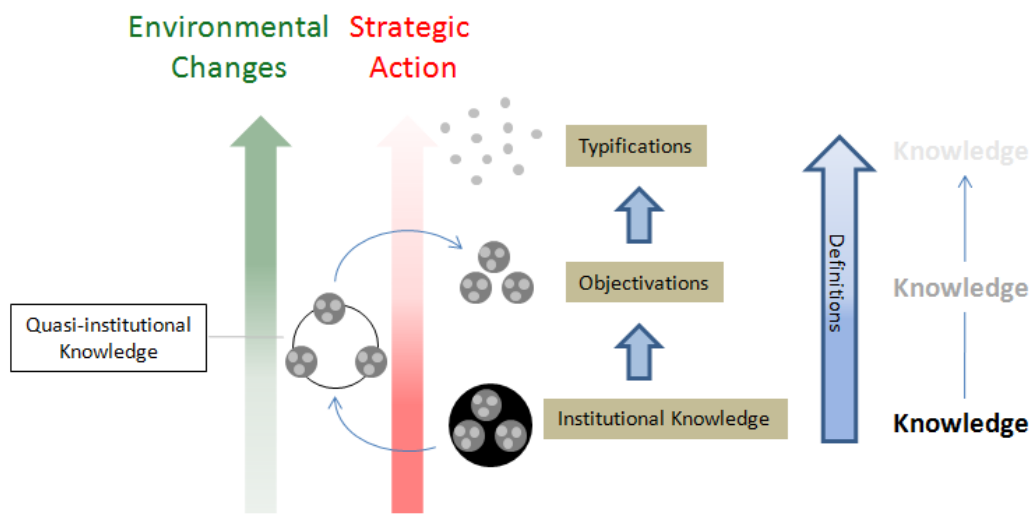


Fig. 143: Quasi-institutional knowledge and institutional knowledge decline.

In what can be considered a form of "revenge" against strategic action, although quasi-institutional knowledge is hardly actionable, two of its features end up enhancing the dispersion and penetration power of part of former new knowledge components. First, as long as quasi-institutional knowledge remains engraved in individual's consciousness, once projects ends and people disperse across different projects (within and outside the company) they end up carrying with them this quasi-institutional knowledge in the form of "project stories", which become a sort of inspiration repertoire for future problematic situations. By dispersing across multiple environments, former knowledge elements gain a reach that they would hardly attain in its institutional form. Second, different from institutional knowledge which is socialized "as is", in a indivisible manner, quasi-institutional knowledge allow for the selective transmission of its components. By enabling selective transmission of its components quasi-institutional knowledge has more freedom to spread, and thus to penetrate more deeply into particular audiences. Insofar, while in quasi-institutional state the once battled knowledge has always the potential to rise up again in neighboring situations, improved and strengthened.

The transmission of quasi-institutional knowledge along projects could be observed in several occasions along data collection. Key objectivations created along PDY, like the "new-SIC spreadsheet", managed to expand in less structured forms towards other projects such as RMAN and PDY2. In a similar way, key knowledge elements developed for UNA3 such as the "proposal completion control" (fig. 70) also propagated in a quasi-institutional form into BGB and influenced one of its new knowledge key elements, the "responsibility matrix" (fig. 99). Much of this transmission happened thanks to the movement of personnel among projects, particularly K.G., which moved to RMAN project, D.C.C., L.M.A. and M.A., which moved to PDY2 project, and C.C. and L.M.A. which moved to BGB project. As such, in the absence of far-reaching strategic action or relevant environmental changes that further weaken its structuring links, former institutional knowledge can survive in quasi-institutional state for quite some time, being recycled along different situations.

Data consistently shows that although equally contributing to knowledge density power and *political action* are two mutually exclusive forces that act at different timeframes along knowledge change. Politics acts at rarefied knowledge states when there is little room for power to exert influence over choice or action. Power, on its turn, acts upon more structured knowledge levels where it can exert a coercive influence over both choice and action. In that sense, knowledge and power, are intrinsically linked, not only power gives knowledge a full existence but it also controls its reproduction. Therefore, to question knowledge is a way to question power distribution.

In the opposite direction, *strategic action* and *environmental changes* are two forces that equally contribute to lower knowledge density and also operate at different timeframes along knowledge change. Though not mutually exclusive, these two forces hardly can be seen operating at the same time. Strategic action operates mainly at structured knowledge levels and has the aim to magnify eventual dysfunctionalities in order to restore existing power balances. If environmental

changes happen in a way that knowledge becomes evidently dysfunctional, strategic action *'raison d'être'* ceases to exist. As such, strategic action is directly linked to the exercise of power and operates as to countervail its self-reinforcing dynamics.

Insofar, in the same way that political action is enabled by a distension in power asymmetry, strategic action is prompted by knowledge dysfunctionalities, particularly those caused by early environmental changes. In that sense, political and strategic action mount to be micro-level forces which compete against one another and act over knowledge in a highly discretionary and subdued way. At the other side of the spectrum, the balance between power asymmetry and knowledge functionality creates a tension that has far-reaching influence over knowledge dynamics. Power can influence the perception of environmental changes almost in the same way that environmental changes can gradually erode power coercive strength. In that sense power and environmental changes mount to be macro-forces that act over knowledge in a very extensive and direct way.

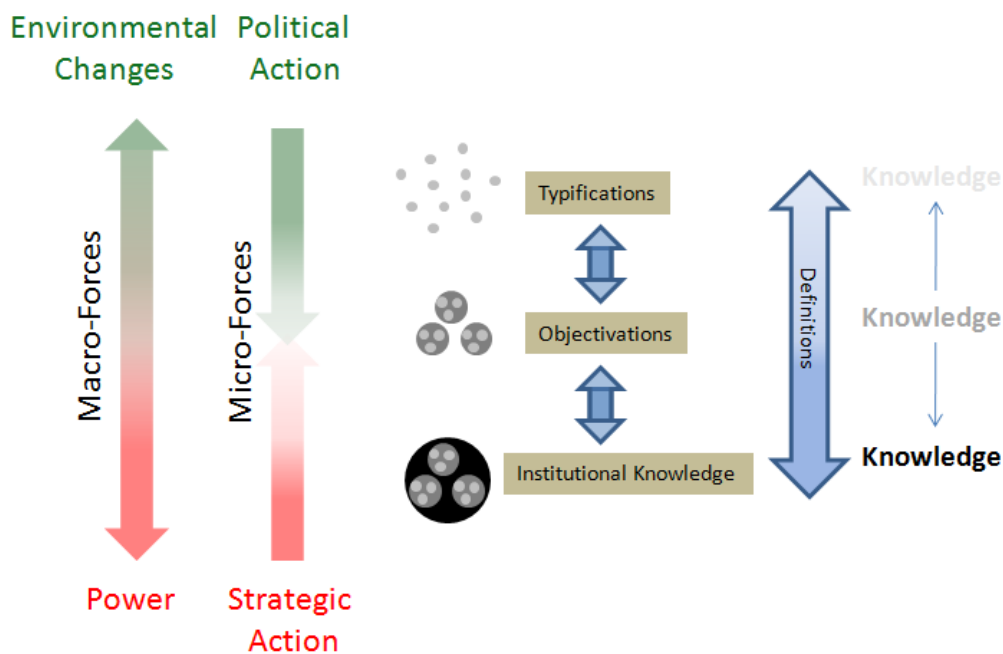


Fig. 144: Changing forces along knowledge change.

Overall, data indicates that knowledge hinges on a balance of four simultaneously countervailing forces: power and environmental changes at macro level, and political action and strategic action at micro-level (Fig. 144). These forces not only create tensions at their respective levels but also interact with one another in ways that apart from extreme situations (i.e.: reification and anomie) set knowledge in state of constant search for equilibrium. Such equilibrium, however, is hardly attainable because any disturbance in their balance soon or later sets the whole system in motion once again. Knowledge change, therefore, is the result of the unfolding dynamics along the sequential succession of these forces in a constant search for equilibrium (Fig. 145).

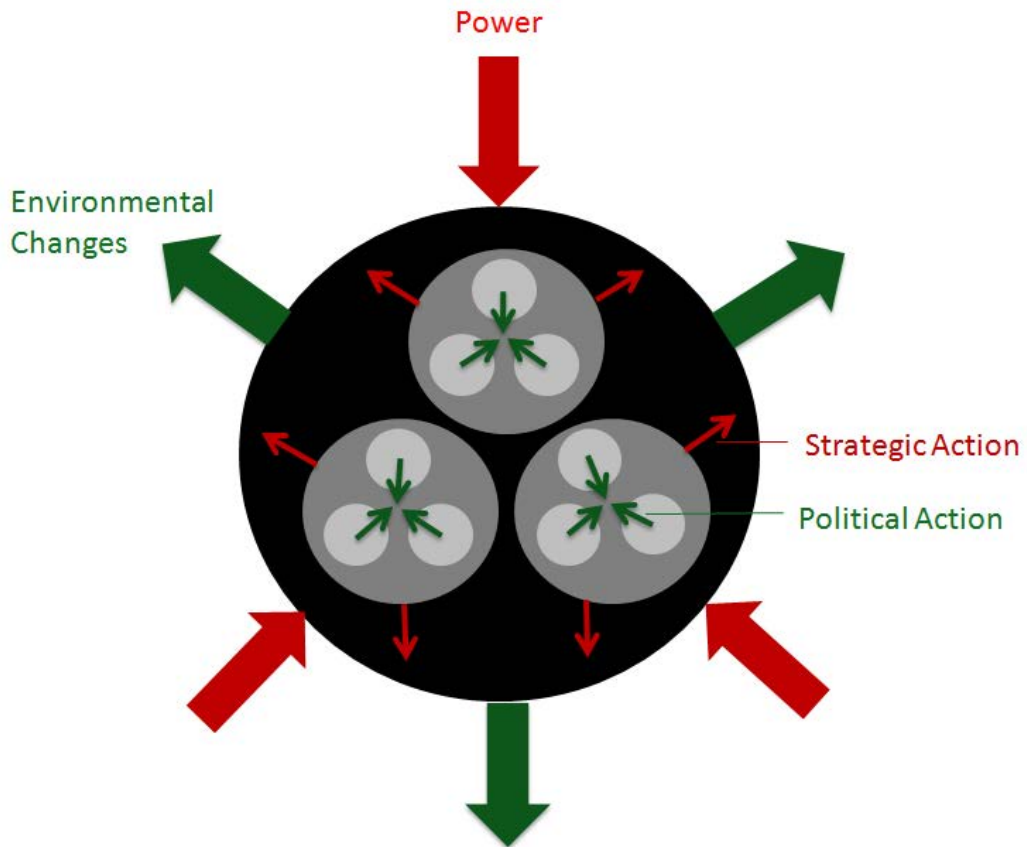


Fig. 145: Simplified framework of the simultaneously countervailing forces acting over knowledge.

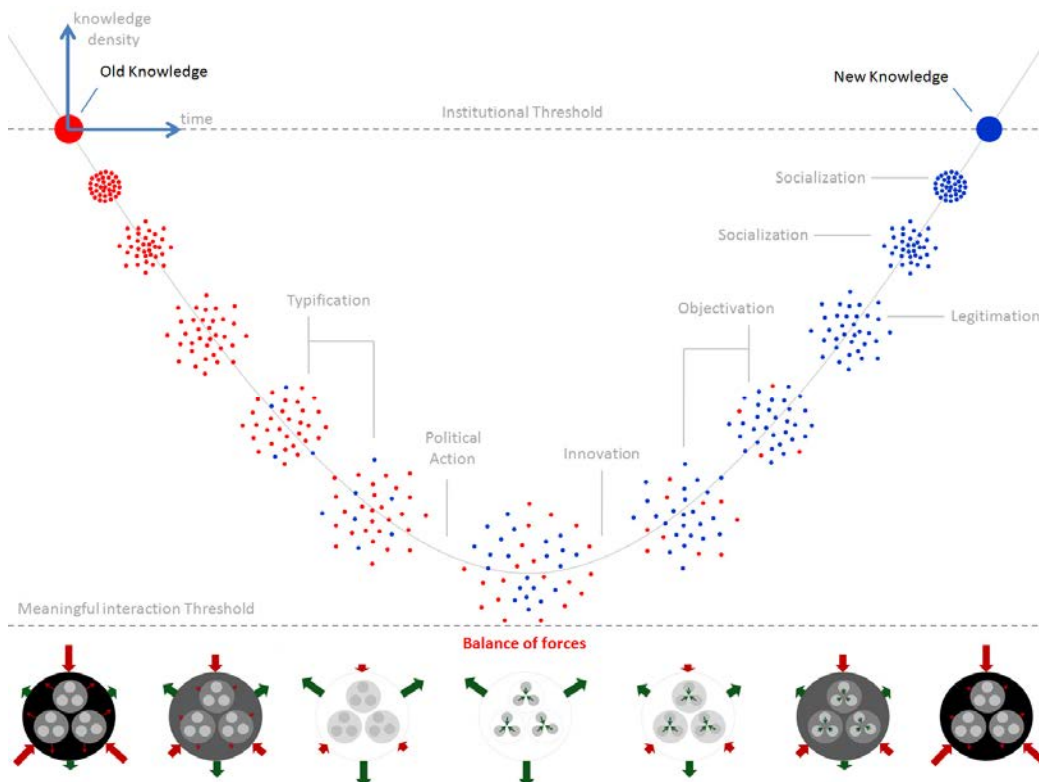


Fig. 146: Balance of forces along knowledge change.

9.4.3- International Project Teams as Innovation Hubs

The theoretical framework previously described provides a backdrop to explain why international project teams are increasingly used to handle complex and innovative tasks within MNEs. This framework also provides the necessary theoretical background to understand how knowledge diversity and politics interrelate within international project teams in order to unleash innovation.

If for firms tasks are mostly well-known and repetitive, and thus, favor knowledge institutionalization *project teams* by definition are special organizational settings designed to produce a complex and unique output. As such, firm's current knowledge is to be confronted with a situation it has not been entirely developed for. Though some important parts of the task are relatively well-known, other are not. More important either, the relationship among these parts, even well-known ones, can present unexpected challenges once brought together. In PDY, for example, though refining projects and 3D design were well-known both by WP-Houston and CNC, how to design a refinery in the same 3D environment simultaneously from two different locations was not. Hardly any manager could have forecasted that such overlapping workshare was far more complex than the usual interface workshare relationship where partners' scopes are separated by well-delimited boundaries.

Despite Clegg & Courpasson's (2004) argument that *project teams* are strongly institutionalized arrangements, data collection shows that most forms of institutionalization within project teams are short-lived. Once projects begin, roles, objectives and codes of practice quickly go into revision and change, mostly thanks to the unique character of the task and the conditions involved in the joint work. Along the three cases examined several changes in roles, objectives and practices could be vividly observed, and attempts to live up to institutionalized ways coincided with observed knowledge dysfunctionalities. A phrase commonly said by project professionals along data collection materialize this perception: "*Everybody knows how a project begins but nobody knows how it ends.*" (D.C.C.).

Overall, projects represent an attempt to reproduce, under relatively controlled conditions, the same *crisis scenario* brought about by environmental changes. As a result, projects do commonly get out of control like BGB, or dangerously get close to collapse before turning good like UNA3. However, most often well planned and managed projects achieve remarkable goals like PDY. Furthermore, environmental changes tend to accumulate for long time before make themselves noticeable. By inducing change at a higher rate, projects turn this catch up process more gradual, and thus, more manageable. Both BGB and UNA3 projects represent risky attempts on the part of CNC to qualify for tasks it did not had prior experience and deemed as important in the future, such as ports and nuclear facilities, respectively. Therefore, project teams are special organizational structures that submit firm's institutional knowledge to conditions that force it into change and improvement at a higher rate than the environment would do, or at least at the same speed, which is the case of highly dynamic environments.

Within mature MNEs, *international project teams* go a step further in creating such crisis scenario by introducing the pressure of *internal competition*. Despite the fact that in this case international project teams are composed by people belonging to the same corporate entity, team members still represent the particular interests of their units of origin. As noted by authors like Birkinshaw & Hood (1998) and Galunic & Eisenhardt (1996), these particular interests can range from expanding business participation to securing a specialized charter in the company, usually at the expense of other units. Even though project members are assigned to non-redundant tasks, their expectations regarding joint work are rooted in what they know from their home units. As such, internal competition gets transferred to the projects either through divergent opinions or through the threat of incumbent substitution, which adds to uncertainty the pressure of corporate survival and status.

Data collection vividly shows how *internal competition* (Birkinshaw, 2000, Cerrato, 2006) show up at early project stages. Along PDY, internal competition became evident in the WP-Houston threat to send their personnel to carry on the 3D design task at CNC, and in the resistance to concede that the overlapping nature of the workshare required changes in the way the design work was traditionally handled. Along UNA3, internal competition manifested in the harsh initial contacts between CNC/WP and WP-Sofia personnel as well as in the divergences between their man-hour estimates. In BGB, internal competition also became salient through WP-Houston attempts to take over CNC/WP project leadership. Overall, *internal competition* is an essential feature of mature MNEs, that by getting transferred to international project teams adds more pressure to team members performance.

Data collection also shows that internal competition within *international project teams* can basically unfold in two ways. Sides can recognize each other as being equivalently capable to define the problematic situation (therefore, "knowers"), and thus, move forwards to the typification and political processes that precede innovation and knowledge change, or recognize differences in their capabilities and establish a hierarchical relationship (master-apprentice), which implies in socialization and few net results in terms of knowledge change, even taking non-identical reproduction in consideration. Overall, data indicates that *internal competition* can also be seen as a driver for another key MNE strategic element that is *collaboration*, particularly of the type that extends firm's knowledge capabilities.

Both at PDY and UNA3, initial rivalries evolved into the mutual recognition of the "knowers" status, and as a result, both project teams managed to go ahead with essential processes for knowledge change, thus arriving at considerable achievements. In opposition, along BGB there was a remarkable capability asymmetry that could only be resolved by trading power for knowledge. As team members struggled to advance their positions without concessions, not even straight socialization became feasible and the net result of knowledge change in the project was highly disappointing. Therefore, for international project teams to yield innovation and knowledge change, as important as setting up challenging project goals, is to match highly experienced project partners in ways they can collaborate towards knowledge advancements.

If the concession of the "knower" status is key for effective communications and further agreement in a setting marked by internal competition, *international project teams* provide a key platform for the establishment of such links, specially through "*bridging assignments*". Differently from "*socialization assignments*", where team members move to the stronger partner to be socialized, in "*bridging assignments*" team members move to the weaker partners in order to gauge the environment and to establish communication bridges. Such communication bridges not only are directly established through personal relations developed along the assignment but also indirectly through the establishment of *referral networks* within project team by conveying a contextualized account of other partners capabilities. By looking at a closer distance to the problematic situation, and becoming full aware of its context of enactment, assigned team members are in position to send a strong feedback to their colleagues regarding the trustworthiness of other team members knowledge, thus promoting *cultural distension* and clearing the way towards collaboration.

Represent examples of "*socialization assignments*", P.D.J. stay in the WP-Houston for PDY, and T.D. stay in WP-Reading for UNA3. In contrast, represent examples of "*bridging assignments*" the stay in Brazil of S.L.J., F.R., S.J.L., G.A. and E.R.K. along PDY, B.M., G.J., G.G., and S.T.V. along UNA3, and W.A. along B.G.B. According to data collection, also contribute to the successful enactment of "*bridging assignments*", intercultural interest on the part of the assigned team member and proximity on the part of its local peers. Collaborate to this argument the performance of B.M. along UNA3, and G.A. along PDY, team members that detached themselves in their depth of engagement and comprehension of the project context. Not by coincidence, the two worst performs in their "*bridging assignments*", corresponded to people who least interacted with local team members and which showed indifferent to the project context, E.R.K. in PDY, G.J. in UNA3 and C.K. in BGB.

Hardly, however, the "knower" status can be granted under conditions of high power asymmetry. If *project teams* display a natural tendency towards power distension, data collection indicates that very often *international project teams* contradict this trajectory. Data suggests that initial power asymmetries tend to resist longer in *international project teams* because their members also represent the interest of their home units, and for this try to secure or advance their power positions, particularly through knowledge socialization. This socialization push not only prevent team members from critically assessing the actual contribution of the their knowledge to project goals but also from recognizing its eventual dysfunctionalities, which tend to be charged to knowledge incorrect application or understanding, result of lack of technical competences or cultural/idiomatic differences. Such socialization push also severely undermines team members' ability to oppose dysfunctional knowledge and unfair partnership conditions as it undermines both actor's self-confidence and self-criticism. If this socialization push remains in place for a long time it brings the additional problem of inertial institutionalization, where dysfunctional knowledge keep being socialized in a self-reinforcing way, even after power asymmetry has been removed, as happened in PDY. To the point that power asymmetry can resist decreasing knowledge density, a crisis scenario may be not enough to spark collaboration and thus knowledge change in *international project teams*.

The mismatch between power asymmetry and knowledge density has far-reaching implications on *international project teams* outcomes. The longer this mismatch is in place, the harder becomes knowledge change and the more likely project failure. Data collection identifies at least three mechanisms to counteract the initial socialization push and rebalance power asymmetries, which are rooted in knowledge diversity, rebalancing acts and exogenous shocks. Data also shows that within international project teams these mechanisms unfold in a sequential fashion way until a resistance point is break. How much of these mechanisms must be applied to revert power asymmetry, however, will depend on the strength of the socialization push and on particular features of the weaker partners.

Although *knowledge diversity* is considered a key characteristic of mature MNEs in general terms, it is particularly salient across international project teams. In line with extant theory, data collection shows that knowledge diversity represent the first line of defense against power asymmetries within international project teams. The simple presence of alternatives in a crisis scenario add up pressure against current knowledge and the power asymmetry that supports it. How this additional pressure will influence knowledge change outcomes depends on how strong power asymmetry and initial socialization push are. Empirical evidence suggests that under low levels of power asymmetry, knowledge diversity alone is enough to counteract the initial socialization push, and consequently, bring down existing power asymmetries. Under high levels of power asymmetry, however, initial socialization push tends to be so strong that knowledge diversity is completely downplayed, thus becoming an ineffective inductor of power distension and also of knowledge change.

Even though knowledge diversity may be unable to revert strong power asymmetries in a direct way, it still indirectly adds to this process. Data suggests that as the mismatch between power asymmetry (or knowledge density) and functionality grows, disadvantaged actors feel compelled to critically review current knowledge, and do that in the light of the available options provided by knowledge diversity. Once doing so, they are in position to first devise the gaps between current knowledge and project goals and engage into *internal political action*, not only to expose those gaps but also to propose new directions. Provided enough management support (e.g.: *knowledge state transmittal, external political action*), disadvantaged actor can keep exploring project contingencies to the point of openly challenging established power asymmetries, a process that could be followed along PDY. Such *rebalancing acts*, therefore, are means by which power asymmetries can be endogenously reduced within international project teams.

However, without the engagement of "change agents" or *innovators* and *management agency*, hardly rebalancing act can go ahead and succeed. In that case, only *exogenous shocks* can offset existing power asymmetries and allow room for collaboration. Can be considered *exogenous shock* any external interference that prompts a completely rebalance of team's power landscape, such as client or corporate intervention. *Exogenous shock* has been the way by which power asymmetry has been counteracted within UNA3 project. Beyond that, only anomie and project failure can be expected as a result of persistent power asymmetries.

Overall, if the power landscape for *international project teams* is complicated by the introduction of external interests, its inherent knowledge diversity also provides tools to overcome it. The persistence of power asymmetries within *international project teams*, however, may render ineffective the use of knowledge diversity to trigger the whole knowledge change process. Data collection indicates that the longer power asymmetry stands within *international project teams* the smaller is the scope of knowledge change and the larger the disturbances caused by the change process. In that sense, although *international project teams* present a great knowledge change potential, this potential can only be fulfilled if the natural tendency of these arrangements towards power asymmetry is countervailed by the ability of its members to focus on project goals and embrace collaboration.

This need for power rebalance within *international project teams* highlights another important investigation insight: the central role that project managers play in the knowledge change processes. Data collection indicates that once in a scenario of lower power asymmetry, project managers exchange the control over the direct manipulation of knowledge elements, to assume the indirect task of conducting the process of change. While in this role, project managers must provide support and set the pace of knowledge change processes so that they can unfold in a focused, open and timely manner.

In this direction, several are the ways by which project managers help knowledge change processes to unfold in a timely and organized manner. First, project managers must keep focus on project goals and continually screen the project environment paying attention to the rising of new typifications in order to keep alternatives at hand. Second, at the first signs of decreasing knowledge density, project managers must provide support for rebalancing acts or actively participating in power distension through knowledge state-transmittal. As debates begin, project managers must provide communicating/framing support for international team members, in order to keep communications flowing, as well as arbitrate the argumentation process to make debates overcome entrenched positions or vested interests. Finally, project managers must prevent knowledge change efforts from taking too long or losing focus, and thus must quickly restore power asymmetry once a viable option consolidates, what is made through *legitimation*.

Overall, project managers are responsible for opening and closing the knowledge change window, which represent the period of time along which knowledge density is deliberately kept low enough for change to take place. Project managers with a solid leadership profile can help international project teams to quickly turn over the whole knowledge change process with a minimum of disturbances. Just as a steady leadership is able to timely influence power dynamics, and thus get the most out of international project teams change potential, a loose leadership can easily make these arrangements to underperform. Ill-prepared management (either technically or managerially) tend to be unable to efficiently mediate and arbitrate debates within project teams. In a scenario of great uncertainty and lower power asymmetry, a lack of leadership behavior on the part of project management can have ruinous effects for the project as BGB case demonstrates.

Right after *legitimation*, project managers still have an additional responsibility regarding the knowledge change process, that is to provide a initial socialization impetus so that new knowledge can gain momentum enough to become self-sustaining. Such impetus may vary in strength, and thus, may yield two different form of socialization. Under a "*power-led*" *socialization*, the initial impetus provided by management is immediately applied and has a very strong coercive character. As a result, new knowledge is rapidly socialized, however, remains only at a superficial level of consciousness, mounting to a form of social performance. Under "*politically-led*" *socialization*, management impetus is weaker and only sporadically applied. As a result, new knowledge is gradually socialized on a peer-to-peer basis, and as such, goes deep into consciousness to the point of being internalized as a belief. Besides, "*politically-led*" *socialization* allow room for *non-identical reproduction* what overtime tend accommodate some level of change and alleviate tension generated along socialization or minor environmental changes.

By fostering knowledge change, project managers are in position to improve the efficiency of project resources, and thus, more easily cope with project goals. Besides, project managers can use these new knowledge resources to leverage their personal power and influence both at unit and corporate level. In this framework, project managers may fell tempted to promote new knowledge socialization beyond project boundaries using the communication channels they have with other project managers within MNE. In doing so, however, they attract the opposition of line managers who see the expansion of their influence through knowledge resources as a threat to their own power position. In reaction, line managers engage into *strategic action* with the intent to cast doubt over new knowledge functionality beyond project boundaries, and thus, block the expansion path. Therefore, to boost new knowledge expansion and promote knowledge change at large it is necessary to continually raise the threshold of political action and take debates into increasingly higher corporate levels, and submit new knowledge to other similar situations across the company. If successful, this will grant new knowledge the basis for "standard practice", and its sponsors will be considered corporate "innovators".

If *strategic action* succeeds in blocking new knowledge expansion, early environmental changes or project termination almost certainly will make it retreat into a quasi-institutional state where its density lowers but some of its structuring remains. At this point, although still held in some actors consciousness, it will be hardly actionable in practical terms. Most likely is that such *quasi-institutional knowledge* can decisively influence current objectivation processes and thus recycle part of its core objectivations into newer knowledge under development. "*Project stories*", therefore, become means by which this *quasi-institutional knowledge* resist time and move along different work environments providing elements of change beyond the setting where it has been initially conceived. In this sense, it can be argued that within mature MNEs, *quasi-institutional knowledge* provide an additional source of knowledge diversity detached from specific national features and which can cross organizational divides embodied in individuals, further enriching the media in which knowledge change occurs.

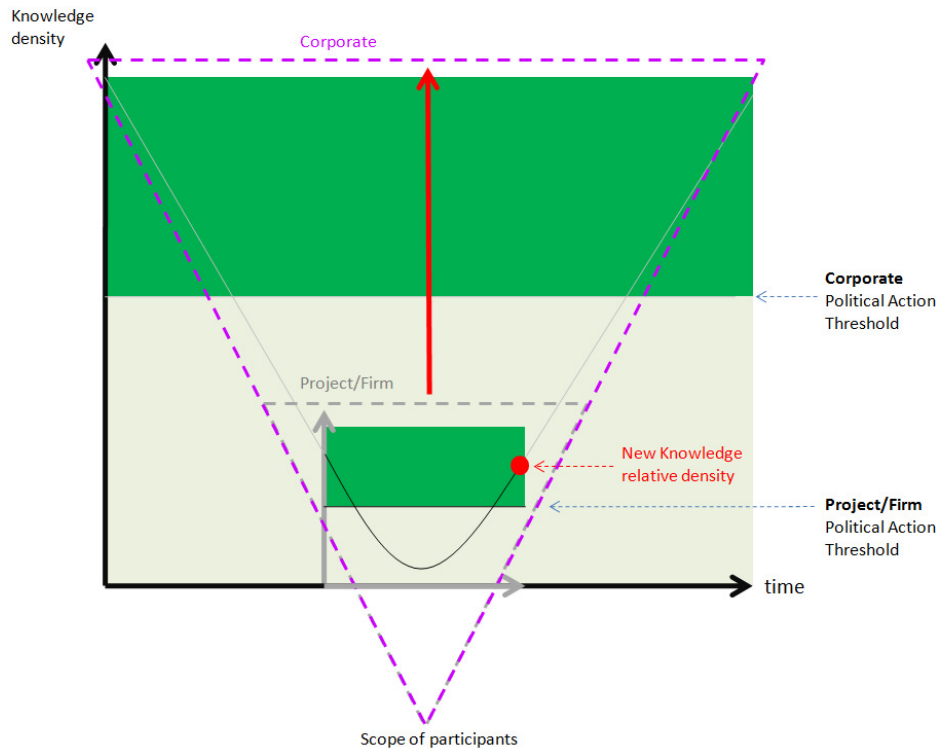


Fig. 147: Moving the threshold of political action to expand new knowledge at corporate level.

Data collection indicates that situational factors beyond the control of team members also influence the functioning and outcomes of *international project teams*. **Initial knowledge density**, for example has been identified as a relevant situational elements along data collection. Contrary to what would be expected, a low initial knowledge density do not automatically translate into an easier knowledge change process nor a high power asymmetry would make it equally difficult. Data suggests that initial knowledge density effects compose with power dynamics developments once project begins. In that sense, low initial knowledge density coupled with long-standing power asymmetries may unleash socialization process difficult to revert, while high knowledge density can be easily overcome if power asymmetries become responsive to early dysfunctionalities. Data indicates that to spark political action and allow room for knowledge change, declining current knowledge density must be met by a moderate or declining power asymmetry. As such, managers within *international project teams* must pay attention to changes in current knowledge density in order to drive power asymmetries in a favorable way for knowledge change to happen.

Knowledge nature has also proved to influence the outcomes of *international project teams* in terms of knowledge change. Data indicates that the more subjective the issues under examination, the less grounded debates become and the harder it is to arrive at noticeable knowledge change. The more objective the problems under examination, the more likely debates can yield a substantive knowledge change. Knowledge nature has also shown to constrain **underlying motivations** behind actor's actions which also affects the prospects of knowledge change. As such, the more straightforward actor's interests, the easier to arrive at a common ground, and

thus at some level of knowledge change. The more furtive and subtle actor's interests, the harder for common ground to be reached, and thus, to yield any knowledge change at all. Overall, the efficiency of *international project teams* in promoting knowledge change is also dependent on *knowledge nature* as it affects team members' ability/predisposition to move into alternative directions.

Beyond knowledge features and situational factors, broad contextual differences have also contributed to the observed outcomes. *External stakeholders* (e.g.: clients, regulatory bodies, community) provide a key source of influence to the knowledge change capacity of *international project teams*. Clients, for example, represent a key source of both power and legitimation, and to the extent they influence intra-company power balances they can decisively influence the outcomes of knowledge change processes. Under heavy client supervision power asymmetry tends to quickly respond to the loss of knowledge density (as in PDY). Such pressure, however, can also become disruptive if not properly gauged (as in BGB), suggesting that there may be a limit on how much client participation, and external stakeholders in general, can contribute to knowledge change within *international project teams*.

The *level of international interaction*, understood as the number of different cultural backgrounds within international project teams, has also shown to influence knowledge change outcomes. While a low number of backgrounds tend to drive *international project teams* into polarization, the reduced number of backgrounds also makes it easier to arrive at a compromise like in PDY. A high number of backgrounds make polarization more difficult, but also make framing harder thus requiring a great deal of political skill to set a level playing field for debates stripped out of cultural biases. Overall, a moderate level of international interaction seems the best approach for international project teams towards knowledge change.

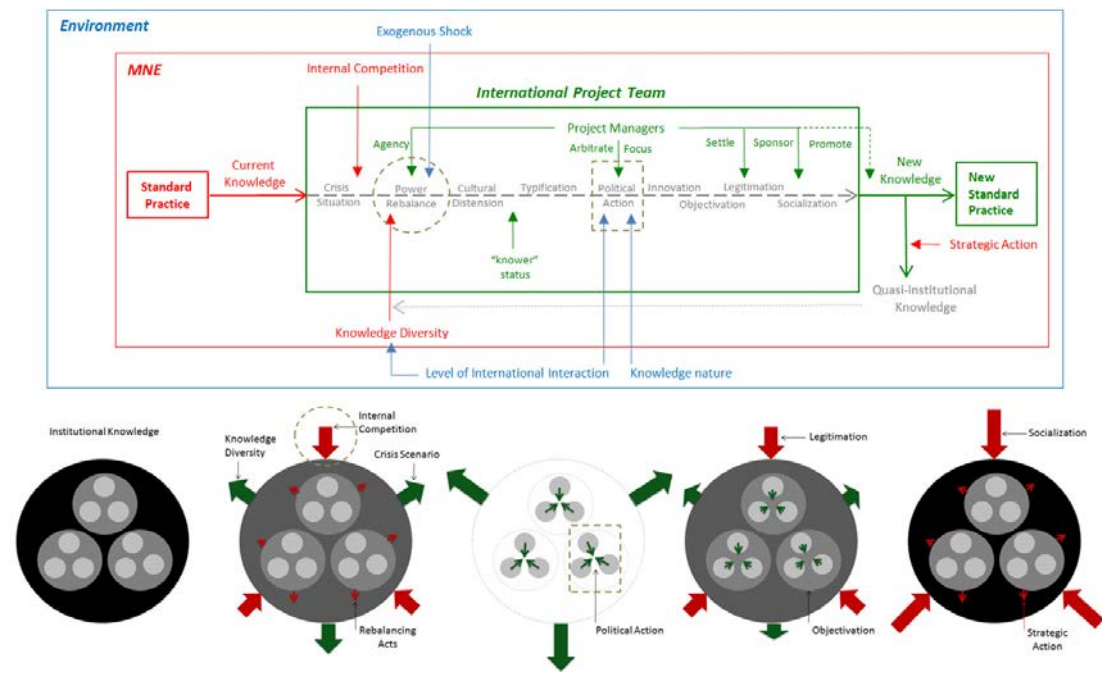


Fig. 148: A model for knowledge change within international project teams.

CHAPTER X
CONCLUSIONS

10.1- CONCLUSIONS

Investigation findings are congruent with the empirical evidence that shows *international project teams* being increasingly used to renew and expand the knowledge basis of mature MNEs. Along this investigation, beyond project goals, at least two new capabilities have been developed within parent company (WP) as a result of international project teams: overlapping workshare (PDY) and global-pricing contracting (UNA3). In that sense, the use of *international project teams* within mature MNEs not only represents a source of profit (through better project execution) but also a source of competitive edge by leveraging firm's knowledge resources.

This investigation shows that the knowledge change potential of *international project teams* derive from a series of features that are specific to these arrangements. If project's unique goals simulate the demands of dynamic environments and submit firm's knowledge to unprecedented situations, *international project teams* add to the challenge *internal competition*, which makes team members to excel themselves in search for corporate status and survival. Given conditions that promote "**cultural distension**" and "**power rebalance**", rivalries can gradually evolve into a singular form of collaboration between equals ("**knowers**"), thus allowing for a setting both knowledge diverse and political prone, essential conditions for conspicuous knowledge change.

The use of *international project teams*, however, is far from a straightforward endeavor. This investigation shows that these settings must be very carefully crafted and managed in order to elicit knowledge advancement instead of power struggle and "cultural clashes". In this regard, data suggests that the knowledge change potential of international project teams can only be fulfilled if similarly knowledgeable partners are put together. Such matching among partners is essential to make sure that collaboration supersedes socialization, thus fostering knowledge advancements. Furthermore, team members must also be carefully selected (i.e.: multicultural interest) and arranged (i.e.: bridging assignments, proximity) otherwise cultural distension will hardly be attained with consequences for power rebalance and mutual recognition.

The investigation also cast light upon the central role that project management hold in *international project teams*. While knowledge diversity is almost a given within these settings, and partner matching is almost an exercise of chance, the conditions that lead to political action, and thus to knowledge change, are heavily dependent on project managers. As knowledge diversity inherently brings to the projects divergent interest, without management support to quickly revert power asymmetries in face of declining knowledge density, ability to frame, arbitrate and provide focus to debates, and determination to support initial socialization, it is more likely that *international project teams* will perform very poorly in terms of knowledge advancement (as BGB did). In that sense, the use of *international project teams* as a collaborative milieu to perform highly innovative tasks is also subject to having highly prepared project management in place.

In this framework, what truly distinguishes the knowledge change potential of *international project teams*, compared to similarly diverse forms of collaboration, such as international joint ventures, is that their structure of governance enable project managers to rein over divergent interests so that power asymmetries can be brought down, making possible the coexistence of political action and knowledge diversity. In doing so, however, project managers are constrained not only by time and resources, but also by their ability to perceive the need for change and communicate it at large. Unable to shift initial power asymmetries, either through internal or external agency, hardly project managers can set the stage for knowledge change to happen within *international project teams*. In that case, their outcomes will be no better than those of international joint ventures or local project teams.

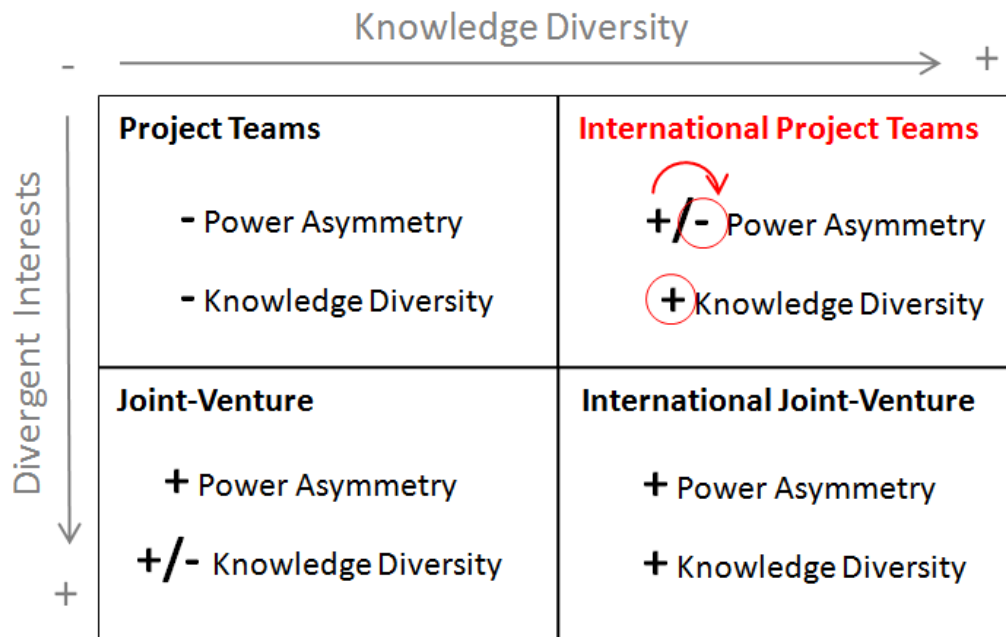


Fig. 149: Comparative chart among different forms of collaborative joint work.

Additionally, several contextual factors were found to influence *international project team's* ability to deliver knowledge change. Among them, at least two were identified as knowledge-related, such as initial knowledge density and knowledge nature. The other ones were identified as actor-related, like external stakeholders and the level of international interaction. Together these elements were found not only affect the ability of team members to rebalance internal power relations in favorable terms but also their ability to arrive at encompassing compromises through political action.

Overall, it can be argued that *international project teams* are innovative prone settings because they bring together critical stances, knowledge diversity, internal rivalry and flexible power relations. Nevertheless, they represent a very complex and demanding work arrangement that requires great deal of management attention, what may not payoff for every task. Insofar, the more dynamic and challenging the business environment in which MNEs participates the more the use of international project teams is recommended as way to gain competitive edge.

10.2- CONTRIBUTIONS TO THE FIELD

In the first place, data examination indicates a considerable correlation between the theoretical framework used to approach knowledge change and the investigated phenomena. Data shows clear signals of theoretically expected processes, such as typification, objectivation, and institutionalization. More, rich data gathered along this investigation enabled to detail the processes and four main forces that set knowledge in motion (i.e.: power, political action, strategic action and environmental changes) along its three basic states and how these forces countervail each other to produce the observable outcomes. In that sense, a key contribution of this investigation to the sociological field and to the business strategy field is a better understanding on the mechanisms that elicit knowledge change.

The dynamic perspective on knowledge developed along this investigation provides important insights to debates involving institutional change (Clemens & Cook, 1999; Buchanan & Badham, 1999; Phillips et al., 2004, Morgan, 2005), organizational learning and dynamic capabilities (Levitt & March, 1988; Smith et al. 2005, Teece et al., 1997; Rindova & Kotha, 2001; Zollo & Winter, 2002; Wang & Ahmed, 2007) and MNE structure and competitiveness (Kogut & Zander, 1992; Zander & Sövell, 2000; Gupta & Govindarajan, 2000; Luo, 2002; Morgan & Quack, 2005; Kostova et al., 2008). Investigation results also confirm assumptions initiated by Ibarra (2003), Crossant et al. (1999), Coopey & Burgoyne (2000), Belanger et al. (2003), Tregaskis (2003) and Lawrence et al. (2005) as well as extend debates regarding the role of power and politics in organizational learning and knowledge change.

Another key contribution of this investigation is to open up the "black-box" of *international project teams* and explain why these work settings are being increasingly used to perform complex and innovative tasks in mature MNEs. The investigation shows how power and politics can be fluidly reconfigured by intrinsic features of *international project teams* in ways that favor innovation and knowledge change. This study also highlights the key role that project managers have in supporting knowledge change within international project teams and how these initiatives affects the delicate power balance that exists between project and line managers. The investigation also cast light on how power and politics control new knowledge expansion beyond project boundaries and how the outcome of this process affects firm's knowledge capabilities.

In this direction, investigation results consistently supports the works of Geppert et al. (2003) and Morgan et al. (2003) regarding creation of new understanding through international interaction. They also contributes to understand how MNE can use their expansion into emerging markets to leverage their capabilities, thus extending the works of Edwards (1998) on reverse diffusion and Rugman & Verbeke (2001) on subsidiary capability building. The concept of *quasi-institutional knowledge* also provides a basis to explain why clustering yield innovation in the works of Pouder & St. Johns (1996), Frost (2001) and Arikan (2009). Results also support Harvey & Novicevic (2004) claims on the need of management building political skill/capital through international assignments.

This investigation also provides insights that can help to disentangle international human resource management debates regarding the tension between homogenization and differentiation of management practices within MNEs (Ferner & Quintanilla, 1998; Beret et al., 2003; Edwards & Kuruvilla, 2005) as well as to revive the intergration-differentiation debate within the international management field (Malnight, 1996, 2001; Birkinshaw & Hood, 1998; Taggart, 1998; Kostova & Zaheer, 1999). New elements of debate were also brought about adding to the expatriation role debates conducted by Selmer (2001a; 2001b), Harzing (2001), Takeuchi et al. (2005), Tarique et al. (2006), and Collings et al. (2010).

In line with authors like Au (1997), Shenkar (2001), Brannen (2004), and Edwards & Kuruvilla (2005) this investigation also downplays the role of cultural diversity in determining international project team outcomes. This investigation shows that culture is a too broad and uncertain construct to be applied to small populations like firms and projects. The investigation highlights that knowledge diversity, understood as direct exposure to diverse institutional contexts, is far more important for international project teams outcomes than cultural diversity *per se*, which the world of mature MNEs hardly fits itself into the national origin label (From which culture belongs an Irish born engineer who has graduate in Australia, worked in Abu Dhabi and Kuala Lumpur for 10 years and for the last 3 years is a project manager in Brazil? Was he even a prototypical Irishman in the beginning?).

In that sense, it is not to say that within along the cases examined there has been a lack of cultural problems, but that cultural misalignments have been limited to minor issues with little (if any) influence to project outcomes. Investigation shows that given conditions that allow for cultural distension (i.e.: "bridging assignments", intercultural interest, proximity) team members were able themselves to resolve cultural misunderstandings even in face of communication disruptions due to the lack of idiomatic domain or the precarious results of some telecommunication technologies used (video and phone conferences). The investigation shows, however, that much harder to crack within international project teams are the institutionally rooted differences embodied in knowledge diversity. For these, only a lengthy and sometimes extenuating process of power rebalancing can allow for mutual understanding and coordinate change.

The investigation also add to the debates on the *knowledge-based view of the firm* (Grant, 1996a; Spender, 1996; Eisenhardt & Santos, 2001; Nickerson & Zanger, 2004; Martín de Castro et al. 2011) as well as those involving organizational structure in dynamic environments, particularly those that point to a link between politics and more responsive forms of organization like Lucas (1987), Child (1997), Pichault (1998), Child & McGrath, (2001), Clegg & Courpasson (2004). In this direction, the present investigation suggests a shift from the traditional focus on 'power struggle', that so far has tinged the study of politics in the field of business strategy and international management, in favor of a process view focused on mechanisms of change and compromise. This conceptual shift may yield a novel approach capable of enhancing our understanding on the dynamism and complex equilibrium involving both multinational activity and business in dynamic environments.

10.3- RECOMMENDATIONS FOR PRACTITIONERS

This investigation suggests that for companies in general, and MNEs in particular, to thrive in dynamic environments they have to signal managers to build up their power resources not only based on their ability to mingle with top management or to deliver financial results but also on their ability to boost firm's competitive potential through knowledge advancements. The investigation provide evidence that management spend great part of their time looking up towards the division of "prime-work" or harnessing their career prospects rather than looking down to daily operations which are frequently left on their own. In that sense, within firms personal/group interests frequently supersedes financial ones, not to mention knowledge-based competitive ones. As such, whenever firms allow for information asymmetry, subjective performance assessment, and non-independent auditing, they will be favoring politicking and strategic action instead of collaboration and political action with due consequences for its long-term competitiveness.

This investigation also brings a tough warning regarding the potentially damaging effect of hesitant or absent project management. Assuming knowledge to be in a constant state of change if an action fails to increase new knowledge density, it will almost invariably decrease it. In this sense, each innovation failure create conditions that reinforce traditional knowledge and also turns futures changes less acceptable. Therefore, will is fundamental for knowledge change within *international project teams*. Project managers must pay attention to the right time for promoting new knowledge beyond project boundaries, just like change agents have while engaging into political action within projects. As such, project managers shall not disperse their efforts into other activities while the change window is open.

Another recommendation for MNE practitioners is that cultural differences must be viewed through a wider prism than that of monolithic and irreconcilable features of groups and of the people that belong to them. The present investigation highlights that culture is a too diverse construct to be portrayed (and used) in definite terms, and people can perfectly agree or disagree on many of its features. Besides, nowadays with all the information, communication and displacement means available, culture shall be seen as an extremely broad guide for action and thought rather than a encompassing "programming of the mind", like in Hofstede's terms. Provided that interests are aligned, interculturality is harnessed and proximity is established, mutual recognition and collaboration almost certainly will develop despite the differences in national or business cultures that might exist.

Business practitioners in general must also understand that knowledge diversity can be built through several different manners away from international ones, and in that sense local companies can greatly benefit from their inner or locational knowledge diversity. Provided that they can emulate similar conditions to that of international project teams (i.e.: knowledge diversity, political action, pro-change leadership) almost certainly they spark great knowledge change potential and thrive in dynamic markets. Evidence of small tech companies mimicking such behavior even in the absence of international exposure abounds in the academic and specialized literature.

The challenge, however, is to balance all these elements on a sustainable basis. As long as power builds up power, in the long term past successes may become a hurdle for future knowledge change.

10.4- STUDY LIMITATIONS

A first important limitation of this study concerns the relatively restricted point-of-view from which the researcher obtained his data. Along projects, for example, multiple key events unfold simultaneously what poses a challenge of “omnipresence” to researcher. Unable to pay attention to all important events at once, researchers have to decide which ones are more relevant and must be followed, from those that are less relevant, and thus, should be ignored. Research selection, however, tends to introduce a bias in data collection towards expected data instead of emerging data. This is a known (and inevitable) limitation in qualitative studies and in order to minimize its effects several measures have been taken which were described in full detailed along the methodology chapter.

Along the investigation, the researcher tried as much as possible to avoid *a priori* categorizations, what has been partially achieved through massive data collection and by postponing data compilation to the end of data collection. Even though, it is almost inevitable that as investigation advances points of interest progressively emerge and somehow end up directing data collection. In reaction to this, collected data has been plentifully exposed along data presentation in order to allow readers to go beyond researcher focus and explore neighboring subjects as well. Moreover, to complement for data transparency, section 5.3.1. (Researcher Standpoint) contains researcher biographic information in order to enable readers to evaluate potential biases he might have unconsciously introduced within investigation.

Another complicating factor for data collection is that several important situations in power and politics studies are “non-events” represented by silences, exit or non-collaborative behavior. “Non-events” are particularly challenging to capture as they require an enormous awareness of the investigation setting and sharp look on part of the researcher to perceive unexpected ruptures in the investigation tissue. As such, although some important “non-events” have been captured, many other have not what can potentially weaken some assumptions made along this investigation. Even though the insider status of the researcher helped to sharpen his attention, data collection received additional care in order to include a great deal of contextual information that later could be used to spot such furtive situations.

A further “perspective-bounded” limitation concerns the relative position the researcher occupied within projects. As a common participant in the projects, researcher’s (lower) hierarchical position prevented him from attending several key events at higher hierarchical level which might have had impact on the conclusions. Moreover, several behaviors and opinions that could be deemed improper or image damaging happened at close doors or within hermetic circles, most of time away from researcher access. In this regard, the same procedure used to report simultaneously important events was adopted, that is, to recollect second-hand data

from key informants and triangulate them to enhance report precision. Noteworthy, however, is that what the researcher was allowed (or not) to see is also highly instructive on the dynamics involving the object of investigation.

Even when perspective and access were not a problem, it is still impossible to depict in full detail the observed phenomena. Bounded rationality and limited research time prevented the researcher from making a completely accurate report of events, and once again choice introduces the threat of investigator bias. In this regard, what has been considered important in this investigation was to be exact in the description of selected events and to convey the readers a rich account capable of bringing them as close as possible from the lived experience.

"Context-bounded" limitations may also to this investigation. A first one, concerns the single locational character of the investigation, where all data has been collected at the CNC/WP São Paulo office, in Brazil. This can be explained by a clear lack of mobility involving Brazilians team members compared to other nationalities (see table 3 next). As far as the data collection was able to capture, apart from top management business trips, only one CNC/WP professional (B.D., Risk Analyst) was sent abroad to engage into a mid-term assignment. Conversely, several meetings, seminars and presentations were attended by professionals from other WP offices, which came to CNC/WP office on a regular basis.

Case	Inflows (to CNC/WP)	Outflows (from CNC/WP)
PDY	12	3
UNA3	6	1
BGB	6	0
Total	23	4

Table 4: Inflows and outflows of expatriates along data collection.

As the willingness of Brazilian professionals to engage into short to mid-term assignments abroad is evident across the investigation, this phenomenon can be credited to a assumption on the part of WP that Brazil was a market to be "colonized" rather than "integrated" Alternatively, as long as mobility opportunities had to be financially supported by the office of origin, one could also say that while from the outset they were viewed as a necessity, within CNC/WP mobility was seen as a symbol of status and thus prerogative of top management personnel only. Either way, data collection became impregnated by contextual information obtained in the São Paulo office at expense of information that could be obtained at other locations.

Even though, sampling is not considered a major limitation within this investigation given that the purpose was to look at the investigated phenomenon at the largest number of perspectives as possible. Out of the several projects that took place along data collection, investigation concentrated its focus in those considered more relevant to understand the object of investigation. Cases spread along key MNE concerns (i.e.: technological, commercial, management), western cultural profiles

(i.e.: Brazil, U.S., UK, Bulgaria) and different outcomes (i.e.: success, draw, failure), substantially enhancing the internal validity of the present investigation.

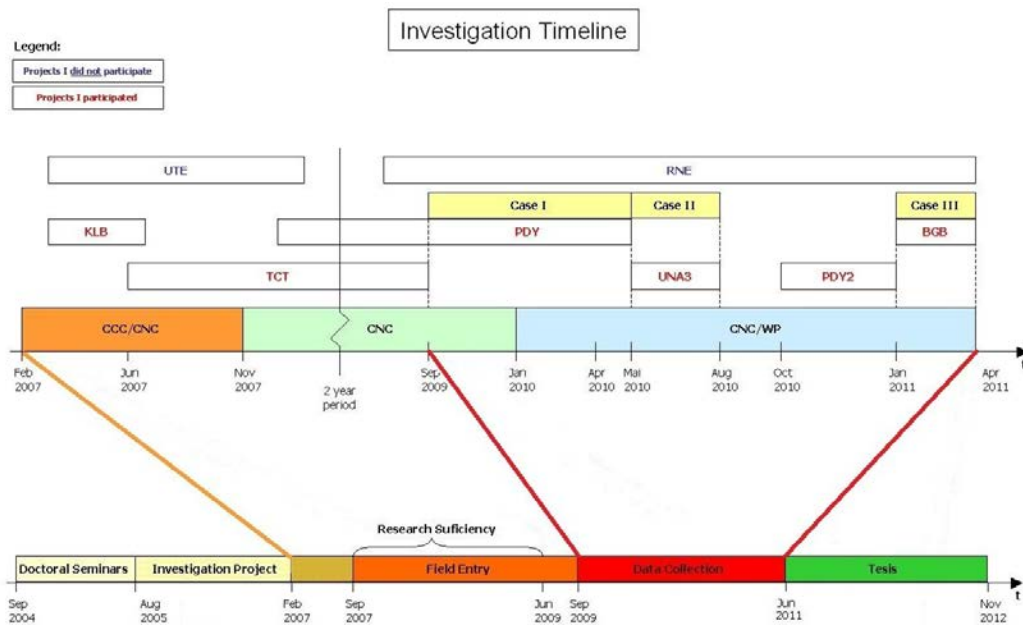


Fig. 150: Investigation time-line

The fact of the researcher being Brazilian-born also introduces a measure of cultural bias within this investigation. Actions, behaviors and speeches of foreign team members may have been misinterpreted or interpreted in less accurate terms compared that to those of Brazilian team members. Additionally, as the main location for data collection was Brazil, researcher might have been subject to embrace a "Brazilian perspective" of events, rather a more neutral one. Following Easterby-Smith & Malina (1999), the way to minimize all these limitations was to be the more transparent as possible regarding data presentation and exhaustively exercise cross-checking of evidence and constantly assume a reflexive position to inspect if a determined line of argumentation has not been contaminated by cultural or author biases.

Time can also be considered a limiting factor for this kind of investigation. Counting the necessary time for case selection/field entry (2 years), for collecting data along three cases (18 months), for processing collected data (6 months), and for analyzing and writing the final report (12 months) it took approximately 5 years to conduct this investigation. The cumbersome amount of time required to work with rich data imposes a harsh limit upon individual researchers on how deep and how far they can go with such investigations. Though it could be argued that a larger set of diverse cases, under longer observation, and deeper analysis would expand the awareness of the studied phenomena hardly it would be attainable for a single researcher within the schedule of a doctoral program. In that sense, case diversity, length of collection and depth of analysis are limitations inherent to the methodological choice when applied to doctoral dissertations.

10.5- SUGGESTIONS FOR FURTHER RESEARCH

Future research could expand the external validity of the present investigation by involving a larger set of investigators distributed along more diverse cases. Cases should vary in location, types of business covered, as well as in and in the array of national composition. For the latter, the inclusion of more eastern team members and eastern project locations would certainly be welcome and make justice to the growing importance of Asian economies in the world economic scenario. The inclusion of a larger number of researchers would also allow medium to large-scale knowledge change process (like UNA3) be more properly registered as long as they can unfold along several years.

It is important to note, however, that this investigation stresses a clear landmark between national diversity and knowledge diversity. By no means gathering a large number of different nationalities translates into knowledge diversity. Given a certain societal background (e.g.: high to upper-middle class), formation pattern (e.g.: U.S. inspired business school) and career path (e.g.: large companies) even the most dissimilar cultural backgrounds can converge in their hands-on business methods. As such, knowledge diversity must be understood as a more encompassing construct that goes beyond personal roots and moves into different approaches. In this regard, another venue of investigation would be the ability of single-national companies to mimic the knowledge diversity found in international project teams and if such form of diversity is capable to generate knowledge change just like the international one.

The field would also benefit from studies aimed at measuring constructs like environmental changes, knowledge diversity, knowledge density, power asymmetries, political and strategic action, and related them with observable knowledge outcomes. Such quantitative analysis not only would help to expand the external validity of the theoretical body the project work setting but would also help to refine it by establishing an order of precedence or relevance regarding which measures would cause higher impact in terms of knowledge change when applied for both firms and projects. In that sense, qualitative studies are key to expand the influence of the theoretical proposition presented through this investigation into broader organizational debates.

Data collection indicates that to take advantage of firm's inherent knowledge diversity without being caught in internal competition, mature MNEs may be increasingly resorting in the use permanent bodies of internal consultancy. These corporate structures are usually composed of international members recruited along several units based on their ability to disentangle complex business situations. Detached from any national identity and unit interests such internal consultants travel around the world giving advice, collecting quasi-institutional knowledge and establishing relationships. An example of this is the "Delivery group" recently created within WP to support projects worldwide. In this framework, it could argued that such internal consultancy not only would represent a way by which knowledge diversity would break up with divergent interests easing knowledge change

processes along international project teams but maybe more important a way turn local project teams into international ones as well. Nevertheless, internal consultancy may be used as well to champion corporate sanctioned knowledge upon units, thus reinforcing power asymmetries and reducing knowledge diversity. In that sense, the creation of these groups and their relationship with local project teams would certainly be an interesting focus for future investigations.

Another interesting focus for future research would be to compare how cultural differences and power asymmetries affects the prospects of conflict and collaboration in international settings. The present investigation suggests that "cultural clashes" though are fed by bad communication and lack of contextual background are indeed sparked by power asymmetries. The ability to impose rather than negotiate a common way is key to turn minor misunderstandings inherent to international exposure into paralyzing deadlocks. Along the three cases it could be observed how initial "cultural clashes" evolved overtime (even in the absence of a common idiom) into mutual understanding and collaboration under power distension, proximity, and cultural interest. Insofar, the field would certainly benefit from a closer look at the relationship between power and intercultural behavior.

Finally, by considering *political action* as the process by which common understandings and logics of action can emerge out of the multiplicity of actors and the diversity of interests, a closer examination of the elements involving power, legitimation, and interpretation is likely to unveil key mechanisms governing the 'life' of MNEs. Moreover, taking into account that a political stance is responsible for MNE critical balances allow room for the idea that MNEs are in a permanent process of redefinition and search for equilibrium, a sort of dynamic order, much more akin to what is empirically seen than those quasi-static frames portrayed by traditional approaches. In that sense, the upcoming of a political approach would certainly represent an advance towards a more encompassing MNE theory.

BIBLIOGRAPHIC REFERENCES

- ABRAHAMSON, E.; FAIRCHILD, G. (1999). Management Fashion: Lifecycles, Triggers, and Collective Processes. **Administrative Science Quarterly**, 44:708-740.
- ABRAHAMSON, E.; FOBRUM, C. (1994). Macrocultures: Determinants and Consequences. **Academy of Management Review**, 19(4):728-755.
- ADLER, N. (1986). **International Dimensions of Organizational Behaviour**. Boston, MA: Kent.
- ADLER, N.; BARTHOLOMEW, S. (1992). Academic and Professional Communities of Discourse: Generating Knowledge on Transnational Human Resource Management. **Journal of International Business Studies**, 23:551-569.
- ADLER, P.; GOLDOFTAS, B.; LEVINE, D. (1999) Flexibility Versus Efficiency? A Case Study of Model Changeover in the Toyota Productive System. **Organization Science**. 10(1): 43-68.
- AFUAH, A. (2001). Dynamic Boundaries of the Firm: Are Firms Better Off Being Vertically Integrated in the Face of Technology Change? **Academy of Management Journal**, 44(6):1209-1226.
- AGARWAL, S.; RAMASWAMI, S. (1992). Choice of Foreign Market Entry-Mode: Impact of Ownership, Location, and Internalization Factors. **Journal of International Business Studies**, 23(1):1-27
- AGUILERA, R; JACKSON, G; (2003). The Cross-National Diversity of Corporate Governance: Dimensions and Determinants. **Academy of Management Review**, 28(3):447-465.
- ALVAREZ, J. (ed.) (1998). **The Diffusion and Consumption of Business Knowledge**. NY: St. Martin's Press.
- AMATUCCI, M; BERNARDES, R. (2007). O Novo Papel das Subsidiárias de Países Emergentes na Inovação em Empresas Multinacionais: O caso da General Motors do Brasil. **Revista de Administração e Inovação**, 4(3):05-16.
- ANCONA, D.; CALDWELL, D. (1992). Demography and Design: Predictions of New Product Team Performance. **Organization Science**, 3:321-341.
- ANDERSEN, O. (1997). Internationalization and Market Entry Mode: A Review of Theories and Conceptual Frameworks. **Management International Review**, 2:27-42.
- ANDERSON, J. (2011). EM not just about China. Financial Times, 3rd June.
- ANDERSON-GOUGH, F.; GREY, C.; ROBSON, K. (2000) In the Name of the Client: The Service Ethic in Two Professional Service Firms. **Human Relations** 53(9):1151-1174.
- AOKI, M. (2001). **Towards a Comparative Institutional Analysis**. Cambridge, MA.: MIT Press.
- ARAUJO, L.; REZENDE, S. (2003). Path dependence, MNEs and the Internationalization Process: A Relational Approach. **International Business Review**, 12:719-737.
- ARGOTE, L; BECKMAN, S.; EPPLE, D. (1990). The Persistence and Transfer of Learning in Industrial Settings. **Management Science**, 36:140-154.
- ARGYRES, N. (1996). Capabilities, Technological Diversification and Divisionalization. **Strategic Management Journal**, 17:129-150.
- ARGYRIS, C; SCHON, D. (1978). **Organizational Learning**, Reading, MA: Addison-Wesley.
- ARYKAN, A. (2009). Interfirm Knowledge Exchanges and the Knowledge Creation Capability of Clusters. **Academy of Management Review**, 34(4):658-676.
- ASHFORTH, B.; MAEL, F. (1989). Social Identity Theory and the Organization. **Academy of Management Review**, 14(1):20-39.
- AU, K. (1997). Another Consequence of Culture: Intra-Cultural Variation. **International Journal of Human Resource Management**, 8(5):743-755.

- AYCAN, Z. (1997). Expatriate Adjustment as a Multifaceted Phenomenon: Individual and Organizational Level Predictors. **International Journal of Human Resource Management** 8(4):434-456.
- BADARACCO, J. (1991). **The Knowledge Link: How Firms Compete Through Strategic Alliances**. Boston, MA: Harvard Business School Press.
- BAHRAMI, H.; EVANS, S. (1995). Flexible Recycling and High-Technology Entrepreneurship. **California Management Review**, 37(3):62-89.
- BAKER, W. (1990). Market Networks and Corporate Behaviour. **American Journal of Sociology**, 96:589-625.
- BAKTHIN, M. (1986). **Speech Genres & Other Late Essays**. Austin: University of Austin Press.
- BARKEMA, H.; BELL, J.; PENNING, J. (1996). Foreign Entry, Cultural Barriers, and Learning. **Strategic Management Journal**, 17:151-166.
- BARKEMA, H.; SHENKAR, O.; VERMEULEN, F.; BELL, J. (1997). Working Abroad, Working with Others: How Firms Learn to Operate International Joint Ventures. **Academy of Management Journal**, 40(2):426-442.
- BARKEMA, H.; VERMEULEN, F. (1998). International Expansion Through Start-up or Acquisition: A Learning Perspective. **Academy of Management Journal**, 41(1):7-26.
- BARNEY, J. (1986). Strategic Factor Markets: Expectations, Luck and Business Strategies. **Management Science**, 32(10):1231-1241.
- BARON, J.; DAVIS_BLAKE, A.; BIELBY, W. (1986). The Structure of Opportunity: How promotion ladders vary within and among organizations. **Administrative Science Quarterly**, 31:248-273.
- BARTLETT, C. (1986). Managing and Building the Transnational: The New Organizational Challenge. IN PORTER, M. (ed) **Competition in Global Industries**. Boston, MA: Harvard Business School Press.
- BARTLETT, C.; GHOSHAL, S. (1989) **Managing Across Borders: The Transnational Solution**. Boston: Harvard Business School Press.
- BARTON, K.; MARTIN, D. (1990). When Politics Pays: Factors Influencing Managerial Compensation Decisions. **Personnel Psychology**, 41:361-378.
- BAUDRILLARD, J. (1984) **Selected Writings**. Stanford, CA: Stanford University Press.
- BAUM, J.; OLIVER, C. (1991). Institutional Linkages and Organizational Mortality. **Administrative Science Quarterly**, 36:187-218.
- BAZERMAN, M.; NEALE, M. (1992). **Negotiating Rationality**. NY: Free Press.
- BECKER, H. (1958). Problems of Inference and Proof in Participant Observation. **American Sociological Review**, 23(6):652-660.
- BEEHR, T.; GILMORE, D. (1980). Applicant Attractiveness as a Perceived job-relevant Variable in Selection of Management Trainees. **Academy of Management Journal**, 25:250-264.
- BÉLANGER, J. GILES, A.; GRENIER, J-N. (2003). Patterns of Corporate Influence in the Host Country: a Study of ABB in Canada. **International Journal of Human Resource Management**, 14(3): 469-485.
- BÈRET R.; MENDEZ, A.; PARAPONARIS, C.; RICHEZ-BATESTTI, N. (2003). R&D Personnel and Human Resource Management in Multinational Companies: Between Homogenization and Differentiation. **International Journal of Human Resource Management**, 14(3), 449-468.
- BERGER, P.; LUCKMANN, T. (1966). **The Social Construction of Reality: A Treatise in the Sociology of Knowledge**. New York: Doubleday & Co.
- BERGER, P.; LUCKMANN, T. (1995). **Modernität, Pluralismus und Sinnkrise: Die Orientierung des Modernen Menschen**. München: Bertelsmann.
- BHAGAT, R.; KEDIA, B.; HARVESTON, P; TRIANDIS, H. (2002). Cultural Variations in the Cross-Border Transfer of Organizational Knowledge: An Integrative Framework. **Academy of Management Review**, 27(2):204-221.

- BIRKINSHAW, J. (2000). **Entrepreneurship in the Global Firm**. London:Sage
- BIRKINSHAW, J.; HOOD, N. (1998). Multinational Subsidiary Evolution: Capability and Charter Change in Foreign-Owned Subsidiary Companies. **Academy of Management Review**, 23(4):773-795.
- BIRKINSHAW, J.; MORRISON, A. (1995). Configurations of Strategy and Structure in Subsidiaries of Multinational Corporations. **Journal of International Business Studies**, 4:729-753.
- BLACK, J. (1988). Work Role Transitions: A Study of American Expatriate Managers in Japan. **Journal of International Business Studies**, 19:277-294.
- BOEHE, D. (2006). Os Papéis de Subsidiárias Brasileiras na Estratégia de Inovação de Empresas Multinacionais Estrangeiras. **Revista de Administração da USP**, 42(1):05-18.
- BOEHE, D. (2007). Product Development in MNC Subsidiaries: Local Linkages and Global Interdependencies. **Journal of International Management**, 13:488-512.
- BOISOT, M.; CHILD, J. (1998). The Iron Law of Fiefs: Bureaucracy Failure and the problem of Governance in Chinese Economic Reforms. **Administrative Science Quarterly**, 33:507-527.
- BOURDIEU, P. (1977) **An Outline of the Theory of Practice**. NY: Cambridge University Press.
- BOYACIGILLER, N.; ADLER, N. (1991). The Parochial Dinosaur: Organizational Science in a Global Context. **Academy of Management Review**, 16(2):262-290.
- BORGATTI, S.; CROSS, R. (2003). A Social Network View of Organizational Learning. **Management Science**, 49:432-445.
- BORYS, B.; JEMISON, D. (1989). Hybrid Arrangements as Strategic Alliances: Theoretical Issues in Organizational Combinations. **Academy of Management Review**, 14(2):234-249.
- BOTTI, H. (1995) Misunderstandings: A Japanese Transplant in Italy Strives for Lean Production. **Organizations**, 2(1):55-86.
- BRANNEN, M. (2004). When Mickey Loses Face: Recontextualization, Semantic Fit and the Semiotic of Foreignness. **Academy of Management Review**, 29(4): 593-616.
- BRASS, D. (1984). Being in the Right Place: A Structural Analysis of Individual Influence in an Organization. **Administrative Science Quarterly**, 29:518-539.
- BRASS, D.; GALASKIEWICZ, J.; GREVE, H., TSAI, W. (2004). Taking Stock of Networks and Organizations: A Multilevel Perspective. **Academy of Management Journal**, 47(6):795-817.
- BROUTHER, L.; BROUTHERS, K.; WERNER, S. (1999). Is Dunning's Eclectic Framework Descriptive or Normative? **Journal of International Business Studies**, 30(4):831-844.
- BROWN, J.; DUGUID, P. (1991). Organizational Learning and Communities of Practice: Toward a Unified View of Working, Learning and Innovation. **Organization Science**, 2(1):40-57.
- BROWN, S.; EISENHARDT, K. (1995) Product Development: Past Research, Present Findings and Future Directions. **Academy of Management Review**, 20(2):343-378.
- BRUSH, C.; WANDERWERF, P. (1992). A Comparison of Methods and Sources for Obtaining Estimates of New Venture Performance. **Journal of Business Venturing**, 7:157-170.
- BUCHANAN, D.; BADHAM, R. (1999). Politics and Organizational Change: The Lived Experience. **Human Relations**, 52(5):609-629.
- BUCKLEY, P.; CASSON, M. (1976). **The Future of the Multinational Enterprise**. London: Macmillan & Co.
- BUCKLEY, P.; CASSON, M. (1998a). Models of the Multinational Enterprise. **Journal of International Business Studies**, 29(1): 21-44.
- BUCKLEY, P.; CASSON, M. (1998b). Analyzing Foreign Market Entry Strategies: Extending the Internationalization Approach. **Journal of International Business Studies**, 29(3): 539-562.
- BUDHWAR, P.; DEBRAH, Y. (2001). Rethinking Comparative and Cross-National Human Resource Management. **International Journal of Human Resource Management**, 12(3):497-515.

- BURGELMAN, R. (1983). A Model of Interaction of Strategic Behaviour, corporate context, and the Concept of Strategy. **Academy of Management Review**, 8(1):67-70.
- BURNS, T. (1966). Micropolitics: Mechanisms of Institutional Change. **Administrative Science Quarterly**, 6(3):257-281.
- BURNS, T.; STALKER, G. (1961) **The Management of Innovation**. London: Tavistock
- BURT, R. (1992). **Structural Holes: The Social Structure of Competition**. Cambridge, MA: Harvard University Press.
- BUTLER, R.; DAVIES, L.; PIKE, R.; SHARP, J. (1991). Strategic Investment Decision-Making: Complexities, Politics and Process. *Journal of Management Studies*, 28(4):395-415
- CALLIGIURI, P. (1999). The Ranking of Scholarly Journals in International Human Resource Management. **International Journal Human Resource Management**, 10(3):515-519.
- CAMERON, R.; NEAL, L. (2002). *A Concise Economic History of the World: From Paleolithic Times to the Present*. NY:Oxford University Press.
- CAMPBELL, D. (1969). Variation and selective retention in Socio-Cultural Evolution. **General Systems**, 16:69-85.
- CANTWELL, J; JANNE, O. (1999). Technological Globalization and Innovation Centers
- CARELLI, R. (2007). *Trabalho Estrangeiro no Brasil*. Boletim Março/2007. Rio de Janeiro: CEDES – Centro de Estudos do Direito e da Sociedade-Universidade Federal Fluminense.
- CASTELLS, M. (1995) **The Rise of the Network Society**. NY: Blackwell.
- CAVES, R. (1971). International Corporations: The Industrial Economics of Foreign Investment. **Economica**, 38:1-27
- CAVES, R. (1992). **Multinational Enterprise and Economic Analysis**. Cambridge, MA: Harvard University Press.
- CAVES, R. (1998). Research on International Business: Problems and Prospects. **Journal of International Business Studies**, 29(1):5-19.
- CERRATO, D. (2006). The Multinational Enterprise as an Internal Market System. **International Business Review**, 15:253-277.
- CHANDLER, A. (1962) **Strategy and Structure**. Garden City, NY: Doubleday.
- CHANDLER, A. (1990) **Scale and Scope**. Cambridge: Harvard University Press.
- CHANG, S.J. (1995). International Expansion Strategy of Japanese Firms: Capability Building Through Sequential Entry. **Academy of Management Journal**, 38:383-407.
- CHAPMAN, M. (1996). Social Anthropology, Business Studies and Cultural Issues. **International Studies of Management and Organizations**, 26(4):3-29.
- CHETTY, S.; ERIKSSON, K.; LINDBERGH, J. (2006). The Effect of Specificity of Experience on a firm 's perceived importance of Institutional Knowledge in an Ongoing Business. *Journal of International Business Studies*, 37(5):699.
- CHILD, J. (1997). Strategic Choice in the Analysis of Action, Structure, Organizations and Enviroments: Retrospect and Prospect. **Organization Studies**, 18:43-76.
- CHILD, J.; McGRATH, R. (2001). Organizational Forms Unfettered: Organizational Forms in an Information Intensive Economy. **Academy of Management Review**, 44(6):1135-1148.
- CITADINI, A. (1999). **Comentários e jurisprudência sobre a Lei de Licitações Públicas**. 3. Ed. São Paulo: Max Limonad
- CLARK, T; GOSPEL, H; MONTGOMERY, J. (1999). Running on the Spot? A Review of Twenty Years of Research on the Management of Human Resources in Comparative and International Perspective. **International Journal of Human Resource Management**, 10(3):520-544.
- CLARK, K.; FUJIMOTO, T. (1991). **Product Development Performance: Strategy, Organization and Management in the World Auto Industry**. Cambridge: Harvard Business School Press.

- CLEGG, S.; COURPASSON, D. (2004). Political Hybrids: Tocquevillian Views on Project Organizations. **Journal of Management Studies**, 41(4): 525-547
- CLEMENS, E.; COOK, J. (1999). Politics and Institutionalism: Explaining Durability and Change. **Annual Review of Sociology**, 25:441-466.
- COASE, R. (1937). The Nature of the Firm. **Economica**, 4:286-405.
- COGHLAN, D. (2011). Action Research: Exploring Perspectives on a Philosophy of Practical Knowing. **The Academy of Management Annals**, 5(1):53-87.
- COHEN, S.; BAILEY, D. (1997). What Makes Teams Work: Group Effectiveness Research from the Shop to the Executive Suite. **Journal of Management**, 23:239-290.
- COHEN, W.; LEVINTHAL, D. (1990). Absorptive Capacity: A New Perspective on Learning and Innovation. **Administrative Science Quarterly**, 35:128-152.
- COHEN, W.; LEVINTHAL, D. (1994). Fortune Favors the Prepared Firm. **Management Science**, 40:227-251.
- COHEN, Y.; PFEFFER, J. (1986). Organizational Hiring Standards. **Administrative Science Quarterly**, 31:1-24.
- COLLEMAN, J. (1990). **Foundations of Social Theory**. Cambridge, MA: Harvard University Press.
- COLLER, X. (1996). Managing Flexibility in the Food Industry: A Cross-National Comparative Case Study in European Multinational Companies. **European Journal of Industrial Relations**, 2(2):153-172.
- COLLINGS, D.; Mc DONNELL, A.; GUNNIGLE, P.; LAVELLE, J. (2010). Swimming Against the Tide: Outward Staffing Flows from Multinational Subsidiaries. **Human Resource Management**, 49(4):575-598.
- COOL, K.; SCHENDEL, D. (1988). Performance Differences Among Strategic Group Members. **Strategic Management Journal**, 9(3): 207-223.
- COOPER, R.; BURRELL, G. (1988). Modernism, Postmodernism and Organizational Analysis: An Introduction. **Organization Studies**, 9:91-113.
- COOPEY, J.; BURGOYGNE, J. (2000). Politics and Organizational Learning. **Journal of Management Studies**, 37(6):869-885
- CROPANZANO, R.; HOWES, J.; GRANDEY, A.; TOTH, P. (1997). The Relationship of Organizational Politics and Support to Work Behaviours, Attitudes and Stress. **Journal of Organizational Behaviour**, 18:159-180.
- CROUCH, R. (2005). Complementarity and Fit in the Study of Comparative Capitalisms. In MORGAN, G.; WHITLEY, R.; MOEN, E. (eds.), **Changing Capitalisms?** Oxford: Oxford University Press.
- CROSSANT, M.; LANE, H.; WHITE, R. (1999). An Organizational Learning Framework: From Intuition to Institution. **Academic Management Review**, 24:522-537
- CROZIER, M. (1964) **Le Phénomène Bureaucratique**. Paris:Le Seuil.
- CYERT, R.; MARCH, J. (1963) **A Behavioral Theory of The Firm**. Englewood Cliffs, NJ: Prentice Hall
- CZIKOTA, M.; RONKAINEN, I. (1997). International Business and Trade in the Next Decade: Report from a Delphi Study. **Journal of International Business Studies**, 28(4):827-844.
- DAFT, R.; LENGEL, R. (1986). Organizational Information Requirements, Media Richness and Structural Design. **Management Science**, 32(5):554-571.
- DACHLER, P. (1997). Does the Distinction between Qualitative and Quantitative Methods Make Any Sense? **Organization Studies**. 18(4):709-724.
- DAVENPORT, T.; PRUSAK, L. (1998). **Working Knowledge**. Boston: Harvard University Press.
- DAWSON, P.; BUCHANAN, D. (2005) The Way It Really Happened: Competing Narratives in the Political Process of Technological Change. **Human Relations**, 58(7):845-865.

- DEEG, R. (2005). Path Dependency, Institutional Complementarity, and Change in National Business Systems. In MORGAN, G.; WHITLEY, R.; MOEN, E. (eds.), **Changing Capitalisms?** Oxford: Oxford University Press.
- DEEHOUSE, D. (1996). Does Isomorphism Legitimate? **Academy of Management Journal**, 39:1024-1039.
- DELIOS, A.; BEAMISH, P. (1999). Geographic Scope, Product Diversification and the Corporate Performance of Japanese Firms. **Strategic Management Journal**, 20(4):711-727.
- DELIOS, A.; BEAMISH, P. (2001). Survival and Profitability: The Roles of Experience and Intangible Assets in Foreign Subsidiary Performance. **Academy of Management Journal**, 44(5):1028-1038.
- DEMSETZ, H. (1991). The Theory of the Firm Revisited. In WILLIAMSON, E.; WINTER, S. **The Nature of the Firm**. NY: Oxford University Press.
- DERRIDA, J. (1978). **Writing and Difference**. London: Routledge & Kegan Paul.
- DICKENS & MALMBERG (2001) - ????
- DIERICKX, I.; COOL, K. (1989). Asset Stock Accumulation and Sustainability of the Competitive Advantage. **Management Science**, 35:1504-1111.
- DiMAGGIO, P. (1997). Culture and Cognition. **Annual Review of Sociology**, 23:263-287.
- DiMAGGIO, P.; POWELL, W. (1983). The Iron Cage Revisited: Institutional Isomorphism and Collective Rationality in Organizational Field. **American Sociology Review**, 48:147-160.
- DiMAGGIO, P. (1995). Comments on "What Theory is Not". **Administrative Science Quarterly**, 40:391-397.
- DiSTEFANO, J.; MAZNEVSKI, M. (2000). Creating Value with Diverse Teams in Global Management. **Organizational Dynamics**, 29(1)45-63.
- DJELIC, M; BENSEDRINE, J. (2001) **Globalization and Its Limits: The Making of International Regulation**. In MORGAN, G.; KRISTENSEN, P.; WHITLEY, R. (eds.), *The Multinational Firm*. Oxford: Oxford University Press.
- DJELIC, M-L.; QUACK, S. (2005). Rethinking Path Dependency: The Crooked Path of Institutional Change in Post-War Germany. In MORGAN, G.; WHITLEY, R.; MOEN, E. (eds.), **Changing Capitalisms?** Oxford: Oxford University Press.
- DONEY, P.; CANNON, J.; MULLEN, M. (1998). Understanding the Influence of National Culture on the Development of Trust. **Academy of Management Review**, 23(3):601-620.
- DOOLEY, K.; VAN de VEN, A. (1999). Explaining Complex Organizational Dynamics. **Organization Science**, 10(3): 358-372.
- DORE, R. (1983). Goodwill and the Spirit of Market Capitalism. **British Journal of Sociology**, 34:459-482.
- DOSSET, D.; GREENBERG, C. (1981). Goal Setting and Performance Evaluation: An attributional Analysis. **Academy of Management Journal**, 24:767-779.
- DOUGHERTY, D. (1992). Interpretive Barriers to Successful Product Innovation in Large Firms. In MEINDL, J.; STUBBART, C.; PORAC, J. (Eds.) **Cognition Within and Between Organizations**. Thousand Oaks, CA: Sage.
- DOZ, Y.; PRAHALAD, C. (1980). How MNEs Cope with Host Government Intervention. **Harvard Business Review**, (Mar.-Apr.):149-157.
- DOZ, Y.; PRAHALAD, C. (1991). Managing DMNEs: A Search for a New Paradigm. **Strategic Management Journal**, 12:81-97.
- DOWLING, P.; SCHULER, R; WELCH, D. (1999). **International Dimensions of Human Resource Management** (3rd Ed.), Boston, MA: PWS-Kent.
- DUNNING, J. (1981). **International Production and the Multinational Enterprise**. London: Allen & Unwin.

- DUNNING, J. (1993) **Multinational Enterprise and the Global Economy**. Wokingham, UK: Addison-Wesley.
- DUNNING, J. (1998). Location and the Multinational Enterprise: A Neglected Factor? **Journal of International Business Studies**, 29(1):45-66.
- DURKHEIM, E. (1897). **Le Suicide**. Paris:PUF
- DYER, J.; NOBEOKA, K. (2000). Creating and Managing a High-Performance Knowledge-Sharing Network: The Toyota Case. **Strategic Management Journal**, 23:660-679.
- DYER, W; WILKINS, A. (1991). Better Stories, Not Better Constructs, To Generate Better Theory: A Rejoinder to Eisenhardt. **Academy of Management Review**, 16(3):613-619.
- EARLEY, C.; SINGH, H. (1995). International and Intercultural Management Research: What's Next? **Academy of Management Journal**, 38(2):327-340.
- EARLEY, P.; MOSAKOWSKI, E. (2000). Creating Hybrid Team Cultures: An Empirical Test of Transnational Team Functioning. **Academy of Management Journal**, 43(1):26-49.
- EASTERBY-SMITH, M.; MALINA, D. (1999). Cross-Cultural Collaborative Research: Toward Reflexivity. **Academy of Management Journal**, 42(1):76-86.
- ECONOMIST, (1992). Go West, Young Firm. May #9:88-89.
- EDSTRÖM, A.; GALBRAITH, J. (1977). Transfer of Managers as a coordination and control Strategy. **Administrative Science Quarterly**, 22:248-263.
- EDWARDS, P.; FERNER, A.; SISSON, K. (1996). The Conditions for International Human Resource Management: Two Case Studies. **International Journal of Human Resource Management**, 7(1):20-40.
- EDWARDS, T. (1998). Multinationals, Labour Management and the Process of Reverse Diffusion: A Case Study. **International Journal of Human Resource Management**, 9(4):696-709.
- EDWARDS, T.; KURUVILLA, S. (2005). International HRM: National Business Systems, organizational Politics, and the International Division of Labor in MNCs. **International Journal of Human Resource Management**, 16(1):1-21.
- EISENHARDT, K. (1989). Building Theories from Case Study Research. **Academy of Management Review**, 14:532-550.
- EISENHARDT, K. (1991). Better Stories and Better Constructs: The Case for Rigor and Comparative Logic. **Academy of Management Review**, 16(3):620-627.
- EISENHARDT, K.; MARTIN, J. (2000). Dynamic Capabilities: What are they? **Strategic Management Journal**, 21(10/11):1105-1121.
- EISENHARDT, K.; SANTOS, F. (2001) Knowledge Based View: A New Theory of Strategy? In A. Pettigrew, H. Thomas, and R. Whittington (Eds.) **Handbook of Strategy and Management**. London: Sage Publications.
- EGELHOFF, W. (1984). Patterns of Control in U.S., U.K. and European Multinational Corporations. **Journal of International Business Studies**, 15(2):73-83.
- ELDSTROM, A.; GALBRAITH, J. (1977). Transfer of Managers as a Coordination and Control Strategy in Multinational Organizations. **Administrative Science Quarterly**, 22:248-263.
- ELG, U.; JOHANSSON, U. (1997). Decision Making in Inter-firm Networks as a Political Process. **Organization Studies**, 18(3): 361-384.
- ELLINGSON, S. (1995). Understanding the Dialectic Discourse and Collective Action. **American Journal of Sociology**, 101:100-144.
- EMERSON, R. (1962). Power-Dependence Relations. **American Sociological Review**, 27:31-40.
- ERRAMILI, M. (1996). Nationality and Subsidiary Ownership Patterns in Multinational Corporations. **Journal of International Business Studies**, 27(2):225-248.
- ERES, M.; EARLEY, P. (1993). **Cultures, Self-identity, and Work**. Oxford: Oxford University Press.

- ERIKSSON, K.; JOHANSON, J.; MAJKGARD, A.; SHARMA, D. (1997) Experiential Knowledge and Cost in the Internationalization Process. **Journal of International Business Studies**, 28(2), 337-360.
- FELDSTEIN, M. (2003). Why Productivity is Growing Faster? National Bureau of Economic Research Working Paper Series, Cambridge, MA. (<http://www.nber.org/papers/w9530>)
- FERGUNSON, C. (1972). **Microeconomic Theory**. Homewood, IL: Richard D. Irwin.
- FERNER, A. (2000). The Underpinnings of Bureaucratic Control Systems: HRM in European Multinationals. **Journal of Management Studies**, 37(4):521-539.
- FERNER, A.; QUINTANILLA, J. (1998). Multinationals, National Business Systems and HRM: The Enduring Influence of National Identity or a Process of 'Anglo-Saxonization'. **International Journal of Human Resource Management**, 9(4):710-731.
- FERRIS, G.; JUDGE, T. (1991). Personnel Human Resource Management: A Political Influence Perspective. **Journal of Management**, 17:447-488.
- FERRIS, G.; KING, T. (1991) Politics in Human Resources Decisions: A Walk on the Dark Side. **Organizational Dynamics**, 20(2):59-71.
- FERRIS, G.; HOCHWATER, W.; BUCKLEY; HARRELL-COOK, G.; FRINK, D. (1999). Human Resource Management: Some New Directions. **Journal of Management**, 25(3):385-415.
- FERRIS, G.; TREADWAY, D.; KOLODINSKY, R.; HOCHWATER, W.; FRINK, D. (2005). Development and Validation of the Political Skill Inventory. *Journal of Management*, 31(1): 126-152.
- FIOL, C. (1994). Consensus, Diversity, and Learning in Organizations. **Organization Science**, 5:403-420.
- FINCHAM, R. (1992). Perspectives on Power: Processual, Institutional and 'Internal' Forms of Organizational Power. **Journal of Management Studies**, 29(6):741-759.
- FISHMAN, T. (2004). **The Chinese Century**. The New York Times, 4th July.
- FLORKOWSKI, G.; FOGEL, D. (1999). Expatriate Adjustment and Commitment: The Role of Host Unit Treatment. **International Journal of Human Resource Management**, 10(5):783-807.
- FORSGREN, M. (1989) **Managing the Internationalization Process: The Swedish Case**. London: Routledge.
- FORSGREN, M. (1990) Managing the International Multi-Centre Firm. **European Management Journal**, 8:261-267.
- FORSTER, N. (1997). 'The Persistent Myth of High Expatriate Failure Rates': a Reappraisal. **International Journal of Human Resources Management**, 8(4):414-433.
- FRAISSE, P. (1984). Perception and Estimation of Time. *Annual Review Psychology*, 35:1-36.
- FROST, T. (2001). The Geographic Sources of Foreign Subsidiaries Innovations. **Strategic Management Journal**, 22(2):101-123.
- FROST, P.; EGRI, C. (1991). The Political Process of Innovation. **Research in Organizational Behavior**, 13:229-295.
- FURTADO, C. (2007). *Formação Economica do Brasil*. São Paulo: Companhia das Letras.
- GALUNIC, D.; EISENHARDT K. (1996). The Evolution of Intracorporate Domains: Divisional Charter Losses in High-Technology, Multidivisional Corporations. **Organization Science**, 7:255-282.
- GALUNIC, D.; EISENHARDT K. (2001). Architectural Innovation and Modular Organizational Forms. **Academy of Management Journal**, 44(6):1227-1247.
- GARGIULO, M. (1993). Two-Step Leverage: Managing Constraint in Organizational Politics. **Administrative Science Quarterly**, 38:1-19.
- GARUD, R.; JAIN, S.; KUMARASWAMY, A. (2002). Institutional Entrepreneurship in the Sponsorship of Common Technological Standards: The Case of Sun Microsystems and Java. **Academy of Management Journal**, 45(1):196-214.
- GEERTZ, C. (1973). **The Interpretation of Cultures**. NY: Basic Books.

- GEPPERT, M.; WILLIAMS, K.; MATTEN, D. (2003). The Social Construction of Contextual Rationalities in MNCs. An Anglo-German Comparison of Subsidiary Choice. **Journal of Management Studies**, 40(3):617-641.
- GEPHART, R. (2004). Qualitative Research and the Academy of Management Journal. **Academy of Management Journal**, 47(4):454-462.
- GEREFFI, G; HUMPHREY, J; STURGEON, T. (2005). The Governance of Global Value Chains. Review of International Political Review, Forthcoming.
- GERINGER, J.; BEAMISH, P.; daCOSTA, R. (1989). Diversification Strategy and Internationalization. **Strategic Management Journal**, 10(1):109-119.
- GHOSHAL, B. (1987). Global Strategy: An Organizing Framework. **Strategic Management Journal**, 8:425-440.
- GHOSHAL, S.; BARTLETT, C. (1990). The Multinational Corporation as an Inter-Organizational Network. **Academy of Management Review**, 15(4):603-625.
- GIBBERT, M.; RUIGROK, W.; WICKI, B. (2008). What Passes as a Rigorous Case Study? **Strategic Management Journal**, 29: 1465-1474.
- GIBBONS, R. (1999). Taking Coase Seriously. **Administrative Science Quarterly**. 44:145-157.
- GIBSON, C.; ZELLMER-BRUHN, M. (2001). Metaphors and Meaning: An Intercultural Analysis of the Concept of Teamwork. **Administrative Science Quarterly**, 46:274-303.
- GILMORE, D.; FERRIS, G. (1989). The Effects of Applicant Impression Management Tactics on Interviewers Judgment. **Journal of Management**, 15:557-564.
- GLASER, B.; STRAUSS, A. (1967). **The Discovery of Grounded Theory: Strategies for Qualitative Research**. Piscataway, NJ: AldineDeGruyter.
- GLIMSTEDT, H. (2001) Between National and International Governance: Geopolitics, Strategizing Actors, and Sector Coordination in Electrical Engineering in the Interwar Era. In MORGAN, G.; KRISTENSEN, P.; WHITLEY, R. (eds.), **The Multinational Firm**. Oxford: Oxford University Press.
- GLYNN, M; BARR, P; DACIN, M. (2000) Pluralism and the Problem of Variety. **Academy of Management Review**, 25(4):726-734.
- GOFFMAN, E. (1959). **The Presentation of Self in Everyday Life**. New York:Doubleday & Co.
- GOMES-CASSERES, B. (1989). Ownership Structures of Foreign Subsidiaries. **Journal of Economic Behaviour and Organizations**, 11:1-25.
- GOMES-CASSERES, B. (1990). Firm Ownership Preferences and Host Government Restrictions: An Integrated Approach. **Journal of International Business Studies**, 21:1-22.
- GOMEZ-MEJIA, L.; PALICH, L. (1997). Cultural Diversity and the Performance of Multinational Firms. **Journal of International Business Studies**, 28:309-335.
- GOVINDARAJAN, V.; TRIMBLE, C. (2010). **The Other Side of Innovation: Solving the Execution Challenge**. Boston, MA: HBS Press.
- GRAEN, G.; LIDEN, R.; HOEL, W. (1982). The Role of Leadership in the Employee Withdrawal Process. **Journal of Applied Psychology**, 67:868-872.
- GRAHAM, J. (1985). The Influence of Culture on the Process of Business Negotiations: An Explanatory Study. **Journal of International Business**, 16: 81-95.
- GRANOVETTER, M. (1973). The Strength of Weak Ties. **American Journal of Sociology**, 78:1360-1380.
- GRANOVETTER, M. (1985). Economic Action and Social Structure: The Problem of Embeddedness. **American Journal of Sociology**, 91:481-510.
- GRANT, R. (1996a). Towards a Knowledge-Based View of the Firm. **Strategic Management Journal**, 17:109-122.

- GRANT, R. (1996b). Prospering in Dynamically-Competitive Environments: Organizational Capability as Knowledge Integration. **Organization Science**, 7:375-387.
- GREY, C. (1994) Career as a Project of the Self and Labour Process Discipline. **Sociology**, 28(2):479-497.
- GRONDIN, S. (2010) Timing and time perception: A review of recent behavioral and neuroscience findings and theoretical directions. **Attention, Perception, & Psychophysics**, 72 (3), 561-582.
- GROSSE, R. (1996). International Technology Transfer in Services. **Journal of International Business Studies**, 27(4):781-800.
- GUILLÉN, M. (2001). Is Globalization Civilizing, Destructive or Feeble? A Critique of Five Key Debates in the Social Science Literature. **Annual Review of Sociology**, 27:235-260.
- GUILLÉN, M. (2002). Structural Inertia, Imitation, and Foreign Business Expansion: South Korean Firms and Business Groups in China, 1987-1995. **Academy of Management Journal**, 45(3):509-525.
- GULATI, R. (1995). Social Structure and Alliance Formation Patterns. **Administrative Science Quarterly**, 40:619-652.
- GULATI, R. (1998). Alliances and Networks. **Strategic Management Journal**, 19(2):293-317.
- GUPTA, A.; GOVINDARAJAN, V. (2000). Knowledge Flows Within Multinational Corporations. **Strategic Management Journal**, 21:473-496.
- HABERMAS, J. (1975). **Legitimation Crisis**. Boston: Beacon Press.
- HABERMAS, J. (1984). **The Theory of Communicative Action**. Boston: Beacon Press.
- HANCKÉ, B.; GOYER, M. (2005) Degrees of Freedom: Rethinking the Institutional Analysis of Economic Change. In MORGAN, G.; WHITLEY, R.; MOEN, E. (eds.), **Changing Capitalisms ?**. Oxford: Oxford University Press.
- HAIRE, M.; GHISELLI, E.; PORTER, L. (1966). **Managerial Thinking: An International Study**. NY:Wiley.
- HALL, P.; GUDYKUNST, W. (1989). The Relationship of Perceived Ethnocentrism in Corporate Cultures Selection, Training, and Success of International Employees. **International Journal of Intercultural Relations**, 13:183-200.
- HALL, P; SOSKICE, D. (2001). **Varieties of Capitalism: The Institutional Foundations of Comparative Advantage**. NY: Oxford University Press.
- HAMBRICK, D.; DAVIDSON, S.; SNELL, S.; SNOW, C. (1998). When Groups Consist of Multiple Nationalities: Towards a New Understanding of the Implications. **Organization Studies**, 19:181-205.
- HAMEL, G.; PRAHALAD, C. (1994). **Competing for the Future**. Boston: Harvard Business Scholl Press.
- HANNAN, M.; FREEMAN, J. (1989). **Organizational Ecology**. Cambridge, MA: Harvard University Press.
- HANSEN, M. (1999). The Search-Transfer Problem: The Role of Weak Ties in Sharing Knowledge Across Organization Subunits. **Administrative Science Quarterly**, 44:82-111.
- HANSEN, M. (2002). Knowledge Networks: Explaining Effective Knowledge Sharing in Multiunit Companies. **Organization Science**, 13:232-248.
- HANSEN, M. (2004). Knowledge Sharing in Organizations: Multiple Networks, Multiple Phases. **Academy of Management Journal**, 48(5):775-793.
- HANSEN, M.; WERNERFELT, B. (1989). Determinants of Firm Performance: The Relative Importance of Economic and Organizational Factors. **Strategic Management Journal**, 10(5):399-411.
- HARDY, C.; PHILLIPS, N.; LAWRENCE, T. (2003). Resources, Knowledge and Influence: The Organizational Effect or Interorganizational Collaboration. **Journal of Management Studies**, 40(2):321-347

- HARVEY, M.; BUCKLEY, M. (1997). Managing Inpatriates: Building Global Core Competences. **Journal of World Business**, 32(1):35-52.
- HARZING, A. (1995) The Persistent Myth of High Expatriate Failure. **The International Journal of Human Resource Management**, 6(2): 457-474.
- HARZING, A. (2000). An Empirical Analysis and Extension of the Bartlett and Ghoshal Typology of Multinational Companies. **Journal of International Business Studies**. 31(1), p.101-120.
- HARZING, A. (2001). Who's in Charge? An Empirical Study of Executive Staffing Practices in Foreign Subsidiaries. **Human Resource Management**, 40(2):139-158.
- HASS, M. (2006). Acquiring and Applying Knowledge in Transnational Teams: The Roles of Cosmopolitan and Locals. **Organization Science**, 17(3):367-384.
- HASSEL, A. (1999) The erosion of the German System of Industrial Relations. **British Journal of Industrial Relations**, 37(3):483-506.
- HATCH, M.; EHRlich, S. (1993). Spontaneous Humor as an Indicator of Paradox and Ambiguity. **Organization Studies**, 14:505-527.
- HAYDEN, A.; EDWARDS, T. (2001). The Erosion of the Country of Origin Effect: A Case Study of a Swedish Multinational Company. **Relations Industrielles**, 56(1): 116-140.
- HAYEK, F. A. (1937) Economy and Knowledge. **Economica**, 3: 33-54.
- HARVEY, M.; NOVICEVIC, M. (2004). The Development of Political Skills and Political Capital by Global Leaders Through Global Assignments. **International Journal of Human Resource Management**, 15(7):1173-1188.
- HENNART, J-F. (1988). A Transaction Costs Theory of Equity Joint Venture. **Strategic Management Journal**, 9(2):361-374.
- HENNART, J-F.; PARK, Y. (1993). Greenfield versus Acquisition: The Strategy of Japanese Investors in the United States. **Management Science**, 39:1054-1070.
- HENISZ, W.; ZELNER, B. (2005). Legitimacy, Interest Group Pressures and Change in Emergent Institutions: The Case of Foreign Investors and Host Country Governments. **Academy of Management Review**, 30(2): 361-382.
- HEDLUND, G. (1986). The Hypermodern MNE: A Heterarchy?. **Human Resource Management**. 25:9-36.
- HEDLUND, G.; KVERNELAND, A. (1984). **Investing in Japan: the experience of Swedish firms**. Stockholm: Stockholm School of Economics Press.
- HEDLUND, G.; RIDDERSTRALE, J. (1997) **Toward a Theory of the Self-Renewing MNE**. In TOYNE, B.; NIGH, D. (Eds.) *International Business: An Emerging Vision*. Columbia: University of South California Press.
- HERRIGEL, G.; WITTKER, V. (2005) Varieties of Vertical Disintegration: The Global Trend Toward Heterogeneous Supply Relations and the Reproduction of Difference in US and German Manufacturing. In MORGAN, G.; WHITLEY, R.; MOEN, E. (eds.), **Changing Capitalisms ?**. Oxford: Oxford University Press.
- HERRIOT, S.; LEVINTHAL, C.; MARCH, J. (1985). Learning From Experience in Organizations. **American Economic Review**, 75:298-302.
- HICKS, R.; MILLER, G.; KINSBOURNE, M. (1976). Prospective and Retrospective Judgments of Time as a Function of Amount of Information Processed. **The American Journal of Psychology**, 89(4):719-730
- HICKSON, D.; BUTLER, R.; CRAY, D.; MALLORY, G.; WILSON, D. (1986). *Top Decisions: Strategic Decision-Making in Organizations*. San Francisco: Jossey-Bass.
- HICKSON, D. (1996). The ASQ Years Then and Now Through the Eyes of a Euro-Brit. **Administrative Science Quarterly**, 41:217-228.
- HILL, C.; HOSKINSSON, R. (1987). Strategy and Structure in the Multiproduct Firm. **Academy of Management Review**, 12(2):331-341.

- HITT, M.; HOSKISSON, R.; IRELAND, R. (1990). Mergers and Acquisitions and Managerial Commitment to Innovation in M-form firms. **Strategic Management Journal**, 11(1):29-47.
- HITT, M.; HOSKISSON, R.; IRELAND, R. (1994). A Mid-Range Theory of the Interactive Effects of International and Product Diversification on Innovation and Performance. **Journal of Management**, 20:297-326.
- HITT, M.; HOSKISSON, R.; IRELAND, R. (1997). International Diversification: Effects on Innovation and Firm Performance. **Academy of Management Journal**, 40(4):767-798.
- HITT, M.; KEATS, B.; DeMARIE, S. (1998). Navigating in the New Competitive Landscape: Building Strategic Flexibility and Competitive Advantage in the 21st Century. **Academy of Management Executive**, 7(1):81-94.
- HOEGL, M.; GEMUENDEN, H. (2001). Teamwork Quality and the Success of Innovative Projects: A theoretical Concept and Empirical Evidence. **Organization Science**, 12(4)435-449).
- HOLM, D.; CHETTY, S. (2000). Internationalization of small to medium-sized manufacturing firms: a network approach. **International Business Review**, 9:77-93.
- HOFSTEDE, G. (1980). **Culture's Consequences: International Differences in Work-Related Values**. Beverly Hills, CA: Sage
- HOSTEDE, G. (1991). **Cultures and Organizations**. London: McGraw-Hill.
- HUBER, G. (1991). Organizational Learning: The Contributing Processes and Literatures. **Organization Science**, 2(Special Issue):88-115.
- HYMER, S. (1960). **The International Operations of National Firms: A Study of Direct Foreign Investment**. PhD Dissertation, Cambridge, MA:MIT Press.
- HYMER, S. (1976). **The International Operations of National Firms: A Study of Direct Foreign Investment**. Cambridge, MA: MIT Press.
- IBARRA, H. (1993). Network Centrality, Power, and Innovation Involvement: Determinants of Technical and Administrative Roles. **Academy of Management Journal**, 36(3):471-501.
- ILES, P.; HAYERS, P. (1997). Managing Diversity in Transnational Project Teams: A Tentative Model and Case Study. **Journal of Management Psychology**, 12(2).
- INKPEN, A. (1998). Learning, Knowledge Acquisition, and Strategic Alliance. **European Management Journal**, 16(2):223-229.
- INKPEN, A.; BEAMISH, P. (1997). Knowledge, Bargaining Power and the Instability of International Joint Ventures. **Academy of Management Review**, 22(1):177-202.
- INKPEN, A.; TSANG, E. (2005). Social Capital, Networks, and Knowledge Transfer. **Academy of Management Review**, 30(1):146-165.
- d'IRIBARNE, P. (1989). **La Logique de L'honneur: Gestion des Entreprises et Tradition Nationales**. Paris:Seuil.
- d'IRIBARNE, P. (2000). Management et Culture Politiques. **Revue Française de Gestion**, 128:70-75.
- ITAMI, H.; ROEHL, T. (1987). **Mobilizing Invisible Assets**. Cambridge, MA: Harvard University Press.
- JACOBSON, R. (1992). The "Austrian" School of Strategy. **Academy of Management Review**, 17(4):782-807.
- JARVIE, I. (1969). The Problem of Ethical Integrity in Participant Observation. **Current Anthropology**, 10(5):505-508.
- JAVERNICK-WILL, A.; LEVITT, R. (2010). Mobilizing Institutional Knowledge for International Projects. **Journal of Construction Engineering and Management**, 136:430-441.
- JOHANSON, J.; MATTSSON, L.. (1988) Internationalization in Industrial Systems: a Network Approach. In: HOOD, N.; VAHLNE, J.. (orgs.) **Strategies in Global Competition**. New York: Croom Helm.
- JOHANSON, J.; VAHLNE, J-E. (1977). The Internationalization Process of the Firm: A model of Knowledge Development and Increasing Foreign Market Commitment. **Journal of International Business Studies**, 8(1):23-32.

- JOHANSON, J.; VAHLNE, J. Management of Foreign Market Entry. **Scandinavian International Business Review**, v. 1, n. 3, p. 9-27, 1992.
- JOHANSON, J.; WIEDERSHEIM-PAUL, F. (1975). The Internationalization of the Firm: Four Swedish Cases. **Journal of Management Studies**, 12:305-322.
- JOHNSON, H. (1970). The Efficiency and Welfare Implications of the Multinational Corporation. IN KINDLEBERGER, C. (ed.) **The International Corporation**. Cambridge, MA: MIT Press.
- JONES, G. (1996) **The Evolution of International Business**. London:Routledge.
- JONES, G.; HILL, C. (1988). Transaction Cost Analysis of Strategy and Structure Choice. **Strategy Management Journal**, 9(1):159-172.
- KACMAR, K.; BARON, R. (1999). Organizational Politics: The State of the Field, links to Related Processes, and a Agenda for Future Research. **Research in Personnel and Human Resources Management**, 17:1-39.
- KAMOCHÉ, K. (1996). The Integration-Differentiation Puzzle: A Resource-Capability Perspective in International Human Resource Management. **International Journal of Human Resource Management**, 7(1):230-244.
- KANTER, R. (1993) **Men and Women of the Corporation**. NY: Basic Books.
- KANTER, R.; BRINKERHOFF, D. (1981). Organizational Performance: Recent Developments in Measurement. **Annual Review of Sociology**, 7:321-349.
- KATZ, R.; ALLEN, T. (1982). Investigating the Not-Invented-Here (NIH) Syndrome: A Look at Performance, Tenure and Communication Patterns of 50 R&D project groups. **R&D Management**, 12:7-19.
- KEDIA, B.; BHAGAT, R. (1998). Cultural Constrains on Transfer of Technology Across Nations: Implications for Research in International and Comparative Management. **Academy of Management Review**, 13:559-571.
- KILDUFF, M. (1992). Performance and Interaction Routines in Multinational Corporations. **Journal of International Business Studies**, 271:63-75.
- KIPNIS, D.; VAN der VEER, R. (1971) Ingratiation and the Use of Power. **Journal of Personality and Social Psychology**, 17:280-286.
- KIPNIS, D.; SCHIMDT, S. (1988). Upward-Influence Styles: Relationship with Performance Evaluation, Salary and Stress. **Administrative Science Quarterly**, 33:528-542.
- KIRKMANN, B.; SHAPIRO, D. (1997). The Impact of Cultural Values on Employee Resistance to Teams: Toward a Model of Globalized Self-Managing Work Team Effectiveness. **Academy of Management Review**, 22(3):730-757.
- KIRZNER, I. (1973). **Competition and Entrepreneurship**. Chigago:University of Chicago Press.
- KNIGHT, D.; PEARCE, C.; SIMTH, K.; OLIAN, J.; SIMS, H.; FLOOD, P. (1999). Top Management Team Diversity, Group Process, and Strategic Consensus. **Strategic Management Journal**, 20:445-465.
- KNIGHTS, K; WILLMOTT, H. (1995). Culture and Control in a Life of an Insurance Company. **Studies in Culture, Organizations and Societies**, 1:29-47.
- KOBRIN, S. (1979). Political Risk: A Review and Reconsideration. **Journal of International Business Studies**, 10(1): 67-80.
- KOGUT, B.; SINGH, H. (1988). The Effect of National Culture on the Choice of Entry Modes. **Journal of International Business Studies**, 19:411-432.
- KOGUT, B.; ZANDER, U. (1992). Knowledge of the Firm, Combinative Capabilities and the Replication of Technology. **Organization Science**. 3:383-397.
- KOSTOVA, T. (1997). Country Institutional Profile: Concept and Measurement. **Best Paper Proceedings of the Academy of Management**:180-184.
- KOSTOVA, T. (1998). Transnational Transfer of Strategic Organizational Practices: A Contextual Perspective. **Academy of Management Review**, 24(2):306-324.

- KOSTOVA, T.; ROTH, K. (2002). Adoption of an Organizational Practice by Subsidiaries of Multinational Corporations: Institutional and Relational Effects. **Academy of Management Journal**, 45(1):215-233.
- KOSTOVA, T.; ROTH, K. (2003). Social Capital in Multinational Corporations and a Macro-Micro Model of its Formation. **Academy of Management Review**, 28(2):297-317.
- KOSTOVA, T. ZAHEER, S. (1999). Organizational Legitimacy Under Conditions of Complexity: The Case of the Multinational Enterprise. **Academy of Management Review**, 24(1):64-81.
- KOSTOVA, T.; ROTH, K.; DACIN, M. (2008). Institutional Theory in the Study of Multinational Corporations: A critique and New Directions. **Academy of Management Review**, 33(4):994-1006.
- KOTTER, J.; HESKETT, J. (1992). **Corporate Culture and Performance**. NY: Free Press.
- KRAMER, R. (1993). Cooperation and Organizational Identification. In MURNIGHAN, J. (Ed.) **Social Psychology in Organizations: Advances in Theory and Practice**. Englewood, NJ: Prentice Hall
- KRACKHARDT, D. (1990). Assessing the Political Landscape: Structure, Cognition, and Power in Organizations. **Administrative Science Quarterly**, 35:342-369.
- KRISTENSEN, P.; ZEITLIN, J. (2001) The Making of the Global Firm: Local Pathways to Multinational Enterprise. In MORGAN, G.; KRISTENSEN, P.; WHITLEY, R. (eds.), **The Multinational Firm**. Oxford: Oxford University Press.
- KUEMMERLE, W. (1997). Building Effective R&D Capabilities Abroad. **Harvard Business Review**, 97:61-70.
- KUMAR, P.; GHADIALLY, R. (1989). Organizational Politics and its Effects on Members of Organization. **Human Relations**, 42:305-314.
- KURAMOTO, R.; APPOLONI, C. (2002). Uma Breve História da Política Nuclear Brasileira. **Caderno Brasileiro de Ensino de Física**, 19(3): 379-392.
- LACHMANN, R. NEDD, A.; HININGS, B. (1994). Analyzing Cross-National Management and Organizations: A Theoretical Framework. **Management Science**, 40:40-55.
- LADO, A.; WILSON, M. (1994). Human Resource Systems and Sustained Competitive Advantage: A Competency-Based Perspective. **Academy of Management Review**, 19:699-727.
- LAM, A. (1994). The Utilization of Human Resources: A Comparative Study of British and Japanese Engineers in Electronics. **Human Resource Management Journal**, 4(3):22-38.
- LAM, A. (1995). Building Integrated Workforces Across National Borders: The Case of British and Japanese Engineers. **International Journal of Human Resource Management**, 6(3):508-527.
- LAM, A. (2003). Organizational Learning in Multinationals: R&D Network of Japanese and US MNEs in the UK. **Journal of Management Studies**, 40(3):672-703.
- LANE, C. (1989). **Management and Labour in Europe: The Industrial Enterprise in Germany, Britain and France**. Aldershot: Edward Elgar.
- LANE, C. (2001). The Emergence of German Transnational Companies: A Theoretical Analysis and Empirical Study of the Globalization Process. In MORGAN, G.; KRISTENSEN, P.; WHITLEY, R. (eds.), **The Multinational Firm**. Oxford: Oxford University Press.
- LANGLEY, A. (1999) Theorizing From Process Research. **Academy of Management Review**, 24(4):691-710
- LANZARINNI, S. (2010). **Capitalismo de Laços**. Rio de Janeiro: Campus.
- LARWOOD, L.; WHITTAKER, W. (1977). Self-serving biases in organizational planning. **Journal of Applied Psychology**, 62(2):194-198
- LAVE, J.; WAGNER, E. (1991). **Situated Learning**. Cambridge, Cambridge University Press.
- LAUDARES, J.; RIBEIRO, S. (2000). Trabalho e Formação do Engenheiro. **Revista Brasileira de Estudos Pedagógicos**, 81:491-500.
- LAURENT, A. (1986). The Cross-Cultural Puzzle of International Human Resource Management. **Human Resource Management**, 25:91-102.

- LAWRENCE, P.; LORSCH, J. (1967). **Organization and Environment**. Homewood, IL: Irwin.
- LAWRENCE, T. (1999). Institutional Strategy. **Journal of Management**, 25:161-187.
- LAWRENCE, T.; MAUWS, M.; DYCK, B.; KLEYSEN, R. (2005). The Politics of Organizational Learning: Integrating Power into the 4I Framework. **Academy of Management Review**, 30(1):180-191.
- LAU, D.; MURNIGHAM, J. (1998). Demographic Diversity and Faultlines: The Compositional Dynamics of Organizational Groups. **Academy of Management Review**, 23(2):325-340.
- LE POIDEVIN, R. (2011). The Experience and Perception of Time, In ZALTA, E. (ed.), **The Stanford Encyclopedia of Philosophy**. <http://plato.stanford.edu/archives/fall2011/entries/time-experience>.
- LEDWITH, S.; SEYMOUR, D. (2001). Home and Away: Preparing Students for Multicultural Management. **International Journal of Human Resource Management**, 12(8):1292-1312.
- LEE, T. (2001). On Qualitative Research in AMJ. **Academy of Management Journal**, 44(2):215-216.
- LEI, D.; HITT, M.; BETTIS, R. (1996). Dynamic Core Competences Through Meta-learning and Strategic Context. **Journal of Management**, 22:549-569.
- LEONARD-BARTON, D. (1992). Core Capabilities and Core Rigidities: A Paradox in Managing new Product Developments. **Strategic Management Journal**, 13(special issue):111-125.
- LEPAK, D. (2009). What is Good Reviewing? **Academy of Management Review**, 34(3): 375-381.
- LEVITT, T. (1960). **Marketing Myopia**. Harvard Business Review, July-August:45-56.
- LEVITT, B.; MARCH, J. (1988). Organizational Learning. **Annual Review of Sociology**, 14:319-340.
- LEWIN, K. (1951). **Field Theory in Social Science**. NY:Harper and Row.
- LI, J.; XIN, K.; PILLUTLA, M. (2002). Multicultural Leadership Teams and Organizational Identification in International Joint Ventures. **International Journal of Human Resource Management**, 13(2):320-337.
- LIEBERMAN, R. (2002) Ideas, Institutions and Political Order: Explaining Political Change. **American Political Science Review**, 96:697-712.
- LIMA, L.A. (2010). **Brazilian Multinationals Positive After the Global Crisis**. São Paulo: SOBEET (Sociedade Brasileira de Estudos de Empresas Transnacionais e da Globalização Econômica)
- LIPPMANN, S.; RUMELT, R. (1982). Uncertainty Imitability: An Analysis of Inter-firm Differences in Efficiency under Competition. **Bell Journal of Economics**, 13:418-453.
- LU, J.; BEAMISH, P. (2001). The Internationalization and Performance of SMEs. **Strategic Management Journal**, 22(3):565-586.
- LU, J.; BEAMISH, P. (2004). International Diversification and Firm Performance: The S-Curve Hypothesis. **Academy of Management Journal**, 47(4):598-609.
- LUCAS, R. (1987). Political-Cultural Analysis of Organizations. **Academy of Management Review**, 12(1):144-156.
- LUGER, M.; SANDNER, K.; MEYER, R.; HAMMERSCHMID, G. (2005). Contextualizing Influence Activities: An Objective Hermeneutical Approach. **Organization Studies**, 26(8):1145-1168.
- LUO, Y. (2002). Capability Exploitation and Building in a Foreign Market: Implications for Multinationals Enterprises. **Organization Science**, 13(1):48-63.
- LYOTARD, J.-F. (1984). **The Postmodern Condition: A Report on Knowledge**. St. Paul: University of Minnesota Press.
- MADHOK, A. (1997). Cost, Value and Foreign Market Entry Mode: The Transaction and the Firm. **Strategic Management Journal**, 18:39-61.
- MAHONEY, J. (2000) Path Dependence in Historical Sociology. **Theory and Society**, 29:507-548.
- MAJUMDAR, S.; VENKATARAMAN, S. (1998). Network Effects and the Adoption of New Technology: Evidence from the U.S Telecommunications Industry. **Strategic Management Journal**, 19(6):1045-1062.

- MALNIGHT, T. (1996). The Transition from Decentralized to Network-Based MNE Structures: An Evolutionary Perspective. **Journal of International Business Studies**, 27(1):43-65.
- MALNIGHT, T. (2001). Emerging Structural Patterns within MNEs: Towards Process-Based Structures. **Academy of Management Journal**, 44(6):1185-1208.
- MANNHEIM, K. (1936). **Ideology and Utopia: An Introduction to the Sociology of Knowledge** (1985 Edition). New York: Harcourt Brace.
- MARCH, J. (1962). The Business Firm as a Political Coalition. **The Journal of Politics**, 24(4):662-678.
- MARCH, J. (1984). Notes on Ambiguity and Executive Compensation. **Journal of Management Studies**, Aug:53-64.
- MARCH, J. (1991). Exploration and Exploitation in Organizational Learning. **Organization Science**, 2(1):71-87.
- MARCH, J.; OLSEN, J. (1984) The New Institutionalism: Organizational Factors in Political Life. **American Political Science Review**, 78:734-749.
- MARCH, J.; SIMON, H. (1958). **Organizations**. New York: Wiley.
- MARTINEZ, J. I.; JARILLO, J. C. (1991) Coordination Demands of International Strategies. **Journal of International Business Studies**, 22(3):429-444.
- MARTÍN de CASTRO, G.; LÓPEZ-SAEZ, P.; DELGADO-VERDE, M. (2011). Towards a Knowledge-Based View of the Firm. **Journal of Knowledge Management**, 15(6): 871-874.
- MAURICE, M. SELLIER, F.; SILVESTRE, J. (1982). **Politique d'Éducation et Organization Industrielle en France et en Allemagne: Essai d'Analyse Sociétale**. Paris:PUF.
- MAYES, R.; ALLEN, B. (1977). Toward a Definition of Organizational Politics. **Academy of Management Review**, 2:672-678.
- MAZNEVSKI, M. (1994). Understanding Our Differences: Performance in Decision-Making Groups with Diverse Members. **Human Relations**, 47:531-552.
- McDOUGALL, P.; OVIATT, B. (2000). International Entrepreneurship: The Intersection of Two Research Paths. **Academy of Management Journal**, 43(5):902-906.
- McEVILY, B.; PERRONE, V.; ZAHEER, A. (2003). Trust as an Organizational Principle. **Organization Science**, 14:91-103.
- McLOUGHLIN, I.; BADHAM, R. (2005). Political Processes Perspectives on Organizational and Technological Change. **Human Relations**, 58(7): 827-843.
- McGRATH, R.; McMILLAN, I.; VENKATARAMAN, S. (1995). Defining and Developing Competence: A Strategic Process Paradigm. **Strategic Management Journal**, 16:251-275.
- McGRATH, R. (2001). Exploratory Learning, Adaptive Capacity, and the Role of Managerial Oversight. **Academy of Management Journal**, 44(1):118-131.
- MENDENHALL, M.; ODDOU, G. (1985). The Dimensions of Expatriate Acculturation: A Review. **Academy of Management Review**, 10(1):39-47.
- MEYER, J.; ROWAN, B. (1977). Institutionalized Organizations: Formal Structures as Myth and Ceremony. **American Journal of Sociology**, 83:340-363.
- MEZIAS, J. (2001). Identifying Liabilities of Foreignness and Strategies to Minimize Their Effects: The Case of Labor Lawsuit Judgments in the United States. **Strategic Management Journal**, 23:229-242.
- MEZIAS, S.; GLYN, M. (1993). The Three Faces of Corporate Renewal: Institution, Revolution and Evolution. **Strategic Management Journal**, 14:77-101.
- MILES, M; HUBERMAN, A. (1984). **Qualitative Data Analysis: A Sourcebook of New Methods**. Beverly Hills, CA: Sage.
- MILES, R.; SNOW, C. (1978) **Organizational Strategy, Structure, and Process**. New York: McGraw Hill.

- MILGROM, P.; ROBERTS, J. (1988). An Economic Approach to Influence Activities in Organizations. **American Journal of Sociology**, 94: 154-179.
- MILLER, D.; CHEN, M-J. (1996). The Simplicity of Competitive Repertoires: An Empirical Analysis. **Strategic Management Journal**, 17:419-439.
- MILLER, K. (1992). A Framework for Integrated Risk Management in International Business. **Journal of International Business Studies**, 23:311-331.
- MILLER, K. (2002). Knowledge inventories and managerial myopia. **Strategic Management Journal**, 23 (8):689-706.
- MILLIMAN, J.; von GLINOW, M.; NATHAN, M. (1991). Organizational Life Cycles and Strategic International Human Resource Management in Multinational Companies. **Academy of Management Review**, 162:318-339.
- MINAYO, M. (1996) **O Desafio do conhecimento: Pesquisa qualitativa em saúde**. São Paulo-Rio de Janeiro: HUCITEC-Abrasco.
- MINTZBERG, H. (1979). An Emerging Strategy of "Direct Research". **Administrative Science Quarterly**, 24:580-589.
- MINTZBERG, H. (1985) The Organization as a Political Arena. **Journal of Management Studies**, 22(2): 133-154.
- MISES, L. (1949). **Human Action: A Treatise on Economics**. New Haven, CT: Yale University Press.
- MOEN, E.; LILJA, K. (2001) Constructing Global Corporations: Contrasting National Legacies in the Nordic Forest Industry. In MORGAN, G.; KRISTENSEN, P.; WHITLEY, R. (eds.), **The Multinational Firm**. Oxford: Oxford University Press.
- MONEY, R. (1998). International Multilateral Negotiations and Social Networks. **Journal of International Business Studies**, 29(4):695-710.
- MONTOYA-WEISS, M.; MASSEY, A.; SONG, M. (2001). Getting It Together: Temporal Coordination and Conflict Management in Global Virtual Teams. **Academy of Management Journal**, 44(6):1251-1262.
- MORCK, R.; YEUNG, B. (1992). Internalization: An Event Study Test. **Journal of International Economics**. 33(1-2):41-56.
- MOREY, N.; LUTHANS, F. (1985). Refining the Displacement of Culture and the Use of Scenes and Themes in Organizational Studies. **Academy of Management Review**, 10(2):219-229.
- MORGAN, G. (2001). The Multinational Firm: Organizing Across Institutional and National Divides. In MORGAN, G.; KRISTENSEN, P.; WHITLEY, R. (eds.), **The Multinational Firm**. Oxford: Oxford University Press.
- MORGAN, G. (2005). Changing Capitalisms? Internationalization, Institutional Change, and Systems of Economic Organization. In MORGAN, G.; WHITLEY, R.; MOEN, E. (eds.), **Changing Capitalisms?** Oxford: Oxford University Press.
- MORGAN, G. (2005b) Internationalization, Institutional Change, and Systems of Economic Organization. In MORGAN, G.; WHITLEY, R.; MOEN, E. (eds.), **Changing Capitalisms?** Oxford: Oxford University Press.
- MORGAN, G.; KELLY, B.; SHARPE, D.; WHITLEY, R. (2003). Global Managers and Japanese Multinationals: Internationalization and Management in Japanese Financial Institutions. **International Journal of Human Resource Management**, 14(3):389-407.
- MORGAN, G.; QUACK, S. (2005) Internationalization and Capability Development in Professional Service Firms. In MORGAN, G.; WHITLEY, R.; MOEN, E. (eds.), **Changing Capitalisms**. Oxford: Oxford University Press.
- NAPIER, N. (1989). Mergers and Acquisitions, Human Resource Issues and Outcomes: A Review and Suggested Typology. **Journal of Management Studies**, 26:271-289.
- NELSON, R.; WINTER, S. (1982). **An Evolutionary Theory of Economic Change**. Boston: Belknap.
- NICKERSON, J.; ZENGER, T. (2004). A Knowledge-Based Theory of the Firm: The Problem Solving Perspective. **Organization Science**, 0(0):1-16.

- NISSEN, M. (2007). Knowledge Management and Global Cultures: Elucidation Through an Institutional Knowledge-flow Perspective. **Knowledge and Process Management**, 14(3):211-225.
- NONAKA, I. (1994). A Dynamic Theory of Organizational Knowledge Creation, **Organization Science** 5(1):14-37.
- NONAKA, I.; TAKEUCHI, H. (1995) **The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation**. NY: Oxford University Press.
- NOVICEVIC, M.; HARVEY, M. (2001). The Changing Role of the Corporate HR Function in Global Organizations of the 21th century. **International Journal of Human Resource Management**, 12(8):1251-1268.
- OCKER, R.; HILTZ, S.; TUROFF, M.; FJERMESTAD, J. (1995). The Effects of Distributed Group Support and Process Structuring on Software Requirements Development Teams: Results on Creativity and Quality. **Journal of Management Information Systems**, 12(3):127-153.
- O'GRADY, S; LANE, H. (1996). The Psychic Distance Paradox. **Journal of International Business Studies**, 27(2):309-333.
- OHMAE, K. (1995) **The End of the Nation State**. Cambridge: Free Press.
- OLIVER, C. (1991). Strategic Responses to Institutional Pressures. **Academy of Management Review**, 16:145-179.
- OLIVEIRA, M.; BORINI, F.; GUEVARA, A. (2009). The Strategic Relevance of the Brazilian Subsidiaries of Multinational Corporations. **Revista de Administração da USP**, 44(4):285-298.
- OCDE - Organization for Economic Co-Operation and Development, (1997). **Globalisation and Small and Medium Enterprises**. Paris: OECD.
- ORNSTEIN, R. (1975) **On the experience of time**. Oxford, UK: Penguin.
- OSTRY, S. (1998). Technology, Productivity and the MNE. **Journal of International Business Studies**, 29(1):85-99.
- OUCHI, W. (1977). The Relationship Between Organizational Structure and Organizational Control. **Administrative Science Quarterly**, 22(1):95-113.
- PADGETT, J.; ANSELL, C. (1993). Robust Action and the Rise of the Medici. **American Journal of Sociology**, 98(6): 1259-1319.
- PARKER, C.; DIPBOYE, R.; JACKSON, S. (1995). Perceptions of Organizational Politics: An Investigation of Antecedents and Consequences. **Journal of Management**, 21(5):891-912.
- PENROSE, E. (1959). **The Theory of the Growth of the Firm**. London: Basil Blackwell.
- PARKHE, A. (1991). Inter-firm Diversity, Organizational Learning and Longevity in Global Strategic Alliances. **Journal of International Business Studies**, 22(4):579-601.
- PEARCE, J.; De CASTRO, J.; GUILLEN, M. (2008) Influencing Politics and Political Systems: Political Systems and Corporate Strategies. **Academy of Management Review**, 33(2):493-495.
- PENNINGS, J. (1975). The Relevance of the Structural-Contingency Model for Organizational Effectiveness. **Administrative Science Quarterly**, 20:393-410
- PENROSE, E. (1959). **The Theory of the Growth of the Firm**. London: Basil Blackwell.
- PENTLAND, B. (1999). Building Process Theory with Narrative: From Description to Explanation. **Academy of Managements Review**, 24(4):711-724.
- PERLMUTTER, H.; HEENAN, D. (1986). Cooperate to Compete Globally. **Harvard Business Review**, Mar-Apr:136-152.
- PERREWÈ, P.; ZELLARS, K.; FERRIS, G.; KACMAR, C.; RALSTON, D. (2004). Neutralizing Job Stressors: Political Skill as an Antidote to the Dysfunctional Consequences of Role Conflict Stressors. **Academy of Management Journal**, 47:141-152.
- PETERS, T. (1987). **Thriving on Chaos: Handbook for a Management Evolution**. NY:Knopf
- PETTIGREW, A. (1973). **The Politics of Organizational Decision-Making**. London:Tavistock.

- PICHAULT, F. (1995). The Management of Politics in Technically Related Organizational Change. **Organization Studies**, 16(3):449-476.
- PICHAULT, F. (1998). A Political Model of Change in Network Organizations. **European Journal of Work and Organizational Psychology**. 7(2):215:232
- PIERSON, P. (2000) Increasing Returns, Path Dependence, and the Study of Politics. **American Political Science Review**, 94:251-267.
- PFEFFER, J. (1981). **Power in Organizations**. Boston, MA: Pitmann.
- PFEFFER, J. (1992). **Managing with Power**. Boston, MA: HBS Press.
- PFEFFER, J. (2010). **Power**. Boston, NY: Harper Collins.
- PIETERSE, J. (1994). Globalization as Hybridization. **International Sociology**, 9: 161-184.
- PFEFFER, J.; FONG, C. (2005). Building Organizational Theory from First Principles: The Self-Enhancement Motive and Understanding Power and Influence. **Organization Science**, 16(4):372-388.
- PHILLIPS, N.; LAWRENCE, T.; HARDY, C. (2004). Discourse and Institutions. **Academy of Management Review**, 29(4):635-652.
- PMBOK Guide - A Guide to the Project Management Body of Knowledge**, 3rd Edition (2004). Newton Square, PA: Project Management Institute.
- POLANYI, M. (1962). **Personal Knowledge: Towards a Post-Critical Philosophy**. Chicago, IL: University of Chicago Press.
- POLDONY, J.; PAGE, K. (1998). Network Forms of Organization. **Annual Review of Sociology**, 24:57-76.
- PORTER, L.; ALLEN, R.; ANGLE, H. (1981). The Politics of Upward Influence in Organizations. In CUMMINGS, L.; STAW, B. (Eds.) **Research in Organizational Behavior**. Greenwich, CT: JAI Press.
- PORTER, M. (1980). **Competitive Strategy**. NY: Free Press.
- PORTER, M. (1990) **The Competitive Advantage of Nations**. NY: Free Press.
- PORTER, M. (1991). Towards a Dynamic Theory of Strategy. **Strategic Management Journal**, 12:95-117.
- PORTER, M. (1992) **Capital Choices: The Causes and Cures of Business Myopia**. Research Report to the U.S. Government's Council on Competitiveness, Washington D.C.
- PORTER, M.; TANSKY, J. (1999). Expatriate Success May Depend on a Learning Orientation: Considerations for Selecting and Training. **Human Resource Management**, 38(1): 47-60.
- PORTES, A. (1998). Social Capital: Its Origins and Applications in Moderns Sociology. **Annual Review of Sociology**, 24:1-24.
- PORTES, A; SENSENBRENNER, J. (1983). Embeddedness and Immigration: Notes on the Social Determinants of Economic Action, **American Journal of Sociology**, 98:1320-1350.
- POUDER, R.; St JOHNS, C. (1996). Hot Spots and Blind Spots: Geographical Clusters of Firms and Innovation. **Academy of Management Review**, 21(4):1192-1225.
- POWELL, W. (1990). Neither Market nor Hierachy: Network Forms of Organization. In STAW, B.; CUMMINGS, L. (Eds.) **Research in Organizational Behaviour**, v.12:295-336. Greenwich, CT: JAI Press.
- POWELL, W.; DiMAGGIO, P. (1983). The Iron Cage Revisited: Institutional Isomorphism and Collective Rationality in Organizational Fields. **American Sociological Review**, 48(2):147-160.
- POWELL, W.; DiMAGGIO, P. (1991) **The New Institutionalism in Organizational Analysis**. Chicago, IL: University of Chicago Press.

- POWELL, W.; KOPUT, K.; SMITH-DOERR, L. (1996). Interorganizational Collaboration and the Locus of Innovation: Networks of Learning in Biotechnology. **Administrative Science Quarterly**, 41(1):116-146.
- POWELL, W.; BRANTLEY (1992). Competitive Cooperation in Biotechnology: Learning Through - Networks?. In NOHRIA, N.; ECCLES, R. (Eds). **Networks and Organizations: Structure, Form, and Action**. Boston: Harvard Business School Press.
- PRADO, C. (2006). **Historia Econômica do Brasil**. São Paulo: Editora Brasiliense.
- PRAHALAD, C. K.; DOZ, Y.L. (1987) **The Multinational Mission**. New York: The Free Press.
- PRAHALAD, C.; HAMEL, G. (1990). The Core Competence of the Firm. **Harvard Business Review**, May:71-91.
- PRATT, M. (2008). Fitting Oval pegs into Round Holes: Tensions in Evaluating and Publishing Qualitative Research in Top-Tier North American Journals. **Organizational Research Methods**, 11:481-509.
- PRATT, M. (2009). For the Lack of a Boilerplate: Tips on Writing Up (and Reviewing) Qualitative Research. **Academy of Management Journal**, 52(5):856-862.
- PUTNAM, H. (1993). The Prosperous Community: Social Capital and Public Life. **American Prospect**, 13:35-42.
- PUTNAM, L.; PHILLIPS, N.; CHAPMAN, P. (1996). Metaphors of Communications and Organizations. IN CLEGG, S.; HARDY, C.; NORD, W. (Eds) **Handbook of Organization Studies**. London:SAGE.
- QUINN, R.; CAMERON, K. (1998). **Paradox and Transformation: Toward a Framework of Change in Organizations and Management**. Cambridge, MA: Ballinger.
- QUINTANILLA, J.; FERNER, A. (2003). Multinationals and Human Resources Management: Between Global Convergence and National Identity. **International Journal of Human Resource Management**, 14(3):363-368.
- RALSTON, D. (1985). Employee Ingratiation: The Role of Management. **Academy of Management Review**, 10:477-487.
- REAGANS, R.; McEVILY, B. (2003). Network Structure and Knowledge Transfer: The Effects of Cohesion and Range. **Administrative Science Quarterly**, 48:240-267.
- REDDING, S. (1994). Comparative Management Theory: Jungle, Zoo of Fossil Bed? **Organization Studies**, 15:323-59.
- REDFIELD, R.; LINTON, R.; HERSKOVITS, M. (1936). Memorandum on the Study of Acculturation. **American Anthropologist**, 38:149-152.
- RINDOVA, V. (2008). Publishing Theory When You Are New to the Game. **Academy of Management Review**, 33(2):300-303.
- RINDOVA, V.; KOTHA, S. (2001). Continuous "Morphing": Competing Through Dynamic Capabilities, form and function. **Academy of Management Journal**, 44(6):1263-1280.
- ROBINS, J.A. (1992). Organizational Economics: Notes on the Use of Transaction-Cost Theory in the Study of Organizations. **Administrative Science Quarterly**, 32:68-86.
- RODRIGUES, S. (2006). The Political Dynamics of Organizational Culture in an Institutionalized Environment. **Organization Studies**, 27(4):537-557.
- RONDO, C.; NEAL, L. (2002). **A Concise Economic History of the World: From Paleolithic Times to the Present**. NY: Oxford University Press.
- ROSEN, C.; HARRIS, K.; KACMAR, M. (2009). The Emotional Implications of Organizational Politics: A Process Model. **Human Relations**, 62(1):27-57.
- ROSENZWEIG, P.; SINGH, J. (1991). Organizational Environments and the Multinational Enterprise. **Academy of Management Review**, 16(2):340-361.
- ROTH, K.; KOSTOVA, T. (2003). The Use of the Multinational Corporation as a Research Context. **Journal of Management**, 29(6):883-902.

- ROTH, K.; MORRISON, A. (1990). An Empirical Analysis of the Integration-Responsiveness Framework in Global Industries. **Journal of International Business Studies**, 21(4):541-564.
- RUGMAN, A. (1979). **International Diversification and the Multinational Enterprise**. Lexington, MA: Heath.
- RUGMAN, A. (1981). A Test of Internalization Theory. **Managerial and Economic Decisions**, 2(4): 211-219.
- RUGMAN, A. (2003). Regional Strategy and the Demise of the Globalization. **Journal of International Management**, 9:409-417.
- RUGMAN, A.; VERBEKE, A. (2003). Subsidiary-Specific Advantages in Multinational Enterprises. **Strategic Management Journal**, 22:237-250.
- RUMELT, R. (1984). Towards a Strategic Theory of the Firm. In LAMB, R. (Ed.) **Competitive Strategic Management**, Englewood Cliffs, NJ: Prentice Hall.
- RUMELT, R. (1991). How Much Does Industry Matter? **Strategic Management Journal**, 12(3):167-185.
- RUMELT, R.; SCHENDEL, D. TEECE, D. (1991). Strategic Management and Economics. **Strategic Management Journal**, 12(Special Winter Issue): 5-29
- RUSS, G.; GALANG, M.; FERRIS, G. (1998). Power and Influence of Human Resource Function Through Boundary Spanning and Information Management. **Human Resource Management Review**, 8:125-148.
- SALK, J.; BRANNEN, M. (2000). National Culture, Networks, and Individual Influence in a Multinational Management Team. **Academy of Management Journal**, 43(2):191-202.
- SHAPIRO, C. (1989). The Theory of Business Strategy. **RAND Journal of Economics**, 20(1):125-137.
- SCHIEIN, E. (1985). **Organizational Culture and Leadership**. San Francisco: Jossey-Bass.
- SCHILLING, M.; STEENSMA, H. (2001). The Use of Modular Organizational Forms: An Industry-Level Analysis. **Academy of Management Journal**, 44(6):1148-1167.
- SCHNEIDER, S. (1988). National vs Corporate Culture: Implications for Human Resource Management. **Human Resource Management**, 272:231-246.
- SCHULER, R.; DOWLING, P; DeCIERI, H. (1993). An integrative Framework of Strategic International Human Resource Management. **International Journal of Human Resource Management**, 1: 717-764.
- SCHULTZ, M. (1991). Transitions Between Symbolic Domains in Organizations. **Organization Studies**, 12:489-506.
- SCHULTZ, M.; HATCH, M. (1996). Living With Multiple Paradigms: The Case of Paradigm Interplay in Organizational Culture Studies. **Academy of Management Review**, 21(2):529-557.
- SCHUMPETER, J. (1934). **The Theory of Economic Development**. Cambridge, MA: Harvard University Press.
- SCHWENK, C. (1989). Linking Cognitive, Organizational and Political Factors in Explaining Strategic Change. **Journal of Management Studies**, 26(2):177-187.
- SCOTT, R.; MEYER, J. (1994) **Institutional Environments and Organizations**. Newbury Park:Sage.
- SERA, Koh. Corporate Globalization: a new trend. **Academy of Management Executive**, v. 6, n.1, p. 89-96, 1992.
- SELMER, J. (2001a). Psychological Barriers to Adjustment and How They Affect Coping Strategies: Western Business Expatriates in China. **International Journal of Human Resource Management** 12(2):151-165.
- SELMER, J. (2001b). Antecedents of expatriate/local relationships: pre-knowledge vs socialization tactics. **International Journal of Human Resource Management**. 12(6): 916-925.

- SELMER, I.; TORBIORN, I.; de LEON, C. (1998) Sequential Cross-Cultural Training for Expatriate Business Managers: Pre Departure and Post Arrival. **International Journal of Human Resources Management**, 9(5):831-840.
- SELMER, I.; de LEON, C. (2002). Parent Cultural Control of Foreign Subsidiaries through Organizational Acculturation: A Longitudinal Study. **International Journal of Human Resources Management**, 13(8):1147-1165.
- SEWELL, W. (1992). A Theory of Structure: Duality, Agency, and Transformation. **American Journal of Sociology**, 98:1-29.
- SHAFFER, M.; HARRISON, D.; GILLEY, K. (1999). Dimensions, Determinants and Differences in the Expatriate Adjustment Process. **Journal of International Business Studies**, 3:557-581.
- SHARPE, D. (2001) Globalization and Change: Organizational Continuity and Change within a Japanese Multinational in the UK. In MORGAN, G.; KRISTENSEN, P.; WHITLEY, R. (eds.), **The Multinational Firm**. Oxford: Oxford University Press.
- SHENKAR, O. (2001). Cultural Distance Revisited: Towards a More Rigorous Conceptualization and Measurement of the Cultural Distance Construct. **Journal of International Business Studies**, 32:171-193.
- SHRADER, R.; OVIATT, B.; McDOUGALL, P. (2000). How New Ventures Exploit Trade-Offs Among International Risk Factors: Lessons for the Accelerated Internationalization of the 21st Century. **Academy of Management Journal**, 43(6):1227-1247.
- SIMON, H. (1978). Rationality as Process and as a Product of Thought. **American Economic Review**, 68:1-16.
- SIMON, H. (1991). Bounded Rationality and Organizational Learning. **Organization Science**, 2:125-134.
- SINGH, J.; TUCKER, D.; HOUSE, R. (1986). Organizational Legitimacy and the Liability of Newness. **Administrative Science Quarterly**, 31:171-193.
- SMINIA, H. (2009). Process Research in Strategy Formation: Theory, Methodology and Relevance. **International Journal of Management Reviews**, 11(1)97-125.
- SMIRCICH, L. (1983). Concepts of Culture and Organization Analysis. **Administrative Science Quarterly**, 28:339-358.
- SMITH, P. (1992). Organizational Behaviour and National Culture. **British Journal of Management**, 3:39-50.
- SMITH, P.; PETERSON, M.; WANG, Z. (1996). The Manager as Mediator of Alternative Meanings: A Pilot Study from China, the USA and the U.K. **Journal of International Business Studies**, 27(1):115-137.
- SMITH, K.; COLLINS, C.; CLARK, K. (2005). Existing Knowledge, Knowledge Creation Capability, and the Rate of New Product Introduction in High-Technology Firms. **Academy of Management Journal**, 48(2):346-357.
- SMITH, K.; SIMMONS, V. (1983). A Rumpelstiltskin Organization: Metaphors and Metaphors in Field Research. **Administrative Science Quarterly**, 28:377-392.
- SÖLVELL, Ö; ZANDER, I. (1995) Organization of the Dynamic Multinational Enterprise. **International Studies of Management and Organizations**, 25(1):17-39.
- SORGE, A. (2005) Systemic Perspective on Business Practices and Institutions: A Plea Beyond Comparative Statics. In MORGAN, G.; WHITLEY, R.; MOEN, E. (eds.), **Changing Capitalisms**. Oxford: Oxford University Press.
- SPENDER, J.-C. (1996). Making Knowledge the Basis of a Dynamic Theory of the Firm. **Strategic Management Journal**, 17 (winter special):45-62.
- STEIN, J. (1988). Takeover Threats and Managerial Myopia. **Journal of Political Economy**, 96(1):61-80
- STUART, T. E., POLDONY, J. (1996). Local Search and the Evolution of Technological Capabilities. **Strategic Management Journal**, 17:21-38.

- STRAUSS, A. (1978). **Negotiations**. San Francisco: Jossey-Bass.
- STRAUSS, A.; CORBIN, J. (1990). **Basics of Qualitative Research**. Newbury Park, CA: SAGE.
- STRYKER, R. (1999). Legitimacy Processes as Institutional Politics: Implications for Theory and Research in the Sociology of Organizations. In **Research in the Sociology of Organizations: Organizational Politics**. BACHARACH, S. ;LAWLER, E. Greenwich, CT:JAI Press.
- SUAREZ, M. (1986). **Petroquímica e Tecnoburocracias: Capítulos do Desenvolvimento do Brasil**. São Paulo:Hucitec.
- SUCHMAN, M. (1995). Managing Legitimacy: Strategic and Institutional Approaches. **Academy of Management Review**, 20(4):571-610.
- SUTTON, R. (1997). The Virtues of Closet Qualitative Research. **Organization Science**, 8(1):97-106.
- SUTTON, R.; STAW, B. (1995). What Theory is Not. **Administrative Science Quarterly**, 40:371-384.
- SWINDLER, A.; ARDITI, J. (1994). The New Sociology of Knowledge. **Annual Review of Sociology**, 20:305-329.
- SZULANSKI, G. (1996). Exploring Internal Stickiness: Impediments to the Transfer of Best Practices within Firm. **Strategic Management Journal**, 17:27-43.
- TAGGART, J. (1998). Strategic Shifts in MNC Subsidiaries. **Strategic Management Journal**, 19:663-681.
- TAINIO, R.; HUOLMAN, M.; PULKKINEN, M. (2001) The Internationalization of Capital Markets: How International Institutional Investors are Restructuring Finnish Companies. In MORGAN, G.; KRISTENSEN, P.; WHITLEY, R. (eds.), **The Multinational Firm**. Oxford: Oxford University Press.
- TAJFEL, H; TURNER, J. (1986). Critical Identity Theory of Intergroup Behaviour. In WORCHEL, S.; AUSTIN, W. (eds.) **Psychology of Intergroup Relations**. Chicago:Nelson-Hall.
- TAKEUCHI, R.; TESLUK, P.; YUN, S.; LEPAK, D. (2005). An Integrative View of International Experience. **Academy of Management Journal**, 48(1):85-100.
- TALLMAN, S.; LI, J. (1996). Effects of International Diversity and Product Diversity on the Performance of Multinational Firms. **Academy of Management Journal**, 39(1):179-196.
- TARIQUE, I.; SCHULER, R., GONG, Y. (2006). A Model of Multinational Enterprise Subsidiary Staffing Composition. **International Journal of Human Resource Management**. 17(2): 207-224.
- TAYEB, M. (1994). Organizations and National Culture: Methodology Considered. **Organization Studies**, 15:429-446.
- TAYLOR, S. (2005) **Making Time: Why Time Seems to Pass at Different Speeds and How to Control It**. Cambridge, UK:Icon Books
- TAYLOR, S.; BEECHLER, S; NAPIER, N. (1996). Toward an Integrative Model of Strategic International Human Resource Management. **Academy of Management Review**, 21(4):959-985.
- TEAGARDEN, M.; Von GLINOW, M.; BOWEN, D.; FRAYNE, C.; NASON, S.; HUO,Y.;MILLIMAN, J.; ARIAS, M.; BUTLER, M.; GERINGER, J.; KIM, N-M.; SCULLION, H.; LOWE, K; DROST, E. (1995). Toward a Theory of Comparative Management Research: An Idiographic Study of the Best International Human Resource Management Projects. **Academy of Management Journal**, 38:1261-1287.
- TEECE, D. (1977). Technology Transfer by Multinational Firms: The Resource Costs of Transferring Technological Know-How. **Economic Journal**, 87: 242-261.
- TEECE, D.; RUMMELT, R.; DOSI, G.; WINTER, S. (1994). Understanding Corporate Coherence, Theory and Evidence. **Journal of Economic Behaviour and Organizations**, 23:1-30.
- TEECE, D.; PISANO, G.; SHUEN, A. (1997). Dynamic Capabilities and Strategic Management. **Strategic Management Journal**, 18(7):509-533.
- TELLES, P. (1994). **Historia da Engenharia no Brasil**. Rio de Janeiro: Livros Técnicos e Científicos Editora S.A

- THELEN, K. (2000) Timing and Temporality in the Analysis of Institutional Evolution and Change. **Studies in American Political Development**, 14 (Spring):101-108.
- THIOLLENT, M. (1997). **Pesquisa-Ação nas Organizações**. São Paulo: Atlas.
- THOMPSON, J. (1967). Organizations in Action: Social Science Bases of **Administrative Theory**. NY:McGraw-Hill.
- THOMPSON, T.; PURDY, J. (2009) When a Good Idea Isn't Enough: Curricular Innovation as a Political Process. **Academy of Management Learning & Education**, 8(2):188-207.
- TOLBERT, P.; ZUCKER, L. (1996). The Institutionalization of Institutional Theory. In CLEGG, C.; HARDY, C.; NORD, N. (Eds.). **Handbook of Organizational Studies**, p.175-190. Thousand Oaks, CA: Sage.
- TOWNSEND, A.; DeMARIE, S.; HENDRICKSON, A. (1998). Virtual Teams: Technology and the Workplace of the Future. **Academy of Management Executive**, 12(3):17-29.
- TREADWAY, D.; HOCHWATER, W; KACMAR, C.; FERRIS, G. (2005). Political Will, Political Skill, and Political Behavior. **Journal Of Organizational Behavior**, 26:229-245.
- TREGASKIS, O. (2003). Learning Networks, Power and Legitimacy in Multinational Subsidiaries. **International Journal of Human Resource Management**. 14(3): 431-447.
- TRIANDIS, H. (1982). Dimensions of Cultural Variation as Parameters of Organizational Theories. **International Studies of Management and Organizations**, 12(4):139-169.
- TSAI, W. (2001). Knowledge Transfer in Intra-organizational Networks: Effects of Network Position and Absorptive Capacity on Business Unit Innovation and Performance. **Academy of Management Journal**, 44(5):996-1004.
- TSAI, W.; GHOSHAL, S. (1998). Social Capital and Value Creation: The Role of Intrafirm Networks.
- TSE, D.; PAN, Y.; AU, K. (1997). How MNEs Choose Entry-Mode and Form Alliances: The China Experience. **Journal of International Business Studies**, 28(4):779-805.
- TUNG, R. (1993). Managing Cross-National and Intra-National Diversity. **Human Resource Management**, 32(4):461-477.
- TUSHMAN, M. (1977). A Political Approach to Organizations: A Review and a Rationale. **Academy of Management Review**, 2(2):206-216.
- TUSHMAN, M.; O'REILLY, C. (1996). The Ambidextrous Organization. **California Management Review**, 38(4):8-30.
- UZZI, B. (1997). Social Structure and Competition in Inter-firm Networks: The Paradox of Embeddedness. **Administrative Science Quarterly**, 42:35-67.
- VANMANNEN, J. (1983). **Qualitative Methodology**. Beverly Hills, CA: Sage Publications.
- VAN de VEN, A. (1992). Suggestion for Studying Strategy Process: A Research Note. **Strategic Management Journal**, 13(Special Issue Summer): 169-188.
- VAN de VEN, A.; HUBER, G. (1990). Longitudinal Field Research Methods for Studying Process of Organizational Change. **Organization Science**, 1:213-219.
- VAN de VEN, A; POOLE, M. (1995). Explaining Development and Change in Organizations. **Academy of Management Research**, 20:510-540.
- VERMEULEN, F.; BARKEMA, H. (2002). Pace, Rhythm and Scope: Process Dependence in Building a Profitable Multinational, **Strategic Management Journal**, 23(3):619-635.
- VERNON, R. (1966). International Investment and International Trade in the Product Cycle. **Quarterly Journal of Economics**, 80:190-217.
- VIGODA, E. (2002). Stress Related Aftermaths to Workplace Politics: The Relationship Among Politics, Job Distress and Aggressive Behavior in Organizations. **Journal of Organizational Behavior**, 23:571-591.

- WALL STREET JOURNAL, (1989). Small Firms Aren't Waiting to Grow Up to Go Global (by GUPTA, U.). December, 5th, B2.
- WALSH, J. (1995). Managerial and Organizational Cognition: Notes from Trip Down Memory Lane. **Organization Science**, 6(2):280-321.
- WALSH, J.; UNGSON, G. (1991). Organizational Memory. **Academy of Management Review**, 18(1):57-91.
- WAGSTYL, S. (2011). Innovation: Replicators no more. **Financial Times**, Jan 01st.
- WANG, C.; AHMED, P. (2007). Dynamic Capabilities: A Review and Research Agenda. **International Journal of Management Reviews**, 9(1):31-51.
- WATSON, W.; KUMAR, K.; MICHAELSON, L. (1993). Cultural Diversity's Impact on Interaction Process and Performance: Comparing Homogeneous and Diverse Task Groups. **Academy of Management Journal**, 36(4):590-602.
- WEBER, M. (1978). **Economy and Society: An Outline of Interpretive Sociology**. Stanford, CA: University of California Press.
- WELCH, L.; LOUSTARINEN, R. (1988) Internationalization: evolution of concept. **Journal of General Management**, 14(2):34-55.
- WERNERFELT, B. (1984). A Resource-Based View of the Firm. **Strategic Management Journal**, 5:171-180.
- WEICK, K. (1995). **Sensemaking in Organizations**. Thousand Oaks, CA: Sage.
- WEICK, K. (1988). Enacted Sensemaking in Crisis Situations. **Journal of Management Studies**, 25(4)-305-317.
- WEICK, K. (1989). Theory Construction as Disciplined Imagination. **Academy of Management Review**, 14:516-531.
- WELCH, L.; LOUSTARINEN, R. Internationalization: evolution of concept. **Journal of General Management**. V.14, n.2, p. 34-55, 1988.
- WESTNEY, E. (1993). Institutionalization Theory and the MNE. In GHOSHAL, S.; WESTNEY, E. (Eds.), **Organizational Theory and the Multinational Corporation**: 53-76. NY: St. Martin's Press.
- WETHERSPAHN, G. (1992). Costing Failures in Expatriate Human Resource Management. **Human Resource Planning**, 15:27-35.
- WHELLER, T.; MODY, A. (1992). International Investments and Location Decisions: The Case of U.S. Firms. **Journal of International Economics**, 33:57-76.
- WHETTEN, D. (1989). What Constitutes a Theoretical Contribution? **Academy of Management Review**, 14:490-495.
- WHITLEY, R. (1992). Societies, Firms and Markets: The Social Structuring of Business System. IN WHITLEY, R. (Ed.). **European Business System**. London:Sage.
- WHITLEY, R. (2001). How and Why are International Firms Different? The Consequences of Cross-Border Coordination for the Firm Characteristic and Behaviour. In MORGAN, G.; KRISTENSEN, P.; WHITLEY, R. (Eds.) **The Multinational Firm: Organizing Across Institutional and National Divides**. Oxford: Oxford University Press.
- WHITLEY, R. (2005) Developing Transnational Organizational Capabilities in MNEs: Institutional Constraints on Authority Sharing and Careers in Six Types of MNE. In MORGAN, G.; WHITLEY, R.; MOEN, E. (eds.), **Changing Capitalisms ?**. Oxford: Oxford University Press.
- WHYTE, W. (1989). Advancing Scientific Knowledge Through Participatory Action Research. **Sociological Forum**, 4(3):367-385.
- WILLIAMSON, O. (1967). Hierarchical Control and the Optimum Firm Size. **Journal of Political Economy**, 75(2):123-138.
- WILLIAMSON, O. (1975). **Markets and Hierarchies: Analysis of Antitrust Implications**. NY:Free Press.

- WILKINS, A. (1984). The Creation of Company Cultures: The Role of Stories and Human Resource System. **Human Resource Management**, 23:41-60.
- WINTER, S. (1987). **Knowledge and Competence as Strategic Assets**. IN TEECE, D. (ed.) *The competitive Challenge: Strategies for Industrial Innovation and Renewal*. Cambridge, MA: Ballinger.
- WRIGHT, P.; McMAHAN, G.; McWILLIAMS, A. (1994). Human Resources and Sustained Competitive Advantage: A Resource-Based Perspective. **International Journal of Human Resource Management**, 5:301-326.
- XU, D.; SHENKAR, O. (2002). Institutional Distance and the Multinational Enterprise. **Academy of Management Review**, 27(4):608-618.
- ZANDER, I.; SÖLVELL, O. (2000). Cross-Border Innovation in the Multinational Corporation. **International Studies of Management & Organizations**, 30(2):44-67.
- ZAHEER, S. (1995). Overcoming the Liability of Foreignness. **Academy of Management Journal**, 18:439-464.
- ZAHRA, S.; IRELAND, R.; HITT, M. (2000). International Expansion by New Venture Firms: International Diversity, Mode of Market Entry, Technological Learning, and Performance. **Academy of Management Journal**, 43(5):925-950.
- ZELLMER-BRUHN, M. (2003). Interruptive Events and Team Knowledge Acquisition. **Management Science**, 49:514-528.
- ZIVNUSKA, S.; KACMAR, K.; WITT, L.; CARLSON, D.; BRATTON, V. (2004). Interactive Effects of Impression Management and Organizational Politics on Job Performance. **Journal of Organizational Behavior**. 25:627-640.
- ZOLLO, M.; WINTER, S. (2002). Deliberate Learning and the Evolution of Dynamic Capabilities. **Organization Science**, 13(3):339-351.
- ZUCKER, L. (1977). The Role of Institutionalization in Cultural Persistence. **American Sociological Review**, 42:726-743.
- ZUCKER, L. (1987). Institutional Theories of Organization. **Annual Review of Sociology**, 13:443-464.
- YIN, R. (1989). **Case Study Research: Design and Methods**. Newbury Park, CA: Sage Publications.