



## **GROWTH CATALYSTS IN SUCCESSFUL ACADEMIC SPIN OFFS: THE CASE OF CATALONIA**

**Felipe Guspi Bori**

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UNIVERSITAT ROVIRA I VIRGILI

## Doctoral Thesis

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# GROWTH CATALYSTS IN SUCCESSFUL ACADEMIC SPIN OFFS: THE CASE OF CATALONIA

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October, 2015



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GROWTH CATALYSTS IN SUCCESSFUL ACADEMIC  
SPIN OFFS: THE CASE OF CATALONIA

DOCTORAL THESIS

supervised by Dra. María Ercilia García Álvarez  
Department of Business Management  
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UNIVERSITAT ROVIRA I VIRGILI

Tarragona  
2015





UNIVERSITAT ROVIRA I VIRGILI

I STATE that the present study, entitled "GROWTH CATALYSTS IN SUCCESSFUL ACADEMIC SPIN OFFS: THE CASE OF CATALONIA", presented by Felipe Guspi Bori for the award of the degree of Doctor, has been carried out under my supervision at the Department of Business Management of this university.

A handwritten signature in blue ink, written in a cursive style. The signature is fluid and somewhat abstract, with a large loop at the beginning and a long horizontal stroke at the end. It is positioned above the printed name of the supervisor.

Dra. María Ercilia García Álvarez

Doctoral Thesis Supervisor

Reus, October 30th, 2015



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## **Abstract**

Academic Entrepreneurship has been at the front end of the discussion about the role of University as a contributor of wealth and employment to society. The performance of the companies that surged from University in Europe has had discrete results that limit the returns of the commercialization of research and the macroeconomic contribution to society. Academic Spin-Off's in Europe do not grow enough and neither scholars nor practitioners have a complete explanation for it.

In the scholar context of Entrepreneurship, literature on growth has been widely studied, as growth is a matter of survival for new companies and a desirable situation for all the stockholders that is associated to success ('big is beautiful'). Literature review studies about Growth coincide in the multidimensional and complex nature of the phenomenon and the need to study growth as a process with novel approaches that open the 'black box' and provide a better understanding of it in order to build theories that explain a greater amount of growth in a greater amount of cases.

Academic Spin-Offs (ASOs) studies on growth are fewer in amount, and share the same conceptual and methodological limitations than wider Entrepreneurship studies plus the specific limitations due to the special characteristics of ASOs. Scholars usually focus on growth in the earlier stages and take a University perspective to analyse the growth of these companies.

The aim of the study is to address these deficiencies observed in previous studies and to uncover the attitudes, beliefs, decisions, actions and milestones that take these companies to grow during a sustained period of time after their earlier stages from the lens of the successful ASO entrepreneurs in Catalonia.

To address this research question we applied a mixed methods design, consisting in a sequential explanatory study. This case of mixed method design consists in an initial quantitative study that produces the results that are the input for the qualitative study. Thus, first we performed the company selection of successful ASO through a quantitative study on the Catalonian ASO to locate those companies whose balance-sheet data show

a sustained high-growth between year 3 and year 6 after its inception. Second, we performed in-depth semi-structured interviews to the founders of these successful companies and a thematic analysis using the qualitative analysis software 'Edet'.

One contribution of this thesis is the identification of the Growth Catalysts that cause an acceleration effect on Catalonian ASO companies, their integration in the Growth Process model and the role the different company capabilities have on it. These growth catalysts are the Top Management Team (TMT) formation and new incorporations, industry partnerships, a market-ready, cutting-edge technical product or service, a big financial support and a strategic turnaround in the business model. These growth catalysts have an influence in all stages of the growth process and combined with the company capabilities developed by the founder and the TMT, accelerate the growth process.

As expected, some catalysts have already been identified in Entrepreneurship or even in ASO literature among the large amount of factors that have been studied and confirmed to have some influence on growth. The academic interest of this study is their identification, the understanding of their effects on the Growth Process and the methodology that allows us to establish causality between the Catalysts and Growth, in the context of this successful Catalonian ASO.

Nevertheless, the study has also brought to light some catalysts and factors that have a significant misrepresentation in ASO literature about growth: First, the importance of previous research activities, in order to build the researchers team, increase market knowledge, accelerate and develop a market-ready prototype and increase social capital with industry. Second, the determinant role played by the team of researchers, who have the commitment, the time and importantly contribute to the growth ambition of the TMT. The formation of the core TMT, mainly based on researchers is previous to the decision of founding the company and conditions its creation. Third, the growth effect of strategic partnerships. Alliances have revealed to be an excellent mechanism to surpass management and commercial barriers that can release hidden capabilities and strengths of both partners. Although the lack of management expertise can restrain its achievement we have noticed that the disposition or intention of the founders to close such agreements could be an important antecedent for growth. Fourth, the effect that a strategic reorientation produces on growth has been completely neglected in ASO and

Entrepreneurship literature. A strategic reorientation means the company has accumulated new resources and capabilities that allow it to address new milestones. It also implies a strategic drive, reflection and planning and supposedly a more effective allocation of resources and use of its capabilities. It also derives a high level of Self-Efficacy, leadership and commitment to purposely change the way things are being done. Business reorientation such as a change in the business model to a more focused product or a new industry niche, or designing a new growth strategy planning can be important growth catalysts, no matter the kind or the direction this reorientation has. Fifth, we confirmed the importance of tacit knowledge given the significant number of successful companies that are based in this type of technology and the scarce returns the commercialization of technologies to these companies produces.

The study also brought out recommendations about controversial issues about ASO performance: with respect to its measurement it concludes the need to assess the stage of development the company is in, in order to decide the adequate measure of performance and the recommendation of taking at least two measures in the studies as not every company will eventually be in the same stage.

With reference to University policies it introduces a new dimension regarding the intensity of the aid, recommending a progressive selectivity and intensity formula instead of a low-low or a high-high constant support as proposed in literature. Regarding the Technology Transfer Office (TTO) productivity it assesses the little monetization and the need of a financial perspective and professionalized structures to face the challenge of obtaining better win-win agreements.

We suggested some paths for research in relation with the influence of the existence of a team of researchers as a key factor in the decision of creating an ASO, the study of different strategies for the monetization of tacit technologies and Students Spin-Offs, the need of wider-scale studies on Growth Catalysts to come across the context limitations of our study, the need of a longer time-frame to study the evolution of non-profitable businesses and the need of in-depth qualitative analysis on those catalysts with scarce or non-existent representation in literature.

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## **1. Introduction to the research topic.**

### **1.1. Academic justification and relevance.**

In the last two decades European Universities have increased their efforts in fostering Entrepreneurship in Public Research Institutions, trying to emulate the successful evolution of american universities. This effort has been accompanied by an increased research attention and academic output in the area of University Entrepreneurship in the last 15 years (Rothaermel, Shanti & Jiang, 2007).

University Entrepreneurship is seen as the last and round-the-circle step of the Transfer Technology process that create new companies with a high growth potential with the aim of generating wealth, qualified job places and economic development (Steffensen, Rogers, & Speakman, 2000; Etzkowitz, 2004).

This view has brought into changes in Universities at the organizational level creating specialized teams on Technology Transfer, science parks, incubators and, at regulatory level, redefining the goals and aim of the University as an institution. The latter has generated controversy in part of the academic body, who do not share this business goal view of the institution (Lee, 1996). These structures have produced an output, mainly in form of patents, licensing and research contracts and the creation of companies based on technologies created from research. These companies are referred in literature as University or Academic Spin-Off's (ASO's).

As a measure of this output Universities and Technology Transfer Offices (TTOs) have traditionally considered the simple accounting of the number of companies created or the numbers of employees enrolled in the early stages. There is an increasing consciousness of the need of taking into consideration measures regarding the mid and long term performance of the company (Rodeiro, 2008: p 284), once it has surpassed a set of barriers or thresholds that guarantee its sustainability (Vohora, Wright, & Lockett, 2004).

A good example of this need is the comparison between ASO in Europe and US. Results indicate that although the amount of new companies in Europe is acceptable, they grow at a significant smaller rate than their US counterpart, not accomplishing by far the social objective of the institution. This situation of high public research and knowledge output from academy and scarce level of transformation of this knowledge to wealth has been called the "European Paradox" (European Commission, 1995; Callan, 2001; Wright, Lockett, Clarysse, et al., 2006).

Thus, there is the belief that "something is still left" when it comes to study the main factors that influence ASO growth that can explain why an average ASO grows faster in some countries, areas, PRIs or universities. Governments, PRIs and universities, TTO's, local industry, seem to exert in fact an influence in ASO's growth. In Spain, while all the plans, subsidies, structures and actions are implemented, results in terms of monetization of research are still far from expectations (red OTRI, 2011). Research on this matter have adopted an academic or institutional perspective, paying special attention to the areas where universities have an intense implication such us Technology Transfer, patents and IP protection and university role and policies.

The reasons why companies grow and the factors that influence this growth has been a widely studied phenomenon in the entrepreneurship literature. However, its complexity impedes to have a clear understanding of it. Very recent studies recognise that previous studies take an overly simplistic, linear view of it and relevant work is needed to understand the processes, routines and capabilities underlying a firm's growth (Koryak, Mole, Lockett et al., 2015).

This doctoral thesis tries to untangle how and why ASO companies grow after their earlier stages. According to the latest findings about growth, because of the complexity and the multidimensionality of the growth phenomenon (Leitch, Hill & Neergaard, 2010), current models do not explain the greater amount of growth (Parker, Storey & van Witelostuijn, 2010). We aspire to bring a new framework to explain the growth process through the study of the actions, attitudes, beliefs, decisions or behaviours that successfully have influenced the growth process from the founder's perspective.

In order to give an empiric bases to relate these identified actions with growth we

decided to locate first “success stories” in terms of growth in the ASO population. Thus, the second novel approach of the study is that the thesis addresses to successful entrepreneurs, whose companies have presented long-term sustained growth, whom we considered best qualified to establish causality between their actions and growth.

Thus, this thesis aims to shed light on how Catalonian ASO companies and institutions can go through the performance problem of European Academic Spin-Offs, taking the founder’s level as the unit of analysis, by providing an insight on how the actions, decisions, procedures, attitudes, beliefs and behaviors that these successful companies showed have influenced the different stages of the growth process and have allowed them to achieve a sustained growth after their earlier stages.

We chose a mixed methodology for the study design (Creswell, Plano Clarck, Gutmannet et al., 2003) categorized as sequential explanatory. The results of the quantitative analysis are used as a purposeful sample for the subsequent qualitative study to explain a phenomenon (Tashakkori & Teddlie, 1998). Thus, firstly, we performed a quantitative analysis of the situation and evolution of the long-term performance of ASO created in a European Region (Catalonia, Spain), from 1999 to 2010, by accounting the main balance sheet indicators in two points of time after the creation of the company. We also located the individual companies that exhibit an abnormal growth and compare these High Growth Spin-Offs (HGASO) performance indicators with with respect to ASO average.

In addition to this objective the quantitative study aims to contribute to a better understanding of the parameters to take into account when study growth in ASO. In the methodology we profoundly discuss and justify each element taken into account into the study. Instead of taking one or two measures of performance, we draw results from different measures to contrast and assess the validity of each one in relationship with ASO performance and the stage presumably ASO is in. We map the ASO in Catalonia for each University from these indicators and draw interesting conclusions regarding the validity of each indicator and its evolution over time.

Once we have located successful High-Growth ASO (HGASO), we performed a qualitative study based on semi-structured interviews with the founders of the

companies, so as to notice the attitudes, thoughts, views and perceived causes of growth for each particular case. HGASO presented some common aspects in their background, their cognitive perception about the business, their risk taking disposition and their goals and behaviours that we try to synthesize. We used the qualitative analysis software 'EDET' for the codification of the factors affecting growth from the literature review and the common characteristics that these High-Growth ASOs presented. Then we extracted a set of actions, attitudes and milestones that these managers accomplished that had accelerated the growth process, and named them 'Growth Catalysts'.

We tried to understand how these 'Growth Catalysts' act, which kind of processes they ignite and what is the role of these processes in the growth output. As a result of this process, our thesis also provide a novel approach on how the growth process takes place, how these growth catalysts influence each of the stages of this growth process and the role of the different company capabilities in the process. In the discussion, we provide arguments about how this growth process design conciliates with existing literature on Entrepreneurship and Growth.

The academic contribution of this thesis lies in the identification of the Growth Catalysts, the role of the company capabilities and their integration in this novel Growth Process model to explain the High-Growth phenomenon in the context of the Catalonian ASO. Other interesting contributions have been made in the field of ASO performance measurement and the key role in ASO performance played by the researcher's team, previous research activities, strategic partnerships and strategic business reorientation.

Regarding the University policies our study confirms the little impact they have on ASO development and performance as they are currently designed and the causes of the scarcity of returns that Academic Entrepreneurship produce in Catalonia, and propose some measures and policy changes as for the kind of University support ASOs need and reveals the important role that tacit technologies can play on the monetization of research.

## **1.2. Business justification and relevance**

There is no doubt that growth is a desirable situation for businesses, because it means success. Bad news is that growth is difficult to predict, achieve and maintain. The quest of the factors that influence this success is a recurrent issue in Entrepreneurship research.

Managers and CEO's are eager to rule in a growing business because it means that strategy and its implementation is eventually working, and a better performance than companies in the same area and/or industry can be an indicator of the manager's ability. Workers generally desire to work in a growing company because it means new internal job opportunities, growing salaries and social recognition.

Financial institutions are more interested in lending to growing companies. Venture capital, future partners, clients and providers have a better disposition to close deals. Local government give incentives to growing businesses because it means more employment and wealth for the region.

This thesis will provide an excellent conceptual framework for managers for better understanding how other companies have achieved sustained growth and how the actions taken have increased their resources and capabilities that had an impact in each stage of the growth model. It also provide different 'success stories' that can reinforce they Self-Efficacy and provide different routes for success they can try to apply to their specific case. The identification of the growth catalysts can be a great help to clarify concrete objectives to pursue in order to achieve growth. Finally, this thesis may make practitioners reflect on the importance of achieving a sustainable growth after the earlier stages of the company and when this growth is due to be achieved.

It also will be indubitably a good help for those academics that do not have experience in business to be able to distinguish between common managerial or business problems and those problems due to the academic status of the company. It also will allow them to identify some strong points and weaknesses in their competitive analysis when defining their strategic planning.

TTO's and university staff involved in the ASO creation process will understand better the problems and obstacles managers find in the commercialization process from the company perspective and how policies and support from University can help from their position to really stimulate ASOs' growth.

Finally, the study will be helpful to Venture Capital since a major objective in VC investment is growth, it will allow to better discriminate ASO firms from their growth potential, paying attention to the signals the thesis provide that may anticipate growth in the commercialization stage.

## **2. Literature Review**

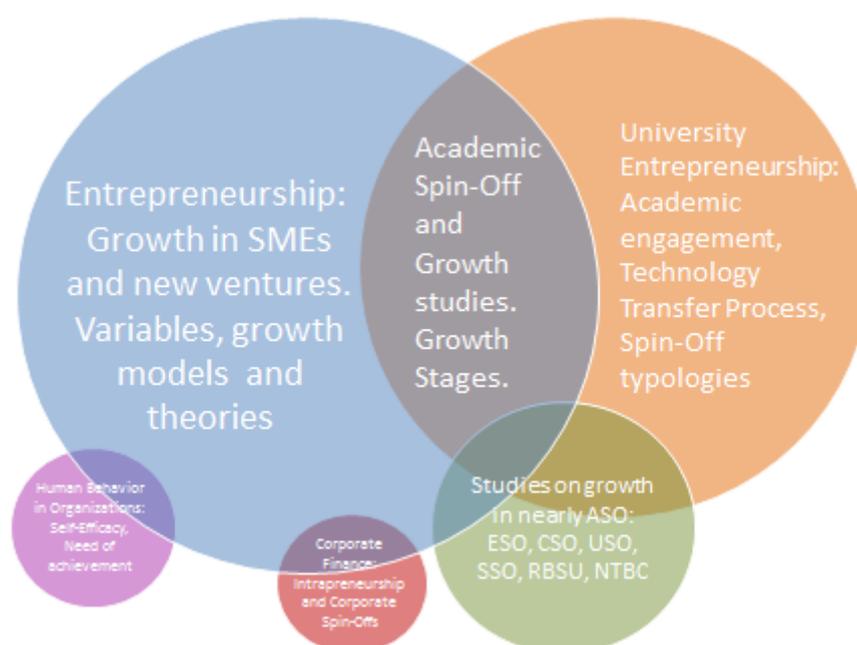
### **2.1. Bodies of knowledge**

The literature review process about University Entrepreneurship throws some light about the different focus of the articles that, although studying the same phenomena take different perspective depending on the lens the academic takes to study it. These different perspectives give an interesting clue of the main bodies of knowledge that can be applied to study this phenomenon. Thus, while there is a group of articles that research on the University and the Technology Transfer (TT) Process, another group focus on the process of formation of a New Company, the type of company created and its growth.

We can subsequently identify two main bodies of knowledge (Fig.1). The first one is related to Innovation, Research & Development and is devoted to study the TT Process: In every academic venture created, the main asset University brings into is scientific or academic knowledge, usually in form of patents or licenses. This process of transferring the research output or research capabilities to a new company is a critical one for company success and its complexity makes it candidate to numerous studies. University policies relating the TT process have been in the centre of the academic debate in last decades (Degroof & Roberts, 2004; Rothaermel et al., 2007).

The other main body of knowledge is Entrepreneurship. Entrepreneurship provides the main theory basement for the literature review of the growth phenomenon. The main point of this thesis is growth since we will try to give insight on how the process that drives a company to grow takes place, from the angle of the founder-manager. Most of the articles about Growth are related to new ventures and consequently, most of the literature on Growth is embedded in the Entrepreneurship literature because getting size enough to achieve sustainability is one of the main objectives in a new created venture manager agenda. General management and strategy journals present a lack of articles on new ventures growth and are biased in favour of growth studies in large corporations.

We also have partially addressed some other bodies of knowledge, which are related to our subject or whose theoretical ground is used in growth or ASO studies. These bodies of knowledge are Corporate Finance (to study the singularities of Corporate Spin-Offs) and Human Behaviour in the organisations (to study cognitive aspects such as locus of control, self-efficacy or need of achievement).



*Fig. 1: Bodies of knowledge and its contribution. Compiled by author.*

In the literature revision process, we have started with broader articles about the evolution of the University Entrepreneurship phenomenon, the Technology Transfer Process and the different output it produces (patenting, licensing, and ASO), the boundaries of the ASO definition and relevant articles that focus on ASO creation and its stages. Next, we learned from start-ups growth studies from Entrepreneurship literature, through an extensive review, extracting the main theories and factors that influence growth, giving special attention articles dedicated to “near-ASO” which are companies that have some similarities with ASO because of their research component, or their spinning-off from Corporations or their strong technology orientation. Finally, we checked how the evolution and state-of-the-art studies in Entrepreneurship about growth reconcile with those singular studies about growth in ASO.

## **2.2. University Entrepreneurship and Technology Transfer**

### **2.2.1. The Entrepreneurial University**

Entrepreneurship has been widely studied as a source of employment generation (Storey, 1982, 1988; Birley, 1987; Kirchoff & Phillips, 1988; White & Reynolds 1996), and economic growth (Kent 1982; Sexton 1986; Storey 1994; Wennekers & Thurik, 1999). Economic evolution in developed countries to a knowledge-based society (Brinkley & Lee, 2006), make the creation knowledge-based companies a top priority for governments to increase productivity and long-term economic growth (European Commission, 2007, 2014). The continuous surge of IT, biotech and other technological companies that generate in record time a huge value for shareholders, wealth and hundreds of qualified labor force jobs have made stakeholders realize of the importance of entrepreneurship in creating wealth. The high knowledge component of Entrepreneurship from Universities and PRI's (Löfsten, & Lindelöf, 2002) increased the interest in the creation of companies from Universities.

According to Etzkowitz (2004), an Entrepreneurial University accepts and fosters systematically entrepreneurial activities and has structures and mechanisms to monitor and stimulate the process (TTOs, licensing offices). Recent authors identify another characteristics of University Entrepreneurship, such as having courses to deliver knowledge and skills related to entrepreneurship (Entrepreneurship Education), policies to accommodate, facilitate and reward entrepreneurship in the academic world, having a systematic planning and monitoring of University Entrepreneurship, fostering links with industry and robust external and internal networks and recruiting star faculty (Meyers & Pruthi, 2011).

UE deployment results in an increase of the number of companies created based in the results of University research, starting at the US. (Smilor, Gibson & Dietrich, 1990; Brett, Gibson & Smilor, 1991; Roberts & Malone, 1996; Carayannis, Rogers, Kurihara et al., 1998; Degroof & Roberts, 2004) and a few European countries such as U.K. (Lockett, Wright & Franklin, 2003) and Sweden (Stankiewicz, 1986, 1994). This effort

was also accompanied by an increased research attention and academic output in the area of Academic Entrepreneurship in the last 15 years (Rothaermel et al., 2007; Djokovic & Souitaris, 2008; Perkmann, Tartari, McKelvey et al., 2013).

Scholars cited legal changes in the ownership of the Intellectual Property of the inventions as key for the US leadership in ASO creation and performance. The Bayh-Dole Act (1980) gave the universities the right to retain the ownership of the inventions and set explicit policies about how to distribute returns among the institutions, researchers and research centers. In European countries, IP ownership laws have historically more inclined to establish the "professor's privilege" that gives higher or complete weight of the IP rights return to the inventor.

In addition to the Bayh-Dole Act (1980), Shane (2004b) appointed other possible reasons for the US leadership in the creation and performance of ASO: the development of financial markets, the boom of the biotech industry and the increase of the university as an equity holder.

The main benefits of ASO creation are increasing the value of the results of R+D (Jensen & Thursby, 2001; Bray and Lee, 2000), job opportunities for academics and researchers, qualified employment, wealth and a significant economic return for universities. However, outside the US, ASO produced poor results (Callan, 2001). Authors argue that University Entrepreneurship economic returns are not enough to cover the expenses of the structures created for commercialization (Condom & Barceló, 2003). In Spain, it seems that these returns are minimal: according to redOTRI survey in 2011, returns from ASO investment in shares represent 0.07% of TTO expenses in 2011. It is obvious that results are far from desired and success of Universities and TTO's in University Entrepreneurship will depend greatly on the performance of the companies created.

Spain, as other European countries has recently modified its regulations on the exploitation of the inventions coming from Universities and Public Research Institutions (PRIs). New "Ley de la Ciencia, la Tecnología y la Innovación" (2011), recognizes mainly the rights of the investors to share the returns of the commercialization of research with Universities and Public Research Institutes (PRIs)

and eases previous restrictions that impeded academics to keep shares of the company, to keep a chair on the company board and to work or collaborate with Academic Spin-Offs.

Spanish and Catalan Universities and PRIs have also followed the European trend in creating supporting structures following the recommendations of academics who claim the need to access to industry and institutional networks (Camisón & March, 1995; Rodeiro, Fernández, Otero et al., 2008; Beraza and Rodríguez, 2010). A big number of programs (Ruiz, Solé & Veciana, 2004) and support structures have been created, with complex relationships between them (Corduras, Urbano, Rojas et al. 2008).

There is also an interest (and a problem) on output measurement of this institutional effort either in form of number of licenses or patents, existence of incubators or science parks, the existence of cooperation programs, number of research contracts, economic development and job creation, number and value of the companies created, articles in journals (O'Shea, Allen, O'Gorman et al., 2004) and on policy benchmarking between the institutions specially in intellectual property (IP) management practices (Siegel, Waldman & Link, 2003a).

When it has been the time to account the results of University Entrepreneurship policies regarding ASOs, the measure of success at the University level has commonly been the simple accounting of the number of companies created (Lockett et al., 2003, 2004, 2005; O'Shea, Chevalier, Allen et al., 2005; Di Gregorio and Shane, 2003; Link and Scott, 2005; González y Álvarez, 2005; Montañez, 2006). In Spain, also institutional surveys and studies have also driven its focus on the number of ASO created (redOTRI, 2010) rather than the type of ASO created (Beraza & Rodríguez, 2012) and its performance.

The factors that influence the entrepreneurial activities can be external to the University such as industry conditions, government policies (mainly Intellectual Property considerations), the existence of external agents and industrial clusters. There are also internal or University-dependant factors, mainly related to the modification of their policies to address common problems that surge in University Entrepreneurship

and to create infrastructures to support entrepreneurship (See Rothaermeler et al., 2007, for an extensive literature review of the factors influencing University Entrepreneurship).

### University policies

University policies should clarify first, its vision of the role and identity of academic (teaching and research vs. entrepreneurship), the scope of research (basic vs. applied) and the limits to the relationship with industry (Etzkowitz, 2003). Second, University has to decide about the support structures, that is, they have to choose a strategy in relationship with budget allocation, the kind of support (intensity vs selectivity) (Powers and McDougall, 2005b), Intellectual Property management (Siegel et al. 2003a) and incentive systems to TTO and academics (Friedman & Silberman, 2003).

This University policies modification must deal with the existing conflicts between University traditional and entrepreneurial view in respect to the role of academics, the mission and the culture of the University and the boundaries of the interaction with industry and the type of research performed. Scholars are not unanimous and some critical voices arise regarding University Entrepreneurship policies questioning until what extent should a public educational institution create companies and commercialize with research (eg.: Lee, 1996).

From the individual point of view, faculty and departments need knowledge and skills to foster cooperation with industry partners and the management of projects, to detect commercial opportunities and to create and run ventures. This may bring as a consequence different behaviours tasks and responsibilities the academic must accept and assume this new faculty role. Whereas contract research is commonly accepted by the academic body, the direct involvement in the creation of a company is sometimes seen as harmful for the research community and administratively difficult (Laukkanen, 2003), suggesting the need for salient and public clarity about what the right behaviours are in Academic Entrepreneurship (“rules of the game”).

To enhance University Entrepreneurship, scholars have tried to understand why some universities are more entrepreneurial than others, what are the barriers they encounter and how can they be more successful in their activities (Rothaermeler et al., 2007). Success stories are studied in detail, such as O'Shea, Allen, Morse et al. (2007) at MIT or Saxenian (1990, 1994) at Silicon Valley, who have identified common elements for success such as the quality of research faculty, the supporting organisational mechanisms as TTO and a faculty culture that encourages entrepreneurship.

Meyers & Pruthi (2011) suggest interesting practical recommendations regarding University policies for the cultural change needed to improve University Entrepreneurship: to recruit star faculty with business and academic experience, to develop links with industry and to create an appropriate incentive structure. In their big scale study in Europe (105 Universities in 14 countries), Van Looy et al. (2011) consistently found a strong positive correlation between scientific productivity of universities and entrepreneurial performance as a University and also with spin-off activity. Their study not only did not revealed any trade-offs between different transfer mechanisms but found that contract research and spin off activity turn out to be positively and significantly related.

Interestingly, Perkmann et al. (2013: p.424) defined a broader construct, "academic engagement" which they define as "knowledge related collaboration by academic researchers with non-academic organisations". Academic engagement is closely aligned with traditional academic research activities and pursued by academics to access resources supporting their research agendas, and includes collaborative research, contract research, consulting and other forms of knowledge exchange. Academic engagement often precedes commercialization in time, and can be considered as an input for it. Consistent with Meyers & Pruthi (2011: p.355-356) findings the best and most successful scientists are also the ones who engage the most with industrial partners. Academic engagement can be seen as an effective tool for mobilising resources at highly ranked institutions. So, academic engagement may be pursued in order to obtain resources, acquiring knowledge and building social capital.

Each University has its own technology transfer and entrepreneurship infrastructures. Another research stream in the ASO literature analyses the organizational designs of universities that inhibit or promote the commercialization of research. The support policies to University Entrepreneurship lead to a variety of semi-independent infrastructures such as technology incubators, science and technology parks. However, the most commonly used vehicle to commercialization is the creation of a Technology Transfer Office (TTO), which identifies, protects and commercializes and licenses Intellectual Property of faculty research.

Main support activities in the start-up phase were internal advising capabilities and network support (Degroof & Roberts, 2004). Besides direct support, TTOs can help ASO in at least two indirect ways, sharing the cost of qualified personnel to lower costs and through University reputation that can give an important signalling effect to potential partners (Mustar, Renault, Colombo et al., 2006).

Scholars have addressed recommendations to the universities in relation to TTO structures and its human resources to increase their efficiency: Common factors involved are TT Officer experience (Powers and McDougall, 2005a), business development capabilities (Lockett and Wright 2005), incentives system (Siegel et al., 2003a; Wright, et al. 2009), methods of commercializing: licensing strategy, licensing vs. equity (Bray and Lee, 2000), project selection (Powers and McDougall, 2005b). Support structures involving high selectivity and support seem better to generate ventures capable of exploiting high potential opportunities (Roberts and Malone, 1996), whereas low-selectivity and low-support policies predispose ventures to adopt a SME format (Degroof & Roberts, 2004).

A numerous group of studies directly linked university infrastructures and policies to the form and growth orientations of the ventures created (Degroof & Roberts, 2004). Again, success stories of University Entrepreneurship the US and particularly in certain universities (MIT, Stanford) are envisioned as an excellent example of how TTO can help to develop the potential University Entrepreneurship (O'Shea et al., 2007; Saxenian, 1990, 1994).

### **2.2.2. Alternatives on Technology Transfer**

Because the academic status of the spin-off, Technology Transfer (TT) is a crucial part of the venture creation. In fact, it is the leit-motiv of it. But before the decision of spinning-off is taken, different alternatives of TT can be evaluated.

Technology Transfer from university can lead to (a) industry-sponsored contract research, (b) consulting, (c) technology licensing, and (d) technology development and the creation of a company (Shane, 2002). Laukkanen (2003: p.374) identified five types of academic entrepreneurship (1) Large-scale research projects, (2) “Supplemental income augmentation” by consulting practices or lectures (3) Industry-University joint research projects (4) Patenting and finally (5) Creating a company. All these activities performed by a Public Research Institution (PRI) or a University are known as commercialization activities because they try to provide an income for these institutions from the academic and research activities, which broadly refers to all the activities outside of the normal university duties of basic research and teaching (Klofsten & Jones-Evans, 2000).

Research on Technology Transfer identifies and analyses the considerations to take into account when a decision is to be made on how to commercialize the technology and especially in the decision of spinning off or licensing. Main topics reflected on this area are the increase in the complexity of the relationship of spin-off compared to license agreements, conflicts of interest among participants and risk aversion of academics and universities (Harmon & Ardishvili, 1997). During the decade of 2000, a stream of literature studies provided arguments to favour ASO creation instead of licensing the technology (Jensen and Thursby 2001; Bray and Lee, 2000) due to their potentially higher revenues for the institution.

This view has been recently questioned by results of University investments in ASO in Europe and conceptually by some authors like Wood (2009), who established four parameters in the knowledge transfer: First, codifiability, or the degree that knowledge can be codified, that is, can be reduced to numbers, formulas, drawing or words (Grant, 1996). Second, teachability, or the degree workers can be trained in this knowledge. Third, complexity, when the innovation needs of different types of knowledges and

competencies combined. And fourth, system dependence, or the extent an innovation needs of many experienced individuals or groups. These four attributes of technology have to be taken into account in the decision of spinning off or simply license the technology. The proper alignment of these factors will minimize transaction costs and consequently will optimize university commercialization efforts.

Furthermore, many academics may be satisfied enough with these low-intensity activities that allow them to gain an extra income and apply their technological skills and experience in the context of industry (Klofsten & Jones-Evans, 2000). Thus, it is not surprising that most popular forms of TT are consulting and contract research, which is not to blame since both activities, consultancy and contract research can, with the right mechanisms, lead to a technology-based spin-off (Westhead & Storey, 1994; Klofsten & Jones-Evans, 2000; Krabel & Mueller, 2009).

There is also an interest (and a problem) on output measurement of this institutional effort either in form of licenses and royalties, economic development and job creation, number and value of the companies created, articles in journals (O'Shea, et al. 2004) and on policy benchmarking between the institutions specially in intellectual property (IP) management practices (Siegel, et al., 2003a).

The TT process itself has its barriers, difficulties and problems. There is abundant literature addressing the main problems that arise during the TT process and they can be grouped in problems related with the flow of information, asymmetric information, informational barriers, problems related with cultural clash, cultural barriers, problems due to the inflexibility in the university policies and bureaucracy, problems coming from the poor management and negotiation capabilities of the Technology Transfer Officer (TTO), and finally problems derived from the different motivations and inefficient reward system for academics and TTO (Siegel et al.2003a; O'Shea et al. 2004; Siegel, Waldman & Atwater, 2003b). It is important to keep these issues in mind because those problems that slow down or impede the TT process can hamper spin-off's growth as well.

The way Universities face these barriers and its policies regarding TT and IP can influence University behaviour and strategic vision of the spin-off firm and

consequently have a significant effect on number of ventures created and its performance.

### **2.2.3. Academic spin-off definition**

Taking a bird-eye look to the existing literature it is clear that there is not a universally accepted definition for academic spin-off. Journal articles present slight differences on what is and is not considered an Academic Spin-Off (ASO) (see Beraza & Rodríguez, 2012 for a literature review on ASO conceptualization).

Simply stated an academic spin-off is a new company that surge from the university. However this simple definition brings some doubts about to what is and what is not considered an academic spin-off. We will establish what are the characteristics and definition of a standard company spin-off and then will go for the term academic as a special type of spin-off.

A spin-off is a term used in Corporate Finance to explain the process of creation of a new company, with autonomous governance, from a parent company with some assets and/or human resources that are transferred. The parent company holds equity of the new company and no cash payment takes place in the process. The adjective sponsored or voluntary spin-off is often used to differentiate it to the situation where a group of shareholders or an external group force the division of the company. Thus, in a sponsored spin-off, the parent firm voluntarily establishes and holds stock in a newly formed company, which intends to perform some of the business of the sponsoring firm (Dahlstrand, 1997).

When the term academic or university is added to spin-off it seems like the initial condition of the parent company retaining a significant equity portion is lost. Thus, the common definition of Academic Spin-Off in literature does not require the University to hold stock in the company. In contrast, Corporate Finance refers to a narrow or pure concept of spin-off: ownership of the parent company and assets (knowledge and tangible assets) transferred from parent company to spin-off. As we will see, these

differences will have implications for research and will help us to understand and benchmark the differences between Corporate Spin-off (CSO) and Academic Spin-off (ASO).

Other questions that have generated controversy in literature are i) the involvement of the academic in the company, ii) the type of technology to be transferred and iii) the purity in the academic background of the entrepreneur.

The issue of who is currently running the new company also brings controversy. Whereas in the Corporate Finance view is commonly understood that top management team comes from the parent company, when this group or individual get shares of the spun-off firm we are talking about an Entrepreneurial Spin-Off (ESO) (Lindholm,1997a).

However, the first definitions of ASO were restrictive and required an academic to move from the University to the company (McQueen & Wallmark, 1982; Smilor, et al., 1990). This question of being the academic the one who is actually the entrepreneur was promptly surpassed by scholars (Nicolaou & Birley 2003; Klofsten & Jones-Evans, 2000) so that currently, being a shareholder or working at the company it is not considered by most authors as a key point in order to consider the new company an academic spin-off. Thus, for an ASO to be considered, the academics not always take part of the TMT, or the company board, and not always hold stock of the spun-off firm.

Consequently, the sole condition to accomplish to be a spin-off in this context is the transfer of some rights, patents, knowledge, or any other output produced by research from the parent institution to the new firm. Again, the type of knowledge transferred has not had a unique interpretation. The Association of University Technology Managers (2002) labelled as “spin-offs” those companies that had received a formal transfer of technology, while the other ones were “start-ups”. Formal meant it had to be any kind of license relationship with the parent organisation (equity, contract), which will imply in most cases, an IP protected, codified technology.

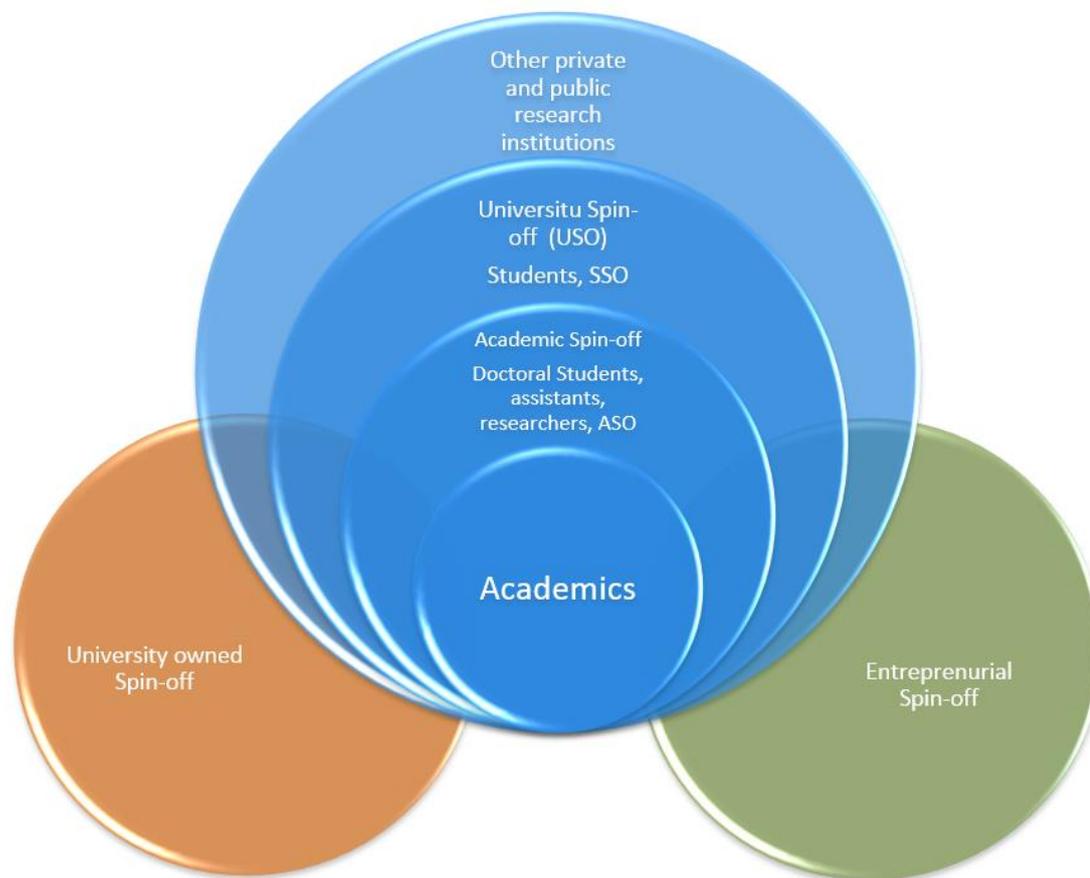
Scholars have argued this restrictive definition for ASO. It is common that the knowledge transferred from University is tacit, but this kind of companies does have a

technology base from University and would not have existed without the university linkages (Bathelt, Kogler & Munro, 2010). Besides they represent a significant part of the ASO/start-up universe (around half in Bathelt study). So, to overlook this group would eliminate a significant group of university firms, which can provide interesting insights in how Entrepreneurial University can benefit local economies.

The other term that requires explanation is “academic”, as some authors differentiate Universities from other Public Research Institutions (PRI) like, technical schools, private R&D departments, large national laboratories and research institutes that create research based spin-offs (RBSO). It also can be differentiated the broader term University from Academic. University spin-off (USO) relates to either the academics, like assistants, researchers and doctoral students (ASO) or even the students (SSO) as promoters of the spin-off (Pirnay, Surlemont & Nlemvo, 2003). ASO is considered to be the genuine spin-off from university because entrepreneurs have a profound technical and research asset that is the base of the spin-off whereas in spin-off promoted by students Technology Transfer has a secondary role, remaining as a simple exploitation of a business opportunity. However, some authors have recently provided evidence that puts in question this last statement showing that companies founded by graduate students are also high quality (Åstebro, Bazzazian & Braguinsky, 2010), and ASO literature systematically forgets about this great flow of Technology Transfer and Economic Development from University. Thus, USO definition is extraordinary heterogeneous and its status depends on the perception of practitioners and academics and consequently can vary considerably. In Figure 2, we try to synthesize these different views of academic spin-off.

Some authors prefer to quit of the “academic” component and talk about Research Based Spin-Off (RBSO), implicitly focusing in the Technology Transfer component of the company as the main characteristic to define it, rather than the entrepreneur’s origin (Mustar et al., 2006).

In line with the latest ASO conception, we adopt a broad definition of Academic Spin-Off, and we take into consideration Pirnay et al. (2003:p.356) definition of ASO: “new firms created to exploit commercially some knowledge, technology or research results developed within a university”.



*Fig. 2. ASO conceptualization. Compiled by author.*

These different interpretations are a dangerous obstacle to scientific rigour when it is time to delimitate the boundaries and the content of each study and lead to a research field where comparing results, generalization and drawing conclusions has an added difficulty and weakens the productivity of the whole area of study.

#### **2.2.4. Academic spin-off stages and milestones**

Once the spin-off is the preferred option to TT, additional issues emerge. These problems or barriers are more “entrepreneurial” and derive from the singularity of creating a new company that involves TT sometimes with the University as a

stakeholder. Looking at the knowledge as a key resource, Lockett (2005), pinpoint the lack of the different types of knowledge required as the main handicap for a spin-off to develop and to grow. Companies need this knowledge to develop and to create a sustainable competitive advantage (Spender & Grant, 1996).

The kind of knowledge gets different significance in each stage of the spin-off process (research and development stage and commercialization stage) and to the different participants in the process (PRI, TTO, academics, entrepreneurs, VC) (Lockett (2005). From this Knowledge Based View perspective, companies need to have technical/scientific knowledge, especially during the development stages and organizational knowledge to develop and growth in the commercialization stage.

Main processes and decisions to be taken during the spin-off are the opportunity recognition, the decision to commercialize and due-diligence, the choice between licensing or spinning-off, the time-period over which TTO's are involved in spin-off's and accessing resources and knowledge (Lockett, 2005:p.984). While some universities set a fixed period for TTO's involvement (1-2 years), others condition this support to achieving certain milestones, especially financial support.

Studies focusing on the creation of Spin-Off's (Ndonzuau, Pirnay & Surlemont2002; Mustar et al. 2006) implicitly set two stages in the ASO, taking the point of the ASO creation to differentiate them, identifying the pre-ASO stage and the post-ASO stage. The pre-spin-off stage had an emphasis in TT issues and the post-spin-off stage, had a focus on finance, management and especially in marketing.

An important group of studies are based on Vohora et al. (2004) perspective, who identified four critical milestones: opportunity recognition, entrepreneurial commitment, threshold of credibility and threshold of sustainability. The new firm has to develop capabilities and to obtain different types of resources to overcome each one of these junctures to achieve growth.

Opportunity Recognition is related with the capability to conceptualize how a technological discovery can be best developed to satisfy a market need. Entrepreneurial Commitment is related with individual emotional commitment to leader the venture in

beyond the start-up phase and it requires Entrepreneurial Orientation. The Credibility threshold is related with the acquisition of the initial resource endowments to start operations. Company human and social capital must generate enough credibility to be able to transact with potential clients, suppliers and partners. At this stage the venture is capable to sell its products or services to intended clients. Finally, the Sustainability threshold refers to the company's ability to reconfigure their weaknesses, inadequate capabilities and social liabilities into distinctive capabilities that generate stable returns. Thus, dynamic capabilities (Teece, Pisano & Shuen, 1997: p.516) are needed for this reconfiguration or resources to develop a competitive advantage that produce sustained returns.

Regarding the Venture Capital perspective we can differentiate two stages in company development. According to the degree of evolution in the company life cycle they differentiate between seed capital and start-up capital. VCs express a clear preference for investment at more evolved stage of the company (Knockaert, Clarysse & Wright, 2010a; Wright, Lockett, Clarysse et al., 2006).

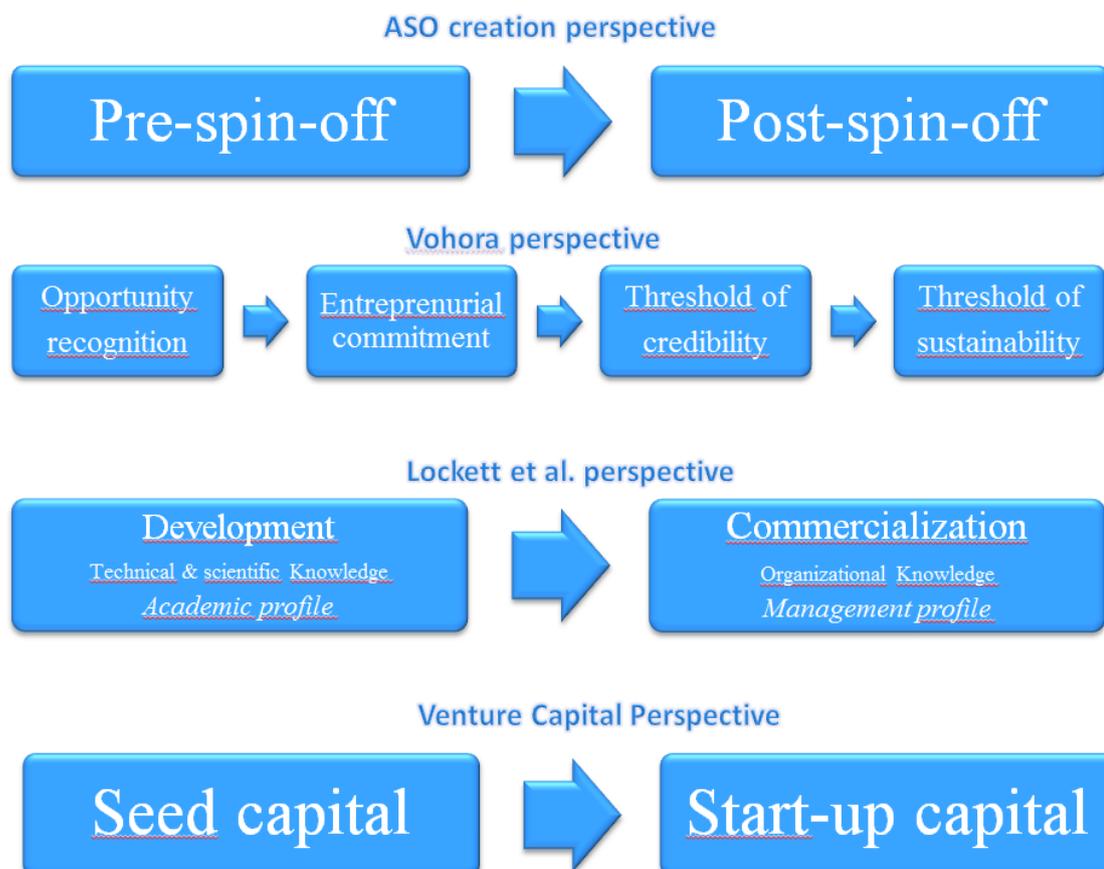


Fig. 3. ASO stages perspectives. Compiled by author.

We tried to reconcile the different author's view on ASO stages in Figure 3. As we can appreciate, authors differentiate an initial stage, before or after the creation of the company where the main process is the transfer of the technology. After this transfer has produced and the product is developed, the company can start its operations and other kind of knowledge is required, such as finance, management and specially marketing. Consequently, the time the company takes to hit each milestone and the knowledge required to advance stages are important factors to take into account to achieve growth.

### **2.2.5. Factors on Academic Spin-Off creation**

From an institutional perspective the success of the University Entrepreneurship is commonly measured by the number of licensing agreements and the number of ASO created. So, it is not surprising that a stream of research is based on the factors that influence such number (Rothaermel et al., 2007). Taking into account the existing gap in Europe between companies created and the performance of these companies we have to be careful with assuming the same hypothesis tested for the creation of ventures to the performance of these ventures. However, it is wise to think of these factors that influence company creation rate to be good candidates to also influence in some way the performance of these companies.

University endowment in facilitate key resources (O'Shea et al., 2005), the paper of TTO's (Markman, Gianiodis, Phan et al., 2005), the paper of incubators as facilitators (Rothaermel and Thursby, 2005), university policies (Di Gregorio and Shane, 2003), the faculty quality (O'Shea et al., 2005), the expenditure on intellectual property protection and the capabilities of the TTO's (Lockett & Wright, 2005), the existence of a science park or an incubator and its age (Link & Scott, 2005), all play a role in the amount of ASO created.

As for the University perspective, there are not many studies at an individual level of analysis on the factors that influence ASO creation. In a massive interview to 2604

scientists, working for a Private Research Institution, Krabel & Mueller (2009) found, in line with other more limited studies, that the main factors that influence scientists to start a business are close ties to industry established through joint research projects with private firms, patenting activity, and prior entrepreneurship experience. Scientists' perceptions about the mission of research and current tenure and income stability can inhibit the intention to start a business. Prior working experience was not found to be an influential factor.

#### **2.2.6. Academic spin-off typologies related with growth**

We address a revision of the main ASO categorization that we think can have a relationship with growth. As some typologies may present higher performance, its classification can give us important clues about the factors that influence growth.

An interesting classification of ASO is based in their business model (Mustar et al., 2006), that is, how the company articulates its value proposition, the identification of the market segment, the position which is taken in the value chain and its intended cost structure and profit margins (Chesbrough & Rosenbloom, 2002). Some authors suggest that the business model may be related with growth (Heirman & Clarysse, 2004). Based on the activities undertaken, we can find services and product companies (Chiesa & Piccaluga, 2000; Pirnay et al., 2003). Based on the definition of ASO, Pirnay et al. (2003) classified USOs depending on the status of the entrepreneur (researcher or student) and the type of knowledge (codified or tacit) transferred as the main dimensions to take into account to create a service or a product oriented company. However, he suggested an association of the students group to the low investment, low growth potential, services companies and to the researchers the high investment, high growth potential, product oriented companies with little evidence to support it.

More refined ASO-specific studies typologies have been provided such us consultants, product oriented or technology asset oriented mode (Mustar et al., 2006). According to their exit driven strategy we can find infrastructure or platform companies whose aim is building assets to seek investor acceptance during most of the early

growth and product companies, which are based on business development, marketing or sales (Heirman and Clarysse, 2004; Druilhe and Garnsey, 2004).

Bathelt et al. (2010) distinguished between sponsored SO, that are the result of particular research project and rely on specific knowledge of a researched technology and unsponsored SO which rely on generic broad knowledge to develop innovative product and services. Despite this theoretical support, both groups considered the role of university in their start-ups process as marginal, reflecting little input or stimulus from university, once the SO is formed.

Some studies suggest a relationship between the type of technology transferred and the time frame to arrive to the credibility and sustainability stages. With a strong IP protection in the case of codified technologies, inventor involvement usually is higher and both produce a quality signalling effect that reduces failure. However these type of ventures can take longer to achieve returns (more than 3 years) due to a potentially overoptimistic inventor and a too embryonic technology (Rothaermel & Thursby, 2005)

Nicolaou & Birley (2003) classified ASO in orthodox (transfer of technology and people), hybrid (TT and researcher member of the firm board and retaining his university activity) and technological (only TT, with researcher as a stakeholder or consultant). They suggested that academic embeddedness in exo-institutional (through TTO or surrogate entrepreneur) and endo-institutional (inter or intradepartmental) networks influences the type of spinout initiated and that exo-institutional business discussion networks will stimulate the academic to act in a more entrepreneurial way due to the benefits of opportunity enhancement, access to resources, timing and referrals accrue.

Titler et al. (1993) established a classification related with growth: New Technology Based Firms (NTBFs) could be slow, transitional and fast growers. Transitional growers are described as consulting, research services or niche players that eventually turn into high-growth companies. These companies had the ambition to grow but, for a variety of reasons postpone their growth plans for a few years.

Different ASO types require different financial endowments and knowledge. Based on these two parameters Druilhe & Garnsey (2004) established a typology ranging from companies dedicated to contract R+D and technical services to infrastructure companies such as in-house manufacturing.

It is important to notice that all these typologies are dynamic and it may be one or successive transformations between each typology (each business model) based on entrepreneur's knowledge, experience and resource requirements (Druilhe and Garnsey, 2004).

### **2.2.7. Academic spin-off versus Corporate spin-off literature**

Another interesting field of study is comparing ASOs with Corporate Spin-Offs (CSOs). Since the nature of the phenomena is essentially the same (the spin-off from a parent company) the comparison of both perspectives could throw interesting issues.

It is interesting to pinpoint that in the study of CSOs, academic research is oriented to Corporate Finance definitions and factors, focusing the attention in the equity value evolution of the spin-off whereas finance considerations receive little attention in ASO literature.

In Corporate Finance, a spin-off is a pro-rata distribution of the shares of the spun-off firm to the shareholders of the parent firm. Thus, no cash payment is implied for either the company or the shareholders. The announcement of a spin-off usually produces a positive reaction in stock prices in US and in Europe (Veld & Veld-Merkoulova, 2004, 2009). However, whereas CSO present a superior abnormal performance in the US, results in Europe are contradictory (Veld & Veld-Merkoulova, 2004).

Factors that can explain the wealth effects from spin-offs are: Increasing industrial focus, information asymmetry, enhance contract efficiency, simplify and align corporate governance, geographical focus and improve management incentives. Other factors that some studies take into account are taxes, regulation, wealth transfers and size

considerations (Krishnaswami & Subramaniam, 1999; Allen, 2001; Veld & Veld-Merkoulova, 2004). It is also interesting the anergy hypothesis (Linn & Rozeff, 1985) arguing that as two companies together can create more value than separately (synergies), they also can destroy value (anergies). Krishnaswami & Subramaniam (1999) stated that private companies that choose the spin-off option had at least one of these characteristics: firms with high information asymmetry, highly diversified, with higher growth opportunities or with liquidity constrain.

It is interesting to apply these factors to the ASO case when studying their performance. For instance, even no cash-flow comes inside the company in the spin-off process, Krishnaswami & Subramaniam (1999) showed that it is easier for the subsidiary firms to raise significantly the amount of money from external financing in the two years period time since their spinning-off. For the ASO case, this effect could motivate academic companies to spin-off early as a way to overcome financial barriers.

As in CSO, one may think that the creation of an ASO could simplify decision making, align TMT with company goals and objectives, improve TMT incentives and motivation and improve access to financing. CSO finance literature can be a good starting point to improve the efficiency of the university investment in ASO, by assimilating the principles and investment techniques of Corporations in spin-offs. For example, whereas growth opportunities do not seem to be a relevant criteria for University to provide support, Corporations clearly tend to cut investment in segments with poor growth opportunities and increase them in industries or companies with high growth opportunities (Rowetta, 2006).

### **2.3. Growth in SMEs and start-ups.**

In the previous chapters we have provided an insight about University Entrepreneurship body of knowledge, its two more common outputs or ways of commercialization of research, licensing and spin-off creation and the characterization of the different typologies and stages of the companies created.

In this chapter we revise the entrepreneurship body of knowledge, to deepen in the understanding of the growth phenomenon in SMEs and start-ups, the factors or elements that influence growth at the different levels of analysis and the theories used to explain growth. In the later chapter we will focus on Academic or University Spin-Offs, so that we will revise the main findings of the articles that address growth on this specific type of companies.

We can find many scientific studies through the entrepreneurship literature that are dedicated to unveil the conditions, characteristics, assets, facts or factors that lead to a new company to increase its size. As we have explained, growth is a desirable situation for SMEs in general but it is especially critical for new companies or start-ups. In the absence of growth both SMEs and new companies survival is challenged, but as firm gets older the impact of growth on survival reduces (Freeman, Carrol & Hannan, 1983). The importance of growth for new ventures might be the reason to explain that most of the research on growth in SME companies refers specifically this subset of new ventures. Consequently, journals where entrepreneurship is the main body of knowledge are the ones where one can find more articles dedicated to the study of the growth process and the factors that influence it. There are just a few articles on general business and management journals but they show a clear bias towards large organisations research, leaving SME and new venture research to specialized journals (Curran and Blackburn's 2001).

Literature about growth focus their initial studies in distilling the factors that make a company grow more than others. In their initial studies the authors tried to statistically relate growth with some company demographic measures such as size or age. (Penrose, 1959; Stinchcombe, 1965; Evans 1987; Kumar 1984). It is reasonable to think that the bigger the company is, the greater is the probability it has accomplished its growth objectives and consequently the board may think it has no sense to grow further away. In a similar way, newer companies grow faster than the older ones (Teruel Carrizosa, Mercedes, 2006). Because there is a decreased entrepreneurial orientation of the firm over time (Lumpkin & Dess 1996), young firms are more innovative, proactive and risk-orientated than older firms (Shane & Venkataraman 2000), and as a consequence of the Theory of Learning (Jovanovic, 1982) and the Knowledge Based View it is probable that older companies that have not accomplished growth will not do it in the future

because their lack of knowledge on how to do it.

After decades of studying the phenomenon of growth in new ventures and SMEs many candidate factors have been proposed. In order to structure them we have grouped the most significant ones depending on the unit of analysis (Fig. 4).

Every company competes in one or more industries and starts its activities in a concrete location. Industry, location and other external characteristics configure a set of advantages or disadvantages for growth that are external to the company and forms our first set of factors. The second group is formed by factors that are internal to the company and over which it has some control. They explain the way the company is organized and competes in the industry. Company dynamics, management practices, strategy, social capital, knowledge and resources accumulation belong to this group. The third level of analysis is the Top Management Team (TMT), its composition, characteristics and size and team dynamics. Finally, there is a fourth group that refers to individual or cognitive characteristics. This group of factors views the company as the sum of the individuals' beliefs, attitudes and behaviours towards growth.

### **2.3.1. External, industry factors that influence growth**

We refer in this area to the conditions that are external to the company and that the company has a limited or non-existent influence on. These conditions have no linking to the entrepreneur or the company but have an influence on its growth.

Thus, company growth depends on the sector or industry company is in (Penrose, 1959; Stinchcombe, 1965) and the growth of this market (Siegel, Siegel & Macmillan, 1993; Sandberg, & Hofer, 1987). Industry structure and dynamics has been recurrently argued as to have an influence on growth (Sandberg, 1986; Baum, Locke & Smith, 2001).

There is wide evidence that companies entering growing markets have a greater chance for growth (Covin, Slevin, & Covin, 1990; Eisenhardt & Schoonhoven, 1990;

Chandler & Hanks, 1994; McDougall, Covin, Robinson et al., 1994; Park, Chen & Gallagher, 2002; Robinson & McDougall, 2001). A growing environment help companies to detect new opportunities and launch new products and services to cover new market niches (Koberg, Uhlenbruck, & Sarason, 1996). A broader product/market strategy is advisable (Sandberg and Hofer, 1987) and alliances are more common and determinant for growth (Park et al. 2002) in these bullish industries. Industry structure can influence on venture growth for example, if it has big financial entry demands (Robinson & McDougall, 2001), or a high level of competition (Baum et al., 2001; Zahra & Bogner, 1999).

Obviously, government policies and legislation can have some influence on growth. Tax incentives, Intellectual Property protection and policies supporting innovation such as soft credits, grants and subsidies, should have some influence on growth, although its real influence is difficult to estimate, as measurement beyond the amount of companies that benefit an specific program or the amount of funds deployed, are difficult to implement. European Commission has a commitment in reducing the innovation gap existing between Europe and the US, and emerging countries such as South Korea or China (European Comission, 2014).

Geographic location is another factor that can influence growth. Firms operating in industrial clusters have more access to specific knowledge and resources linked to the industry where they are competing (Hanson, 2000; Saxenian, 1990, 1994). Some geographical areas have more access to private and public financing opportunities (Saxenian, 1990, 1994).

With a higher level of abstraction these factors are related with opportunity. External factors, market conditions, size, growth and structure hide opportunities that a new or existing company can exploit. As we have seen, many authors rely on this construct to explain company growth to a great extent.

### **2.3.2. Company factors**

This other group of factors refer to the internal resources, characteristics and assets and how the company manages them. Most important organizational theories in the literature of growth emerge at this level: the Resource Based View or Knowledge Based View and Network and Social Capital theories. As we will see they are somehow linked and they try to study the same phenomenon, each of them from a different perspective.

According to the Resource Base View (RBV), having the financial, human and social capital resources enable growth to be achieved (Penrose, 1959; Wernerfelt, 1984; Rumelt, 1984). Having these resources depends on a great way on the ability or knowledge of the managers to hire, train and compensate the adequate people, rise financial resources and to have social capital to acquire the desired resources. As a consequence, growth is linked to the acquisition and the application of entrepreneurial and managerial knowledge configured as a resources (Penrose, 1959; Pitelis, 2002; McPherson & Holt, 2007). So according with the Knowledge based View, (KBV) growth is influenced by the processes through which knowledge is acquired and applied, and the possession of this knowledge determines until a great extent the expansion of the firm (Greiner, 1972, 1998; Churchill and Lewis, 1983, Scott and Bruce, 1987).

Linking with the competitive advantage theory, when such resources are not imitable, not substitutable and not transferable, they may produce a sustainable competitive advantage (Barney, 1991). Sirmon, Hitt, Ireland et al. (2011) give insights on how resources are used to create a competitive advantage and how resources are connected to the strategies the firm pursues. So, they called resource orchestration to the managerial actions regarding structuring the firm resources, bundling these resources into capabilities and leveraging these capabilities to realize a competitive advantage. These managerial actions are different for different strategies, different stages of the firm's cycle and different levels of management hierarchy.

Entrepreneurs have first to attract resources to the new venture, and this is a hard task because the company credibility is to be built at its initial stages (Brush, Greene, & Hart, 2001). Another important task for the founders is to search and allocate the right

type of resource to stimulate business growth. It is widely accepted that the incorporation of financial resources (Bamford, Dean, & McDougall, 2000; Cooper, Gimeno-Gascon, & Woo, 1994; Lee, Lee, & Pennings, 2001) and human capital resources (Birley, 1987; Cooper et al., 1994) contribute to the venture's growth.

Resource acquisition and allocation are much related with strategy and how the managers organise and structure the company for growth. A good number of studies reveal the importance of strategy on venture's growth. However, there is not a consensus on which type of strategy is conducive for growth. For Siegel et al. (1993) and Parker & Storey (2010) a strategy focused on a single product leads to a higher venture growth whereas other authors such as Lee (2006) found higher growth rates with a diversified strategy or Baum et al. (2001) considered that broad product strategies based on innovation and high value added over-perform low-cost and focused strategies. These contradictory results supports the belief that the strategy-growth relationship depends on the fit this strategy has according to the resources the company disposes (Chandler and Hanks, 1994), the industry the company is in, its structure and the competitive barriers (Robinson & McDougall, 2001) and the time the company starts competing in the industry (Sandberg and Hofer, 1987). Financial capital and networking capabilities play an important role on the acquisition of resources which make possible the choice of different growth strategies (Chen, Zou & Wang, 2009). However, determined successful strategies have been identified in High-Growth company studies such as having a strong marketing department and a main product that is a major contributor to sales (Parker et al., 2010). Particular strategies such as innovation and exporting have also been reported to have a strong relationship with growth (Love & Roper, 2015).

Finally, another stream of research relates resource acquisition with the social capital of the firm. According to the Social Capital and Network Theories (Lin, 1999; Burt, 1992) organizations are influenced by external actors that impede, help or release resources that facilitate the growth of companies. Several researchers have stated that networks somehow facilitate the whole process from its inception to achieve seniority: Major findings in how networks help in company development relate to the maintenance of a competitive advantage (Kogut, 2000), the acquisition of critical innovations (Pisano 1990; Powell, 1990) and the acquisition of financial resources and

expertise by receiving advice, counselling, guidance and endorsement (Aldrich & Zimmer, 1986; Birley, 1985; Greve, 1995). New companies can find contacts, counselling, emotional, social and innovation help. Thus, social capital can be an important mechanism to surpass the liabilities of newness and smallness (Baum, Calabrese & Silverman, 2000).

Social capital is a complementary asset to human capital. While human capital refers to the knowledge and abilities of the individuals, social capital refers to the connections between persons, groups or organisations (Coleman, 1990). These relationships form a group of rules and norms, information channels and obligations and expectations (Coleman, 1988). According to Adler & Kwon (2002:18) the main asset of social capital is goodwill defined as “the sympathy, trust and forgiveness received by friends and acquaintances”, who give information, influence and solidarity. So this set of information, help, resources provided by the social context where the firm is in influences the company economic decisions (Granovetter, 1985) and consequently impacts on its performance and growth.

We have classified the academic production in four groups of resources the company acquires, allocates and exploits that are conducive for growth because they increase the capacity of the company to exploit the opportunity. These resources are Financial Resources, Human Capital, Organisational capital and Social Capital.

### **2.3.2.1. Financial Resources**

Having more resources is considered better for new venture's growth compared to resource constrained companies (Lee et al., 2001; Cooper et al. 1994). However, some entrepreneurs successfully pursue opportunities without enough funds or with strong resource constraints (Starr & MacMillan 1990).

The entrepreneurship literature has extensively studied the process of accessing to large external financing from Venture Capital, Business Angels and others (Bhide 1992;

Winborg & Landström, 2001). However most ventures do not access to this financing flow mainly because of the fear of losing control of the company (Cliff, 1998), because the company has not developed enough to be attractive to investors or because of the high transaction costs or information asymmetries of external financing (Cassar 2004).

To face this reality, new ventures can opt for bootstrapping techniques that allow entrepreneurs to develop new opportunities without external financing. Bootstrapping develops two strategies: to minimize the need of financing and to acquire external resources at little or no cost through friends, subsidies and family (Winborg & Landström, 2001). There is not a consensus in literature about if bootstrapping is conducive for growth. Although it can have high opportunity costs (Starr and MacMillan 1990) sometimes it is the only feasible way to access to external financing (Van Auken 2005; Ebben & Johnson, 2006), or even it can produce benefits because they allow entrepreneurs to focus on a more efficient use of resources (Bhide 1992). Although bootstrapping may not stimulate growth it seems that it does not penalize it or even it can favor it by reducing the amount of funds needed (Vanacker, Manigart, Meuleman et al., 2011).

Recent development of alternative ways of funding such as crowdfunding, has had a warm welcome in certain technology industries. Nevertheless, its novelty, the limited access for some industries that generate interest by investors and the lack of awareness and financial expertise of the entrepreneurs, make it an alternative for a very few companies at their initial stages.

### **2.3.2.2. Human Capital**

Entrepreneurs have a set of capabilities that allow them to identify business opportunities and exploit them (Penrose, 1959). The tenure of these capabilities produces an important influence on company growth. Literature use to treat these capabilities as an asset the entrepreneur possess and mostly it relates this asset with past experience in terms of entrepreneurship, industry or management experience.

Past experiences (successful or failed, Rae and Carswell, 2001) produce a learning effect on the entrepreneur that must have the ability to adapt the criteria and circumstances of past decisions to the new environment (Gray, 2002). Nicholls-Nixon, Cooper & Woo (2000) found this skill of perceiving and adapting to new environmental scenarios as key for growth. Macpherson & Holt (2007) concluded that the influence of experience on growth is identified as “the ability to learn and to apply that learning to change strategies”. They claim to adopt an evolutionary lens to appreciate how knowledge and resources configured as human capital are developed.

Literature identifies the following experience and skills in human capital that are valuable for growth: First, prior industry experience (Jo & Lee, 1996) brings an established network and applicable marketing expertise. Second, management and business experience, (Smith and Gannon, 1987; Sexton, Upton, Wacholtz et al., 1997; Carson and Gilmore, 2000; Kakati, 2003) brings management expertise and applicable knowledge in other industries. Entrepreneurial experience (Cooper et al. 1988) brings knowledge about the entrepreneurial process and can avoid costly mistakes. Prior experience also has an indirect influence on growth through the ability of the managers to access resources (Gompers, Lerner & Scharfstein, 2010; Hallen & Eisenhardt, 2012).

There is broad consensus in literature about the influence of industry experience and higher education in growth, whereas there are contradictory studies about management and especially about the influence of entrepreneurial experience in growth (Barringer, Jones & Neubaumet, 2005). Unger, Rauch, Frese et al. (2011) reconciled the influence of human capital in entrepreneurial success in their meta-analysis of over 70 independent samples, concluding that human capital have a significant, but small influence on growth or profitability. This relationship was higher for outcomes of human capital investments (knowledge/skills) than for human capital investment themselves (education/experience), for young businesses compared to old businesses and for human capital with high task-relatedness. In another meta-analysis of 66 studies nearly at the same time, Crook, Todd, Combs et al. (2011) found this relationship of human capital and performance was strong.

If the current human capital do not show the required knowledge or abilities, it is suggested that knowledge may be incorporated in the firm by recruiting new members

to the TMT (Littunen, 2000; Littunen & Tohmo, 2003, hiring experts (Kaulio, 2003) or consultants (Hill, Nancarrow & Wright, 2002). Learning from experience and new incorporations provide the knowledge to adapt and growth (Macpherson & Holt, 2007).

### **2.3.2.3. Organizational capital. Processes, systems, cultures and structures.**

The entrepreneur's ability to create processes and systems that stimulate this learning from experience and support knowledge transfer inside the company is an important antecedent for growth (Macpherson & Holt, 2007). Thus, the way entrepreneurs organize and structure a company through its internal processes and systems also influences growth (Spender, 1989; Chrisman, Bauerschmidt & Hofer, 1998).

Organisational processes evolve: they are initially set or tried as a solution of a specific need as a result of learning-by-doing, trial and error, experimentation or improvisation (Zollo & Winter, 2002). When this process proves to be effective it is repeated and afterwards routinized. When these growth-oriented processes are routinized and are effective, it is considered as a growth capability (Bingham, Eisenhardt & Furr, 2007). Examples of these processes and systems can be innovation in processes (Georgellis, Joyce & Woods, 2000), the dissemination of the owner human's capital Barringer and Greening's (1998), formal training to solve specific problems (Patton & Marlow, 2002), human resource management policies (Wyer & Mason, 1998).

Other studies focus on the way cultural aspects influence organisational learning of the company to stimulate growth (Sadler-Smith, Spicer & Chaston, 2001; Gray & Gonsalves, 2002).

Systems that focus on specific knowledge management tools have also been studied but their influence on growth is not conclusive. When growth occurs, tensions between competing systems appear (Fombrun & Wally, 1989; Kazanjian, 1988). March's (1991) concludes that these systems are always in tension and have indeed to be appropriately balanced and managed, oscillating between exploration (Research, new markets exploration) and exploitation (production quality, efficiency).

Although many authors claim the benefits of soft process technologies (Davig and Brown, 1992; Smith, Boocock & Loan-Clarke, 2002; Ghobadian, Mole & O'Regan, 2003; Mole, Ghobadian, O'Regan et al., 2004), project management (Dean, 1986), or human resource management and marketing systems (Chaston and Mangles, 2000), some authors confirm that the adoption of these technologies does not help to knowledge management in small and more informal firms with limited skills. So it is an important question for the managers to know when, how and what systems should be applied.

Despite of the numerous studies that state the influence that systems, cultures and structures have influence on growth through organizational learning there is a lack of conclusions on the factors that mediate the usefulness of each particular system of organizing an its influence on growth and the processes through which these organizational learning systems are embedded into the firm in order to support growth. In consequence, there is to be concluded that systems and processes can both support and constrain growth. (Jones and Macpherson, 2006).

Lockett, Hayton, Ucbasaran et al., (2015) identified four management processes that facilitate growth, innovation, new product development, new market development and internationalization. Koryak et al. (2015) also identified organic growth through continuous improvement and alliances and acquisition processes as conducive for growth. Both Growth processes and routines and resources are growth capabilities. Although there is evidence enough in literature about the positive relationship between growth capabilities and growth, little is known about the determinants of these capabilities (Koryak et al., 2015).

A group of studies investigate the influence of the knowledge systems on growth considering the environment the company is in, leading to the concept of absorptive capacity (Cohen and Levinthal, 1990). According to these studies, knowledge management systems are necessary not only to distribute knowledge internally but to acquire this knowledge externally, basically from networks. External knowledge acquisition can be improved through practices that support information exchange

(Terziovski, 2002) and flexibility in inter-firm relationships (Young, Sapienza & Baumer, 2003).

#### **2.3.2.4. Networks and Social Capital**

Thus, in addition to the internal systems of knowledge, entrepreneurs acquire external knowledge from networks as a result of the social capital and the environment (Watts, Cope & Hulme, 1998). Both evolve over time as also evolve the knowledge the company needs. Network theories have been used to establish a connection between the social capital the company has and its performance (Lee & Tsang, 2001; Lee, et al., 2001).

However, the company usually finds limitations to the type or resources available because the entrepreneur usually prefers informal and social network contacts (Anderson & Boocock, 2002), because technical knowledge networks have its own limitations (Boussouara & Deakins, 1999), or because there are big cultural gaps to access to supportive networks (Lerner, Brush & Hisrich, 1997).

Another important limitation is de lack of entrepreneur's relational assets (Perren, 2002; Hyvonen, Tuominen & Eralinna, 2004). Succesful knowledge transfer from networks requires specific social skills both relational and attitudinal (Tjosvold & Weicker, 1993; Blundel & Hingley, 2001).

There is a wide consensus that networks and social capital have to be actively managed to get good results. There is a complete bunch of proposals academics do in order to improve the access and the quality of the new venture's networks: new venture support programs (Chrisman and McMullan, 2004), government initiatives (Bell, Murray & Madden, 1992), mentoring and coaching (Deakins, Sullivan & Whittam, 2002; Clarysse and Moray, 2004) non-executive directors (Boussouara and Deakins, 2000), peer networks (Floren, 2003), university knowledge transfer initiatives (Weinstein, Nicholls & Seaton, 1992), professional and specialists networks (Parker,

Winter & Tabernacle, 2003; Fuller-Love & Esyllt, 2004) and costumers joint programmes (Blundel and Hingley, 2001).

Different networks structures and their relationship with growth have been studied. There is evidence to affirm that two dimensions, the depth and the diversity of the network positively influence knowledge transfer and thus growth. Granovetter (1985) found to types of network embeddedness: relational embeddedness, which refers to the relationship between the actor and the partner, and structural embeddedness, which refers to the position of the actor in the structure of the network. Two dimensions influence the strength of the relational embeddedness: reciprocity and trustworthiness and explain the intensity of the exchange of values, norms, beliefs and duties. Regarding the structural embeddedness the variable to take into account is redundancy. When redundancy is high, communication flows more effectively and common norms, attitudes and rules are easier to stablish and there is not brokerage opportunities for actor holding unique information (Burt, 1992).

Literature agrees that social capital plays an important role in the survival of the company and performance (Lee & Tsang, 2001; Lee et al., 2001), but it is not so clear which type or characteristics of the network really influences survival or performance. The structural dimension or the relational dimension (Gulati, 1998) or the optimal network structure seem to depend on the type of action the company is taking (Aldrich and Zimmer, 1986).

### **2.3.3. The management team**

Many new ventures are not founded by a single entrepreneur but a team that join together their experiences, knowledge and abilities. Management teams provide a wider range of experience and broader access to networks in order to support growth processes (Mcpherson & Holt, 2007). Two dimensions of the team have been studied in literature: heterogeneity and size. The more heterogeneous and big the group is, the slower the decision process is and the more space for disagreement, which can be beneficial for growth (West & Meyer, 1998). On the contrary, cohesion in a group leads

to faster decision making but increases the likelihood of group thinking (Lant, Milliken, & Batra, 1992). There is a certain degree of agreement in literature that both size and heterogeneity have a direct positive contribution on growth (Eisenhardt & Schoonhoven, 1990, Vissa & Chacar, 2009), but until to a point where it has no or even a detrimental effect, with slow decision making and frequent conflicts between the TMT members. Prior experience working together can have a positive effect by minimizing these conflicts (Roure & Maidique, 1986). Team heterogeneity has also an indirect positive influence on growth by contributing to team learning (Clarysse and Moray, 2004) and the acquisition of resources (Hayton and Zahra, 2005).

As the company evolve, TMT composition and dynamics also change. Entrepreneurs have to manage resources and allocate and exploit them in an efficient and cost effective manner. From an initial team of multi-skilled people, as the organization grows they organize tasks, functions, define processes and systems with more specialized workers with higher opportunity scanning capabilities (Box, White & Barr, 1993).

When literature refers to the entrepreneur it has to be taken into account that the decision process in a company is dynamic and when the entrepreneurial team is formed, each member of the team has a weight in the decision processes and conforms a part of the entrepreneurial soul of the company. The effect of these attitudinal or behavioural changes on growth is a question commonly neglected in literature, which centres its attention on human and social capital incorporation.

#### **2.3.4. Cognitive or individual factors**

The fourth area of study in the growth of new companies focuses in the individual characteristics of the entrepreneur and each of the members of the board or the management team since aggregation of the features of their members reflect the company reality (Alchian & Demsetz, 1972).

Entrepreneurs make assessments, judgements or decisions about growth applying their mental models or cognitive profile, and growth will depend firstly and directly on

the decisions entrepreneurs make (Gilbert, McDougall & Audrestch, 2006). These mental models are shaped to a large extent, by knowledge and experience (Hodgkinson & Healey, 2008).

This cognitive level is set out by several authors to have an influence on how much the venture grows. Besides the ability of the entrepreneur to achieve growth, sometimes a limited growth responds to a specific desire to not to grow the firm (Cliff, 1998). This limited aspiration of the entrepreneur to achieve growth can be caused by the owner fear to either loose the company control (Cliff, 1998), loose the family-like character (Davidsson, Achtenhagen & Naldi, 2007) or the fear of compromising company survival or worsen worker's conditions (Wiklund & Shepherd, 2003). So the entrepreneur has to be sure that he can control growth (Box et al., 1993).

It is important for researchers to take into account growth intention because, unlike one may think, it varies considerably among entrepreneurs (Liao & Welsch, 2003; Wiklund, Davidsson, & Delmar, 2003).

It is clear that Growth Intention (broadly defined to include ambitions, aspirations and expectations) predicts growth (Tiler, Metcalfe & Connell, 1993; Barringer et al., 2005; Delmar & Wiklund, 2008; Wiklund & Shepherd, 2003). Entrepreneurs tend to perceive more opportunities and less risk and costs than non-entrepreneurs (Vecchio, 2003). Consequently, some entrepreneurs desire to grow more their ventures than others because of their perception of the risk-benefit binomial or simply because they are more risk oriented.

So the strategic decision to actively pursue growth (growth intention) is an important condition to effectively achieve this growth (Chandler & Hanks, 1994; Cliff, 1998; Gilbert, McDougall & Audrestch, 2006).

Growth intention has an influence in the formulation of organizational and competitive strategies and in goal setting. Goal setting theory (Locke and Latham, 2002) is generally accepted as conducive for growth in SMEs (Baum et al., 2001; Baum and Locke, 2004). These high goal-settings (Baum & Locke, 2004) as well as the extent to which these growth goals are communicated to the employees also influence growth

(Baum & Locke, 2004; Barringer et al. 2005).

Three dimensions have influence in actual growth through the role played on Growth Intention: perceived Ability, perceived Need and perceived Opportunity (Davidsson, 1991).

Perceived ability, a construct later refined as perceived feasibility (Koryak et al. 2015) is measured as Self-Efficacy. Founders that believe in themselves to achieve growth also helped growth to finally be realized (Baum & Locke, 2004). Self-Efficacy can help to understand why some entrepreneurs decide not grow more the company because they have the perception they will not succeed in this scenario (Vecchio, 2003). Self-Efficacy brings focus, persistence and intensity to entrepreneur decisions and actions. Self-Efficacy has been found to be a strong predictor of growth orientation (Douglas, 2013) and growth itself (Baum & Bird, 2010; Baum et al., 2001; Baum & Locke, 2004).

Another variable related with Growth Intention is Need. Need can be seen as financial Need but also as Need for Achievement (McClelland's 1961), concept that has been deeply discussed already in literature. (see, e.g., Begley and Boyd 1987; Miron and McClelland 1979). We can conclude that Need for Achievement is a variable that can influence Growth Intention, but depending on the value given to achievement in each culture.

The third dimension, related with the perceived Opportunity reflects the willingness or desire for growth and has also evolved to perceived desirability (McGee, Peterson, Mueller et al., 2009). Growth Intention also implies risk taking. Entrepreneurs that have high growth plans for their businesses assume that heavy investment and expenses should be incurred and show higher disposition to take risk (Gartner & Shaver, 2012). The riskier the opportunity is, the greater performance the start-up shows (Dencker & Gruber, 2015).

Applying the opportunity cost theory, Cassar (2006) concluded that Growth Intention is influenced by entrepreneur current household income, education and managerial experience, in the way that the higher these variables are the greater is growth intention.

Entrepreneurs' growth intention influences growth but the ability the leader shows "to influence and direct the performance of a group members toward achieving those organizational goals that involve recognizing and exploiting entrepreneurial opportunities" (Gupta, MacMillan & Surie, 2004: p.242) influences growth as well. Although some attention has been paid to entrepreneurial leadership, little attention has been paid to the cognitive and motivational profile of the leaders (Koryak et al., 2015).

In the area of abilities Sternberg (1997, 2004) studied what he called Successful Intelligence and claim for it as an understudied area in new-venture's growth. Besides Social Intelligence which is useful for network building (Baron & Markman, 2003) and Emotional Intelligence, Stenberg studied other Intelligence types. Successful Intelligence is situational and can be improved. It refers to the entrepreneur's capacity of capitalize his strengths, compensate his weaknesses and adapt to his environments being capable to swift actions and develop multiple improvement activities that propel company growth. Entrepreneurial Self-Efficacy moderates this relation with firm's growth (Baum & Bird, 2010). Very few studies have been performed in this area. There are some studies relating practical and analytical intelligence to personal success (Stenberg, 1995, Cici, 1996). Gimeno, Folta, Cooper et al. (1997) linked analytical intelligence and Entrepreneurship performance. Creative intelligence (creativity) should be an essential characteristic for designing new products, processes and business models (Baron, 2004 and Baron & Markman, 2003).

Wright and Stigliani (2013) strongly recommend more attention to the influence of entrepreneurial cognition on growth beyond the opportunity recognition and start-up creation taking a multi-level approach that takes into account the individual, the firm and contextual-level influences on growth.

Another element can illustrate why entrepreneurs start a business is commitment. Lau & Busenitz's (2001) study found that owner's commitment was positively related to intention to grow a firm.

In conclusion, we would say that although there are a great number of studies linking growth to the factors and variables identified above there is a heavy feeling that current

frameworks do not explain the greater amount of growth (Parker et al., 2010). We would add that the big amount of approaches difficult a simple unique model but maybe it is due to the multidimensional, heterogeneous and complex nature of growth (Leitch et al., 2010). Academics claim for a more longitudinal research (Davidsson et al. 2007) and more research about the causes, effects and process of growth for the development of a more fine-grained theories (Sheperd & Winklund, 2009) to have an holistic understanding of the phenomenon, especially among academics.

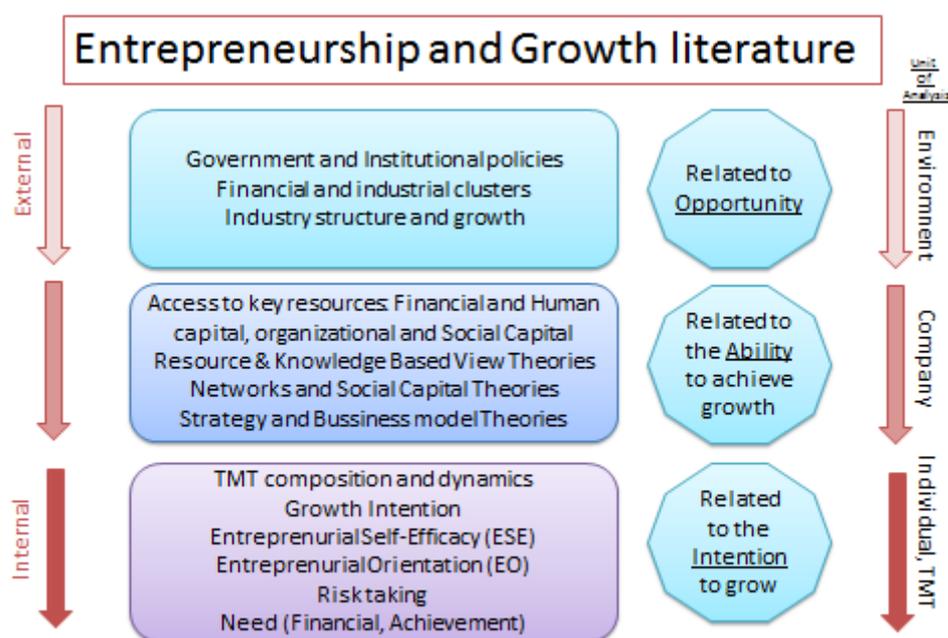


Fig. 4. Entrepreneur and Growth literature. Compiled by author

#### 2.4. Nearly ASO: ESO, CSO, USO, SSO, RBSU, NTBC and Growth

In the previous chapter we extensively reviewed the articles that study growth of the SMEs and new-ventures. In a similar research direction there is a group of studies that perform research on companies that present several common characteristics with Academic Spin-Offs and for that reason they worth an analysis in a separate chapter. Thus, research on these companies could be relevant to understand ASOs' characteristics and behaviour. Some typologies have in common that they are Spin-Offs

companies but the parent can be any institution (Entrepreneurial Spin-Off, ESO) or a private corporation (Corporate Spin-Off, CSO). Some of these studies compare ASO and CSO or ESO performance. Others study companies whose components come from the university (Students, SSO) but there has not been a Technology Transfer process from university. Other studies have in common the technological and research specificity of the company, such as Research Based Start-Ups (RBSU) or New Technology Based Companies (NTBC).

Lindholm (1997a), defines Entrepreneurial Spin-Off (ESO) companies as those where initial product idea was originated in the previous employment of the founder. He found that in technological new companies in Europe, ESO and CSO show a significant higher growth than non-SO entrepreneurial companies. However, this superior performance in sales does not show up until around 10 years after spin-off. This could give an idea of the necessary time frame to the full development of the new venture, and subsequently to study the growth phenomenon.

Lindholm (1997b) also stated that ASO in Sweden usually were very small companies with slow growth. CSO grew faster than both ASO and non-spun-off companies. Some other studies have been performed comparing ASO with CSO's with similar results (Ensley & Hmielesky, 2005; Zahra, Van de Velde & Larraneta, 2007; Wennberg, Wiklund & Wright, 2011). Possible reasons for this difference could be that parent companies in CSO provide more business support for example in developed products, customer and supplier contacts and marketing channels.

As for Wennberg et al. (2011), CSO knowledge advantages related with the industry experience of the CSO founders, outweigh all the possible advantages of USO founders. Thus, non-spin-off companies simply do not have this support whereas in the ASO case, university apparently only provides knowledge in research and technology, but lacks of the industry, marketing and sales knowledge that CSO provides. To surpass this weakness, they recommend to increase commercial and industry capabilities of ASO through TMT incorporations. Zahra et al. (2007) studied the Knowledge Conversion Capability to transform inventions into products and detected that some of these capabilities such as conceptualization and visioning of applications of knowledge,

needed Social Capital in industry and business which normally Academic Spin-Offs lacked.

Lindholm (1997a) measured performance in ESO, and tried to identify different pre and post spin-off factors that affect growth. He found that no pre-spin-off factors, background, motives, transaction, ongoing relation, and potential synergies, had a relationship with growth whereas two post-spin-off factors, internationalization, and technology related acquisitions had a positive association with growth.

Colombo & Piva (2012), studied the different strategies ASOs adopt to improve their initial capabilities. In comparison with non-academic NTBFs, ASOs tend to establish alliances and to invest more in technical activities than in commercial activities. Their results support Ensley & Hmielesky (2005) conclusions suggesting that the differences in performance between ASO and CSO are associated with the composition of the TMT with a more homogeneous entrepreneur team and less developed team dynamics in ASO.

Other studies also questioned the benefits university produce on ASO, as regarding their degree of performance (Colombo & Delmastro, 2002, George, Zahra & Wood, 2002; Quintas, Wield & Massey, 1992).

RBSU and NTBC usually aim to base their competitive advantage in technology and require heavy investments in related assets such as research, equipment and product development. Consequently, academics study in detail these peculiarities and the studies have in common that they put a strong emphasis in finance resource acquisition (especially Venture Capital) and in the influence of technological capabilities on growth.

Heirman & Clarysse (2005) found in their RBSU study, a strong relationship between growth and commercial experience of the founding team, an international market approach and raising large amounts of VC, whereas starting with a market-ready product did not affect growth.

Colombo & Grilli (2009) analyses VCs growth contribution by establishing a dual indirect beneficial effect: the “coach” function strongly supported by his study and the “scout” function. The ability of the founder’s to raise VC have also an indirect but strong positive effect on growth taking into account the dramatic positive impact of VC investment on these NTBC growth.

Knockaert et al. (2010a) focused on the selection behaviour of VC at the seed stage and identified a new interesting type of VC investor. Besides financial and people investors they typified the technology investor, who is primarily concerned about the protection and other technology characteristics and the contact with the founder of the start-up. Technology Venture Capitalists do not only invest in “perfect deals” and assume more uncertain technological or financial propositions and are used to invest in the seed stage.

Scholars studied and found a positive influence on growth of specific tech-type company capabilities such as financial resource capability, technological capabilities, entrepreneurial orientation and networking capabilities (Lee et al., 2001; Chen et al., 2009). The combination of these capabilities influenced the different growth strategies: organic growth, partnership and acquisition (Chen et al., 2009).

As we have seen, CSO and ASO count on different resources to transfer to the spun-off company. Similarly, regarding the technological knowledge characteristics can be different and can influence growth in a different way. Moreover the characteristics of the parent institution will influence the impact of knowledge characteristics on growth. Tacit knowledge in universities is different from tacit knowledge cumulated in corporations. Clarysse, Wright & Van de Velde (2011) found that a narrow-focused tacit technology benefits CSO growth, whereas a broad technology would be further beneficial for an ASO. This broad scope would allow the ASO to cover from an imperfect market possibilities assessment and to change from one market application to another in case their initial plans come to a dead end.

Regarding the Technology Transfer process, some basic ideas can be drawn from spin-off literature. The parent company help the spun-off company from transferring assets to it, mainly in form of knowledge and access to resources (financial, customer

networks...). A parent company can transfer three kinds of organizational knowledge, production, marketing and technological knowledge. When there is technological knowledge to transfer, in order to maximize it through learning, Sapienza, Parhankangas & Autio (2004) recommends to pay attention to the degree of overlap to the parent company. Both too much or too limited overlap hamper knowledge development in the spun-off firm. Other factors to take into account in Technology Transfer processes are the stage of technology development cycle (Heirman & Clarysse, 2004) and the differences between codified (protected) technology and tacit technology without formal protection (Hindle and Yencken, 2004).

## **2.5. Academic spin-off and growth**

In previous chapters we thoroughly review Entrepreneurship and Management literature regarding the firm's growth phenomenon with special attention to the relevant subset of start-ups, and try to group and categorize the multiple factors according to the level of analysis to provide a holistic approach to the phenomenon. We analyse afterwards the studies about growth of different groups of companies that are near the ASO area of study such as Research or Technology Based Companies, Corporate Spin-Off's, Students Spin-Offs and specially those studies that compare growth between these different groups.

We focus in this chapter on the studies that specifically examine the growth of Academic Spin-Offs companies, comparing the state-of-the-knowledge of the more advanced start-up growth with the state-of-the-knowledge of ASO growth (Fig. 4 and Fig. 5).

Three main novel dimensions arise in ASO growth literature, which are non-existent or non-relevant in Entrepreneurship. First is Technology Transfer, as for the intrinsic nature of ASO implies the company created will have a greater technical component than a start-up, and the type of company created will have certain peculiarities that can affect growth. Second, the effect on growth the University policies and structures

produce. Third, the consequences on growth of the special academic status the founder of the company has.

Several studies report a poor performance of ASO in Europe (Shane, 2004a; Siegel et al., 2003a; Harrison & Leitch, 2010; Chiesa & Piccaluga, 2000). European ASO is reported to be smaller and slow growing when benchmarked with US and Canadian counterparts and when benchmarked with European CSO (Lindholm, 1997b). However, there are several success stories and studies in US and Canada about the performance of ASO. (Saxenian, 1990, 1994; Vincett, 2010). Vincett, (2010) reported a 12% exponential sales increase per year of age, from year 1 to year 30 for 111 Canadian pure ASO (academics, with high quality research). These facts have increased the interest in the commercialization stage of the ASO and in the key issues to achieve a sustainable growth.

Degroof and Roberts (2004) grouped the explanations posited for these differences in governmental effects, through tax disincentives and regulations, the underdevelopment of capital markets in Europe, the division between academia and industry in Europe, the singular development of high-tech areas in US, the lack of growth orientation and differences in cultural values between Europe and US, such as social acceptance of failure or entrepreneurship orientation.

### **2.5.1. University level**

University policies regarding Academic Spin-Offs have been at the core of the controversy. Each university has its own culture, incentive systems, rules and procedures, and these policies adopted by academic institutions significantly affect the growth potential of the ASO (Degroof and Roberts, 2004).

When measuring the entrepreneurship activity, academics typically refer to the number of spin-off created and the rate of creation of new companies. This tendency to measure University entrepreneurship output as the amount of spin-offs created has contributed to produce a tendency to maximize the number of companies through low

selectivity and low support policies that have been challenged by some authors (Roberts and Malone, 1996; Degroof and Roberts, 2004). These authors are more favourable to a high selectivity and high support formula as the main two dimensions for a technology commercialization policy that produce high-growth potential companies.

In developed areas like US there is a universe of external agencies (such as VC funds) that have expertise and experience in selecting companies with growth potential and providing them with resources. In under-developed environments where these agents do not exist this high selectivity and support policies are more needed. Nevertheless, these high support policies require a high amount of resources that low-medium universities, do not always dispose. They propose to look for creative partnerships to overcome these limitations.

University efficiency in resource endowments in Europe is constantly put in question since the type of company these policies produce is low-growth low-profile firms. Harrison and Leitch (2010) pointed out that the cost of university in Technology Transfer structures outweighed the returns to the university and put in question the output of the academic spin-out activity in the UK, as with a few notable exceptions, companies were small lifestyle businesses with a tiny influence in the regional economy.

Doutriaux (1987) exposed that these University policies produced academics that also were part-time entrepreneurs who were not so “aggressive” and growth oriented as full-time entrepreneurs, and consequently academics could only aspire to commercialise technology through licensing or devote all his energy to develop the new venture. He stated that the type of ASO created (service vs. manufacturing) can also affect growth. Olofson & Wahlbin (1984) find that highest ASO growth rates were precisely those formed by academics that left the University. According to Roberts & Hauptman (1986), academic involvement could lead to higher effectiveness of the TT process.

Effects on longstanding interaction with University have different results. Some authors maintain that keeping and fostering ties with university are beneficial since they can provide infrastructures, technological competencies and expertise (Gubeli & Doloreux, 2005) whereas others find a negative effect on growth of firms maintaining

contracts with university (Doutriaux, 1987). Strong ties with university reduce failure of the firms but seem to slow development and growth of the firm (Rothaermel & Thursby, 2005).

### **2.5.2. Company level**

Another stream of research centres its attention on the spin-off performance and the key issues that drive spun-off companies to succeed commercially, or the factors that affect performance. Lockett, Siegel, Wright et al. (2005) recommended the use of the Knowledge Based View, and to focus on the knowledge gaps of each of the level of analysis (individual, team, company) at each stage of the company development. So, although these levels are not absolutely discrete the classification of studies according the level of analysis can clarify the whole picture of ASO growth.

#### *(Barriers, resources, knowledge and capabilities)*

Most of the studies of performance in ASO at a company level apply the RBV or the KBV, and conditions growth to the possession of a set of resources, knowledge and capabilities that scholars, due to the academic condition and the type of company produced have difficulties to incorporate to the company. For example, scientists are unlikely to have the knowledge and skills to identify and exploit business opportunities (Franklin et al., 2001). This capabilities view can be seen as an extension of the RBV, in which not only the organization asset's but also its capabilities lead to organisation performance (Winter, 2003). For some authors this lack of resources or capabilities is seen as barriers or obstacles the company has to overpass.

For O'Shea et al. (2005), there are barriers that impede access to resources and knowledge and subsequently limit growth. These obstacles for growth are technology, human capital and financial. He reported that initial financial support as an important barrier in the ASO case. In early stages, financial resources come from universities and

public agencies. In a second stage financial capital comes mainly from Friends and Families, Business Angels and Venture Capital.

Financial barriers are frequently reported to be one of the critical resources for ASO to stimulate growth. Wright et al. (2006) and Knockaert, Clarysse, Wright, et al. (2010b) provide evidences of the reluctance of Venture Capitalists to invest in early stages in technology companies. Reported causes of this situation are procedures for a realistic valuation of IP are poorly developed and designed (Leitch and Harrison, 2005) and ASO ventures themselves are not prepared enough for venture capitalist evaluation (Zacharakis, Meyer & DeCastro, 1999). According to Wright et al. (2006), main barriers to access VC for ASO are the lack of knowledge required to develop an attractive and meaningful investment proposal, the knowledge gap in technical matters between financial investors and academics, poor financial expertise of the TTO, the commitment of the TMT, the technological risk assessment, the IP protection by university and the lack of ability of the VCs, entrepreneurs and the TTO to negotiate an appropriate deal. Information asymmetries of the participants in the negotiation lead to higher levels of failure in the area of ASO.

Despite of the evidences about the difficulty of ASO to get VC and the poor disposition of VC to invest in ASO, some studies come out with results on the contrary. About Munari and Toschi (2010) study we would argue that it is based on a science-based sample of ASOs, and precisely that industry is clearly positively biased for VC investment (Knockaert 2010b, Zhang, 2009). Ortín & Vendrell (2010), apply the complementary assets theory to explain the interest of ASO managers to take VC investment. However, we think it lacks arguments in favour of the supply side since the lack of capabilities may increase entrepreneur's interest of ASO in VC but clearly weakens VC's interest on the company. Besides, the knowledge contribution of VC hardly will substitute management skills since VCs' role is played mainly in the consulting function and advice rather than in day to day management or executive responsibilities (Pinch and Sunley, 2009).

Academics also identified that publicly funded VC firms and investment managers with a higher degree of academic experience are more interested in investing in ASO.

This presence of VC on academic companies seem to be greater in science-based business (Knockaert et al., 2010b, Munari and Toschi, 2010)

However, ASO is showed not to be a bad investment for VC, at least in the US, ASO that successfully get a VC investment, raise similar amounts and do not present significant differences in performance in terms of profits or employment. ASO represent 9% of the VC operations and most of their businesses were in life science and information technologies industries (Zhang, 2009). In addition, VC presence in ASO board can also have beneficial consequences for company performance, through its differential characteristics. Goodstein, Gautum & Boeker (1994) identified three different functions: networking, facilitating access to resources, monitoring, aligning shareholders and managers interests and strategic activities. Abell & Nisar (2007) summarized these advantages in giving advice and support, helping with the team culture, creating strategic alliances, or exercising corporate governance. Several studies revealed that VC increases the active role of board (eg. Fried, Bruton & Hisrich, 1998).

The lack of capabilities of ASO companies is not limited to financial resources. Wright, Vohora & Lockett (2004) analyse these lack of capabilities of a standard USO and thoroughly justified in a qualitative study that USO were not qualified due to their financial shortness and lack of management expertise to fully exploit the commercial potential of their technology. So they propose joint-venturing with an industry partner to surpass these resource and capabilities constrain.

Geenhuizen & Soetano (2009) studied the main obstacles for growth on ASO through a longitudinal and cross-sectional analysis. Grouping barriers in marketing, financial and management, they found that barriers diminished overtime but in different intensity. Marketing barriers were higher and take longer to reduce. The study took a six year time frame and concludes that the different thresholds established by Vohora, were reached much faster by highly innovative companies than by standard ASO. For highly innovative companies the credibility threshold was encountered as soon as year zero (Y0) to one (Y1) from its creation, followed by four years of substantial problem reduction (a reduction rate of 100% at Y6). For low-medium innovative companies, the credibility threshold manifests at Y4. Most low to medium-innovative companies fail to

reach sustainable returns at Y6. It is questionable however, the mechanism the authors used to categorize a companies as a highly or medium innovative firm.

Thus, according to the results of the study, in order to design an effective support program, the characteristics of the ASO have to be taken into account, with long-term support for non-innovative Spin-Offs. The study also leaves interesting secondary data about the size of the ASO, some years after its creation: 58 companies, 90% survival after 6 years of existence, 65% have less than 5 employees, 28% between 5 and 15. This picture matches with other studies, like Mustar, Clarysse & Wright (2007), who find a survival rate after six years of 75% and that 80% of the survivors firms employed less than 10 persons. When researchers deepen about the possible reasons for this small size two relevant data were cited: part-time jobs of the entrepreneur elsewhere (70%) and small investment needed, with high self-financing (over 70%).

### Strategy

As we have seen in entrepreneurship literature, strategic orientation is an important point for growth. However there are strategies that are more conducive for growth than others. ASO have basically two strategic options (Pries & Guild, 2007) for the commercial exploitation of the technology: to address to the markets of technology and license or transfer rights or to address to the product markets and develop their own products and services. Different types of problems arise from each approach: Markets of technology imply dealing with information asymmetry and the disclosure of information. Besides, buyers have to deal with the uncertainty of the readiness for the product or application and the market uncertainty for the new product or service. Product markets require additional skills and complementary assets as manufacturing capabilities and distribution networks.

About the type of technology transferred, interesting findings have been recently made. Karnani (2012) studied virtually all the German ASO between 1973 and 2009 (621 companies) finding that 55% were based on not codified (tacit, non-patentable) technologies and performed in terms of employment similarly to codified technology ASO. The observed importance of tacit knowledge suggests the great commercialization potential that could be apparently hidden within the area of tacit knowledge.

One of the most pursued growth strategy is internationalization. Few studies have been performed for ASO. Bjørnåli and Aspelund (2012) established positive relationship between TMT functional heterogeneity and similar ages and internationalization of the ASO and suggest that industry experience presented a U-shaped curve. Pettersen & Tobiassen (2012) found that networks acquired at different stages and network changes greatly affected growth and internationalization in these focal firms. So, ASO should seek different types of networks and specially KIT (Knowledge, innovation and technology) networks for the ASO case.

### Networks

Soetano & Geenhuizen (2009) also studied the influence of social networks in ASO growth, finding a positive influence on growth of the heterogeneity of the social backgrounds of partners among three other factors such as tightness (structure), strength (quality) or spatial orientation (local/external). As we have observed previously, networks play an important role in start-ups growth: apart from finance resources, young firms need knowledge and resources such as the capability to identify business opportunities, strategic management or negotiation skills. Knowledge requires interpretation and absorption into memory through a learning process (Cohen & Levinthal, 1990) and networking can help in gaining knowledge and interpretation capacities being in connections with other actors that poses this knowledge (Soetano & Geenhuizen, 2009).

Social capital and TMT networks have been commonly related with ASO performance. Two parameters are especially important for Grandi & Grimaldi (2003) in founding teams: their intention to set up relations with external agents and the frequency of this interaction. Social networks (exo-institutional, intra-departmental, inter-departmental network, surrogate entrepreneur and TTO) are also important because they determine the structure of the spin-off (Nicolaou & Birley, 2003). Networks are especially determinant for the survival of a young firm. Many studies confirm the importance of networks on a new venture's growth. Interestingly, Walter, Auer & Ritter (2006) propose the construct Network Capabilities reflecting the ability of networking and not only the existence of the network. These Network Capabilities (coordination,

relational skills, market knowledge and internal communication) have a direct influence on ASO growth and also moderates the relationship between entrepreneurial orientation and growth. In consequence, EO has an influence on growth depending on the context in which it occurs but it has been found to have a significant direct effect on the realization of competitive advantages.

Founder's relationships with venture investors help new ventures to receive VC and so, to avoid failure and/o enhance performance (Shane and Stuart, 2002).

### **2.5.3. Management Team level**

One of the parameters that have received some attention is the influence on spin-off performance of the composition of the management and foundation team. Shane (2002) concluded there were two different models of entrepreneurial company interaction with universities. The first, promoted by academics, which identified a university discovery that aims to commercialize by starting a new company. The second model was one in which an entrepreneur sought assistance from the university to further develop his or her company. The skills and abilities of the founder (research versus industry experience or both) are different and can influence significantly firm performance.

Aligned with these findings, Franklin et al. (2001) state that the ideal combination for higher growth are the academic entrepreneur, who has experience in academic and scientific knowledge management, and the surrogate entrepreneur, who accumulates knowledge and experience to drive the company through the commercialization stage. According to his study surrogate entrepreneurs are better than academics at opportunity recognition and identifying the market, increasing the probability of succeeding commercially. However, identifying these entrepreneurs may be difficult as it requires the university, or the academic, to have suitable networks. Instead, Clarysse and Moray (2004) argued that instead of hiring outsiders, coaching inventors leads to better performance.

Also regarding the management team in spin-offs, Ensley & Hmieleski (2005), analyse the differences between TMT in academic spin-off and non-academic ventures. They apply the isomorphism theory to state that the higher the heterogeneity of the TMT the better performance. Vanaelist et al. (2006) studied different heterogeneity types: whereas industry experiential heterogeneity help to the development of the venture, results about entrepreneurship experience heterogeneity are not conclusive and foremost, they perceived a cognitive homogeneity in the strategic orientation as related with innovation, support, rules and goals. Even though newcomers present different experience from original team members they show a comparable strategic orientation. Entrepreneurs choose their team members according to interpersonal arguments rather than economic arguments. Although initially ASO board shows a great diversity in its composition, there is a convergence over time in subsequent board changes, which are mainly driven by the board chair (Bjørnali & Gulbrandsen, 2010).

#### **2.5.4. Individual level**

Stepping aside the University policies and company factors discussion in literature about how to enhance ASO growth, Hayter (2011) claims that scholars have to pay attention to the motivations and ambitions of the entrepreneurs themselves. According to his study, growth motivation of academic entrepreneurs may also be a factor that hampers growth since a large percentage of academic entrepreneurs have little interest in growth and they define success in terms of technology diffusion, technology development, financial gain, public service and peer motivations.

Besides their scarce motivation for growth, academics have to face their role identity transformation. Through the work of Jain, George & Maltarich (2009), we can learn that scientist have to evolve their role identity to adapt it to the normative, abilities, beliefs and priorities from the academic to the business world. This is not an easy process and can generate conflict and dissatisfaction. From in-depth interviews it can be stated that academics tend to preserve and prioritize its academic role and often develop a defence mechanism to protect it. This can bring as a consequence that scientist do not put

enough attention and effort in commercialization activities. TTOs have a heavy influence in the success of balancing both roles.

Knockaert et al. (2015) establishes a relationship between cognitive styles and Growth Intention. Academics with a knowing style like to make decisions with a large amount of information and details based on facts. They will probably feel uncomfortable with the high degree of uncertainty of growth-oriented entrepreneurial ventures. Higher levels of working experience would add more information and facts to decisions and can diminish this effect. Growth oriented ventures require a great amount of planning so a planning cognitive style will fit with growth intentions.

Championship behaviours influence on performance has also been studied for the ASO case (Walter, Parboteeah, Riesenhuber et al. 2011). Quite surprisingly, pursuing an innovative idea found to be not related with sales growth, whereas network building had a positive relationship and persisting under adversity and taking responsibility were beneficial until an extent (had an inverted-U shape influence): sticking far too long to a business idea, a strategic path or a decision can be seen as a resistance to change and may undermine the enthusiasm of team members.

### **2.5.5. Holistic studies**

Few studies take a holistic approach on the growth phenomenon of ASO: Chiesa & Piccaluga (2000) stated that their low growth rate in Italy was mainly due to the long term current academic job status, financial barriers and academic lack of management skills. In the Harrison and Leitch (2010) study, the problems academic entrepreneurs found to develop their ventures were the academic pressure, spin-off the company too early in the development process and the constraining influence of the regional and industry environment (ex. recruitment, market size, scale of sectorial clusters). Hayter (2013) take the entrepreneur's unit of analysis and consider in his cross-sectional study the positive influence of several factors, taken from entrepreneurship literature on growth: ASO entrepreneurs with faculty consulting, an outside CEO, taking advantage of multiple and external IP sources, Venture Capital investing and establishing joint

ventures influence Spin-off success in terms of commercialization. Negative factors are an obstructionary TTO, university equity, university services, previous SO experience, state funding and ASO age.

In Spain, there are just a few studies addressing ASO and growth (Rodeiro, 2008; p. 164), which present many of the factors affecting growth already studied in previous European literature. In one of these very few studies, Ortín & Vendrell (2014) detected that ASO's had an initial underperformance that disappeared after 2 or 3 years. After this period, productivity grew faster in ASO, and consequently can have the opportunity to generate more wealth than a simple start-up.

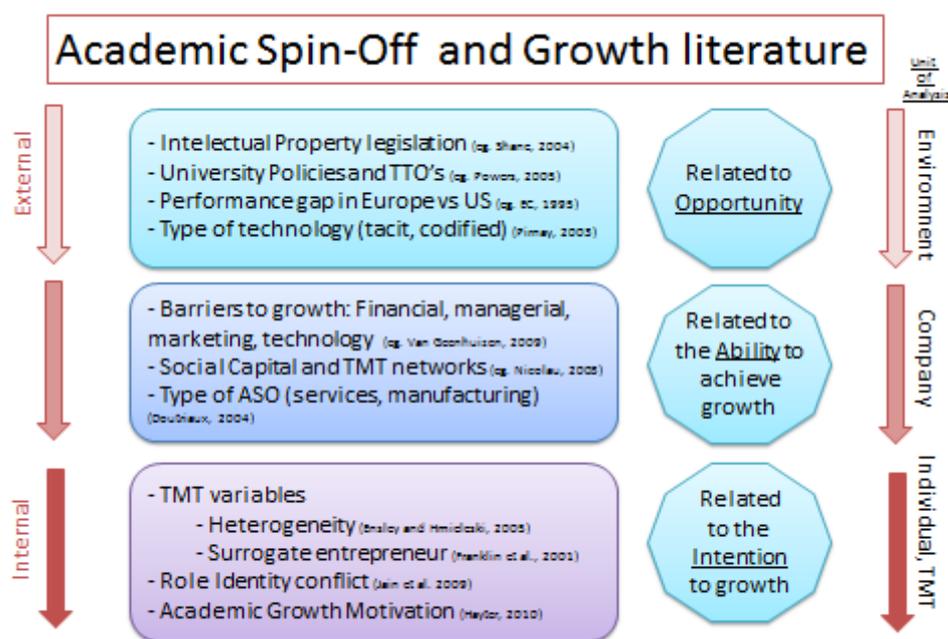


Fig. 5. Academic Spin-Off and Growth literature. Source: Compiled by author.

## **2.6. Methodologies and theories applied to explain growth in ASO**

From the methodological perspective, in qualitative studies there is an important use of the case method and in-depth interviews to the different participants, faculty, TTO's, and entrepreneurs, with the aim of understanding and describing the phenomenon. Quantitative articles are mainly based on surveys and usually apply correlation analysis to prove relationships between different factors found in qualitative analysis or try to validate statistically the main variables that influence the processes related with Technology Transfer and ASO creation.

When studying the factors that influence high growth, quantitative methodologies are mainly applied, through different regression techniques. In terms of research methods a majority of studies rely on surveys. These surveys have been progressively refined with the use of multiple items per construct, pre-testing of items and the use of different statistical methods.

We consider that qualitative studies could help in the comprehension of the growth phenomenon since there are subjective issues that are not recognized by objective indicators (Davidsson, 1991) that have demonstrated their influence in growth, such as need, satisfaction, entrepreneur orientation or self-efficacy.

There is a scarcity of articles studying the application of different economic theories to academic entrepreneurship. Most of the articles are atheoretical and focus on the empirical description of the process rather than the explanation of it through a theory. Authors agree that the field of study of Growth lacks of a well-founded theory development that cause a slow development of it (Sheperd & Winklund, 2009).

Theories applied to explain the factors that influence growth in new ventures are Social Capital theory from sociology and Resource-based theory from strategic management whereas other theories commonly applied to entrepreneurship as agency theory, complex systems theory, stewardship theory and institutional theory are rarely found in academic entrepreneurship.

Social Capital theory and Resource-based theory are both organizational theories that explain growth as a result of internal and external factors. The Social Capital theory perspective sets the relational capacity of the components of the company as determinant for growth. Thus, networks are seen as a sustainable competitive advantage that facilitates the entrepreneur a fast-track to discover opportunities, achieve access to resources and gain credibility. Although research in networks has advanced in last 20 years some issues related with growth are still unclear, like the kind of network that best enhances growth, networks with high or low redundancy (Coleman, 1990 vs. Burt, 1992), density (Coleman, 1990), heterogeneity (Reagans & Zuckerman, 2001), and ties strength (Batjargal, 2003) are network factors to take into account when analysing performance.

From the Resource-based theory perspective the determinant for growth is the availability of key resources that can be either assets, human capital, financial or competencies that combined and exploited can create synergies and competitive advantages that are strategic and difficult to copy. Resource-based theory perspective is the most extended theory when explaining ASO growth: Geenhuizen & Soetano (2009), Chandler & Hanks (1994), O'Shea et al. (2005), Heirman, A., Clarysse, B., (2004), Lockett (2005), Lee et al. (2001), Rumelt (1974), Grant (1996), Sapienza et al. (2004).

When studying the influence of the team on growth, agency and stewardship theories are used to explain the alignment between the different members and alignment of TMT and shareholders (Wasserman, 2006). This could be an interesting approach to study the University, TTOs and VC role on ASO growth.

Other studies also introduce factors related with growth that are empirically grounded such as HRM practices (compensation, recruitment) or business practices such as product superiority, innovation, utilization of new technologies. (See a compilation of studies in Barringer et al., 2005).

## **2.7. Concluding remarks, gaps in research**

In this literature revision we have extracted the main studies addressing the growth of different groups and types of companies. From the extensive entrepreneurship literature we have learned the complexity and multidimensionality of the growth phenomenon (Leitch et al., 2010) and how the huge amount of different constructs related with growth limit the progression in this field. Different groups of authors produce similar factors with similar definitions but different hints and this spectacular richness of terms and constructs make very difficult to formulate grounded theory based on previous studies. For example, elements such as Growth Intention, Growth Willingness and Growth Ambition or Resource Based Theory, Knowledge Based Theory and Competence Based Theory, may present similarities but also slight differences that make researchers to use one or another with extreme caution. Thus, the lack of a well-founded theory development causes a slow progress in the knowledge of the phenomenon (Sheperd & Winklund, 2009).

Moreover, the amount of variables and factors that intervene in the growth process is so big that a majority of studies focus on a particular factor or group of factors making difficult to have a holistic view. Taking into account the extensive entrepreneurship and ASO literature, researchers will have a long (but finite) list of factors that sometimes have some influence on growth. However a lack of knowledge persists on the intensity of that influence and the mediators and the circumstances this intensity varies. Additionally, empirical analysis of the drivers of the new venture's growth has low predictive accuracy and low concurrent validity between the different growth measures (Wright & Stigliani, 2013).

Besides this complexity, due to their quantitative approach, a majority of studies failed to establish a causal relationship between the factors studied (Wicklund & Sheperd, 2003). The presence of non-causal factors can provide a signalling effect to detect companies that have more chances for growth and might help to third parties to predict growth in some way but establishing this causality is important for practitioners, especially for entrepreneurs that will have to actively pursue those factors that really have an influence and make the company grow and not those that just appear when the company grows. Causality also helps academics to have a better understanding of the

phenomenon and how the different factors intervene in the growth process. Thus, qualitative studies are convenient to deepen on these causal effects of each factor because it allows know these processes and the role of each factor on it. In our opinion, it is crucial to distinguish between growth drivers and growth signals, and this is a big gap in literature.

Another relevant matter for practitioners is about the factors over which the entrepreneur has no or little control, such as size or age of the company or the industry the company is in.

Another claimed area of improvement is about longitudinal research. Already Penrose (1959, p. 88) stated that “growth is a process, size is a state”. Many studies are cross-sectional analysis with the difficulty to perceive this process view of growth. Thus, scholars welcome more longitudinal studies on growth (Davidsson et al. 2007). Academics tend to try to elucidate the antecedents that produce the intended outcomes missing the study of the process itself (Sheperd & Winklund, 2009). We think this black-box approach can miss some of the factors that are determinants for growth to occur.

In conclusion, it seems that current frameworks in Entrepreneurship literature do not explain the greater amount of growth (Parker et al., 2010), so we would say that despite of the great number of studies linking growth to a variety of factors and variables there is need of qualitative research to explore the "whole picture" and propose new frameworks to explain growth as a process (Leitch et al. 2010).

The study of ASO growth applies the main organisational theories of growth to a specific subset of start-ups that have an academic nature. In consequence, gaps in literature found on growth for start-ups also apply for the ASO case. However, ASO present some peculiarities due to its academic character, and specific studies to clarify the role and influence of University, the academic and the technological nature of these companies.

Although literature about start-ups growth is much more extensive and theoretically developed, in some way, ASO literature has followed different routes that have led to interesting results. For example, the stage-based theory developed by Vohora et al.

(2004) that has been largely used in ASO literature, has not had a similar development in Entrepreneurship literature.

Vohora et al. (2004) pointed out that the new venture had to surpass its threshold of credibility and its threshold of sustainability, the first to have access to resources (financial) and the second to achieve sustainable profits. It is clear these two stages are crucial to achieve growth in ASO. However, little empirical research has been made on the conditions, factors, decisions, actions, attitudes and beliefs that influence the achievement of each milestone. This constitutes an important research gap this project will try to fulfil, taking the Vohora view of stages and milestones to the empirical arena.

For example, studies based on ASO stages, are not very clear about the product development stage. As University goal is basic research, we think the degree of the product development and its market-readiness will definitely influence the time the company takes to reach to next stages. It is not after the product is market-ready that the company can begin to generate turnover and growth.

Finally few studies focus their attention on the performance of the new venture created after its early stages, neither in entrepreneurship nor in ASO literature. There are studies about how to manage growth for large corporations in the management literature but there is a significant lack of them when addressing the problems a start-up and particularly an ASO face after their early stages.

As we have revised, there are external or environmental factors that affect growth of a start-up importantly, especially, industry competitive structure and growth (Covin, et al., 1990; Eisenhardt & Schoonhoven, 1990; Chandler & Hanks, 1994; McDougall et al., 1994; Park et al., 2002; Robinson & McDougall, 2001). Government policies, location, and university influence the chance for growth of an ASO as well (Degroof and Roberts 2004). Although it will not be a central point in our study it is important to notice the amount of relevant studies that put an emphasis on the importance of industry dynamics on growth.

Another understudied area regarding the University participation in the company is about the due diligence and negotiation process and the financial and economic approach to it. Every company that spin's from university has to assign a value to the

assets that each shareholder contributes with. Not every company valuation technique would be applicable with the context of a very early stage of life cycle and the complexity of an academic institution with particular goals and objectives. Little has been studied about how the process is and what are the methods used in this valuation and about how the negotiation process has been undertaken. The particular characteristics in the application of finance principles of valuation to the spinoff process in the case of academic spin off also constitutes an interesting gap in research.

Related with the bodies of knowledge we have perceived little influence of finance literature of Corporate Spin-Offs in the Academic Spin-offs literature. Spinoffs can also be found in corporations as a growth strategy. Little has been found about what implications and knowledge can be applied from the private companies' perspective to the spinoff process in the academic case. Benchmarking between different types of spin-off to validate hypothesis on performance is an underexploited area of research. The few studies performed have been quantitative and limited to the comparison of the results in terms of growth of each type (corporate or academic) of company. We think that qualitative and theoretical studies comparing both types of spin-offs can lead to interesting results. For example, CSO literature explains the corporation criteria for spinning-off a company, its advantages in form of reducing information asymmetries, accessing to financial markets, the presence of anergies, improving management incentives or accessing to financial markets. These criteria could be evaluated from the University perspective regarding the decision of spinning-off or licensing. Another area for research could be the investment evaluation criteria CSO use to give or maintain active support to a SO. These criteria could also be evaluated and integrated in the University support policies to Academic Entrepreneurship.

As we have pointed out in the literature revision, there are some studies about ASO performance. A first group focus on its differential characteristics in the composition of the Top Management Team (TMT) and the profile and background of the entrepreneurs. From this approach interesting differences have been found in ASO versus CSO, or versus a standard new venture, between academic and non-academic entrepreneurs, and between ASO with a heterogeneous team versus a team formed only by scholars. These facts suggest a relationship between team components quality and characteristics and firm growth.

Whereas the effect on growth of the size and composition of the TMT has been extensively studied in Entrepreneurship, little research has been performed on the effect TMT incorporations have had on growth beyond the addition of knowledge. Attitudinal or behavioural effects such as their weight in the decision processes, their entrepreneurial orientation or their growth orientation have been neglected in previous literature.

One of the main role of the board and the TMT is strategic planning and implementation. Although some studies have found the strategic approach for growth to be related with growth, like internationalization or acquisition of technological companies (Lindholm, 1997a), the relationship between the existence and type of growth strategy and the effective company's growth in ASO is also an understudied area.

Capabilities seem to play an important role on ASO growth. Although some capabilities are widely studied such as network, marketing or management capabilities, we find an absence in literature of ASO growth an analysis of the effect of other capabilities such as leadership capabilities.

Regarding University policies we agree with authors who have warned that University Entrepreneurship measurement based on the number of ASO created can have perverse effect on these policies so that we agree with their suggestion for measures based on the performance of the companies rather than the simple accounting of this quantity.

As for the Academic Spin-Off definition, an interesting point related with SSO is worth to be mentioned. As one can state through simple observation of some industries where creation of new companies by students with a certain support from its universities lead to enormous fast-growing companies (Google, Yahoo,...). There is also some notorious cases of college-dropout entrepreneurs such as Steve Jobs, Bill Gates and Michael Dell. Despite of their not purely "academic" status, because of their student condition, one cannot doubt of the technological base of the company and networks used in the company formation come out from the university. This phenomenon led to enormous returns in terms of wealth for its geographical area. Pirnay et al. (2003) stated

the misrepresentation of the student collective in USO studies. Åstebro et al., (2012) shows that in three universities of US and Europe undergraduates in science and engineering start-ups created at least an order of magnitude more companies than ASO founded by their faculty and they were not low quality SO. It is not a volume effect (there are more students than academics) but recent graduates are twice as likely as their faculty to create a start-up.

Student entrepreneurship has received little attention on University Entrepreneurship literature. Similar policies and incentives could be applied not only to academics, but also the students to foster entrepreneurship and TT from university, since technological base is apparently not difficult to evaluate. Alumni have certain advantages compared to academics (lower opportunity costs, different backgrounds and experiences, more possibilities of opportunity recognition). It could be an interesting area to study as well to study the relationship between the academic body and the student body to establish joint new companies or any kind of TT collaboration between academics and alumni.

The evolution in the ASO conception and the different definitions has been an important obstacle to compare the results of the different studies and to draw general conclusions and to build theories. We gave arguments to select a broad definition of ASO so that not to miss a great percentage of companies whose knowledge is based on tacit technologies (Bathelt et al. 2010) or where the academic is not present in board or management (Nicolaou & Birley, 2003), or simply left academia some years before effectively starting the company, because of the long TT process and product development (Müller, 2010).

Thus, taking these last three considerations we can conclude that we have to be very careful when we evaluate the commercialization of research and the wealth created from spinning-off companies from University. The existence of SSO, the tacitness of the technology transferred, the creation of companies from ex-researchers, make us think that the real impact of companies that are created from Universities can be much bigger than it is accounted.

### **3. Research design and methodology**

#### **3.1 Research objectives**

Literature about ASO growth is fragmented and there is a lack of theories and frameworks that explain a big amount of growth. There is still not a clear understanding on how growth takes place, its processes and the factors that have an influence on it. This situation is especially acute in the study of growth in the commercialization stage of the ASO companies.

There is a lack of studies that bring into new approaches to study the phenomenon, qualitative and holistic studies on ASO that allow to establish a causal relationship with growth, studies that focus on growth as a process, longitudinal studies, studies that take into account the company level longitudinal studies and finally, studies that take into account more than one performance measure to improve the validity of results.

The aim of the study is to address these deficiencies observed in previous studies and to uncover the attitudes, beliefs, decisions, actions and milestones that take these companies to grow during a sustained period of time after their earlier stages from the lens of the successful ASO entrepreneurs in Catalonia, with a focus on the commercialization stage.

Our objectives are, first, to isolate those actions, factors, decisions or behaviours that have had an influence on growth in ASO companies at the commercialization stage from the founder-manager level of analysis and to give insights about the role each of those hints play in the growth process. Second, to characterize how the successful ASOs in Catalonia have grown by emphasizing the common factors successful companies have. And finally, to measure ASO growth using different factors and to try to harmonize results and give consciousness about the implications of using each variable.

### **3.2. The study design**

The main objective of this research is to unveil new barriers or facilitators of growth of the Catalonian academic spin-offs in the commercialization stage. The proposal of research must try to fulfil the existing gaps in literature by analysing from the company perspective how growth process takes place in successful Academic Spin-Offs. We collect these special ASOs that have had an uncommon growth in our area of study and intend to pick up common characteristics, attitudes, objectives, processes or milestones in their evolution, factors, facts or conditions that have driven these companies to growth and eventually to success.

This company selection of successful ASO is performed through a quantitative study of the Catalonian ASO universe to extract those companies whose balance-sheet data show high growth. We gave a relevant role to the selection of the companies. We defined success in terms of performance grounding the sample with the measures that have been tested in previous literature. However, we also considered alternative measures that gave a complete picture of eventual long term company success and provided theoretical basis to our decisions. At the end, we came out with an explicit sampling frame to discriminate companies according to the purpose of the study.

The quantitative preliminary study gave as a result the ASO that could be considered as High-Growth companies in Catalonia. Although we could reach to a better and more precise understanding by performing a case-study on just one particular case, we felt that any of these individual cases with its unique results would have made very difficult any attempt of generalization of the conclusions. So we decided to perform an in-depth interview of each company. Through multiple interviews we could validate if the presence of factors, facts, roles, milestones, attitudes are shared in other cases or there are some particular properties that are not shared with anyone. So, multiple cases gave as confidence of the degree of generalization. In-depth interviews were chosen as the main method of research, because the issues studied required profound insight, some flexibility (semi-structured), and catching up non-verbal communication.

One of the novelties in the approach of the study consists in the use of a mixed method design (Tashakkori and Teddlie, 1998). The use of multiple methods can

neutralize or cancel out some of the disadvantages of each of them separately, but implies longer time and effort in the study (Creswell et al. 2003). Authors have increasingly recognized the advantages of mixing quantitative and qualitative methods. Procedural guidelines for mixed methods studies have evolved and visual models, notation systems and a typology of designs have been created.

According to Creswell et al. (2003:p.165) definition, “A mixed methods study involves the collection or analysis of both quantitative and/or qualitative data in a single study in which the data are collected concurrently or sequentially, are given a priority, and involve the integration of the data at one or more stages in the process research”.

In this definition the author incorporates the main three methodological issues that researchers who choose to conduct a mixed methods design have to consider. These are the priority or weight given to the quantitative vs qualitative analysis, the sequence of the data collection and analysis and the points in the research process at which quantitative and qualitative phases are connected and the results are integrated (Morgan 1998; Creswell et al. 2003). In order to provide clarity and additional insight, authors recommend to visually represent the mixed method procedures and results in a visual model (Creswell et al. 2003).

Thus, we have to address these three issues to assess the compliance of the study design from the methodological point of view. First, priority or weight depends on the study goals and the scope of quantitative and qualitative research questions and the particular design of each phase (Morgan, 1998). In our study, the priority is clearly the qualitative research phase with a thematic focus on understanding the central phenomenon of growth after the earlier stages. Such focus leads us to the collection of open-ended data through semi-structured interviews. This emphasis is represented with the capital letters in Figure 6 according to the notation system developed for mixed methods research (Ivankova, Sheldon & Creswell, 2006).

Second, mixed methods design can be concurrent or sequential. The design of the study and the sequence of the methods used relates with the objectives being sought. In our study we take the population of the Catalonian ASO in the quantitative study to explore in more depth success cases in the qualitative phase. Thus, our study was

necessarily sequential because we used the output of the quantitative phase as an input for the qualitative phase.

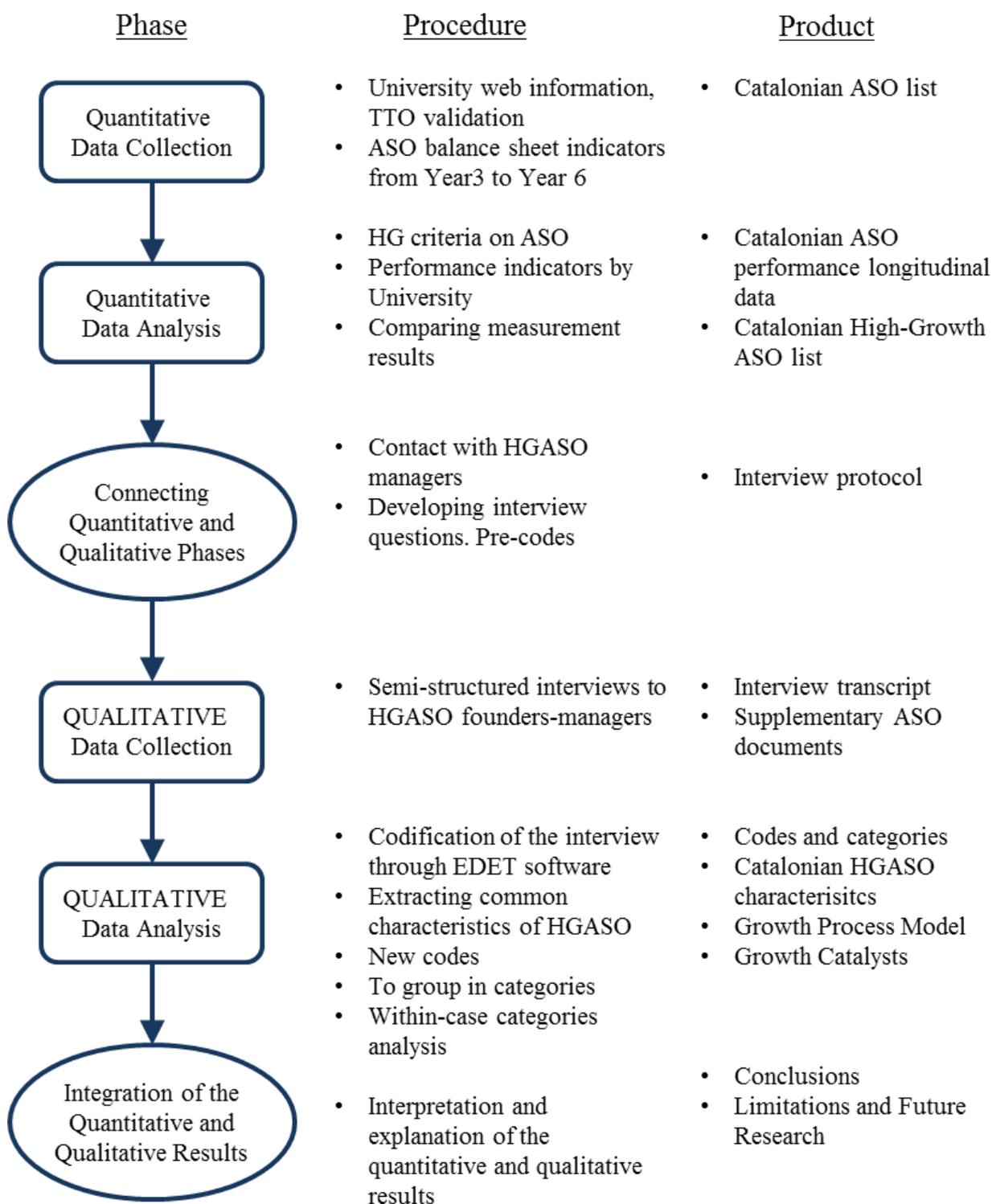


Fig. 6. Visual model for the study design procedures based on Ivankova et al. (2006).

Third, authors also emphasize the importance of defining the stage of integration, that is, the stage of the research process at which integration of quantitative and qualitative data collection takes place (Tashakkori and Teddlie, 1998). This is easily visualized through the visual modelling of design of the study process (Fig. 6). In our study, we integrated the results of the quantitative and qualitative phases during the conclusions of the outcomes of the entire study. In the discussion section, we combined the results of both phases of the study to more fully understand the context where HGASO and the type of influence University policies had on company growth as an important part of the answer of the research question. Thus, we interpreted the results of the quantitative phase to confirm the “European Paradox” in the Catalonian ASO, the type of companies that were produced and the results in ASO performance of the Catalonian University policies. Then we discussed the within-case studies to give the insights on how some special cases had accelerated their growth process and had over-performed the average ASO. This process allowed to further clarify the quantitative results and to give proposals about the problems and possible solutions for the University Entrepreneurship policies. We cited qualitative and quantitative published studies on the topic that were aligned with findings to support our propositions.

Out of the six majors mixed methods designs defined by Creswell et al. (2003, pp 178) our study corresponds to a explicitly mentioned as “common variation” of a sequential Explanatory Design where the initial quantitative phase of the study is used to characterize individuals (ASO companies) along certain traits (High-Growth) of interest to the research question. This type of design uses quantitative results about participant characteristics to guide purposeful sampling for the qualitative phase (Tashakkori and Teddlie, 1998). These characteristics can refer to outliers or extreme cases (Caracelli & Greene, 1993) as our selected High-Growth ASO are.

This variation has also been named as quantitative preliminary design (Morgan, 1998) or the participant-selection variant (Creswell, & Plano Clark, 2007: p. 83), and researcher places priority on the second qualitative phase instead of the initial quantitative phase. This variant is used when researcher is focused on qualitatively examining a phenomenon, but needs initial quantitative results to identify and purposefully select the participants. Although as mentioned before the quantitative analysis did provided a context and valuable information about the results of University

Entrepreneurship, its main objective is to identify these companies that present an extraordinary growth with the purpose of untangle the growth process and the actions, decisions, attitudes and behaviors that accelerate this process. As this is the main purpose of the study our priority is the qualitative study.

In the following chapters we account the main characteristics of the context of the study, the region of Catalonia and University Entrepreneurship in The Catalanian University System. Then, we provide arguments for the methodological decisions about the measures of performance, the time frame and the High-Growth criteria selected for the screening. We detailed how and from we extracted data and the different decisions we made in every step of the selection process.

Once we had the selection of the High-Growth ASO, we contacted their founders-managers, validated their ASO status and performed the in-depth semi-structured interviews. We transcript the interviews to EDET software, assigned codes, reduced them to categories and extract the common characteristics that were relevant for the growth process.

### **3.3. Mapping the growth of Academic Spin-Offs in Catalonia**

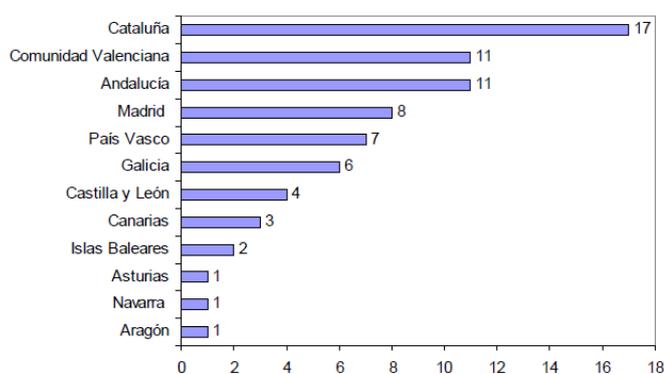
#### **3.3.1. University Entrepreneurship in Catalonia**

Catalonia is located in the northeast of Spain. It accounts for the 16% of Spanish population, and its GDP is slightly over (1%) the Spanish media. The Catalanian University System is composed by twelve universities, eight public universities, and four private universities. Bigger three universities are public and have high university rankings: Universtitat de Barcelona (UB), Universitat Autònoma de Barcelona (UAB) and Universitat Politècnica de Catalunya (UPC).

We performed the exploratory study for the Catalanian private and public universities because of the prevalence of this area in Entrepreneurial University and

innovation (Fig. 7) and because is a region that has rapidly changed from an economy based on production competition to an economy of competition based on innovation (Global Competitive Index from the World Economic Forum, 2011).

Catalonia has developed pioneer research in medical care, energy and urban, economic and social innovation; is well positioned in scientific production by population or GDP with respect to an average European country, and has a qualified market of professionals as well as a highly qualified researchers, teachers and students (Urbano & Guerrero, 2013).



**Fig. 7.** Number of ASO created in Spain from 1998 to 2005. Rodeiro, 2008, pg. 230.

Same authors, Urbano & Guerrero (2013) stated that although Universities in Catalonia have adopted the Entrepreneurial University mission and have created the structures to foster entrepreneurship, there is the necessity to evaluate the real effect of University Entrepreneurship in the long term.

### **3.3.2. Decisions about methodology**

In our study, we revised the main methodological points of controversy that ASO studies have encountered, the problems that have arisen and we made a justified decision on each of these points. These points are: (i) ASO definition, (ii) Measures of growth, (iii) Relative or absolute variables in growth measurement, (iv) Sustained or fluctuant growth, (v), ASO stages and milestones (vi) Time period and (vii) Measure of High Growth, HGASO selection criteria.

### ASO definition

Scholars use a broader or a more restrictive definition of an ASO in their studies. It is a recurrent problem to take into account when comparing results between ASO studies to define the borders of what is considered as an ASO company.

We adopted the definition of ASO from Klofsten & Jones-Evans (2000): “new companies created from universities to exploit knowledge created by academic activities in a profit making perspective”. Thus, we considered ASO from a broad perspective, not requiring them to be formed exclusively by teachers or to be partially owned by university. So a company formed by students or entrepreneurs would have worked for the study if a TT process existed.

We think that taking into account only the TT process when this process is codified, that is, there is knowledge in form of patents that is transferred misses a big amount of University Entrepreneurship activity and consequently it does not have to be left out of the analysis.

### Measures of growth

Different measures of growth have been used in SMEs studies. It is not clear in literature until what extent this variety can lead to different conclusions in each study. Measures of growth in academia are usually related with relative or absolute growth on revenues or employees. However, practitioners state that different stakeholders pursue different growth objectives. Growth is a desirable situation for all the groups that interact in and with the company (managers, owners, public administrations, workers, unions, suppliers...). Small and slow growth companies are perceived as indicators of poor performance (Cliff,1998), and until some extent, socially disregarded ("Big is beautiful"). However each group has its favourite variable to maximize. Thus, the growth objective measure investors normally pursue are measures of return such as net profit, generated cash-flow, EBITDA or ROI. Some studies also use more peculiar measures such as total company asset (related with investment). Public administration

and unions prefer to maximize employment, suppliers prefer purchases and fixed assets, whereas for owners the variable to maximize in the long run is Net Profit or ROI.

According to Achtenhagen, Naldi, & Melin (2010) there is a gap between the meanings attached to growth for academics and for practitioners. Leitch et al. (2010) suggest that one potentially valuable role for academic researchers is to explore the stakeholders' differing social realities and meanings. In a large-scale quantitative study of 2455 SMEs they test the relationship between the commonly used measures of growth (employment growth, sales growth, profit, returns on equity [ROE], returns on assets [ROA]) and entrepreneurs' perceived growth relative to their competitors in terms of increase in company value. As for entrepreneurs, profitability and company value were the most valued measures for growth and a substantial amount would select a combination of measures as the most relevant to measure growth.

As in the Entrepreneurship field, ASO literature is not an exception and generally used measures are employment or sales growth (Geenhuizen and Soetano, 2009, Smilor et al. 1988, Shane, 2004; Lindholm, 1997a, 1997b; Vincett, 2010; Degroof and Roberts, 2004). Measures on growth based on employees have caused some controversy, since it can be difficult to sustain because not always are necessarily related with growth in sales or profits. Measures based on employees are used in the early stages of the firm, when the generation of revenues and profits are small related to the investment and in that industries where time to market is long (e.g. biotech). Sales as a growth measure had also not been exempt of critics, since in large and/or growing firms do not necessarily equate to profitable performance (Davidsson, Steffens, & Fitzsimmons, 2005).

So, the growth measure chosen is considered a methodological unimportant option, although a few authors have already warned of the important consequences in the study results. Chandler, McKelvie & Davidsson (2009) studied the relationship between these two variables stating that they not always are interchangeable. Most complete study about this methodological problem is the review of literature of Leitch et al. (2010) that reveals the inadequacy of using only one measure of performance and that these measures were largely limited to sales or employment.

In order to avoid this danger in the validity of our study we have compared the results of ASO activities in each Catalonian university in terms of Turnover, number of employees, profits, assets and leverage.

#### Relative or absolute variables in growth measurement

Gilbart's law stated that the company growth is independent from its size. Several studies have been conducted to state the validity of the law. A majority of them concluded that Gilbart's law can be applied (with some limitations) particularly in the long run, but is especially inexact with small companies. Gilbart's law is specially fragile for small companies in the sense that small companies grow more than its bigger counterpart when sales or employees are the measure selected (Sutton, 1997; Hart & Oulton, 1996; Teruel Carrizosa, 2006; Lotti, Santarelli & Vivarelli, 2009).

Differences in growth for small companies along time are significant: Parker et al. in 2010 found that the mean annual sales growth of gazelles between 1992 and 1996 was 36%, but surviving gazelles grew by just 8% between 1996 and 2001, being unable to sustain growth even in better macroeconomic conditions than the previous five years period. However, Whittington (1968) for the UK, and Wagner (1992) for West Germany demonstrate that high growth firms grew faster than the industry average growth in the following periods.

Since ASO companies selected for our study were SMEs it was wise to try to diminish the size effect by taking a combination of relative and absolute values or consider a minimum size to take data into account (Smallbone, Leig & North, 1995; Dahlgvist, Davidsson & Wiklund, 2000). Another way to diminish this effect is to consider the initial point of time some years after the creation of the company, so that relative values are more representative. Thus, in order to moderate the size effect, we chose a combination of relative and absolute measures of growth.

#### Sustained or fluctuant growth

Garnsey (1998) explored the different phases in the company early growth. Internal and industry forces and resource endowments force the company to pass through

different growth paths with fluctuant, reinforced or reversal growth.

Some studies consider high growth exclusively as a necessarily steady growth arguing that one or two shot growth can be due to an acquisition or a non-replicable event in the environment. Delmar, Davidsson & Gartner (2003) explored this heterogeneity in the growth patterns and they classified companies in super-absolute and super-relative companies, sales growers, acquisition growers, erratic one-shot growers, sales growers and employment growers. Other authors on high growth also show that patterns of growth change over time (Garnsey, Stam & Heffernan, 2006) and that high-growth can appear in short periods of time followed by a decline or slower rate (Hull and Arnold, 2008).

We consider that there is not sufficient evidence to reject fluctuant, one shot growth or any pattern of growth. Besides, growing through acquisitions or heavy investment could be a valid strategy for growth and can lead to further operations in the same way in the future. So, whatever is the origin of growth or its pattern over time, we cannot find a reason to invalidate any kind of growth pattern. In consequence we take an average compound growth in three year time as a valid measure for growth.

#### Academic spin-off stages and milestones

Some authors split ASO development in phases or stages the company has to go through to achieve maturity. The resources and knowledge required in each stage evolves and different barriers arise and have to be overcome. Growth will occur depending on the resources the company has or the ability to get these resources from outside. Looking at the knowledge as a key resource, Lockett (2005), pinpoint that the lack of the different types of knowledge required as the main handicap for a spin-off to develop and grow. Companies need this knowledge to develop and to create a sustainable competitive advantage (Spender & Grant, 1996).

The kind of knowledge gets different significance in each stage of the spin-off process (research and development stage and commercialization stage) and to the different participants in the process (PRIs, TTOs, academics, entrepreneurs, venture capitalists). From this Knowledge Based View perspective, companies need to have

technical/scientific knowledge, especially during the development stages and organizational knowledge to develop and growth in the commercialization stage.

An important group of studies are based on Vohora et al. (2004) perspective, who identifies four critical milestones: opportunity recognition, entrepreneurial commitment, threshold of credibility and threshold of sustainability. The new firm has to develop capabilities and obtain different types of resources to overcome each one of these junctures to achieve growth.

One study has been found about the different ASO ages to surpass each milestone. Geenhuizeng & Soetano (2009) found that more innovative companies reached credibility threshold as far as year 1 and reach sustainable returns before Y6. On the contrary, low to medium innovative ASO encounter credibility threshold at year 4 and failed to reach sustainability at Y6. According to this study 53% of the companies where highly innovative, that is their product or service was a breakthrough or new for the sector and the expenditure on R&D was over 25%.

### Time period

Time frame chosen in literature of growth in small and medium companies is highly variable and normally ranges from 3 to 10 years (Parker et al., 2010). In high growth or gazelle's literature is more common to take a 3 to 4 years approach (Birch & Medoff, 1994; Acs, Parsons & Tracy, 2008; Moreno and Casillas, 2007) although there are studies with 10 and even 20 years.

In our case it is not a trivial decision because we are interested in companies with a sustainable growth (that is, with profitability) and this can appear in some years after the start of the operations, but it has to be short enough for companies to maintain his ASO characteristics and to have a minimum number of companies with rapid growth.

In consequence a time frame of six years is enough according to Geenhuizen and Soetano, for this group of highly innovative companies to present high growth and achieve sustainable returns. We chose this time frame because it is our estimated period in which companies had surpassed early stages, had created structures for growth and

had to some level achieved the credibility stage. So high growth, if occurs, will show in approximately those years.

As stated, some authors on growth think six years can be a short time frame to measure performance. According to Lindholm (1997a), measuring the growth of the ESOs (as compared to non-spin-offs) can be stated about ten years after the establishment of the firm, and this outperformance manifests precisely from the sixth year of life. This is not contradictory with our decision since we are looking for this group of companies that achieve High Growth early in their development. High growth literature also account for HG periods of 2 to 3 years followed and preceded by average industry growth.

However, it is to notice that most ASO studies take either established or new firms in a period of time (Parker et al., 2010), and evaluate results each year. The novel approach of our study is that we chose to study a period of three year time after three years of operations for all the companies in the period studied. This way we compare companies at the same time in their development.

The initial time point was set in year 3 for two reasons. On the one hand companies take some time to complete the TT process, create structures, complete product (service) design, and surpassing first stages. Geenhuizen & Soetano, set this time between 1 to 4 years. So at Y3 most HGASO candidates would have shown attractive returns and growth. On the other hand, we wanted to diminish size effect and avoid super-high relative growth measures due to the smallness of the firms. Based on this study we take a time frame from Y3 and Y6 from inception, as we consider that is the time ASO firms should grow and reach the sustainability stage.

#### Measure of Rapid Growth, High Growth or Gazelles. HGASO selection criteria

Some empirical works establish a dichotomy measure for high growth in SMEs and consider that a firm grows rapidly when it achieves a growth point. A common measure is companies that double their initial size in a period from 4 (most common) to 11 years (Littunen and Tohmo 2003, Smallbone et al. 1995, Acs et al. 2008), which represents an annual compound rate from 19% to 7%. The National Commission on Entrepreneurship

(2001), established the frontier of rapid-growth in employment risings by at least 15% per year, in a five year period (which represents doubling its size).

Birch & Medoff (1994) at MIT, defined gazelles as “growth-orientated companies that have achieved a minimum of 20% compound sales growth each year over the previous five years, starting from a base of at least \$100,000”. EU project KITE has also used this measure of rapid growth jointly with other studies (Feindt, Jeffcoate & Chappell, 2002). So, we can conclude that there would be a general agreement stating that a company with a continued annual growth of around 20% is commonly considered as a high growth or fast growing one.

In conclusion, for our study HGASO candidates should accomplish these three criteria that take into account scholars recommendations about growth measurement: (i) At least 6 years old, (ii) at least 300k€ of turnover at year 6 and (iii) at least 20% of annual compound turnover growth from year 3 to year 6.

### **3.3.3. Company selection process**

Since a database of spin-offs was not available, first step was to gather information to identify spin-off firms. We obtained the information mainly from each university web page and then validate the information through a short telephone interview to the director or assistant in the TT department of each university. ASO list was collected from the main public and private universities in Catalonia, Universitat de Barcelona (UB), Universitat Autònoma de Barcelona (UAB), Universitat Politècnica de Barcelona (UPC), Universitat Pompeu Fabra (UPF), Universitat Rovira i Virgili (URV), Universitat de Lleida (UDLL), Universitat de Girona (UDG), Universitat de Vic, Universitat Ramon Llull, Univesitat Oberta de Catalunya.

Only six universities reported to have companies that surged from university or officially had support from them through a Technology Transfer process. They were asked to validate the companies and qualify them as properly ASO because there has been Technology Transfer or simply start-up companies. We eliminate from the list

those considered by the TTO's as simple start-ups. We also asked about the university holding any stock in the companies and if there were any venture capital firm as stockholder.

In Spain companies are due to register their financial data in "Registro Mercantil". Registration normally takes a year (December 2011 already have data of the year 2010). The year of spin-off creation was considered year zero (Y0). Balance sheets from 1999 to 2010 were gathered from "Registro Mercantil" and SABI database and analyzed for each company by indexing seven variables: Turnover, Number of Employees, Profits, Total Assets, Leverage and Equity Value.

Although it is compulsory in Spain to register records in "Registro Mercantil", there are many reason not to have them available: some companies presented a particular company structure (cooperative or not a limited liability company...), others were in a closure process, are too young and do not have 3 or 6 years of life or others simply do not comply with the norm, which is usually an indication of poor activity level. Some others have been found with different names since universities normally use its commercial name, rather than the company name. Other companies could have suffered a corporate operation (merge or takeover) that transform company in a different one or have moved headquarters to another country. To compare company data we have considered year 1 as the first year with turnover different from zero or the following tax year after formation. Most companies reported sales the same year of foundation and if no sales are reported, the following year was considered year 1.

From an initial pool of 168 companies, we asked TTO's to discriminate proper ASO from start-ups, and 38 companies were disregarded for not being proper ASO according with the given definition. We also did not consider 40 more companies for not having accounting records in the official "Registro Mercantil", leaving 90 companies to study. In a similar study performed by Ortín and Vendrell (2014) from 496 Spanish companies they could only find accounting records in 104, which is an abnormal percentage of 21%. We found records on 67% of ASO, which is also a fairly low percentage anyway, taking into account that is legally compulsory to register financial data in Spain.

From these 90 companies, 63 were more than three years old (Y3), and only 35 have

records at year 6 (Y6). So there are 27 companies that are too young and although they have been located in “Registro Mercantil” database, did not have records for Y3. And 28 companies with data in Y3 but not in Y6. As we mention before, possible reasons for these are probably because either they had not released their data to “Registro Mercantil” at the time of the study, or they have been extinguished or had a very limited activity, or in more rare cases they have been merged or acquired by another company or moved outside Spain.

We tested how these 35 companies accomplish with the criteria of size in Y6 and growth that characterize a High-Growth Academic Spin-Off (HGASO). Finally only 13 companies have been considered as High-Growth.

We can appreciate the increase in size on ASO with data on Y6 shown in Table I. A majority of ASO’s have a turnover of less than 1 million EUR at Y3, but only 13 sell less than 0.1 million EUR. At Y6 only 9 out of 35 do not achieve the minimum size to be a HGASO candidate. Table II shows the amount of ASO created by each university.

Turnover (Euro)	with data in Y3	with data in Y6
< 100KE	13	2
<300KE	25	7
<1ME	16	16
<3ME	7	5
>3ME	2	5
	63	35

**Table I:** Turnover distribution of ASO companies in Y3 and Y6

Main Catalonian universities (Universitat of Barcelona and Universtitat Autònoma de Barcelona and Universitat Politècnica de Barcelona) account for most of the ASO companies (Table II) and for the total HGASO in Catalonia (Table III).

University	Y3	Y6
UAB	18	6
UB	17	9
UDG	4	3
UPC	21	17
URV	3	-
<b>Total general</b>	<b>63</b>	<b>35</b>

**Table II:** Number of ASO with data at Y3 and Y6 by University

From 63 companies with Y3 records, 28 were in the Biotech industry (6 HGASO) and the other 35 were in the engineering and computer and IT industry (7 HGASO). From 63 companies with Y3 records, the bigger three university account for the total of HGASO (Table III).

University	HGASO	BIOTECH HGASO
UAB	3	1
UB	6	4
UPC	4	1
<b>Total</b>	<b>13</b>	<b>6</b>

**Table III:** Number of HGASO and Biotech ASO with data by University

Regarding VC and university involvement in form of equity, from 63 companies with Y3 records, 17 reported to have Venture Capital (27%). Only 4 of these 17 accomplished HG criteria (23%). From 63 companies with Y3 records, 9 reported to have University as a shareholder. Only one of these 9 achieved HG criteria.

### 3.4. Untangling the ASO growth drivers from the founder's perspective

Academic literature generally accepts that growth is a multivariable and complex concept and that although there are certain factors that clearly influence growth there is a lack of well-founded knowledge on causes and how the process of growth takes place (Wicklund & Sheperd, 2003; Davidsson, 2004). Academics take a black-box approach trying to relate growth with inputs and consequently missing the study of the process itself.

Through semi-structured interviews to the founders-managers, we opened this black-box and untangled the main components of the growth process, trying to validate, to conceptualize and to group them into codes and categories to explain the growth process through the lens of the managers and board components. Some new factors also showed up. We also tried to find the strength of the influence of each variable for the ASO case in the commercialization stages.

### **3.4.1. The interview protocol design**

We design a semi-structured interview with three parts. Although the protocol design is extensive (Annex D), we adapted it to each interviewee and company and focused on those questions that better reflected the situation of the company we were interviewing as the interview progressed. We add notations with suggested issues related with the questions, but we tried to respect how the participants structured and framed their responses and we only suggested them if we felt the interviewee needed it for a better understanding of the question and to suggest issues that appeared in previous questions and could be related with the current questions.

Questions were open-ended and not every question was asked to every participant. Also, new questions surge from the answers and were addressed to the interviewee since we were more interested in knowing the individual perceptions of the processes than in comparing results.

#### *The founding process*

The first part of the interviews was devoted to put in context the company related to the external factors that can influence growth, such as, industry considerations, governmental and industrial support, university and TTO's support so we asked about a brief history of the company, contrasting data with the company demographics and the role of these actors in ASO growth.

We asked about the history of the company and its origins, the reason to create the venture (incumbent backed, necessity or opportunity SO) (Bruneel, et al, 2012), its different stages, the kind of assets transferred: only technology, the academic having some involvement but retaining its academic position (Hybrid SO) or both technology and academic being completely transferred (OrthodoxSO) (Nicolau and Birley, 2003).

We asked about a brief industry analysis from a strategic point of view: stage of the industry, growing markets, barriers of entry, competition, integration degree, and

growing alternatives. Industry structure influences growth capabilities of companies (Sandberg, 1986).

We started with this sort of questions to make the interviewed feel comfortable because he was not talking about internal matters, current staff, decisions or situations. But we do not wanted to dedicate to these contextual matters more time than needed not to decrease attention of the interviewed persons. So, we asked just a few questions to clear how these points related were with growth.

At this point we were capable of determine if governmental subsidies or policies, industry structure or situation, and TTO's and university had indeed a singular influence on each particular company's growth.

#### *TMT and founder growth factors*

Selected companies were outperformers in the catalonian ASO universe. As we have stated before, growth is initially an intention of the company (Gilbert, Mc Dougall & Audertsch, 2006) and therefore of those that composed the TMT, board and shareholders. At the early stages this decision and its strategic implementation normally relies on the entrepreneur (purely academic or not), but as the company goes through different stages the balance of power can shift or become influenced by other members of the board or the TMT. Thus, it was essential for us to study how these changes took place and how they influenced in strategy design and decision making.

Each of these stakeholders and TMT members could have different interests, beliefs, perceptions, aspirations and agendas (Gibb 2000, Buss 2002, Leitch et al., 2010) that could influence their growth willingness. So, a realistic insight of individual's motivations, interests, sense of fairness, was crucial to understand company's attitude towards growth.

As stated in the literature review, growth willingness is influenced by different factors in the cognitive arena like Entrepreneurship Orientation (Pérez & Sánchez, 2002, Rauch, Wiklund, Lumpkin et al., 2009, Roberts, 1991), Entrepreneur Self-Efficacy (Kickul, Gundry, Barbosa et al., 2009), Perceived Opportunity, Need and

Ability (Davidsson, 1991). Since the collective EO of the company is formed in some way by the individual's EO, we tried to determine composition of the company's EO from its individuals, but trying leverage at the same time who are the key influencers in each team and who had a strong view and leadership in this area. We also pay attention to the informal influencer's structure and decision making.

Management style was another concern, since there are characteristics in the management style commonly associated to managers (Wright and Stigliani, 2013), with a slower analytical approach based on data, and an intuitive style with fast decision making based on sensations. Different management styles, procedures and culture can lead to a different orientation for growth.

Since decisions on how and how much growing the company rely on owners and eventually on managers and we focused precisely on them. We did take some time and questions to try to find out which are their motivations about growth from a cognitive perspective, how they made the decision and how they faced the process.

So, we analysed each one of the micro level actors, trying to identify the heterogeneity of the board and TMT, the role and background of each component (academic, surrogate, TTO, other privileged testimonies...), their personal objectives regarding the company, their compensation structure, risk taking attitude, their influence among the board/TMT members.

We also asked about the evolution of the board / TMT, since changes in this team and particularly, new incorporations with different motivations, criteria and results can be the trigger for company growth (Vanaelist, 2006). We asked about the role of the different kind of components of the board/TMT, (University, TTO, Academic, Surrogate entrepreneur, Venture Capitalist, Business Angels, Industry partners) and their influence in the factors that promote growth, for each case, according to academic literature.

### *Business development process*

Entrepreneurship and technology transfer literature enhance the importance for the company to have or obtain the necessary resources and knowledge for new companies' growth (Penrose, 1959). Rumelt (1974) identified three areas of knowledge that have a strong influence on growth: production, technology and marketing. According to the RBV, main barriers for growth in SME are having the human, financial, and social resources enable growth to be achieved (Birley and Westhead, 1994; Cooper et al., 1994). ASO literature points out the importance of commercial knowledge, as the more difficult barrier to overcome in order to achieve growth (VanGeenhuizen & Soetanto, 2009). So we asked about what type of resources and knowledge had been critical for growth in each case, what type, if any, was missing and which ones were the different resource acquisition strategies to adequate resources to surpass growth barriers (Harrison & Leitch, 2010).

Literature identifies technical knowledge as the main knowledge transferred in ASO rather than a competitive advantage based on marketing, sales or distribution (Pérez Pérez, & Martínez Sánchez 2002, Clarysse et al., 2011) and the kind of technical knowledge transferred influences performance (Sapienza et al., 2004). So we asked questions about the technological knowledge transferred: broad or narrow, tacit or codified, knowledge relatedness with the parent firm and technology novelty.

Finally, but not less important, the other group of factors that influences growth in new ventures are those related with networks. Networks are seen as facilitators of the access to the resources the company needs. So we tried to stablish the types of networks the company is strong or weak at: marketing, KIT, reputational, co-optition (cooperation-competition), networks (Lechner & Dowling, 2003) and also financial networks, and the density and homogeneity of the network. Again, the importance of networks has been already stated in previous literature, but we tried to throw light on how was the process to understand what sort of networks were needed and how did they accomplish having access to those networks.

### **3.4.2. The interview process**

The preliminary quantitative study identified the thirteen ASO companies that fulfill the High-Growth selection criteria. As we mention before these companies are mainly in the biotechnological and pharmaceutical industry and the technology and information technology (IT) industry. Main Catalonian universities (Universitat of Barcelona and Universtitat Autònoma de Barcelona and Universitat Politècnica de Barcelona) account for the total of HGASO in Catalonia.

For the interviews to be performed the procedure was as follows. We contacted the TTO from each university and ask about the name of the founder/s of each of these HGASO. Then we made a first telephone contact to try to get an interview to the founder-manager. All the founders we could reasonably contact were interviewed. The reasons not to interview a company is because it has been extinguished or in a liquidation or failure process, or because the founders when contacted stated that the company, was not really an ASO because it had had neither University or academic intervention, nor a Technology Transfer process. In one case the academic-founder had deceased. In Table IV we present the companies we finally interviewed, their names (figurative), industry, university, year of foundation and the position of the person interviewed.

We focused on getting the interview with academic-founders but with a managerial position into the company, because for the objectives of our research the knowledge accumulated through managerial experience was essential to have real insights about the growth process. Thus, our priority was top-management, rather than academics that had not had a day-to-day responsibility in the company during the growth process.

Before the interview, we got information about the company through its web page and its balance-sheet track records in terms of turnover, employment, assets, activity, leverage, shareholders and other indicators of performance. The order of the interviews was according to the availability of the interviewees. The interviews were recorded and took between 45 to 120 minutes. The interviewee was asked about the anonymity of the company name and the confidentiality data and opinions delivered.

Foundation	Industry	University	Company Name	Interviewees
2001	BIO - PHARMA	uab	PetPharma	Founder-academic and founder-researcher - manager
2001	TECH-IT	uab	--	Academic - founder deceased
2002	TECH-IT	uab	VisioScan	Academic - founder
1999	BIO - PHARMA	ub	--	Founder stated the company is not an Spin-Off from university
2000	BIO - PHARMA	ub	FunGen	Researcher - founder, no academics
2001	TECH-IT	ub	--	Founder stated the company is not an Spin-Off from university
2001	BIO - PHARMA	ub	--	Without activity. In a failure process. Contact missed.
2003	TECH-IT	ub	WindModels	Founder-researcher-manager
2003	BIO - PHARMA	ub	PharmaSint	Founder-industry experienced manager
2002	BIO - PHARMA	upc	--	Without activity. Extinguished
2000	TECH-IT	upc	--	Without activity. Extinguished
2001	TECH-IT	upc	OpticMetro	Founder-academic-manager
1997	TECH-IT	upc	Softraffic	Founder-academic-manager

**Table IV:** High-Growth ASO companies interviewed. Compiled by author.

The main activity of the HGASOs interviewed was:

*PetPharma:* Dermatology products for the veterinarian industry and laboratories.

*VisioScan:* ID fraud prevention through scanning solutions.

*FuncGen:* identification of biomarkers for the development of new therapeutic tools.

*WindModels:* Highly precise meteo forecast through modelling systems.

*PharmaSint:* Fully integrated chemistry services for the fine chemical, pharmaceutical and biotech sectors.

*OpticMetro:* To develop, manufacture and commercialize high-end metrology tools.

*SofTraffic:* Traffic modelling software.

Text from the interviews was totally transcribed and qualitative content analysis (Altheide, 1987; Mayring, 2000) was performed. The analysis was carried out using EDET software, version.32-bit ('Editor for Ethnographers', available from <http://www.etnologia.uw.edu.pl/www/program-edet>) for computer-aided qualitative data analysis (Annex II).

Based on the literature review and the research question and the objective of the study, we developed a first set of themes and a first codification scheme (Annex III) which we modified, incorporating some new codes after performing the interviews, and some personal codes. Codes were reduced to a first set of factors which we named as "Growth Factors" (Annex IV) that represent factors that mainly according to scholars can have an influence on growth. In parallel, a new set of themes was developed, reflecting the idiosyncrasy of these High-Growth companies with the characterization of the main common features they presented. We called this set of codes "Catalonian HGASO characteristics". Then we revised, combined and reduced both "Growth Factors" and "Catalonian HGASO characteristics" focusing in the interpretation of the influence of these common characteristics on growth, leading to the categories named as "Growth Catalysts".

Thus, our set of codes is structured in three parts: "Growth Factors", "Catalonian HGASO characteristics" and "Growth Catalysts".

Our first set of codes were named "Growth Factors" (Annex IV) are classified according to the context each factor acts: individual, TMT, company and external factors.

Obviously external actors policies and behaviours such us University, government and other institutions influence growth. Industry conditions, such us industry growth, degree of competition, entry barriers and maturity also can impede or facilitate the amount of growth of the ASO. Taking into account these issues, our study focuses in the internal factors, processes and behaviours that have influence in growth.

Managers and companies continuously evaluate their resources, assets and the way they make business. In some point, some companies make the decision to incorporate persons to the TMT to increase their resources in form of knowledge, abilities and effort. This is the consequence of a strategic thinking process, a risk evaluation process

and the effect of some intrapersonal factors that influence it to happen and the way it does.

At the individual level, the factors that influence this decision taking is important because it leads to growth and the way these incorporations take place in the ASO case are also important because the success on the growth strategy will depend on a great way on the managers recruited for this purpose.

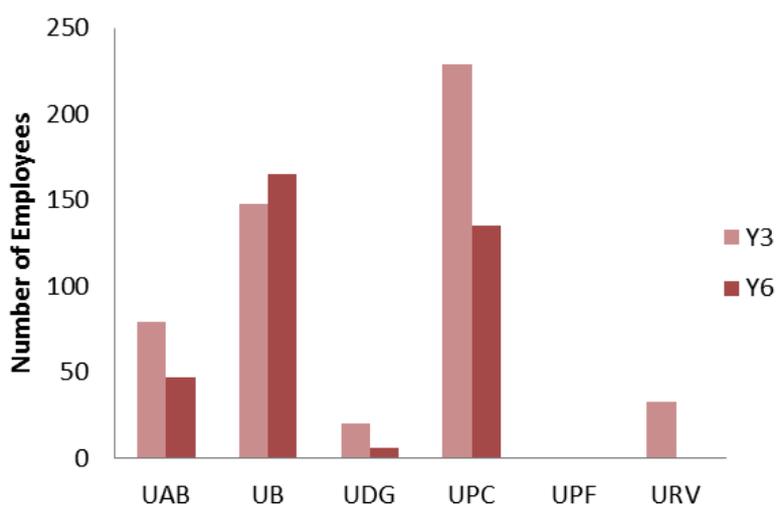
In the second set of codes called “Catalonian HGASO characteristics” we extracted common features that characterized these companies. These codes are not necessarily related for growth, but, as we were interviewing a subset of ASO companies that had presented High-Growth, their common characteristics provided interesting clues and insights on the causes, factors, attitudes, decisions and behaviours that are conducive for growth. With the results of the categorization of “Catalonian HGASO characteristics” we extract some more factors for the “factors” set that had a misrepresentation in literature but were present in the cases studied.

With these two sets of codes, “Growth Factors” and “Catalonian HGASO characteristics” we create a set of categories that identified these actions, decisions, factors, attitudes or behaviours that had accelerated the growth process, which we called “Growth Catalysts”.

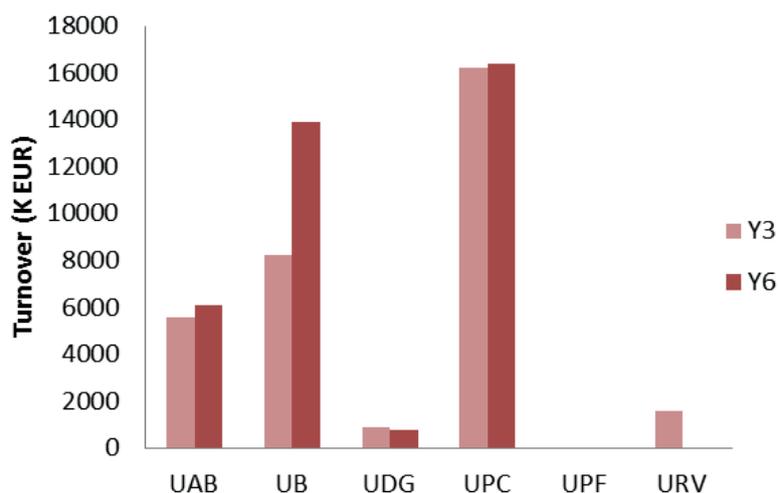
## 4 Results

### 4.1. Catalanian ASO Performance. The impact of different growth measures by University.

The different indicators of ASO activity in Catalonia allow us to compare the results of the different measures of performance. Aggregated measures of Turnover, Employees and Assets give an estimate of the wealth generated to society by ASO. Thus, from our study, ASO created between year 1999 to 2010 with more than 3 years of operations generated 24.1 million EUR turnover, employed 509 people and had total assets of 55.5 million EUR at Y3 (Fig 10,11, 14).



*Fig. 10. Aggregated ASO Turnover by university.*

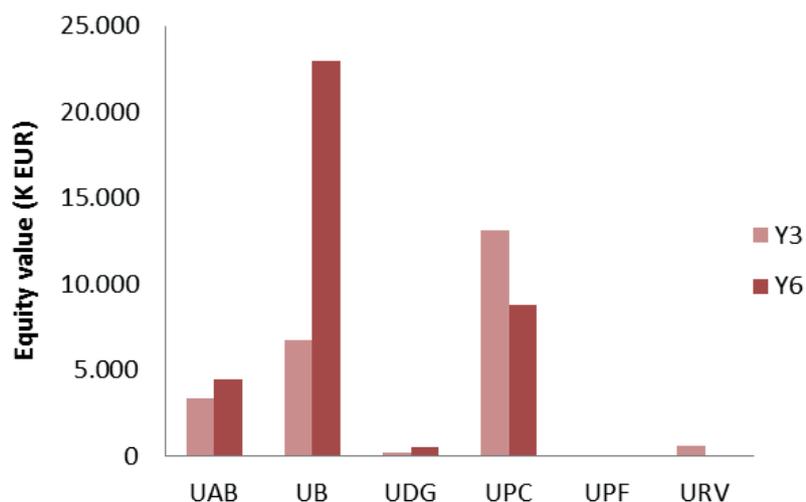


*Fig. 11. Number of ASO employees by university.*

If we focus only on companies which have data on Y6 and Y3 and calculate growth, these companies have grown from 15.1 to 34.7 million EUR in turnover, from 35.4 to 71.5 million EUR in assets and from 269 to 310 employees. However, key point is that aggregated profits although improved remain negative from -4.7 to -2.1 million EUR.

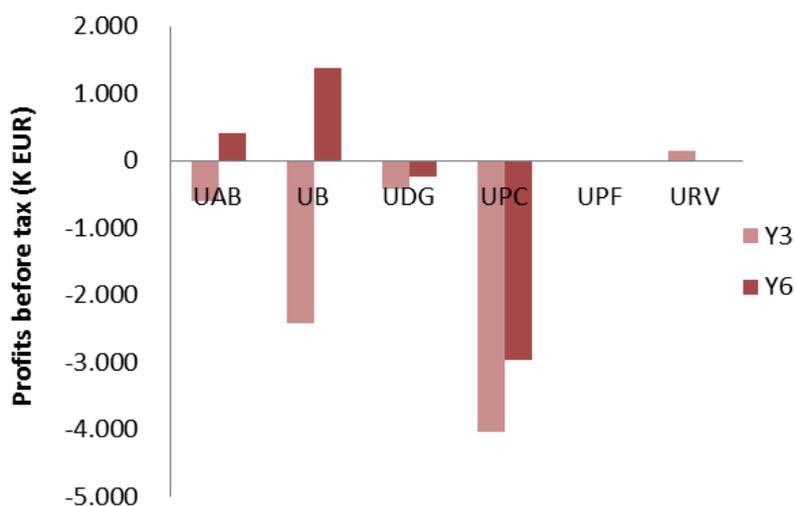
Turnover is the most common indicator for company performance. Sales increase is commonly used to size the company and is a measure of product/service success. The more is sold the more human and utilities are needed, that is more employment and more assets. In order to achieve a sustainable growth, this increase in sales should end in significant improvements at the bottom line, through a better asset management and productivity increase.

We can appreciate from Table II and Fig. 10-14, that this route not always stand: performance results at the university level show that ASO from UPC have more companies, with more turnover in Y3 and Y6, companies in Y6 presented more productivity than Y3, and roughly the same level of investment. This surprising employment drop could have an explanation on the necessity to cut costs to improve the profit and loss statement. This reduction in the number of employees can bring as a consequence losing valuable knowledge that could difficult future growth. However, profits are profoundly negative in Y3 and Y6. Accumulated negative results lead to a significant Equity Value loss.

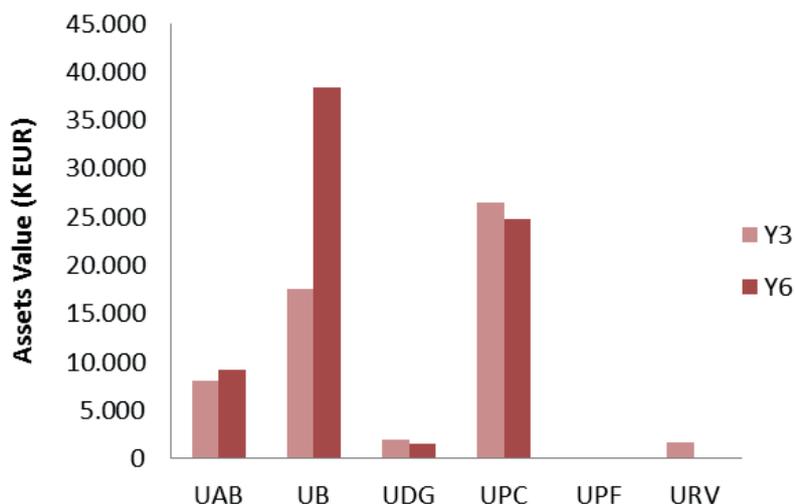


*Fig. 12. Aggregate ASO Equity Value by university.*

UB and UAB have better balanced figures (Fig. 10-14) and both of them presented aggregated positive results in Y6. The effect those results have in Equity value is impressive in the case of UB. Nine ASO companies from UB more than double Equity value of 17 ASO from UPC. Thus we can appreciate the key role profits play when it is time to assess ASO performance.



*Fig. 13. Aggregate ASO Profits before Tax by university.*



*Fig. 14. Aggregate ASO Assets Value by university.*

Taking average company measures Fig. 20 data show that UPC creates bigger companies in term of Assets at year 3 and have better initial performance in terms of sales on Y3 (Fig. 15) but that grow slower in the following years, not accomplishing sustainable returns neither at Y3, nor at Y6 (Fig. 19).

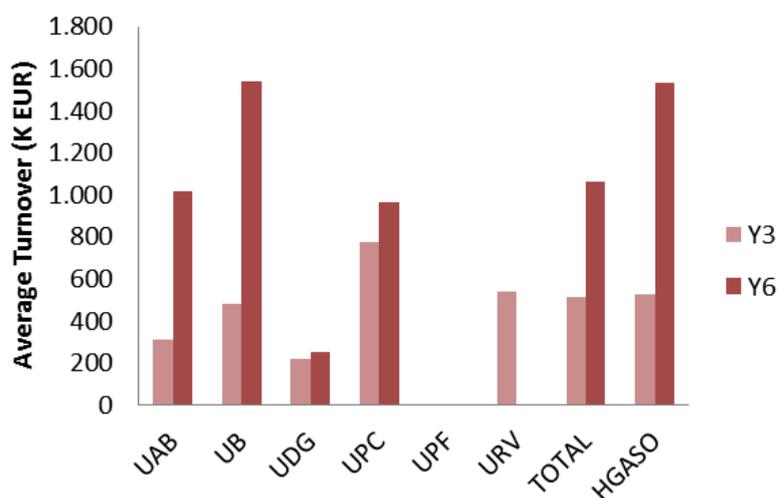
Equity values in Y3 (Fig. 17) are an indicator at this point of company life of the investor confidence and effort. We can see that is fairly variable in each university and around 0.4 million euro on average. At Y6 important losses or profits diminish or increase this value so differences between universities enlarge at Y6 where all universities had losses except for UAB and specially UB that made a turnaround in results.

These positive results allow UB and UAB to reduce leverage, whereas UPC remains at around a 70% of debt probably close to their debt limit (Fig. 21).

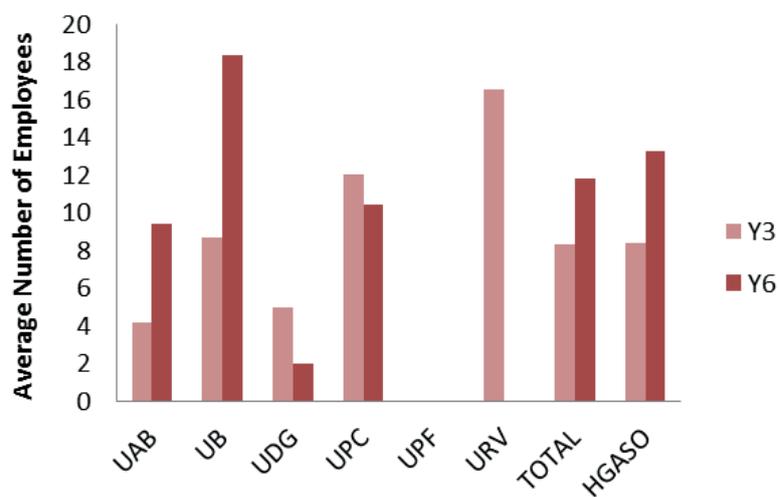
## **4.2. High-Growth ASO**

Only 35 companies have data at year 6, and thirteen of these companies match all three criteria for being considered HGASO. Six of them in the biotechnology industry three in the computing engineering industry and the rest are in other engineering areas.

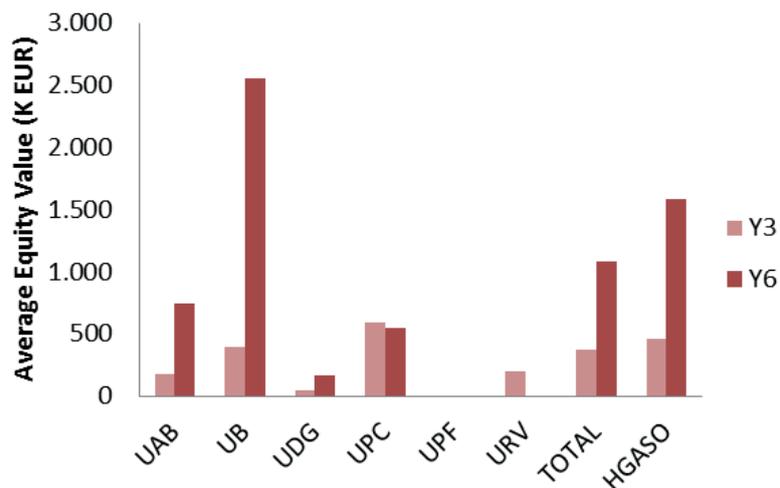
We compare average ASO measures with average HGASO data. Average turnover in ASO in Catalonia is around 0.5 million euro that multiplies by 2 on average at year 6 and by 3 on average for HGASO. On the other hand, employment on those companies roughly grew more than 50%.



*Fig. 15. Average ASO and HGASO Turnover by university.*



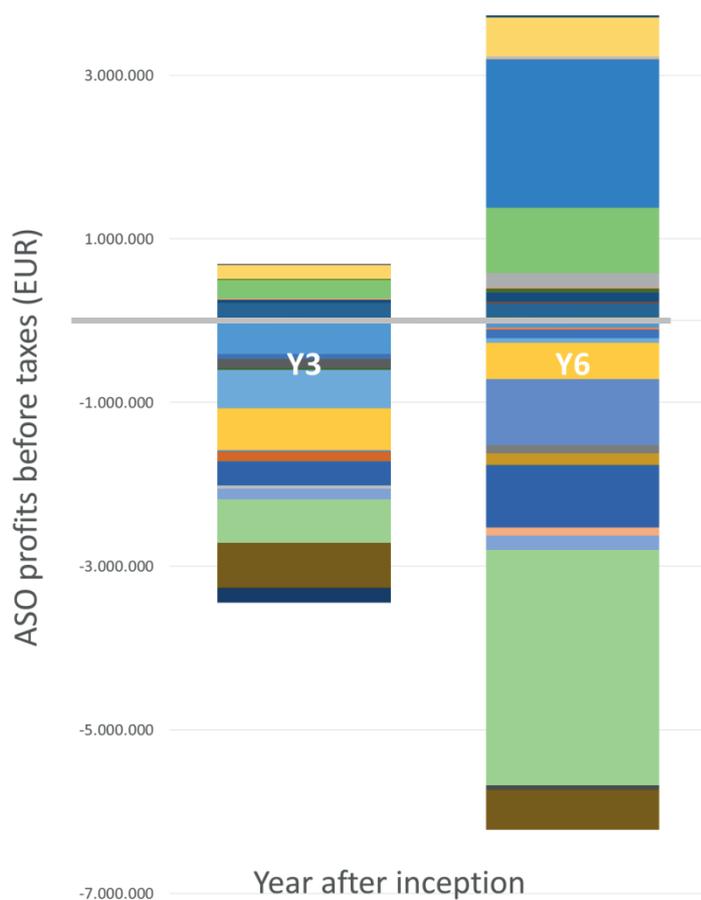
*Fig. 16. Average ASO and HGASO Employees by university.*



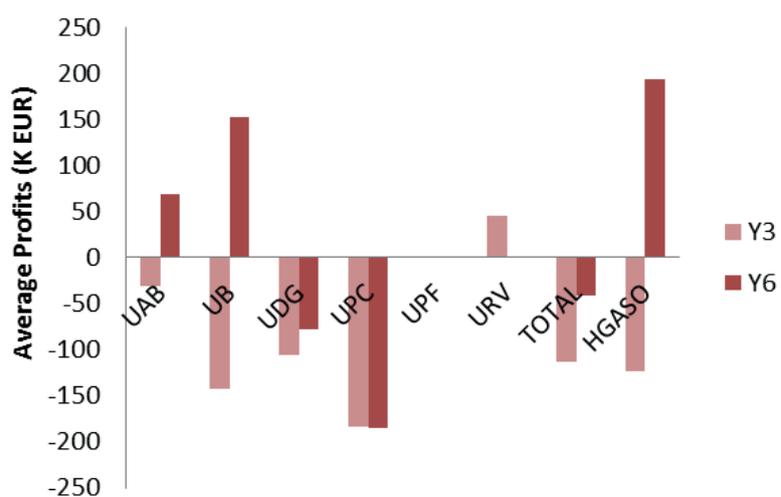
*Fig. 17. Average ASO and HGASO Equity Value by university.*

At an individual level there are a small number of companies that explain the major part of the profits/losses account. UAB has 6 ASO with an average profit of 69.122 EUR, 5 ASO near breakeven and one winning 421.232 EUR at Y6. UB have 9 ASO at Y6, 5 of them with moderate losses, 1 with moderate benefits and 3 with strong profits records (> 500 K EUR) for its size. On the other hand UPC has a larger amount of 17 ASO, 14 of them with moderate profits/losses and 3 with high losses that turn the university average to loss.

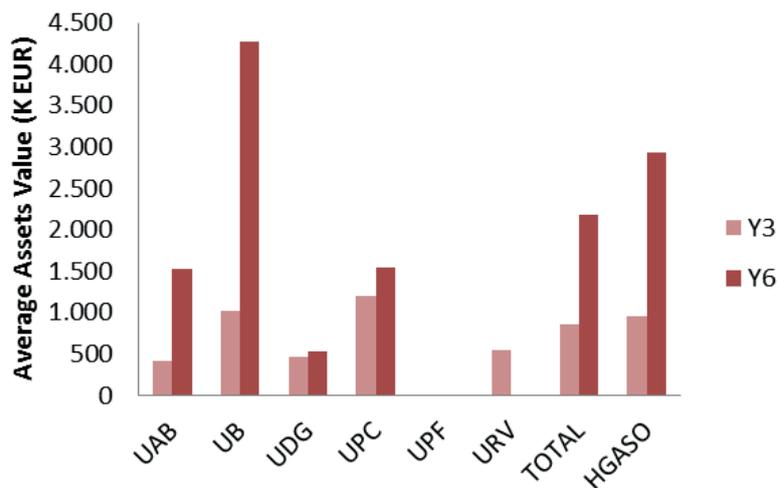
The positive evolution of HGASO through time can be stated in Fig 19, with an impressive improvement in results that allow companies to have access to further financial resources to invest, increase total assets and maintain or even reduce its leverage level. Total average profits are negative in Y3 (-113 KEUR) and in Y6 (-42 KEUR), with substantial differences between universities, whereas HGASO show average losses in Y3 (-124 KEUR) but an impressive turnaround to positive returns at Y6 (193 KEUR).



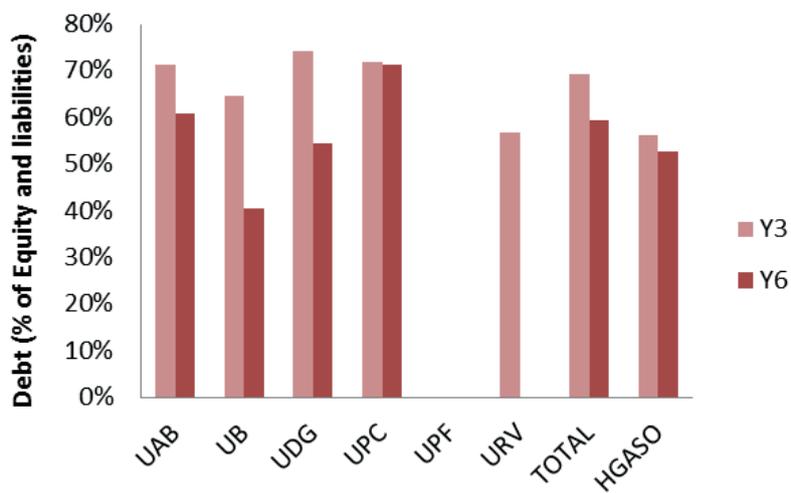
**Fig. 18.** Individual ASO Profits before Tax in Y3 and Y6.



**Fig. 19.** Average ASO and HGASO Profits before Tax by university.



*Fig. 20. Average ASO and HGASO Assets Value by university.*



*Fig. 21. Average ASO and HGASO percentage of debt on Total Equity and Liabilities by university.*

In this chapter we presented the results of the quantitative analysis of the Catalonian ASO and High-Growth ASO. Through study we have been able to extract the evolution in Y3 and Y6 of the different performance measures commonly used by scholars for each university and type of company to try to infer if these companies had been successful at the commercialization stage and they had effectively arrived to the threshold of sustainability (Vohora et al., 2004). As we have seen, maybe the most noticeable feature besides their superior performance is their turnaround to profits during these years.

The other output of the quantitative analysis was to identify these High-Growth companies as they are the purposive sample for the qualitative study. The results of the qualitative study are presented below and have two parts. First, we gave a set of common characteristics these HGASO present which are not necessarily related with growth. Second, we provide the list of the Growth Catalysts as the main result of the qualitative study.

### **4.3. Catalanian High-Growth ASO characteristics**

In this chapter we give a first set of qualitative results of the semi-structured interviews that have been performed to the founders of the companies which have been selected as High Growth Academic Spin-Off in Catalonia.

High-Growth ASO showed some common characteristics that led to a set of codes named as “Catalonian HGASO characteristics” that could be somehow related to their growth or success, and help to understand the ASO arena in Catalonia and how winners are formed and their key characteristics. As explained in the methodology these are codes that have appeared as a result of the interview and are not theoretically constructed.

These Catalanian HGASO characteristics are:

#### *Tacit knowledge, no patents*

Some authors have studied how the type of knowledge or technology transferred influences the venture’s growth. Tacit technologies are based on knowledge that cannot be reduced to patents, numbers or formulas.

#### *TMT composition*

*Core team has worked together previously.* The entrepreneur team is formed before taking the decision to set the company and have had working experience together.

*Initial team of researchers.* The team is formed by a team of young researchers who have the time, motivation and need to set the venture, and eventually by part-time academics.

*Academics not in the TMT* Academics do not have an executive position. They are board members with no day to day responsibilities. Academics, at most, give support in the technical area of the company.

*Experienced industry manager.* The firm has started its activities with an experienced manager who is responsible of the new ASO management. Sometimes this manager can also be a shareholder.

*Initial industry activities before creation, Initial research services provider*

The company has already taken part in research activities for the industry. Core entrepreneur team has leader research contracts with industry.

*Commitment, engagement with the project in the TMT*

There is a small group of entrepreneurs, normally a team of researchers who are fully engaged with the venture. This team works full-time and exclusively for the company, without academic or research activities outside the company.

*Scarce academic, research opportunities*

The scarce opportunities to continue an academic career have driven their decision to set or join the new venture

*Governmental financial support*

The company has received a valuable support by the government

*University support*

*Facilities or equipment.* Entrepreneur has valued the possibility of renting university equipment and facilities as an important help in their initial development.

*Credibility* Entrepreneur has valued the positive effect on the company performance of the image of technical competence the company has projected to their clients because of their links with the university.

### Conservative Financial Strategy

The interviewed entrepreneur/s showed a conservative financial strategy. They do not have in mind to search for Venture Capital or other kind of external investor, leveraging the company through bank loans or any other kind of financial operation, rather than own generated cash-flows.

In order to represent the degree of presence of each characteristic we represented them in a matrix (Table V).

Catalonian HGASO characteristics		Pharma	Func	Wind	Pet	Visio	Optic	Sof
		Sint	Gen	Model	Pharm	Scan	Metro	Traffic
Tacit knowledge, no patents		X	X	X	X	X		X
TMT composition	Core team worked together previously	X	X	X	X	X	X	X
	Initial team of researchers		X	X	X	X	X	X
	Academics not in the TMT	X	X	X	1/2	X	X	
	Experienced industry manager	X				X	X	X
Pre-founding industry activities (research services)		X	X	X	X	X	X	X
Commitment, engagement with the project in the TMT		X	X	X	X	1/2	X	X
Scarce academic, research opportunities			X		X			X
Governmental financial support		1/2	1/2	1/2	1/2	X		X
University support	Facilities or equipment.	X	1/2	X				
	Credibility.	X	1/2		X	X	1/2	X
	Others					X	X	X
Conservative Financial Strategy		X		X	X	X	X	X

**Table V:** Catalonian High-Growth ASO characteristics. Compiled by author.

## 4.4. Growth Catalysts

In section 3.4., we presented the codification used for the Qualitative Analysis and we developed the theoretical support to the codes used. From the theoretical codes of factors that influence growth in ASO and the characteristics of the Catalonian High-Growth ASO we have condensed results and generated six categories which we have named as Growth Catalysts that could explain the High-Growth of some ASO in Catalonia. The matrix below (Table VI) synthesized the presence of each of the growth catalysts on the HGASO interviewed:

Growth catalysts	Pharma	Func	Wind	Pet	Visio	Optic	Sof
	Sint	Gen	Models	Pharma	Scan	Metro	Traffic
<i>TMT formation and new incorporations</i>	X	X	X	X	X	X	X
Active search of			X		X	X	
Industry Partnerships			X	X	X	X	
<i>Market-ready, cutting-edge technical product improvement</i>	X		X		X	X	X
<i>Big financial support</i>		X			X		X
Aggressive strategic turnaround and implementation	<i>Business model reorientation</i>	X	X		X	X	X
	<i>New industry niche exploitation</i>			X	X		X
	<i>Acquisitions</i>						
	<i>Internationalisation</i>	X					
	<i>Growth strategy planning</i>	X	X		X	X	
<i>University support</i>							

**Table VI:** Growth catalysts. Fuente: Compiled by author.

In chemistry a Catalyst is “a substance that causes or accelerates a chemical reaction without itself being affected” and is accepted outside this field as “an agent that provokes or speeds significant change or action”. And we felt this is precisely the effect these identified codes produce in the growth process and in growth as an outcome. Although their acquisition most of the times did not had a specific growth purpose they produced a growth acceleration effect through the different stages of the growth process.

We have extracted the most representative thoughts and opinions of the founders of the High-Growth ASO that have led to consider each Growth Catalyst.

### **TMT formation and new incorporations.**

The Resource Based View theory has been widely used to explain the growth of new created companies in the entrepreneurship literature. Resources and Knowledge are essential to grow a company. The main task of the founder at the early beginning of the venture is to visualize what resources the company will need and more important, how the company will get these resources. This decision process and its execution is crucial because the speed these resources are incorporated will determine the speed the company develops and grow. We try to find the factors that influence the founder or the

board to make the decision to incorporate resources and the criteria to incorporate the appropriate type of resource to the ASO.

The company accounts with an initial small group of knowledge, motivation and abilities and keeps nurturing its competences through the incorporation of new members to the TMT and board who bring additional knowledge, motivation and abilities to expand the ASO.

### Initial industry activities before creation

Interestingly, this acquisition of knowledge, motivation and abilities is being initiated in all cases far before the company was started. In-depth interviews revealed that in all cases, founders have had a background of intense previous collaboration with the industry. A majority of companies had had research projects for companies working in the industry. These previous activities allowed the founders

1. To know and understand the stage of development of the technology used in the industry, its trends and the main needs companies and clients had. To detect new opportunities and market niches.

*“We detect the business opportunity when we discovered the technology I need for my research was not available in the market. From that moment I started a new line of research in optic surface metrology and I directed a total of four doctoral thesis that allowed us to keep developing the product”*  
(OpticMetro)

2. To create a small team of researchers and interact with them establishing a professional link. Intense collaboration let to know each member values, behaviour and competences.

*“We convince the major that they need the simulator and they engage in the project. This fact allowed me to create a team, to hire skilled people and to*

*give them some stability... having a team formed from the university, working together for 12 years was initially a great advantage because it built strong personal links, and similar values and behaviors” (SofTraffic)*

3. To start developing a prototype to show to potential clients and investors, and consequently to shorten product time to market.

*“The more intense the effort is in the initial stages, the more advanced the commercial prototype is and the more one can shorten the time product is launched to the market” (SofTraffic)*

4. To know the market and establish a relationship with the key players (networks): competition, channels of distribution, suppliers, client requirements and future needs.

*“When we were at the University we already received collaboration proposals with private companies, we already perceived the forecasting had several applications in the industry: safety, transport, air quality, mass media...” (WindModels)*

5. To get used to business behaviours, attitudes, priorities, goals and culture. With time, they improve their capabilities and self-confidence.

*“They (the academics) knew a lot about chemistry (it was a great help) but they had no knowledge about industrial big-scale production of chemicals, different from laboratories, with sustainable ecological products, with an efficient process, etc. Another weakness was teacher mentality, different from private companies, more interested in the scientific side, discovering inventions but not focused in accomplishing and objective, timing and secrecy. They were interested in making diffusion of the inventions more than patenting and exploiting it.” (PharmaSint)*

### TMT composition and incorporations

Due to its academic and research origins the initial TMT is unbalanced in its competences and showed a strong bias to technical knowledge and abilities. On the one hand, this bias allows the company to focus and reinforce product development, and the team to share similar values and behaviors, but on the other hand ASOs showed a lack of a commercial, management, financial and industrial knowledge and abilities.

*“This homogeneity, having a team formed from the university, working together for 12 years was initially a great advantage because it developed strong personal links, and similar values and behaviors... the only one who was externally exposed was me...the rest live in a bubble” (SofTraffic)*

However, this lack of knowledge and abilities have been surpassed either with the day to day experience of some team members, who are assigned to new functions or through new incorporations to the TMT. The vision to perceive the areas where to improve core competences has been widely signaled as decisive for growth.

*“He (the academic) wanted to create a Company but he has a clear vision to join someone coming from the private industry” (PharmaSint)*

This ability to perceive the areas where resources are needed has been studied in entrepreneur literature and can be accelerated if the entrepreneur has experience in entrepreneurship, in the industry, in management or if he has a set of capabilities related with management and networks. Due to its academic background ASO founders usually show a lack in this sort of experiences and abilities. So, the degree ASO founders have and develop these abilities is key to create a balanced TMT and turn out to be a core competence the founders must show in a High-Growth ASO.

Incorporations have to do not only with weaknesses or a lack of a determined knowledge or ability, but also with growth strategy. Thus, in many cases incorporations take place also in the technical area, because of the vision of the founders to compete

with a technologically outstanding product or service, and in other cases, in a functional area they strategically want to be strong at.

*“One of the important decisions that influenced growth was having a strong financial management: to hire a financial manager. It gives the company easy access to key people for VC future rounds, bank credit...” (FuncGen)*

Managerial, marketing, human resources and financial knowledge and abilities can be gained over time and, in a few cases, management functional areas were assigned to academic or researchers. However, none of these cases have cited the assignment of these functions to academic/researchers (or the area they had been assigned) as key or important for growth, whereas the cases (the most) where this resource provided through TMT incorporations, it has been widely mentioned as very important for growth. We can conclude that most of the cases have incorporated external managerial, commercial or financial knowledge to the TMT and these incorporations have been key for high growth.

Most of the HGASO have been formed from an initial group of researchers who have worked together for years. This group sometimes has been pushed to create the venture due to the lack of opportunities to continue researching in the university. Nevertheless, those years of research have been crucial to get technical knowledge. Research contracts with industry have allowed them to know industry needs and to detect business opportunities. Research groups have also been an important way to nurture the company with new qualified technical staff in later stages.

*“The University is wizened, with little chances to progress. We were disappointed with the opportunities as a researcher. The opportunity cost of not trying it was low” (FuncGen)*

*“There were two PhD students and me (academic) and when they finished as the University did not have any opportunity to offer we decided to create the Company” (PetPharma)*

*“In the University there is no option for researchers to have long-term contracts over 3 years. At the time of renewal you may have to fire the team....so*

*I find myself in an objective situation that if I could not have a permanent team, all the time I would had to start from zero and that way, research could not progress... this situation make me realize that maybe there was a way out through the creation of a company” (SofTraffic)*

A common point in TMT incorporations and functions is that in all cases there is a group of people with Full-Time dedication to the new venture. This engagement is an important characteristic of these HGASO that is valued by investors and other third parties, because it gives credibility to the firm as a project.

*“My skin was at stake” (PharmaSint)*

New incorporations had brought mainly experience (knowledge), abilities and time, but in the cases studied their personal network has not been important for growth. Networks that are important to grow the business are already developed by existing TMT or academics, but usually not brought by TMT new incorporations.

In some of these success stories, academics have not been in day to day responsibilities, besides the technical department which normally depends upon them. Although it has been marked in some cases the fact that the academic not being in the TMT as an important factor for the ASO growth there are some other cases that the academic effectively did have these day to day responsibilities. The common point however is that these responsibilities are related with the technical department or at least there are other members of the TMT with managerial, financial or marketing responsibilities. In many cases are the research students who occupy these positions at an adequate cost with satisfactory results. These research students are fully engaged with the company, are young, do not have an opportunity cost, need the employment and learn fast. Only in one case the academic take active day to day business and marketing functions because he got a leave from university to launch the new venture. In all cases, the academic with full-time employment in University can do no more than help in technical matters and being on board but cannot push the company ahead in the day to day basis, firstly because a lack of time to do it.

*“The founder wanted that a person from the industry runs the Company. Teachers keep aside the firm management. I have always thought that this*

*combination was key for the company success because our clients saw us as a team with scientific knowledge from University, but also as businessmen”.*  
(PharmaSint)

*“Founders were three university teachers who collaborate with the research center. From the beginning, our intention was to devote to the company the time it requires but from a part-time perspective without leaving our academic activities. Instead, the company should have its own management team... we were at front of the technical development, but another person runs the company. We progressively left our company duties”* (VisioScan)

*“To hire an experienced general manager was key in achieving growth. I was the CEO but the company management was entrusted to this person. Afterwards, we incorporated him as a shareholder. The other shareholder is the R+D manager”.* (OpticMetro)

### **Active search of Industry Partnerships (Technical/Commercialization)**

In a few cases, the founders had the ability to perceive the lack of knowledge and experience in some functional areas and decide to search for an industry partner to join as the company. Joining an industry partner, allows the founder to share the risk and can add not only knowledge and experience in diverse functional areas, but also important assets such as access to distribution channels or the possibility to join to partner’s strategic agreements.

The rest of the companies have tried to solve this issue through new TMT incorporations in management with an intense commercial dedication. Companies that have actively searched for a business partner to exploit commercialization opportunities have reported great benefits of this sort of partnerships.

*“We got in touch with a US Company that was doing the same as we were doing. We first signed a collaboration agreement and afterwards we created a joint-venture in 2009. In 2011 we sold them a 51% of our company and acquire*

*15% of their holding company. The company has subsidiaries in Brazil, Mexico, Ecuador... and our original company changed its goal and started developing applications in another market niches". (WindModels)*

*"Second decision that had a strongest influence on growth the most was to have an industrial partner with reliable distribution and commercial channels". (OpticMetro)*

Finally, one of the companies openly commented that the commercial deficit in its structure and operations had hampered their growth and recognized they could have growth at a higher rate with the adequate resources in this functional area, either through a partnership or a team incorporation. A program for entrepreneurs at a business school was important to realize of this deficit.

### **Market-ready, cutting-edge, technical product improvement**

Most of the HGASO based its business strategy on having a technologically superior product or service, and their founders think this competitive advantage has been the main factor that has allowed company growth.

*"I really do think that the Company resisted in bad times was because the product we sold was really technologically good, whereas our competitors sold a wide range of similar products, we were specialized in this product which I think was the world's best." (VisioScan)*

*"(a decision important for growth) To have awareness that inside the Company there was enough talent and knowledge to develop competitive products that were at the technological edge. We wanted to have a breaking-new product, which was some steps ahead of existing technologies with high value added, to compete on quality, not in price." (OpticMetro)*

In many cases, early company incorporations have been on the technical staff, although the company already had a strong technical department, giving priority to the

technical development compared to others business areas. This commonly shared vision, had in some cases generated controversy with business consultants that recommended to market a product that have not reached its excellence according to the founder.

*“We had two advantages, first, the quality of the product, the computer models were more advanced than our competitor’s. Second, we exhibited a fast response to client requirements. This generated trust. My reasoning was that since we did not had financial support, we had to be in technologically ahead. We invested our returns hiring a technician to further improve the product” (SofTraffic)*

Having a technologically outstanding product or service is probably in the adn of any ASO, and it is its natural way to compete since their differentiating asset ought to be the technical knowledge brought by the technology transferred and the people who know this technology. However, due to their background, academics might be tempted to try to excel in the technical arena more than would be needed or may initiate research projects that are away from its product or services commercial application. Generally, HGASO founders think that technical excellence has been determinant for growth. However, some founders criticize this view arguing that academics have a bias towards research and technical development that can sometimes hampers growth, since this product oriented strategy has as a consequence a greater allocation of resources in R+D and since resources are finite other areas may suffer a lack of resources.

*“Sometimes the right decision is to stop doing something more than deciding what to do. There are start-ups that focus too much in technology and little in what market really needs” (WindModels)*

Some of the founders interviewed think that being close to the market and listening to client needs have been also an important factor for growth, because it has allowed them to increase the value proposition for the client and also to introduce new applications for the product or service, discovering new market niches.

*“The key for success is to listen to the daily problems of our clients that make possible to detect opportunities... to stop developing the technology and to visit clients and study the market, to build a value added proposal and to standardize.*

*We left the scientific focus apart and studied how we started selling the technology we had.” (WindModels)*

In consequence, the fact that all the HGASO have had previous industry activities through research contracts is obviously an important factor which helped the company to develop the right product or service for the market because being in touch with a clients can validate the market interest of the product.

Having a prototype has been also signaled as an important milestone for growth. It allows the company to present it to potential clients through events, fairs... and consequently, to validate the buyers interest, to make is first business, to collect improvement ideas, and visualize next developments. Consequently, the degree of development of this prototype at the time of the venture creation is an important factor for company growth.

*“The big step ahead is to bring the technology to the market, make a tangible prototype you can sell” (WindModels)*

Time to market has also been cited as key for growth. Results from basic research need to pass a process that will lead to the first marketable prototype. This process could refer to different projects, adaptations and validations depending on the industry but can include the design of the industrial process to produce significant amounts of a chemical (PharmaSint), the user interface, the language options, or robustness of the software (SofTraffic, WindModels, VisioScan) or clinical tests or health authorization processes (FuncGen, PetPharma).

These processes can take years in most cases and it can cause the project to slow or even to fail. Thus, a proper and realistic perception of the resources and time needed for this process is an ability a founder of an ASO must have. Time to market evaluation seemed to be especially important for the companies that had redesigned their strategy from a services company to a product company, which is a common growth catalyst to High Growth in our study.

*“The other very important issue for growth took place in 2008, when we made an important leap in product quality. We tried to produce larger series, to*

*industrialize the company and to adopt manufacturing techniques (kan-ban) and management methodologies” (OpticMetro)*

*“There is a basic research stage and another stage to develop a prototype. Our software had an important research base. Besides, between the prototype and its commercial use there is a gap. The critical question in many cases is how you do fill this gap. This gap will always exist because University cannot take into account commercial uses and requirements. It is different that you are the user of the software and you can easily fix the problems that arise because you know it than if this software is to be used by a third party. You have to make a software robust enough to sell it. This is one of the requirements to sell the software, but University is not responsible for this development. A critical problem is how to fill it (financially)...The more intense the effort is at the earlier stages the more developed the commercial prototype is and the shorter the time to market is” (SofTraffic)*

It is also interesting to pay attention to the type of technology transferred. Two of the companies interviewed mentioned that the wider the technology, the bigger the growth potential because of the undiscovered market niches.

*“The enormous advantage of our technology is that it is cross sectional and the product has applications in the optic, dermatology, semiconductors, paper, medical devices and forensics industries and this is a great advantage that we did not imagine when we first write our first business plan.” (OpticMetro)*

Regarding the type of technology, it is also interesting to notice that a majority of HGASO are created based on tacit knowledge, brought by the founders (especially academics) of the venture. Only two companies based the technology transferred on patents.

## **Big financial support**

Access to financial resources is a commonly cited barrier for growth in ASO and entrepreneur literature. Managers should have the ability to allocate resources to maximize performance but the amount of money the company is able to raise in form of investment, debt or subsidies will determine the amount of resources the company can dedicate to the project and consequently the speed of development of the company.

*“There is no doubt that our model will be very difficult to replicate because now there are not subsidies like before. We gathered and starting support of 500.000 Euros that allowed us to hire people and start selling.” (VisioScan)*

HGASO development projects are long run, and managers valued to have recurrent financing opportunities as an important factor for growth, that allows them to keep a research team during the product development period.

*“At that time there were temporary UE three year programs that we managed to concatenate, so that we had a sustained financial support that allowed us to have a 5-6 full time researchers team.” (SofTraffic)*

In many HGASO the amount gathered from investors is significant, and they have recognized this resources allowance as key for growth.

For the specific ASO case the financing opportunities come from non-professional investors (university environment, government, industry partners...). In fact, a majority of founders consider professional investor conditions as abusive and unacceptable for their case, so many of them have considered but rejected this sort of financing opportunities

*“I need a capital that allows me to make a step ahead in growth that I am not able to finance with the resources I generate. If you (potential investor) ask me for a 10% annual return I cannot accept it” (SofTraffic)*

There is one unique exception, FuncGen, which recruited a financial manager to raise capital with excellent results as a part of their growth strategy. Its founder

emphasized these Venture Capital investments as key for growth, not only for the financing itself but also for their methods, organization and management supervision.

In fact, most of the HGASO were proud to exhibit a conservative financial strategy, based on the initial equity investment and the resources generated from operations. The reason for this approach could be, as stated before, the poor conditions of the offer, but also indicates that the founder's expected return on investment of these additional funds is also poor, or at least, it reveals a lack of vision or experience to evaluate, not only the cost of the investment, but their returns. Other entrepreneurs retrospectively admitted that this excessive caution had in fact limited their growth.

*"I am satisfied with the growth achieved. Basically it is matter of risk. You want to growth but you want this growth to be sustainable. We wanted to grow without debt with our own resources (this is something I would change). I think that probably we were too conservative and because of that we have loose some opportunities as for example, international expansion, increase the team..."*  
(WindModels)

It indicates a low risk threshold of the founders, as well. They are not willing to take financial risks and leverage the company. It could also be interpreted as an indicator of the scarce motivation for growth Academic Spin-Offs entrepreneurs have.

*"We have been studying the possibility of incorporating investors, but we neither reached to close any agreement nor were proactive in this matter. We preferred to go slower"* (VisioScan)

In some cases, the incorporation of an industry partner has been preferred to Venture Capital, due to the knowledge, experience and assets (distribution channels) this partner provided.

*"I absolutely think that an industrial partner is better. A Venture Capitalist only takes risk but the partner puts in experience, knowledge, relationship with clients..."* (OpticMetro)

Finally, although they are reluctant to look for extra financing tools, all the companies are predisposed not to take Cash-Flow out of the company in form of dividends. Benefits are retained in the company to sustain future growth. So, managers

are generally uncomfortable with other financing alternatives different from self-financing, and especially with professional-type investors, but they showed an interest to bring in funds into the company by retaining earnings. So it is not a matter of “how much money I need”, it is about “this is the money I have”.

### **Aggressive strategic turnaround and implementation**

One of the more commonly mentioned growth catalyst is the change in the way ASO make business. This strategic reorientation may be due to a discovery of a new market niche or as a consequence of a strategic thinking process or simply as a market demand. In many cases this reorientation implies a widening of the value chain, integrating a part that until then was performed by a supplier or a vendor. This new activity can be intensive in labor force or imply heavy investment in assets and a strong increase in sales.

### **Business model reorientation**

One of the most common turnaround in the business model is the transition from a services company to a product company. Companies based on research changed their business model and started to make research for themselves and to commercialize their own products. Software companies integrate hardware and sold the whole package or started selling not only the software but services related to that software. Engineering companies produce the whole measurement product instead of providing technical advice. It is interesting to notice that these companies decide this change some years after creation.

*“Our philosophy is to go beyond a services company and to start doing our own research instead of doing it for a client” (PharmaSint)*

*“I am very proud of the decisions I made as a manager, based on Porter’s competitive analysis. In 2008, the Company earned some money through a*

*combination of research services and our own research. I reached to the conclusion that current situation was unsustainable because the environment was adulterated by public grants that were not going to last forever. We had no competitive barriers and industry demanded commoditization, low prices, more productivity, huge investments... we were fighting with pharma spin-out companies, with more resources. So what we can do? I decide to create our own patents which are the starting point to have a protected asset. We turn out to be a product company.” (FuncGen)*

*“We thought about changing to a product company to facilitate growth because that way we do not need more labor force and so it is a good path for us. As a service company we had ups and downs and being a product company was a good decision. We made for the first time some strategic thinking in an IESE program called “Growth Academy”. The idea to change to a product company came out at that program.” (PetPharma)*

*“In my opinion the first decision that had more impact on growth was to produce the scanner instead of simply to sell the software. We started with a prototype but there is a long way to produce: the process, suppliers, logistics, investment...” (VisioScan)*

*“The other very important issue for growth took place in 2008, when we made an important leap in product quality. We tried to produce larger series, to industrialize the company and to adopt manufacturing techniques (kan-ban, just-in-time, lean manufacturing) and management methodologies” (OpticMetro)*

*“They define the Company as a software company and my definition was that it was a project company, because we could do complementary developments that clients demanded and we were the best positioned to assume them. Now our growth and more profitable line are precisely these projects in US and Australia. This way we avoided crisis.” (SofTraffic)*

### New industry niche exploitation

Two of the companies with a higher growth were able to find and develop new applications for their research and address their efforts to new market niches that have allowed them to accelerate growth.

*“In 2006 we detect a new use for our software to produce wind maps for renewables energies. We got in touch with an American company that was doing nearly the same, but in the US. We sign a collaboration agreement and afterwards a joint-venture...”* (WindModels)

*“The enormous advantage of our technology is that it is cross sectional and the product has applications in the optic, dermatology, semiconductors, paper, medical devices and forensics industries and this is a great advantage that we did not imagine when we first write our first business plan.” ...“We make an strategic plan four years ago and decided to go to new market niches”* (OpticMetro)

### Acquisitions

Although acquisition has been mentioned by some authors as a route to accelerate growth, no High-Growth ASO have presented this pattern of growth, probably because the need of financial resources to do it.

### Internationalization

As a consequence of the type of company ASOs are the natural market to their product or services have an international scope. The model of a company starting its operations and having their suppliers and clients in one country is not common for the ASO case. Companies that are so intensive in technology and scientific knowledge in so specific market niches usually give a supranational scope to their operations. So we may say that some HGASO are inevitably driven to international sales because of the

specificity of their market. In most cases, the company was international from its very beginning.

*“Our market is the world” (OpticMetro)*

*“The company could start its operations because the market was international. Our first projects were abroad”(SofTraffic)*

*“The company had a collaboration agreement with a swiss company even before its creation so that with started with a base of turnover.” (PetPharma)*

Although four out of five ASO companies mention internationalization as an objective they do not mention the decision to internationalize as important for growth at these stages.

In two cases, the company decided to internationalize some years after their operations, with different results: (PharmaSint) they recruit an experienced manager to internationalize with good results. In other (VisioScan), the intended internationalization was through a company own subsidiaries and did not produced the expected returns.

The rest of the companies got good results from internationalization through partnerships, alliances and joint-ventures with local or multinational partners. Thus, we could consider the international scope as a growth catalyst for this type of companies, because most of these successful companies did present this feature although we consider that the real catalyst is the search of this international partnerships or alliances. More research would be needed in this growth catalyst.

Again going global requires a heavy investment that maybe these companies cannot afford.

*Growth strategy planning*

Some entrepreneurs showed they had a plan to achieve the desired growth. Having a plan to execute and making active steps towards its consecution accelerates the company dynamics and consequently can lead to growth.

*“We hired Peter because we had a growth plan and we set him some objectives”* (PharmaSint)

*“We write a strategic plan because we wanted to give a step further, and this step was to exploit new industries and new countries”* (VisioScan)

*“After some years of operations, there was a point that I decided that the company should work with the base of strategic planning. In the second one, is when we realize we had to prepare for growth. This was the sentence: ‘To prepare for growth’.”... “We make an strategic plan four years ago and decided to go to new market niches”* (OpticMetro)

However, it looks like it is not until some years of operations that this strategic planning appeared. In their first stages it seems that company efforts are addressed in survival and resources were not incorporated to the company in order to produce growth, but as a consequence this growth had been achieved and required more resources.

### **University and institutional policies and aid**

University role in Academic Spin-Offs performance is especially interesting because University policy and aid is a specificity of these kind of companies. Neither the University nor the government help seemed to have an important role in the growth of the ASO. None of the companies have mention University aid as a relevant factor in their performance. Instead, a majority have mention University policies and rules as too rigid and non-appropriate.

*“Initially the University was going to take stocks in the company, but at the end they did not because they did not know how to do it. They could not invest money*

*in a private company. Now they are investing. The unique aid we got from University was that they explain us which subsidies we could get, but it was really very little help.” (PetPharma)*

Some of them did even see a step back in the last decade regarding flexibility:

*“Now the great flexibility I had in 1997 is not anymore, they pose many problems, they are very rigid, they look at you as their enemy. They look at you as if you were going to steal the money. In the last project they demanded very tough conditions.” (SofTraffic)*

Some negative factors also come from the dogmatic vision and lack of business knowledge and experience of the University:

*“Regarding technology, University is of very little help, there is not structure, there is someone that knows some product or technology but lately it has degenerate a lot.” (OpticMetro)*

*“The University conception was that of the “professor Frank syndrome” in the sense that they think a teacher makes an invention which it is transformed into a patent and this patent is somehow exploited. This is the traditional vision that is in their mentality. If you come out with a proposal that does not perfectly fit, no one knows what to do. This is what happened in my case.” (SofTraffic)*

*“As an example, we were going to register the software and since the University is the IP owner we had a lot of trouble to transfer the rights to the company. When we got an agreement we detect that the commercial name of the software was not even registered in the IP office because a misunderstanding. They lack the basic knowledge about Technology Transfer... with the help of the Dean, the University provided us with a business expert... and his vision was the opposite to ours, and it was of no help.” (SofTraffic)*

Another issue regarding University is the culture and values regarding Academic Entrepreneurship. Some companies have mentioned the detrimental effect of the University culture regarding ASO companies might had had in their creation and development.

*“At that moment, investing in a Company from University was not well perceived by everyone in the University, because of its public function”*  
(PetPharma)

However, founders mention its aid as useful under some circumstances, so it is worth deepen in the kind of aid that has been provided and the perceived influence in growth of that help.

University support can be very different in kind. Founders valued specially the possibility to use high cost technology equipment and, in one case, the possibility to access to a leave that allows the academic to dedicate more time to the Spin-Off development. These two kinds of support are the most valued by founders: the use of equipment is more related with the possibility of providing core services to the industry and influences especially the existence of the venture.

*“Scientific Park of Barcelona has allowed us to create a company with low investment because we had a very high cost equipment that even a lot of private companies cannot afford. So we can share this equipment. Rental is high but no investment is required. We never could had afford these investments of some millions of Euros.”* (PharmaSint)

*“University should be capable of creating a web of companies. They do not have money but they have equipment and a little branding but it has not been used to launch these companies. Decision making, profits share... a change of the rules of the game is needed.* (FuncGen)

The second one, in the unique case studied, definitely influenced growth. The academic, who has technical knowledge about the product or service, assumes the responsibility of the first client contacts and leaders the initial commercial development of the company.

Although, it may not have an appropriate knowledge or experience in the functional area, at this stage, the development of the product is not completely finished and this technical knowledge can be an important asset in sales. Besides, it allows the founder to have first-hand information about the market perspective and client requirements and needs.

*“During some years the Dean give me a leave and I could devote this time to launch the company so that it survived the critical first three years.”*  
(SofTraffic)

In the rest of the companies the research students or new incorporations are the ones who commonly assume this responsibility.

In some cases University acted as an investor and hold a percentage in company's stock. In any case this participation is seen as financial, because the investment shareholders pay out to create the company are small. The percentage comes determined by university policies and is small (3% to 10%). The university acts as a passive shareholder and do not have a disinvestment strategy. Founders are neutral to this investment, they find that it does not have a beneficial nor detrimental effect on growth.

Another factor that some authors have mentioned is credibility. In has not been mention in any case as important for growth and seems that this credibility is more linked to the academic himself than to the university as a brand. This credibility of the academic is provided by the network the academic has as a consequence of his academic production, the research contracts with the industry he has promoted and his work as a teacher.

Regarding government and other public institutions, again, some particular cases valued different kind of aids. However, none of the founders have an enthusiastic vision of this help as decisive for either company creation or growth. One company mention the usefulness of a CIDEM program called “microempreses” that allowed companies to act as companies (invoicing clients, have personnel, assets, share administrative and operational expenses...) without being legally constituted, as a simple and fast-path to start. Another company mentioned the use or “Centre de Supercomputació” as useful to make their initial designs and research.

However, most mentioned aid is financial. Some companies receive small amounts as a subsidy, some others receive soft credits, but none of them found any interesting big-scale equity operation with any of the governmental tools offered. They thought conditions were very rigid and too demanding.



## 5. Discussion

### 5.1. ASO performance in Catalonia

We have provided a quantitative characterization of the Catalonian ASO through their balance-sheet indicators of performance, with a focus in the evolution of these indicators after the earlier stages. Figures 10-14 show the aggregated turnover, employees, equity, profits and assets value of the Catalonian ASO. The purpose of the study is not to compare the weight of these figures with Catalonian GDP, total employment and other macro statistics, but to observe the evolution of these indicators over time.

After 3 years of performance, ASO's face critical junctures, and depending on the industry and the company's resources and capabilities, companies should already have overcome the threshold of credibility and entered in the sustainability stage, generating enough returns to convince stakeholders of its long-term viability. If we compare Y6 with Y3 (Figures 15-17, 20), we can observe substantial average turnover and employee increases which are the measures commonly used to measure performance and company growth. Equity value also increases reflecting that although profits remain negative, in general terms, investors keep investment in those companies. Assets value also increase almost in the same proportion as Equity.

However, our results indicate that performance of ASO in Catalonia in terms of profits is poor in Y3 and in Y6, with average losses on both exercises (Fig. 19). And profits are precisely what validate sustainability in the long run (Vohora, 2004), because they provide cash-flow to pay debt or to increase investment, they give stability and good perspectives to employee salaries and because they validate the company in front of the investors accomplishing their ROE objective and increasing company value. From the investor point of view, the attractiveness of a business with heavy losses during at least six years is very difficult to justify. Business plans with six years losses are very unusual.

This situation is obviously detrimental for the company, but also for the university and the TTO, since there is no “success story” to show to future entrepreneurs, and workers and managers will probably have high short term pressure for results. Risk of failure will make financing conditions get tougher, and the company less attractive for new investors and to recruit new talent.

So we can conclude that ASO companies in Catalonia in most cases take at least three years to achieve sustainable returns and a majority of the firms do not achieve them at year 6. The question here is if those companies will ever achieve this milestone or it is simply a matter of time. As we already stated, losses during a six year period is a difficult situation to downturn.

Differences between universities are significant. In line with previous studies in Spain, bigger Universities (UB, UAB, UPC), with more resources in TT infrastructure and R+D expenditure account for more ASO created (Rodeiro 2008) and for more HGASO. The average ASO company in Catalonia showed poor performance in terms of growth sales and employment, with average loses at Y6. This poor performance and growth orientation, especially in the long term is in line with previous studies in Europe (Chrisman, Hynes & Fraser, 1995; Ensley and Hmieleski, 2005; Zhang, 2009; Harrison and Leitch, 2010).

Good news are that there is a small group of companies that exhibit superior performance (Fig.7-9, 11). HGASO are companies that not only exhibited a compound average growth of 43% on sales during 3 years, but also showed employment growth in 16%, increasing productivity and that had made a turnaround from losses to significant profits of 13% on sales in Y6.

This selected group exhibits a sound evolution in their main indicators, and it has arrived on average at the desired stage of sustainable returns. When we study the individual companies some of them show spectacular figures (Fig.10). The impact of only one high-growth company can represent a turnaround on the university-TTO performance results. So these results cannot be taken into account to judge the task of the TTO, but definitely they should cause a consideration about the productivity of TTO's, their objectives and where to focus their efforts.

## 5.2. University and Venture Capital investment in ASO

University Entrepreneurship can give positive returns to universities through ASO ownership. In our study, University presence in the company as a shareholder is minimal. Either the TTO failed to identify the potential of the company or the University has a non-ownership policy. Both are detrimental for the University. As we have noticed in the study, a HGASO can multiply in three years its book equity value. Besides due to profit generation, their future expected cash-flow can produce market values of the equity much higher than book's equity value. So it represents a missed opportunity to invest for TTO and University, and also to help finance entrepreneurship structures and to justify their task from an economic point of view.

When considering not only the effect for University but also the aggregated impact in society in terms of turnover, employees or profits, it seems that quality is better than quantity, so we advocate to focus on high potential ASO because are the ones that will have high impact on long term performance, by increasing selectivity and consequently offering more support to selected companies. Thus, there is a certain base to subscribe some affirmations of those who are critical with the way University Entrepreneurship is deployed, with TTO's structures with low selectivity and support (Roberts and Malone, 1996; Degroff and Roberts, 2004).

When University enters in the company's equity, usually it takes around 10% ownership. The percentage normally obeys to a University policy rather than an objective valuation of the knowledge and assets transferred to the ASO or any financial estimation of the expected returns. It looks like little attention has been paid to the maximization of this possible income.

We also tried to establish a connection of VC ownership with ASO growth in our study. There is a consensus that VC help to overcome financial barriers, provides credibility, bring new knowledge to the company and provide scouting and coaching functions and access to networks (Fried et al., 1998; Davila, Foster & Gupta, 2003; Colombo & Grilli, 2009). Although some authors found they tend to outperform compared to those without VC (Heirman and Clarysse, 2005), there is not a complete consensus on it. In our study, the percentage of companies with VC is very similar for

HGASO and ASO, so their presence as a shareholder does not seem to be a good predictor of HG for the Catalanian ASO.

### **5.3. Measures of performance and success**

Another methodological discussion is how we measure or evaluate the results of the University Entrepreneurship, as the number of ASO created is the most common and widely employed measure of success (Link and Scott, 2005; Rodeiro, Fernández, Otero & Rodríguez 2012; Lockett et al., 2003; Lockett and Wright, 2005; O’Shea et al., 2005; Powers and McDougall, 2005; Di Gregorio and Shane, 2003). As we had the opportunity to confirm, due to the huge differences between companies’ figures, the amount of ASO created does not have any relationship with total wealth created, number of jobs or investment. Besides, it also can have a perverse result on the TTO propensity to policies with low selectivity and low support type if the objective is just to maximize the amount and not the quality of the companies created. Nevertheless, there are studies that defend the number of ASO created as an appropriate measure of performance of Academic Entrepreneurship (Corsi & Prencipe, 2015). In our opinion this study lacks of an appropriate time frame discussion and definition.

Other studies based the evaluation of University Entrepreneurship on performance, mainly turnover (eg. Wennberg, Wiklund & Wright, 2011; Geenhuizen and Soetano, 2009, Smilor et al. 1988, Shane, 2004; Lindholm, 1997b, 1997a; Vincett, 2010; Degroof and Roberts, 2004), but also employment or assets or a combination of measures. However, our study reveals that for ASO companies, a heavy investment or hiring does not always lead to enough turnover to generate profits, so that future growth and sustainability can be seriously compromised. According to data, it is wise to think that neither employment nor turnover at Y3, are good predictors of future performance of ASO. Looking at the individual results it appears clear that it is not until profits appear that one may think that the company has a chance to grow in the long term. Our point is that is not at least until profits appear that we have a measure of real success of ASO. Until then, tracking the amount of ASO, employment or assets can be a measure of the amount of job done, but not of results in terms of increasing wealth for community or

monetization potential for Universities. Thus, University and TTOs should pose their eyes in profits. Profits guarantee sustainability, the generation of more resources for growth and are the last step in company development. Growth in assets, employment or turnover does not necessarily guarantee sustainability, but it is true that these variables can be used to anticipate profits because they happen before in the business process or product cycle. Thus, chronologically one may think that after investment and employment, turnover arrives and after a period of time, profits. As Black (2003) indicates, profits may not provide a complete picture for valuation of start-ups, but they become incrementally informative as firms move into a growth stage.

In conclusion, two dimensions are important to assess at the time of choosing a performance measurement (Figs. 22, 23). First, the stage of development the companies measured are in. Whereas returns are the unbeatable measure that explains that the company has reached to the sustainability stage and that has serious opportunities for future growth, if the companies have not arrived to this stage, other measures have to be adopted. In a similar reasoning, turnover would be a good measure to take from the credibility stage and assets, employment or the number of companies can be a good measure for the very earlier stages. However, in our opinion Academic Entrepreneurship is a long term process with long term effects, and consequently we advocate for avoiding fruitless measures as the number of companies accounted and to focus on aggregated profits or company value in Y3 as the best measure for Academic Entrepreneurship. Although with delay it would give a realistic measure of the degree of success of University policies and structures on Entrepreneurship.

Earlier Stages	Credibility	Sustainability
<i>Assets</i>	<i>Turnover</i>	<i>Returns</i>
<i>Employment</i>	<i>Employment</i>	<i>Equity value</i>
<i>Number of firms</i>		<i>Turnover</i>

↑

ASO inception

**Fig. 22.** Growth measurement at each stage. Compiled by author.

Second, the meaning of success for the party involved (Fig. 23). As Leitch et al. (2010) pointed out, success has different meanings for practitioners and academics. We would extend this argument to University, TTOs, employees, managers, government... Each of them can pursue different measures because their objectives are different.

	Earlier Stages	Credibility	Sustainability
University policies			
Academics			
Managers			
Owners			
Government			

↑  
ASO inception

*Fig. 23. Dimensions of Growth measurement. Compiled by author.*

#### 5.4. The Growth Process

Based in the Entrepreneurship literature we will try to identify the key points in the growth process of a new venture or a SME. Following the recommendation of scholars (Druilhe & Garnsey, 2004), we address the growth phenomenon in a holistic way and as a process, trying to disaggregate the different stages of it. Merging the existent literature with the different growth processes we have observed in the interviews we have designed a model for the process of growth (Fig 24) that explains where and how the growth catalysts act.

In the Entrepreneurship literature review we have provided extensive arguments of the importance of the cognitive level in the growth process. Growth depends firstly on the decisions entrepreneurs make (Gilbert, McDougall & Audrestch, 2006). We deliberately placed cognitive factors first because growth decision ignites the growth process and we think it has a strong causal effect. As Gilbert et al. (2006) states: “Entrepreneurs must choose growth, and growth will occur if...” So, the decision to actively pursue growth, operationalized as Growth Intention, is a condition to

effectively achieve growth (Chandler & Hanks, 1994; Cliff, 1998; Gilbert, McDougall & Audretsch, 2006; Delmar and Wiklund, 2008), and it is situated at the very beginning of the growth process. The Entrepreneurship literature suggests that growth intention depends on perceived desirability and perceived feasibility (Koryak et al. 2015). Perceived desirability depends on individual attitudes towards incomes, risk, decision-making autonomy, work effort and work enjoyment (Gartner & Shaver, 2012; McGee, et al., 2009). Perceived feasibility depends on Self-Efficacy that plays a central role on motivation (Baum and Bird, 2010) and is a strong predictor of growth orientation (Douglas, 2013).

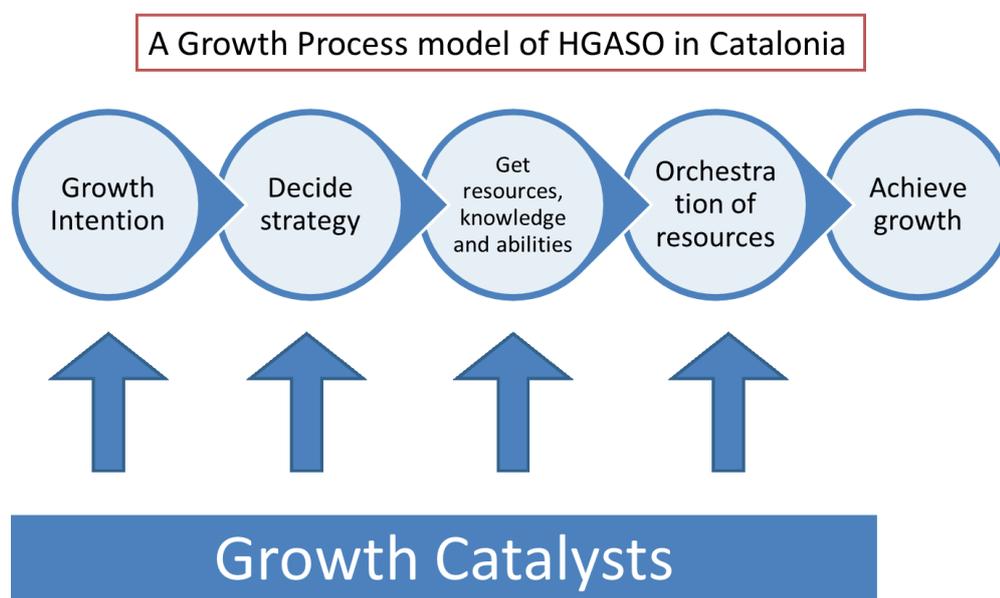
The second stage is growth strategy. Growth intention has an influence in the formulation of organizational and competitive strategies and in goal setting. Goal setting theory (Locke and Latham, 2002) is generally accepted as conducive for growth in SMEs (Baum et al., 2001; Baum and Locke, 2004). As we extract from literature review there is not a right or wrong strategy but the strategy-growth relationship depends on the fit of this strategy to the company resources (Chandler and Hanks, 1994), its competitive position (Robinson & McDougall, 2001), and the industry momentum (Sandberg and Hofer, 1987).

With time, company acquires knowledge, resources and capabilities. The ability to get resources (financial and human) and incorporate knowledge and capabilities to the company is key for growth (Bamford, et al. 2000; Cooper et al., 1994; Lee, et al., 2001, Birley, 1987; Cooper et al., 1994). In parallel, with time, company improves their organic resources (including financial resources, through cash-flow generation), and TMT capabilities and knowledge through the learning effect of past experiences (Rae & Carswell, 2001; Unger et al. 2011), learning by doing, trial and error, improvisation and experimentation (Zollo & Winter, 2002). Thus, the third stage is the acquisition of resources, knowledge and abilities.

Once the set of resources, knowledge and abilities are incorporated to the company the fourth stage refers to how these are deployed, combined, and further developed to achieve growth. Some authors named this resource deployment as orchestration of resources (Sirmon et al. 2011, Wright, Clarysse & Mosey, 2012). An adequate and effective resource orchestration is key for growth. General management practices rely

on this stage and a proper execution of these practices support growth on SMEs (Barringer et al., 2005). To routinize growth-oriented processes (Bingham et al., 2007), to balance exploration and exploitation activities (March's, 1991), to increase absorptive capacity (Cohen & Levinthal, 1990), to maximize learning effects (Rae & Carswell, 2001) are reported as good practices in this stage.

Finally, as a result of the process, the company is in condition to achieve growth. Growth catalysts are milestones (objectives) that have an outstanding effect on the different stages of the growth process.



**Fig. 24.** A Growth Process model of HGASO in Catalonia. Compiled by author.

The growth process is dynamic. Each stage of the growth process can have an effect on the others and modify them (Fig. 25). For example, growth outcomes reinforce future growth processes. A successful growth process will obviously have a positive effect at a cognitive level, will have a credibility impact on internal and external stockholders and will provide the company with more intellectual and financial resource stocks (O'Cass & Sok, 2013). Or, for example, learning effects can increase capabilities that makes possible to implement the intended strategy or to access to different strategic options for growth (McPherson & Holt, 2007).

Each stage in the growth process requires a different set of capabilities, for example Growth Intention requires leadership capabilities of the founder to transmit this growth intention and involve in the process firstly the TMT and secondly the rest of the company through the implementation of the strategy (Gupta et al. 2004). It also requires exploration capabilities and external networking capabilities that ignite this motivation through “success stories” whereas for example, the orchestration of resources requires mainly management capabilities.

Social Capital and networks when actively managed contribute to the quality and speed of the process. Each type of network can help in different steps of the growth process, but literature specially recognise its influence in resource acquisition and in expertise by receiving advice, counselling, guidance, emotional, social and innovation help and endorsement (Aldrich and Zimmer, 1986; Birley, 1985; Greve, 1995).

This vision of the growth process reinforces the main idea expressed in the literature revision and chiefly expressed by scholars of viewing the growth of the company as a result of a set of assets in form of tangible resources (Resource Based View) and (intangible) intellectual or knowledge capital (Knowledge Based View). Tangible resources are mainly financial resources whereas knowledge assets refer to intellectual property, human and social capital and organizational knowledge. This accumulation of resources and knowledge evolves and improves through internal building and the external acquisition of these assets. Garnsey (1998:p. 523) exposed this evolutionary view of resources: "Firms must access, mobilize and deploy resources before they can generate resources for growth". This evolution in their resources and knowledge stock, modify their perceptions of the company potential for growth, allow the company to adapt strategies, to incorporate more resources and to achieve growth by an adequate management of these resources.

ASO literature did not signalled any factor conducive to think ASO founders as they had a greater growth motivation over an ordinary new venture. On the contrary, from the attitudes expressed in the interviews, one may think that due to the opportunity cost and background of the academic, they have a cognitive scheme favourable not to assume risks and their goals are more related with work enjoyment rather than financial success. As a result, we found an expected low desirability towards growth. Moreover,

their lack of business and management knowledge may dumper their Self-Efficacy and as a consequence their perceived feasibility. From the interviews one can extract that they see growth as a need for survival and as long as they achieve survival, growth loses interest.

Despite the initially low Growth Intention of the academic entrepreneur, in the cases studied, ASO can develop a strategic thinking process that stimulate them to evaluate their competitive position and their resources and decide to search for growth catalysts. Some authors suggest that the availability of resources can significantly modify the strategic options of the company (Chandler and Hanks, 1994; Chen et al., 2009) and influence the type of company (product or services) the ASO is (Pries & Guild, 2007). Thus, the ASO entrepreneur can consider existing resources and capabilities are not enough for success, but using networks, they can either incorporate new resources and capabilities to the company or adopt a feasible strategy with the resources available.

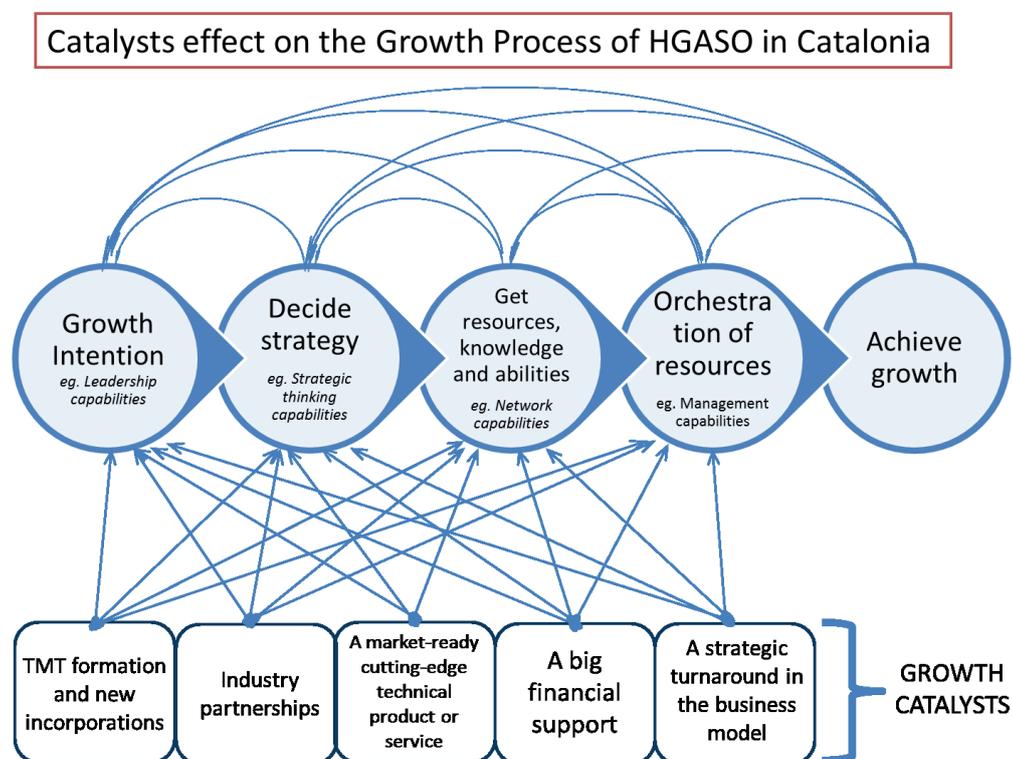
The fourth stage in the growth process is the orchestration of resources, referred as the way the ASO entrepreneur organizes, coordinates, assists and makes these resources work together in an efficient manner. For the ASO case, the importance of this stage was suggested initially by Lockett et al. (2005): acquiring organizational knowledge has a determinant role on growth, since ASO usually lacks of this kind of knowledge.

Sometimes the growth catalyst is actively searched by the entrepreneur, because they had a clear idea of their competitive strategy. For example, first incorporation of one of the ASO interviewed was a Financial Manager with the clear intention of searching for Venture Capital, or they recruit more researchers and technicians searching for the technological excellence. Nevertheless, sometimes they simply opportunistically reached to a growth catalyst. For example, although the majority of the TMT incorporations did not have a growth objective, in the interview they have been signalled as key for growth. Three of the seven companies decided to accomplish a business strategy reorientation after different business programs at business schools. So there is not a unique route to obtain growth catalysts.

Numerous capabilities mentioned in ASO Growth literature as important for growth play an important role in gaining growth catalysts, such as network capabilities (Walter

et al., 2006) and absorptive capacities (Cohen and Levinthal, 1990). Other capabilities such as leadership capabilities seem to play an important role in shove the company to the next step in the growth process.

Besides the effect of each stage in the previous ones, each Growth Catalyst obtained has an effect on all the stages of the growth process (Fig. 25). For example, an industry partnership when achieved might force the company to rethink its product or market strategy, decide a new allocation of resources and the success can positively reinforce its Growth Intention.



*Fig. 25. Catalysts effect on the Growth Process of HGASO in Catalonia. Compiled by author.*

## 5.5. The Growth Catalysts

We have extracted from the interviews a set of growth catalysts that have a positive effect in the growth process of ASO:

### **TMT formation and new incorporations.**

As we have seen in the literature revision, academic entrepreneur tend to preserve and prioritize their academic role, they have an opportunity cost and do not have growth ambitions (Chiesa & Piccaluga 2000; Jain et al., 2009; Hayter, 2011). In our interviews we have observed that the primary objective of the ASO was survival, not growth and that the academic founder does not have an ambitious growth planning or strategy. The companies studied had grown, we would say, despite of the lack of the growth intention of their academic founders. Fortunately for the ASO interviewed this lack of growth ambition has been at least partially provided by researchers and TMT incorporations. Thus, we can assert that TMT members and new incorporations play a key role in the growth intention and consequently in the growth of the firm. The point in our study is that the existent TMT, usually formed by researchers or the TMT incorporations can be growth catalysts because they contribute with their growth ambition to start a growth process. This appreciation is consistent with Bjornali & Gulbrandsen (2010) study of the formation and evolution of the board, in which the key board members are associated with the progress of the ASO from one stage to another.

Network Capability act as facilitator of the process of incorporating human resources. They also can act at the internal level of the entrepreneur or the researchers if they get to know similar cases or success stories to increase their self-efficacy.

The second point is that TMT members and new incorporations can be growth catalysts because they incorporate knowledge, abilities and time to their area, improving company capabilities (management, commercial, negotiation, network or technical).

### Initial industry activities before creation

One of the most common characteristics in the companies interviewed is the involvement in industry activities, mainly in form of contract research before the ASO was created. Several authors (eg. Krabel & Mueller, 2009) found that contract research and other prior activities with industry had a significant (and positive) relationship with ASO creation, suggesting that these contracts act as an “incubation device” for the spin-off company.

The fact that nearly all the companies did had this sort of contracts and that many of them spent many years in the pre-foundation stage seem to suggest that this activities effectively can also have an impact on ASO performance and growth.

Academics that actively collaborate with industry recognize more business opportunities and have the market knowledge and acumen to evaluate them. Literature has related the influence of industry activity in ASO creation with opportunity recognition, market knowledge and networks (Nerkar & Shane, 2003; Vohora, Wright, & Lockett, 2004). Although important, our study add some additional dimensions: the researchers team formation, who are the core of the company TMT, the growth acceleration as a consequence of a previous prototype development that allows to reduce the time to market and the knowledge of the business culture, behaviours and goals. At a cognitive level, previous industry activities improve perceived capabilities and self-confidence.

We think that the team of researchers is a key element in the academic decision of creating a venture and its growth. As we have seen in literature, academic does neither have the time, the need, nor the growth intention and he has high opportunity costs and role conflicts. However the situation is completely different for researchers that leave their research activity in the university to establish an ASO with the academic. Although they may have a lack in management and business knowledge and skills, they have the commitment, the need and the time to make the venture grow. So the existence of this team of researchers plays an important role for growth in the cases studied, through their growth intention. This question has been neglected from previous literature studies, which focus on the knowledge and abilities added by experienced

manager's incorporations and surrogate entrepreneurs (Franklin, 2001; Hayter, 2013). It is obvious that initially researchers will not provide management knowledge or ability but they can contribute to the firm growth with their intense desire to grow the company or growth ambition, and they can develop managerial abilities and experience with time.

We also did observe some HGASO had taken advantage of previous research contracts to gain knowledge and skills to develop a prototype, or at least significantly advanced in its development before the company foundation. This time reduction allows the business process to accelerate and the firm to have early income and market feedback which turned out to be determinant for company development. These activities help to reduce a usual problem detected by Harrison and Leitch (2010), regarding spinning-off the company too early in the development process. Knockaert et al. (2011) gave evidence that when tacit knowledge is involved as in most of our cases, it is most effectively transferred when a substantial part of the researcher's team join the new venture. Literature has pointed out research funding has also have been an important way some companies have used to not only create their team but also to at least partially, develop a prototype. This would partially explain previous literature positive relationship between this research funding and Spin-off creation and success (Dietz, 2000; Dietz & Bozeman, 2005).

Previous contacts with industry through contract research had also other beneficial effects. ASO commonly have a limited Network Capability and Social Capital related to industry because of its background (Zahra et al., 2007). Contact with industry help to conceptualize and visioning the applications of the inventions and to develop the right prototypes according to industry needs, so it constitutes a critical input to acquire the capability to convert inventions into products. So, social capital with industry reveals as a must have capability for an ASO and previous collaborations and research contracts with industry as the natural way to acquire this knowledge.

Finally, relations with the industry can have a beneficial effect on the future management team of the company by providing them with business attitudes towards goal-setting, goal-orientation, planning, delivering time, negotiating, pricing, value-added, efficiency, saving policies, project management, etc. The systematic awareness of this attitudes and skills would eventually increase its abilities but also increase their

self-efficacy for the creation and growth of a new venture. This periodic contact also increases cultural proximity and familiarity which is essential for network interaction and effectiveness Adler and Kwon (2002). Additionally, contact with industry may increase relational and social skills of the academic entrepreneur. This Network Capability has a direct influence on ASO growth (Walter et al., 2006).

### TMT composition and incorporations

It is not surprising that many of the successful companies interviewed recruited an experienced manager for the TMT and pointed out this decision as important for growth. As we can see in Barringer's et al. (2005) literature revision article, there is considerable evidence that general management processes are supportive for growth in SMEs. The lack of management capabilities of the academic entrepreneur has been a recurrent issue in literature review (Chiesa & Piccaluga, 2000; Lockett et al., 2005). Thus, the incorporation of a surrogate entrepreneur or a surrogate manager or an industrial partner, is seen according to the resource theories as a resource provider that plays value-added roles in ASO development (eg, Franklin, 2001). The resources need changes at each stage of development and the ASO adapts its TMT to that need through human resources incorporations. Outside incorporations in the TMT revealed to be key to overcome Vohora's critical junctures (Bjornali & Gulbrandsen, 2010).

TMT incorporations also contribute to improve team dynamics. Team heterogeneity has been an important factor to explain growth in the Entrepreneur literature (Gilbert et al. 2006). As Ensley and Hmielesky (2005) stated the homogeneity of ASO teams is much higher than an independent new venture. They suggest that this homogeneity may affect venture's performance because of the immature TMT dynamics. Based on the institutional isomorphism theory, they argue that the source for ASO incorporations is primarily the university environment, giving as a result endogenous TMT without the essential contribution or a manager with experience in management or the industry. Moreover, University may not have the ideal network for this sort of incorporations. We stated that ASO interviewed early broke with this tendency and recruit experienced managers, with apparently no relationship with University, fact that supports the idea of the convenience of incorporating an experienced manager as a way of increase the team heterogeneity and improve team dynamics.

TMT composition is dynamic and the heterogeneity of the team may change over time. However, according to Vanaelist et al. (2006), although newcomers had different experience from the original team members, they show a comparable strategic orientation leading to a more cognitive homogeneity in the team. Cognitive homogeneity may explain the ASO lack of conflicts in the majority of the ASO interviewed. Although conflict may be beneficial to certain extent because it can lead to a strategic reorientation it also may cause rupture with some TMT members which usually damages the company in terms of reputation, motivation and performance.

Another consideration in the TMT is its size. All the ventures studied had a board and a TMT with around 4-6 members. The size of the team and its influence on growth did had some debate on entrepreneurship literature Gilbert et al. (2006), but has been somehow overpassed in ASO arena. However we think it is an important matter because of the special characteristics of ASO team, the poor dedication the academics may have because of their dedication to their university activities. Thus, the amount of human resource the new company is able to incorporate can be an important dimension for ASO development.

### **Active search of Industry Partnerships (Technical/Commercialization)**

When two companies establish a partnership is because the collaboration is in the interest of both parties. One partner expects the other to provide a set of money, assets, knowledge, capabilities or a combination of them. The resources transferred determine the type of partnership (financial, technical, commercialization).

Besides financial partnerships, which are addressed in another chapter, we can find Technical Partnerships in ASO. An industry player addresses the company looking for help to develop an industry solution to a problem. This type of partnership allowed the company to have a stable cash-flow, to develop a prototype, to further develop the product or to know new applications of their research. Sometimes the industrial partner went beyond in his involvement and took stocks in the ASO to jointly exploit the

commercialization of the product. This is a case of combined partnership that provided the board with financial resources and managerial experience and market knowledge. Joint-venturing with an industry partner were present in two of the seven HGASO. With a joint venture ASO can solve its financial shortness and the lack of management expertise (Wright et al., 2004).

Another type of partnership is related with commercialization, either to exploit a market niche, to have access to the distribution channels or to internationalize the company, an industry partner related with commercial activities is maybe the most complementary partner for an ASO. Besides market knowledge, partner can provide also with industry networks, access to distribution channels, new market niches, management knowledge, support in administrative activities, coaching and important business synergies with the ASO. According to Van Geenhuizen and Soetano (2009), marketing barriers of ASO are higher and take longer to reduce compared to financial and management. A commercial partner is shown to be an effective way to reduce commercial barriers.

In a different study, Soetano and Van Geenhuizen (2009) found a positive relationship with growth in partners with social background heterogeneity. Consequently, partnerships related with commercialization could give access to interesting networks to access to new business opportunities, new markets in other countries or new product niches.

So we conclude, according to our results, that industry partnerships, and especially those addressed to commercialize, are growth catalysts because it can provide the company with important resources, knowledge and capabilities that are important for growth, such as organizational and management knowledge, market knowledge, access to industry networks, access to distribution channels, support infrastructures in functional areas such as IT, administrative, human resources. Alliances may allow a combination of resources from both partners that can liberate hidden or unexploited strengths or competitive advantages.

This organizational and management knowledge was essential to succeed in the commercialization stage according with Lockett et al. (2005). Looking for an industry

partner can be an excellent way to acquire these capabilities and additionally to incorporate different assets related with commercialization that lead to important synergies that propel growth.

An especially important subset of commercial partnerships is the search of a partner to internationalize. The unique case of a partnership for the international expansion of the firm gave excellent results so that we can no more than reinforce the appropriateness of this growth catalyst. Internationalization and the factors that influence on it, have been studied as a desirable growth avenue (Bjørnåli and Aspelund, 2012; Pettersen & Tobiassen, 2012).

It is important to notice that with one exception the HGASO founders that actively expressed their intention to search and incorporate partners closed in fact deals with more than one partner. Consistent with Grandi & Grimaldi (2003) study about the positive effect of the intention to setup relations in company success, this active and open attitude to look for and promote partnerships can be an important precedent for this catalyst.

Curiously, one may expect that technical networks of academics and researchers offered them the possibility of stablishing technical alliances with other Universities or Public Research Institutions to jointly research or develop prototypes. Through these partnerships, the team could afford bigger projects, higher goals and bigger access to networks. However, in the cases studied there is not any case of technical partnerships with public institutions or Universities. We do not know for the reasons for this significant lack of this kind of agreements in HGASO. Maybe the academics are traditionally reluctant to this sort of partnerships or this kind of technical partnership is not a growth catalyst, which is consistent with Bathelt et al. (2010) findings that considered the role of University, even in sponsored Spin-Offs as marginal.

Interestingly, the benefits of business partnerships in company's growth have a complete misrepresentation in ASO literature according to its importance. Just a few authors have mentioned them as a valuable dimension to take into account when studying growth (Wright et al., 2004; Chen et al., 2009; Baum et al. 2000; Koryak et al., 2015).

However, in practice, ASO may encounter some difficulties to reach to an agreement with a potential partner because of their little management experience and knowledge and negotiation skills (Dickson et al. 2006). This is a good example on how growth catalysts can nurture each other creating synergistic effects: managers incorporation can bring to the company these skills that can help to get another growth catalyst: industrial partnerships.

### **Market-ready, cutting-edge technical product improvement**

Successful innovation and new product development is associated with the growth of the firm in the entrepreneurship literature (Freel & Robson, 2004). In the ASO literature, Geenhuizeng & Soetano (2009) stated that more innovative companies arrived earlier to the credibility and sustainability stages. It has been very difficult for our study and its methodology to operationalize the variable “degree of innovation” and also very difficult to judge it qualitatively. However, we can say that because of the company and TMT characteristics and strengths, that High-Growth ASO founder’s competitive strategy is generally based on developing a cutting-edge technical product or service.

This strategic intention to be the technological leaders of the industry is obviously related with the degree of innovation of the ASO. Obviously the degree the objective of being the technological leader is accomplished the degree of innovation will have had an influence on ASO’s growth. So, we could not say at this point that pursuing a strategy based on innovation will lead to growth because this strategy have to produce the adequate results. But we can conclude that if these results arrive, the growth potential is high. So, we would conclude that having cutting-edge technical product/service is a growth catalyst.

Dangers of pursuing this growth catalyst are a bad financial and timing planning, an insufficient resource allocation and development in the rest of the functional areas that can hamper growth once the product objectives are completed. And, of course, the possibility of failure in the objective of accomplishing a technologically excellent

product or having a product not adapted to the market needs. So, not only the product developed revealed to be at the front-edge of technical development, but also it is essential that this product is market-ready and effectively solves a market need. That is, the end product has to have a market with clients interested in buying it. Without this characteristic the ASO can be immersed in a normally long and uncertain process to adapt the product to the market, having to assume an extra costs and time. This adaptation can require for example to adapt functionality and characteristics, usability and design to different costumers and markets needs and cultures or to pass legal authorizations, tests and normalizations.

Again we have to emphasize the importance of other growth catalysts to get another one, since TMT incorporations and previous researcher team industry activities can develop the market orientation needed to produce an adequate product from the market point of view.

Related with the type of technology transfer there are contradictory studies about the convenience of spinning-out a wider technology of a narrow focused one (eg.: Siegel et al., 1993, vs. Baum et al., 2001; Heirman & Clarysse, 2005). One of the problems ASO face is product development and market-readiness (Müller, 2010; Lockett et al., 2015), also expressed by some of the founders interviewed. We may think that the wider the technology is (the nearer to basic research) the more effort in product development the company has to do. However, it has the benefits that derive from having a wider range of applications and markets and the option to address to the ones that are more interesting or beneficial (Baum et al. 2001; Clarysse et al. 2011). Due to the lack of financial resources of the ASO and the time already needed to have a marketable product, we would recommend tackling this objective at the University or PRI level rather than at a company level. However we had in our sample two of the more successful companies whose products had a range of applications in different industries, which have taken advantage of their situation allowing them to grow further away of what as initially expected. To benefit from this situation the TMT should have developed exploration capabilities and networks to identify and actively pursue new business opportunities in other industries. Nevertheless, both cases based its growth in the application the ASO was created for. In both cases further applications justified the

creation of new independent companies, once the company had accomplished its long term growth objectives.

So, although having a wide technology is an interesting characteristic to look up at the time of creating the company and it can constitute an interesting contingency plan for the long run or even it can complement growth in the long run, we think is not a growth catalyst to pursue by itself. Besides, entering a new industry requires resources (additional product developments, market studies, more personnel), it is time consuming and can distract TMT from the exploitation activities. So we recommend dealing with this strategic option at the board level. In line with this view, some authors have revealed the importance of a focused strategy on growth (Siegel et al., 1993).

Another dimension in the type of technology transferred is the possibility to transfer a codified or a tacit knowledge from University. Whereas a codified technology is protected by patents that provide a tangible support to transfer, tacit knowledge refers to the broad technological knowledge the academic has and that makes possible to develop commercial products. In line with recent studies (Karnani 2012), we were surprised of the relative weight of tacit technologies. Only 2 out of 7 HGASO were based on patents. This situation is an interesting path for research regarding University policies and support in Catalonia regarding ASO.

### **Big financial support**

Probably most studied kind of partnership is financial, in a variety of forms such as Venture Capital, Business Angels or the known as FFF (Friends, Fools and Family). Whereas the last one, just provide money (usually in a small amount) and the investment is based on trust, more professionalized formulas such as Venture Capital must care their investment and have some tools for supervision and control, and in some cases provide with important beneficial side-effects such as the coaching function to entrepreneurs, giving business advice, evaluating the commercial strategy and the recruitment of key company personnel (Pinch and Sunley, 2009), networking, facilitating access to resources, monitoring, aligning shareholders and managers interests, and strategic activities (Goodstein et al., 1994), giving advice and support,

helping with the team culture, creating strategic alliances, or exercising corporate governance (Abell & Nisar, 2007).

Access to financing has been repeatedly recognised as an important resource for company growth (Chiesa & Piccaluga, 2000; Geenhuizen & Soetano, 2009; Hayter 2013). Growing a company requires investment, human resources and, especially for Research and Technological companies, time for product development and compliance. As we have previously seen, when looked from entrepreneur lens, resources needed are a barrier to surpass.

Financial support sometimes conditions the existence of the company but also conditions the assets the company has access to. Thus, it influences the intensity of the investments, the amount and quality of the human resources and it even conditions growth strategy (Chandler and Hanks, 1994). Thus, some strategies, like acquisitions need a big amount of resources from the early beginning and consequently it could not be developed by a great number of companies.

A big financial support reduces uncertainty and allow the managers to focus on business development. When it is long term it allows the managers to adapt it to the life product timing. Besides, it allows a coordinated allocation of resources, accelerating growth.

Finally, a big financial support (mainly venture capital) has a signalling effect on third parties and also on stakeholders: shareholders, clients, suppliers, employees and the entrepreneur because it means that someone gives credibility to it. The bigger the investment is, usually the more professional the investor is and the more credibility provides (Davila et al., 2003).

In our interviews we have observed the long distance between VC investing approach and academic investing approach. Knockaert et al. (2010b) stated there is such a similarity bias that makes extremely difficult an agreement and increases the selection cost by VC and ASO. The cases studied confirm this statement. Although many attempts were made, only the ASO that recruit an experienced financial manager arrived an agreement with VCs.

Like Geenhuizen & Soetano (2009) study, we could state that ASO financial strategy mainly consists in self-financing combined with some subsidies they had access to. We confirmed this feature for Spanish ASO in the study of Ortín, Salas, Trujillo et al. that reveals that the vast majority (79%) of the ASO counted only with funds from their founders and eventually with some bank loan guaranteed by the same founders. However, due to their positive results, in our study financial barriers do not seem to be a factor to worry about in year six for our HGASO. But it probably has been an issue for those companies without positive results at Y6.

This situation drove us to a difficult decision for private or public investors in a situation of financial scarcity. Is it more interesting to invest or subsidize a company with positive returns and a successful track that wishes to increase its growth or to dedicate these resources to companies that need these resources to survive?

Despite some bootstrapping literature places financial scarcity as an advantage (Bhide 1992), as for the considerable investments technological and biopharma industries have to face, we are more aligned with the beneficial effects financial resources produce, especially in the case of a professionalized or an industry partner. Another more modern ways of financing such as crowdfunding reveals to be a useful tool for ASO type of companies; technological, high risk, at their initial stages

### **Aggressive strategy turnaround and implementation**

There is a consistent agreement among scholars that the growth process of the spin-off is not absolutely standard, nor necessarily linear (Druihe and Garnsey, 2004) and that studies generally overlook the diversity in the activities ASO companies perform (Ucbasaran, 2001). The type of ASO created influences its growth potential, but the amount and type of resources and knowledge needed for each type of company are also very different. For example, consulting companies are intensive in technical knowledge and labor force and require little fixed assets investment whereas product companies require infrastructure and manufacturing and marketing knowledge. The cases studied

clearly showed how ASO's business model evolves and changes as the company learn and accumulate more knowledge and resources.

Which products to commercialize, which markets, how to compete, are strategic decisions the founder takes. We have learned in the interviews that companies modify their business model and evolve to more developed companies through strategic thinking and the knowledge and experience accumulated. So, being or not legally a company, we have seen as the founder's team has evolved from simple Research contracts, to provide technical product development contracts, consultancy or software to manufacture or produce their own end-products and in some cases, even to have their own production infrastructure.

Through our inductive process through the interviews most of the strategic reorientation of business was related with the transition from markets of technology to product markets and was widely highlighted as one of the most important factors that lead to firm's growth. However, we would say that competing in the markets of technology is not a choice as Pries & Guild (2007) suggest, since at the earlier stages the ASO do not have other option than to accumulate skills, knowledge, resources and self-confidence enough to feel it can compete in the product markets. Product markets require higher investments, additional skills and complementary capabilities.

In our examples, there are many cases in which the strategic reorientation of the business has been mentioned as key for growth, and founders are, we could say, proud of their strategic vision.

To migrate to product markets would eventually increase the size of the company in the mid-term. For example, a company dedicated to produce scanners to read ID documents will have more size (in a simplistic view) than the company dedicated exclusively to sell the software this scanner uses to third parties. Or a company dedicated to sell products for pets allergies will in the mid-term have more employees and sales than an ASO that is dedicated to research projects related with this area.

However other type of strategic decisions would not necessarily lead to a growth in sales or employees but lead to more value added for the company. This is the case of

FunGen, where the company decides to quit their production activities and to dedicate their resources to their core business, which is research. The company also evolved from doing research for third parties to do their own research, so that the results of research will remain in the company that can license it to third parties.

Product markets require additional skills and complementary assets such as manufacturing capabilities and distribution networks (Pries & Guild, 2007). It also requires higher investments. Expected returns are higher, but also operational and financial risk. Having a trustful industry network gives the chance to build new skills and the right assets but also the confidence to assume higher risks. Again, it is the market and technology knowledge, previous experience and resources availability what makes this decision to happen. Probably the growth intention or willingness already existed before but it is not until these elements conflate, that the company is prepared to make this step. Thus, in line with Chen et al. (2009), we can conclude that the availability of resources can have an additional indirect influence on growth because the kind and amount of resources and knowledge conditions strategy and the type of strategy developed influences growth.

The other dimension that helps to increase enough confidence to take higher risks is past experience. Positive results contribute to accumulate resources but also increases board Self-Efficacy to decide to go to the “next step”. In consequence, a positive performance feedback is another important element to decide a strategic turnaround.

This process may be slow, since during the way, the founder may distract his attention, and be prisoner of his current status quo, the type of company he has and the way he the venture competes in the market (Degroof & Roberts 2004). However as we have seen in our examples, HGASO in Catalonia have all showed this evolution. It is not until the founder feels that he has the financial resources, the knowledge and the market pulse that through a strategic thinking process he decides to go one step beyond.

Significantly, nearly all cases interviewed, started with a different competitive strategy and make a turnaround as a consequence of a reflection process. So they had the ability realize of the evolution of their new capabilities and decide to evolve to a new business model. This reflection process sometimes has usually been incited by an

external agent (business schools mainly) and sometimes come as a result of a market demand, after the company has been some years competing in the market (i.e. has some industry experience), has tried other competitive strategies and has improved their capabilities.

So, for the strategic reorientation to take place, external inputs through markets or business networks are needed to set up a strategic reflection process that ends with the strategic reorientation if the experience in industry has improved company's capabilities and individual Self-Efficacy of the TMT members.

However, managers have to take into account that the fact of simply change strategy will not necessarily take the company to the growth path. Obviously managers have to decide the adequate strategy that maximizes growth and choose the right strategy and not just a different one. However, as reasoned before, to change the way the company competes in the industry or its business model can be an important signalling effect of future growth.

### **Acquisitions and Internationalization**

According to some authors in the Entrepreneurship literature, acquisitions can be an interesting route to grow in contrast with organic growth (Mckelvie & Wiklund, 2010). The incorporation of new companies accelerate the acquisition and exploitation of resources (Koryak et al., 2015). It is viewed as a fast path to access new capabilities and potential new growth paths for the ventures (Lockett, Wiklund, Davidsson et al., 2011). So acquisition seems to be an excellent growth catalyst for ASOs.

Similarly, some authors in management literature have previously concluded that strategies such as internationalization or acquisition have an important impact on growth (eg.:Lindholm, 1997a). Although it is no doubt of the growth effect of these strategies, academics noticed the difficulty to set them up in the early stages because it takes a long time to develop and commercialize products before an internationalization or a strategic international alliances can take place (Björnali & Aspelund, 2012; Pettersen, 2012).

These growth catalysts require of high financial requirements that ASO do not have, management knowledge and a profound knowledge of the industry players and structure. ASO companies seem to have some structural impediments to get and exploit these catalysts in their earlier stages.

Although more conservative HGASO expressed their intention of sell in the international markets, the high finance requirements limit their expansion. We would say that internationalization or acquisition growth strategies are not realistic without an aggressive partnership and alliances search in finance and marketing functions.

### **University policies and support**

University policies and support has been in the centre of the Academic Spin-Off debate and has been widely studied in academic literature. Although the University intention in Europe to replicate the US successful structures is laudable these success structures have revealed to be very difficult to imitate with results, and the Catalanian case has not been an exemption. Literature points out the lack of adequate structures, University and governmental regulation and policies, University culture and mission and cultural European issues related to Entrepreneurship.

Our results confirm the academic view of the problems and challenges University in Europe has regarding Academic Entrepreneurship. As for the University support policies, Roberts & Malone (1996) distinguished two factors in these policies from University and its institutions: selectivity and support, showing that with limited availability of resources only two strategies were possible, either low selectivity and low support or high selectivity and high support. They recommended this last one for environments with a scarce entrepreneurship development. With the cases studied we could classify Catalanian University Entrepreneurship support as low selectivity and low support.

Degroof & Roberts (2006) conclude that low selectivity-support policies influence the growth orientation of the firm and predispose the entrepreneurs to adopt SME format. As we have seen in our studies, most of the companies studied started as

companies providing research services and not as “product” companies. However, high selectivity-support requires more resources than other policies so they recommend to look for active partnerships and to turn to aggregated supra-institutional structures to give adequate support.

Another dimension is how Universities support ASO, that is, the kind of aid provided. Degroof & Roberts (2004) define support in each stage of the venture. In initial stages support relates with advising in opportunity identification and selection, in IP protecting, and business concept testing. In the later stages, University support occurs mainly in advising in research matters through a continuous collaboration with the research institute and a support network related with research institution partners and firm’s management and board advisors.

In our interviews, founders have sadly expressed their disappointment with university support as an institution. The most valued help is the access to technical equipment and in a specific case the leave that allowed the academic to have more time to dedicate to the venture. These are some of the traits they think support was not adequate: First, rigidity, as they think the singularity of the needs of each ASO requires for a more personalized and flexible support versus a standard “unique offer” support. Second, entrepreneurs felt this aid should be a long term support versus short term or “one shot”, because their product development, market readiness and commercialization efforts take some years to be achieved. Third, the quality of the support from the University structures was poor. And fourth, and more widely expressed, they felt they needed a more intense support. Present support is so mince that it was considered in the majority of cases as negligible.

The needs of these HGASO founders also coincide with Roberts & Malone (1996) and Powers and McDougall (2005) in the sense that institutions have to be aware that this “democratic”, low intensity support for everyone, is not what these scholars recommend and is in the base of the needs expressed by interviewed founders. They are also in line with Van Geenhuizen and Soetano (2009) suggestions to design more personalized and long-term support programs taking into account the time required for main barriers to reduce. Thus an interesting issue to point out is that maybe with a long

term soft support, Universities can help companies to acquire growth catalysts and grow.

These results somehow contrasted with Ortin et al. (2007) study, where around 50% of ASOs considered aid from public institutions as key or important for the survival or growth of the company. However, they considered this support process as slow and difficult. Because of the type of aid (information, founding process, training, business plan) it seems that this support refers mainly to the creation process rather than with company performance.

Regarding the type of support founders consider support in management, business and commercial as non-existent or not adequate. Although in some cases some sort of advice in Intellectual Property, Legal procedures and business consultancy has been provided, results in this particular area were far from being satisfactory. In contrast with literature, where infrastructures and particularly Technology Transfer Offices have been signalled as important for growth (O'Shea et al., 2007) any HGASO mentioned their help neither significant nor related with growth. These facts take us to the idea that maybe university structures in Catalonia are not qualified and professionalized enough to assume that advising functions, especially in business related areas such as management or marketing where only an experienced and professional TTOs can really add value to the commercialization research process (Lockett and Wright, 2005).

As we have seen in literature review (Geenhuizen & Soetano, 2009) and in the interviews, managerial and especially marketing barriers take longer to reduce for the ASO case, and University has shown not to be the ideal institution to structure this support for growth. So authors suggest trying to attract or get in touch with this knowledge by introducing entrepreneurs to specialized networks, hiring a surrogate entrepreneur, training abilities, acquiring capabilities through experiences or even looking for partners at business schools (Wright, Piva, Mosey et al., 2009).

Some founders valued specially having the funds that allowed them to test the concept in the market and produce the first prototype to surpass the concept testing phase. This support would imply a great initial dedication of resources to that area and a long term commitment from the university. Thus, not only the intensity but also the

timing of the support is not aligned with entrepreneurs' needs that are more aligned with a continuous support to the company especially addressing product development, and management and commercialization issues.

University gives support to the ASO entrepreneurs but also is expected to monetize their investment and obtain some returns for their task, mainly through two kinds of agreements: license fees from University to the ASO, which pays back royalties as a percentage of sales and taking positions on the company stock. From the HGASO only in one case did University had a percentage (10%) of the stock whereas two companies had license agreements and paid royalties to the University. According to our interviewees license agreements are easier to evaluate and agree, and at least they provide some economic flow to the University. In the cases studied, ASO payments are related to sales, reducing the operational risk of the venture, and participants see it as a fair, win-win agreement. Obviously the degree this expected percentage cover the R+D expenses carried out by University can be a way to help the ASO development. Since many intangible factors apply, it shows to be difficult to evaluate a "fair" percentage, and consequently it seems that each University or Research Institute applies the same pre-fixed percentages to all their operations. In any of the cases studied there has been a valuation of the resources the University has endowed with, nor a long term benefit perspective or exit strategy considerations to set the price. As we noticed in the literature revision, whereas in the CSO literature focuses a great part of the attention in the investment from a financial point of view we confirm this lack of culture or interest from the University side. This poor development of the procedures for a realistic valuation of research has also been detected by Leitch and Harrison (2005).

Some authors pointed out that taking stock in the ASO can greatly help to increase the revenues from the commercialization of the technology (Jensen & Thursby, 2001), even as much as up to 10 times as compared to licensing (Bray & Lee, 2000). Nevertheless, the evaluation of taking ASO stock is far more complex to quantify and to agree than a license fee. Many business contingencies have to be taken into account and legal aspects are dense and complex. In line with Powers & McDougall (2005) and Lockett and Wright (2005) our results support the idea that experience and business development capabilities of the Technology Transfer Office are important dimensions for this structures to be effective, and it seems that current TTOs in Catalonia are not

adequate to leader this process in a way that gives satisfactory results to both parties. In a similar direction, some authors have warned that the lack of financial expertise of the TTOs can constrain ASO growth (Wright et al., 2006). Besides, the institutional view of the University in the cases studied shows its risk aversion and their reluctance to this sort of investments because of the higher uncertainty in returns, and the lack of a corporate finance vision and culture. As some authors point out the TTOs incentives structure as an additional dimension to study when approaching this problem (Siegel et al., 2003a; Wright, et al. 2009).

Despite of these possible benefits, our results support the idea that University investment as a shareholder for the cases similar to Catalanian University, with low profile infrastructures, low selectivity and low support policies that produce small and “life-style” companies and scarce business and financial experience of their TTO’s, should be only reserved for special cases where a license agreement is difficult to undertake (Harmon, & Ardishvili, 1997). We agree with Wood (2009) that Transaction Cost Theory seems a good approach to decide which type of commercialization of research best suites to each case since it seems that University investment in ASO can have high costs not only in the transfer of the technology but also in administrative, bureaucracy, legal and company governance and compliance.

As we have seen university support is qualified as “poor”. As we perceive it, the only way to intensify this help without requiring additional budget is to have recurrent cash-flows from previous activities that allow the university or institute research to address new support projects. However, the lack of financial and business objective vision of the University, makes it difficult to take this strategy to practice. Thus, Universities in Catalonia are immerse in a “financial trap”, they do not get enough funds from their commercialization research activities so they do not have funds to intensify support on selected ventures or research projects, so results of these projects give poor economic returns for the University.

This lack of profit-goal vision is confirmed by the fact that only 3 of the 7 HGASO interviewed had some economic compensation for the TT from University. The other four had benefit from the tacit knowledge from University with no reward for the institution. The existence of a high acumen of tacit knowledge that is apparently hidden

in the area of tacit knowledge has been also pinpointed by Karnani (2012). A possible way to solve this issue is through partnerships with more professionalized companies that have either a business or industry knowledge such as industry players or partnerships with professionals with financial investment knowledge such as seed capital companies.

As some interviewees pointed out University culture in Catalonia also hampers research commercialization and especially spin-out activities. This need to reduce ambiguity and establish a clearer “rules of the game” and the need of action to change University culture, is widely supported in literature (Laukkanen, 2003; O’Shea et al., 2007).

Finally, it is interesting to notice that two of the more successful HGASO come from Research Institutions that depend on University. These units have specifically technology transfer and the creation of companies as one of their purposes. The extent these institutes are managed as companies, have market incentives and are profit oriented will help to clarify the roles and goals of each organisation allows differentiating basic research with a scientific interest from applied research with a commercial exploitation.

## 6. Conclusions

It is the purpose of this thesis to untangle the complexity of the growth process in the specificity of the Academic Spin-Off companies in the Catalonia area. To address the study we employed a mixed-methods design consisting in a sequential explanatory study: the initial preliminary quantitative study gave us a purposeful sample of High-Growth ASO to perform the subsequent qualitative study. Through the qualitative analysis of the success cases we identified the growth catalysts and how and where do they act in the growth process.

In the quantitative study we learned that commonly used measures of performance, such as employment, assets or turnover seem not to be a good predictor of future performance of ASO, and it is not until profits appear that the company can grow in the long term. Although each University has its own TT infrastructures, only the big three produced a significant amount of companies. From the initial pool of ASO companies, only 13 had accounting records in Year 6 and presented High-Growth. Differences among Universities are significant when the measure of success is mid-term performance. Only those universities whose companies had made a turnaround to profits reported growth in turnover and employment in Y6.

Our first contribution is methodological. Scholars should consider two dimensions to evaluate which measure to take when measuring ASO performance success. Whereas some measures seem not to be significant at the very early stages, such as profits, others seem to have a low predictive accuracy of mid-term performance. So, we strongly advocate that each stage has its own appropriate measures and that it is important that these measures are combined if researchers can have difficulties in appraising the stage the firm is in. The other dimension is the different meaning of success in performance for the different participants. Universities measure the result of their policies and structures in the number of companies created whereas for other parties (managers, government, employees...) this number may have very limited significance. Whatever the measure is stakeholders should be especially aware about profit generation so that companies present a “balanced growth”. Measures as assets or employment, and even turnover seem not to be as robust as profits to predict future growth.

As for University policies, there is little doubt about the reduced effectivity of the current support structures and programs at the company level. Supporting formulas are low quality, poor in quantity and focused on the earlier stages. The strong impact of one unique successful case have on the TTO performance seems to drive us to a high selectivity – high support formula. Bad news is that it is difficult to predict which companies will experience growth in the future. And University resources in Catalonia are scarce.

Consistently with the study of van Geenhuizen & Soetanto (2009), our qualitative study indicates that companies take some years to learn, increase their capabilities and grow. Consequently, our proposition is that this high quality-intensity help is not necessary, nor convenient at the beginning of the firm creation. On the contrary, we conclude that help has to be personalized, long-term and with a progressive selectivity-intensity while the firm earns credibility, resources and capabilities for growth. Long-term support allows the companies to develop new capabilities and to successfully incorporate growth catalysts. Companies go through a “natural selection” process and the more advanced the company is in this process, the more probable success is and the more intense this aid can be.

Thus, regarding the University support policies this study contributes with the incorporation of a new dimension (time) to the duality selectivity-support formulas and the convenience of an increasing support type (increasing selectivity- increasing support) that allows to give all companies an opportunity for growth and reduces failure impact whereas is aligned with the needs of the company.

As for the support structures current TTO seem not to have the adequate knowledge and abilities to add value to the process neither to the University, nor to the company. Financial and business knowledge and experience as well as negotiation, social and management abilities are frequently mentioned in literature and are crucial to successfully evaluate and negotiate a support or investment proposal. This weakness brings as a consequence a little monetization of the commercialization of research of the TTO in Catalonia. Tacit knowledge, which represented 5 out of the 7 High-Growth ASO interviewed and represent 55% of the ASO accounted in (Karnani (2012) study, provided no returns and codified

technologies provided scarce resources compared with the infrastructure investment in TTOs. This absence of returns limits the support potential of the University to new ventures, so that the University is captured in a “financial trap” regarding the commercialization of technology. In our opinion, there are more similarities than differences between ASOs and RBSU from different universities and research institutes, so that a certain degree of consolidation of TT infrastructures would help to have more resources for the professionalization of such structures. Although the need of a professionalized structure has been noted in some studies in Europe, the consequences of this situation not only in ASO performance but also in the scarce degree of monetization of the Academic Entrepreneurship have been overpassed in previous literature. It is not only that TTO can enhance or reduce ASO performance, it also has a strong impact in the degree University takes advantage of this monetization opportunity.

Despite of the lack of an efficient support from University, some companies have presented a high growth during a substantial period of time. Catalanian High-Growth ASO is not the history of a breakthrough invention that is exploited through patents and licenses. It is a history of a team that has been doing research for a long time, which is in contact with the industry players, who visualizes an opportunity and exploits it by making intelligent business decisions and investing lots of time and effort in it. After some years of experience, the founders increase their Self-Efficacy, and their knowledge and abilities improve. If the company results are satisfactory, they allocate more and more resources into the company according to their strategic thinking. There is a point in time, that they get or find a growth catalyst that propels its growth. To understand how and where these growth catalysts act we have draft a novel framework for the growth process that integrate the lasts findings in the Entrepreneurship Literature.

These growth catalysts are TMT formation and new incorporations, industry partnerships, a market-ready, cutting-edge technical product or service, a big financial support, and a strategic turnaround in the business model. Other growth catalysts that may be present in other ASO cases but have not been observed are acquisitions and internationalization and University support.

Once a Growth Catalyst is obtained it has an influence in all the stages of the growth process and it may activate the search of further growth catalysts. Obtaining growth catalysts is very much related with increasing the company stock of resources and capabilities but also with giving a different and more effective use of this stock, with the overall effect of accelerating the growth process.

Different capabilities are more relevant in each stage of the growth process. We would highlight leadership capabilities at the Growth Intention stage, Strategic Thinking to choose the best strategy, Network Capabilities to obtain adequate resources and Management and organizational capabilities to orchestrate these resources.

As the company is, the growth process is dynamic and in the development of each stage, when a growth catalyst is achieved, there is an influence in all the stages that reinforce the growth process. So the growth process is a continuous, live process. The founder of an ASO analyses his company and the industry in a continuous basis, refines the strategy, nurtures the company with resources and allocate them to get a competitive advantage.

The qualitative study also reveals the importance of the cognitive level in the growth process. Growth Intention is the initial necessary stage in the growth process which has important implications for stakeholders, who will seek a founder or a team that envisions and decides to pursue growth catalysts. Its consecution will have an important signalling effect as a precedent for growth. This signalling effect could be used by TTOs to intensify or graduate the amount of support to deliver.

An important contribution of this thesis is the identification of the Growth Catalysts that cause an acceleration effect on Catalonian ASO companies, their integration in the Growth Process model and the role the different company capabilities have on it, and some important factors that have an effect in the growth attainment and have been neglected, misrepresented or set aside in ASO literature.

First, we outlined the importance of previous research activities. The relationship between previous research activities and spin-out formation have been stated by

some authors because it makes possible opportunity detection because of their superior market knowledge and their social capital with industry. We also mentioned these two aspects as important to elaborate a high-value proposition and in consequence not only to have influence on ASO establishment but also as important factors to stimulate growth. Previous research activities allow the founder to build the researchers team as the core future TMT and to accelerate and develop a market-ready prototype. Both features have revealed to be key for the growth of the firm.

Second, the determinant role played by the team of researchers, who have the commitment and the time and importantly contribute to the growth ambition of the TMT. The formation of the core TMT, mainly based on researchers is previous to the decision of founding the company. The bigger the start-up team is, the more quantity of this resource the company has, so it seems that the size of the team play an important role on growth potential.

Third, the importance of reaching to strategic partnerships into the commercialization area to enhance growth has a complete misrepresentation in growth literature. Alliances have revealed to be an excellent mechanism to surpass management and commercial barriers that can liberate hidden capabilities and strengths of both partners. Although the lack of management expertise can restrain its achievement we have noticed that the disposition or intention of the founders to close such agreements could be an important antecedent for growth.

Fourth, the effect that a strategic reorientation produce on growth have been completely neglected in ASO and Entrepreneurship literature. A strategic reorientation means the company has accumulated new resources and capabilities that allow it to address new milestones. It also implies a strategic drive, reflection and planning and supposedly a more effective allocation of resources and use of the capabilities. It also derives a high level of Self-Efficacy, leadership and commitment to purposely change the way things are being done. Business reorientation such as a change in the business model to a more focused product or a new industry niche, or designing a new growth strategy planning can be important growth catalysts, no matter the kind or the direction this reorientation has.

Fifth, we have confirmed the relative weight of tacit technologies and knowledge in the type of technology transferred from the University. There is an absence of returns the commercialization these technologies produce, that weakens the potential of the Technology Transfer Office.

For practitioners, knowing the catalysts other ASO have attained that have accelerated its growth process, and understanding how this influence has been exercised is an interesting knowledge since it gives them feasible goals to achieve if they pursue a growth objective. ASO managers can evaluate their organization capabilities and allocate resources to obtain growth catalysts. In contrast with other studies, the founder's perspective of the growth phenomenon attributes to the growth catalysts a causal effect on growth and consequently it has to be viewed by practitioners as objectives to pursue to obtain growth.

The study also provide some practical hints about how companies have obtained growth catalysts: specific business programs, active search and personal founder abilities have played a role in its attainment. It seems that network capabilities and absorptive capacities play an important role in the acquisition of growth catalysts. Besides, the conceptualization of the growth process, the capabilities and the growth catalysts needed to accelerate growth will undoubtedly clarify the possible paths to obtain growth results. Founders and managers must have the intention to grow and the firm must acquire the necessary capabilities at each stage to take advantage of these extraordinary growth accelerators.

This thesis has tried to disaggregate the different stages in the growth process and has identified the causal effect of the Growth Catalysts that have propelled growth of successful Catalonian ASO, providing a holistic framework to understand the causes, processes and effects that relate with Growth and their causal effect. With this model we reconciled the latest findings in the Entrepreneurship Literature on Growth with the singularity of the more dispersed studies on ASO growth. Some of these catalysts have been encountered among the enormous amount of factors that Entrepreneurship literature conclude to have an influence on growth. Other catalysts have a non-existent or minimal representation on ASO literature. We also draw interesting

conclusions, insights and recommendations about the University support policies and ASO performance measurement.

## **7. Limitations of the study and implications for further research.**

The growth phenomenon is multidimensional, heterogeneous and complex (Leitch et al. 2010) and science have still not been able to provide a valid framework to study the process of growth. Based on the literature review on Entrepreneurship, the research objectives and the results of the study, we built a growth process model to analyse the impact of the growth catalysts on each stage and to understand how the different company capabilities fuel the process of growth for the successful Catalonian ASO.

Founder's perspective, although biased, includes all the experiential load, and the knowledge of the complexity of the industry and the company, so that his view of the growth catalysts seems to be better sounded than the opinion of external agents, especially if the researcher is looking for causality as we were.

Most of the interviewees were academics and consequently their answers also presented a bias that reflect their academic culture, thoughts and behaviours. However, we interviewed the academic founder that was nearer to the day-to-day management in the company so that they had an experiential learning through years at the front of the company that may have moderated this bias.

In our study we have identified successful ASO from a growth based perspective and carefully extracted those common catalysts that founders reveals as to be critical for growth. However we have not studied non-HGASO, to state the reasons for these companies not having obtained, searched or applied these growth catalysts with success. Similarly, we do not have studied cases where growth catalysts had been obtained, with no effect on growth. So we cannot asses the search or achievement of these catalysts is a differential characteristic of HGASO versus non-HGASO. Through the study of growth catalysts that failed, researchers could determine the conditions of a growth catalyst to effectively drive the company to growth.

Although the capabilities and the acquisition of growth catalysts play an important role propelling the growth process, more qualitative studies would be useful to deepen in the type of capabilities that are more relevant to obtain catalysts and

through which mechanisms or techniques these catalysts are effectively obtained. It would be advisable as well to perform wider-scale studies on Growth Catalysts to come across the context limitations of our study.

The identification of the Growth Catalysts also suggest the need of further research on those accelerators that had had a non-existent or a misrepresentation in Entrepreneurship literature such as such as the strategic reorientation of the company and in ASO literature, such as the influence of the existence of a team of researchers in ASO creation and in ASO performance through their growth ambition and the size of the team.

In the quantitative study we also found some limitations that are worth to be mentioned. First, the availability of a complete list of ASO in Catalonia. We found that universities usually do not have an exhaustive database. Available data is scarce and sometimes relies on TTO or TTO personal records. Many factors make us think that the ASO list provided by TTOs might be incomplete: Some other companies may have been formed based on tacit technology with informal collaboration agreements with academics without the acknowledgement of the TTO or the University. Other studies have reported that academics often leave University and established the company some years after this decision (eg. Müller, 2010). So, there is a difficulty in calculate the total impact of University Entrepreneurship on society in terms of total wealth or employment.

Similarly, as we pointed out in the literature review there seems to be a significant amount of companies founded by student that are based on tacit technologies, that have had a misrepresentation in literature over years (Pirnay et al., 2003; Åstebro et al., 2012). Student Spin-Offs (SSOs) constitute an interesting and unexplored avenue for future research.

This hidden set of companies are obviously based in tacit technologies, so in consequence they are difficult to track, since they do not have any formal relationship with University. More studies are needed about the impact of these sort of companies and the opportunities for monetization or collaboration for University they represent.

Second, there is also a lack of public detailed information on the companies where University has invested, the license agreements that have been made and their returns, which makes it difficult to make research on the type of industries, agreements and type of TT process that produce better results. Only aggregated measures are released through redOTRI survey, and obviously this situation limits the possibility of wide scale studies.

Besides, the youth of many companies lead to a lack of data of a significant group of companies for Y6. However, the quantitative study confirms some of the conclusions on previous studies in Europe about the poor performance of ASO and dig into the doubts about the way ASO and TTO success are measured. When studied at the University level, differences in University's and TTO's policies lead to significant different results in the long term ASO performance. Whereas there are a small group of companies with High-Growth and sustainable and substantial returns on Y6, there are universities which companies made heavy investment and recruiting and present heavy losses at Y6 that we think can threaten not only the company's growth but their survival.

Thus, longer studies are needed to complete the history of these problematic ASO's, in order to know if the downturn period is even longer than Y6 and those companies have finally achieved sustainable returns. If future High-Growth ASO phenomenon is a matter of small vegetative companies that make a big step ahead or these bigger unprofitable companies make a downturn in their results.

We have found that assets, employees and sales figures in early stages (near Y3) not always are good predictors of future company profitability and growth. So, early ASO measures should be interpreted with extreme caution. As a consequence more quantitative studies are needed to confirm if there is any stage of the company at which they are really a good predictor for company success.

The context of our study is the Catalanian ASOs and therefore, conclusions cannot be straight forward generalized to other geographical areas. However, several studies have appointed that regarding University support, there are several countries and areas in Europe with similar low-selectivity, low-support policies, with similar results (European Commission, 1995; Callan, 2001; Wright et al., 2007). Regarding the

qualitative study it is to notice that the Growth Catalysts identified do not contain any specific characteristic of the area studied compared with other areas in Spain or in Europe, such as IP laws or governmental or University aid. In consequence, we are optimistic about the possibility of extend results to other ASO companies Spain and certain areas of Europe.

We hope the conclusions of this thesis will encourage scholars to address further studies on this complex but essential phenomenon.

## 8. Bibliography

- Abell P., & Nisar, T. M., (2007). Performance effects of venture capital firm networks  
Research paper *Management Decision*, 45, 5, 923-936.
- Achtenhagen, L., Naldi, L., & Melin, L., (2010). Business growth—Do practitioners  
and scholars really talk about the same thing? *Entrepreneurship Theory and  
Practice*, 34, 289–316.
- Acs, Z. J., Parsons W. & Tracy, S, (2008). High impact firms: Gazelles re-visited.  
*Washington D.C., Small Business Administration*.
- Adler, P. & Kwon S. W., (2002, Jan). Social Capital: Prospects for a New Concept. Paul  
S. and Seok-Woo. *The Academy of Management Review*, 27, 1, 17-40.
- Alchian, AA., & Demsetz, H., (1972). Production, information costs, and economic  
organization. *American Economic Review*, 62, 5, 777–795.
- Aldrich, H. E., & Zimmer, C., (1986). Entrepreneurship Through Social Networks. *The  
Art and Science of Entrepreneurship*, 3-23.
- Allen, J., (2001, April). Private Information and Spin-off Performance. *Journal of  
Business*. 74, 2, 281-306
- Altheide, D., (1987). Reflections: Ethnographic content analysis. *Journal of Qualitative  
Sociology*, 10, 1, 65-77.
- Anderson, V. & Boocock, G., (2002). Small firms and internationalisation: learning to  
manage and managing to learn. *Human Resource Management Journal* 12 (3), 5–  
24.
- Åstebro, T, Bazzazian, N, & Braguinsky, S (2012). Startups by recent university  
graduates and their faculty: Implications for university entrepreneurship policy.  
*Research Policy*, 41, 4, 663-67.
- AUTM (Association of University Technology Managers) (2002). AUTM licensing  
survey. *Northbrook, AUTM*.
- Bamford, C. E., Dean, T. J., & McDougall, P. P. (2000). An examination of the impact  
of initial founding conditions and decisions upon the performance of new bank  
start-ups. *Journal of Business Venturing*, 15, 253-277.
- Barney, J. B., (1991). Firm resources and sustained competitive advantage. *Journal of  
Management*, 17 (1), 99–120.
- Baron, R. A. (2004). The cognitive perspective: A valuable tool for answering  
entrepreneurship’s basic “why?” questions. *Journal of Business Venturing* 19 221–  
240.

- Baron, R. A., & Markman G. D., (2003). Beyond social capital: The role of entrepreneurs' social competence in their financial success. *Journal of Business Venturing*, 18, 41–60.
- Barringer, B. R., Greening, D.W., (1998). Small business growth through geographic expansion—a comparative case study. *Journal of Business Venturing* 13, 6, 467–492.
- Barringer, B. R., Jones, F. F., & Neubaum, D. O., (2005). A quantitative content analysis of the characteristics of rapid-growth firms and their founders. *Journal of Business Venturing*, 20, 5, 663-687.
- Bathelt, H., Kogler, D.F. & Munro, A.K. (2010). A knowledge-based typology of university spin-offs in the context of regional economic development, *Technovation*, In Press, Corrected Proof.
- Batjargal, B., (2003). Social capital and entrepreneurial performance in Russia: A longitudinal study. *Organizational Studies*, 24, 4, 535-556.
- Baum, J. A.C., Calabrese, T. & Silverman, B. (2000). Don't go it alone: Alliance network composition and start-ups performance in Canadian biotechnology. *Strategic Management Journal*, 21, 267-294.
- Baum, J. R., Locke, E. A., & Smith, K. G. (2001). A multidimensional model of venture growth. *Academy of Management Journal*, 44, 292-303.
- Baum, J. R., & Locke, E. A. (2004). The relationship of entrepreneurial traits, skill, and motivation to subsequent venture growth. *Journal of Applied Psychology*, 89, 587-598.
- Baum, J. R., & Bird, B., (2010). The successful intelligence of high-growth entrepreneurs: Links to new venture growth. *Organization Science* 21, 2, 397–412.
- Begley, T. M., & Boyd. D. P., (1987). A comparison of entrepreneurs and managers of small business firms. *Journal of management*, 13, 1, 99-108.
- Bell, J., Murray, M., & Madden, K., (1992). Developing expertise: an Irish perspective. *International Small Business Journal* 10, 2, 37.
- Beraza, J. M., & Rodríguez, A., (2012). Conceptualización de la spin-off universitaria revisión de la literatura. *Economía industrial*, 384, 143-152.
- Beraza, J. M., & Rodríguez, A., (2010). Estructuras de intermediación para la transferencia de conocimiento universitario: las oficinas de transferencia tecnológica, *Revista Propiedad intelectual*, Año IX, 13, 152-176.
- Beraza, J. M., & Rodríguez, A., (2012). Types of spin-offs in a university context: a classification proposal. *Cuadernos de Gestión*, 12, 1, 39-57.

- Bhide, A. (1992). Bootstrap finance: The art of start-ups. *Harvard Business Review* 70, 109–117.
- Bingham, C., Eisenhardt, K., & Furr, N. R., (2007). What makes a process a capability? Heuristics, strategy, and effective capture of opportunities. *Strategic Entrepreneurship Journal*, 1, 1, 27–47.
- Birch, D. L., & Medoff, J., (1994). Gazelles. *Employment Policy and Job Creation*, 159-167.
- Birley, S., (1985). The role of networks in the entrepreneurial process. *Journal of Business Venturing* 1, 107-117.
- Birley, S. (1987). New ventures and employment growth. *Journal of Business Venturing*, 2, 155-165.
- Birley, S. & Westhead, P., (1994). A taxonomy of business start-up reasons and their impact on firm growth and size. *Journal of Business Venturing*, 9, 7–31.
- Bjørnali, E. S., Gulbrandsen, M., (2010). Exploring board formation and evolution of board composition in academic spin-offs. *Journal of Technology Transfer*, 35, 92–112.
- Bjørnali, E. S., & Aspelund, A., (2012). The role of the entrepreneurial team and the board of directors in the internationalization of academic spin-offs” *Journal Int. Entrepreneurship*, 10, 350–377.
- Black, E. L., (2002). Usefulness of financial statement components in valuation: an examination of start-up and growth firms. *Venture Capital*, 2003, 5, 1, 47-69.
- Blundel, R.K., Hingley, M., (2001). Exploring growth in vertical interfirm relationships: small-medium firms supplying multiple food retailers. *Journal of Small Business and Enterprise Development* 8 (3), 245–265.
- Box, T. M., White, M. A., & Barr, S. H., (1993). A contingency model of new manufacturing performance. *Entrepreneurship Theory & Practice*, 18, 2, 31-45.
- Boussouara, M., Deakins, D., (1999). Market-based learning, entrepreneurship and the high technology small firm. *International Journal of Entrepreneurial Behaviour and Research*, 5, 4, 204–223.
- Boussouara, M., Deakins, D., (2000). Trust and the acquisition of knowledge from non-executive directors by high technology entrepreneurs. *International Journal of Entrepreneurial Behaviour and Research*, 6, 4, 204.
- Bray, M. J., & Lee, J. N., (2000). University revenues from technology transfer: licensing fees vs. equity positions. *Journal of Business Venturing*, 15, 5/6, 385–392
- Brett, A., Gibson, D., & Smilor, R., (1991). University Spin-off Companies: Economic Development, Faculty Entrepreneurs, and Technology Transfer.

- Brinkley, I., & Lee, N., (2006). The knowledge economy in Europe. *The work foundation*, London.
- Burt, R. S., (1992). *Structural Holes*. Harvard University Press.
- Callan, B., (2001). Generating Spin-Offs: Evidence from the OECD” *Science Technology Industry Review*. Special Issue on Fostering High Tech Spin-Offs: A Public Strategy for Innovation, 26, 13–56.
- Camisón, C., & March, I., (1995). Estrategias de cooperación y de innovación con soporte territorial y parques tecnológicos: un estudio empírico, *Revista Europea de Dirección y Economía de la Empresa*, 4, 1, 11-33.
- Caracelli, V. J., & Greene, J. C., (1993). Data analysis strategies for mixed-method evaluation designs, *Educational Evaluation and Policy Analysis*, 15, 2, 195-207.
- Carayannis, S. E., Rogers, E. M, Kurihara, K., & Allbritton, M. M., (1998). High Technology spin-offs: From government R&D laboratories and research universities, *Technovation*, 18, 1, 1-11.
- Carson, D., & Gilmore, A., (2000). SME marketing management competencies. *International Business Review*, 9, 3, 363–382.
- Cassar, G. (2004). The financing of business start-ups. *Journal of Business Venturing*, 19, 261–83.
- Cassar, G., (2006). Entrepreneur opportunity costs and intended venture growth. *Journal of Business Venturing*, 21, 5, 610-632.
- Chandler, G. N., & Hanks, S. H. (1994). Market attractiveness, resource-based capabilities, venture strategies, and venture performance. *Journal of Business Venturing*, 9, 331-349.
- Chandler, G. N., McKelvie, A., & Davidsson, P., (2009). Asset specificity and behavioral uncertainty as moderators of the sales growth — employment growth relationship in emerging ventures. *Journal of Business Venturing*, 24, 4, 373-387.
- Chaston, I., Mangles, T., (2000). Business networks: assisting knowledge management and competence acquisition within UK manufacturing firms. *Journal of Small Business and Enterprise Development*, 7, 2, 160–170.
- Chen, X., Zou, H. & Wang, D.T., (2009). How do new ventures grow? Firm capabilities, growth strategies and performance. *International Journal of Research in Marketing* 26, 294–303
- Chesbrough, H., Rosenbloom, R.S., (2002). The role of business model in capturing value from innovation. *Industrial and Corporate Change*, 11, 3, 529–544.
- Chiesa, V., & Piccaluga, A., (2000). Exploitation and diffusion of public research: the case of academic spin-off companies in Italy. *R & D Management*, 30, 4, 329–339.

- Chrisman, J.J., Bauerschmidt, A., & Hofer, C. W., (1998, Fall). The Determinants of New Venture Performance: An Extended Model. *Entrepreneurship Theory and Practice*.
- Chrisman, J.J., Hynes, T., & Fraser, S., (1995). Faculty entrepreneurship and economic development: the case of the University of Calgary". *Journal of Business Venturing*, 10, 267–281.
- Chrisman, J.J., & McMullan, W.E., (2004). Outside assistance as a knowledge resource for new venture survival. *Journal of Small Business Management*, 42, 3, 229–244.
- Cici, S. J. (1996). On Intelligence. *Harvard University Press*, Cambridge, MA.
- Churchill, N.C., Lewis, V.L., (1983). The five stages of small business growth. *Harvard Business Review*, 61, 3, 30–39.
- Clarysse, B., & Moray, N., (2004). A process study of entrepreneurial team formation: The case of a research based spin-off. *Journal of Business Venturing*, 19, 1, 55–79.
- Clarysse, B., Wright, M., Lockett, A., Van De Elde, E., & Vohora, A., (2005). Spinning out new ventures: a typology of incubation strategies from European research institutions. *Journal of Business Venturing*, 20, 183–216.
- Clarysse, B., Wright, M., & Van de Velde, E., (2011). Entrepreneurial Origin, Technological Knowledge, and the Growth of Spin-Off Companies. *Journal of Management Studies*, 48, 6, 1420-1442.
- Cliff, J. E. (1998). Does one size fit all? Exploring the relationship between attitudes toward growth, gender and business size. *Journal of Business venturing*. 13, 523-542.
- Cohen, W. & D. Levinthal (1990). Absorptive Capacity: A New Perspective on learning and Innovation. *Administrative Science Quarterly*, 35, 128–152.
- Coleman J. S., (1988). Social Capital in the Creation of Human Capital. *American Journal of Sociology*. 94, Supplement: Organizations and Institutions: Sociological and Economic Approaches to the Analysis of Social Structure, 95-120.
- Coleman J. S., (1990). *Foundations of Social Theory*. Harvard University Press.
- Colombo, M.G., & Delmastro, M., (2002). How effective are technology incubators? Evidence from Italy. *Research Policy*, 31, 1103–1122.
- Colombo, M. G., & Grilli, L. (2009). On growth drivers of high-tech start-ups: Exploring the role of founders' human capital and venture capital. *Journal of Business Venturing*.
- Colombo, M. G. & Piva, E., (2012). Firms' genetic characteristics and competence-enlarging strategies: A comparison between academic and non-academic high-tech start-ups, *Research Policy* 41, 79– 92

- Condom, P. & Barceló, P., (2003). Modelos de apoyo a la creación de spin-offs, *Iniciativa emprendedora*, 41, Octubre-Noviembre-Diciembre, Deusto, 34-53.
- Cooper, A. C., Dunkelberg, W.C., Woo, C.Y., (1988). Entrepreneurs' perceived chances for success. *Journal of Business Venturing*, 3, 2, 97-109.
- Cooper, A. C., Gimeno-Gascon, F. J., & Woo, C. Y. (1994). Initial human and financial capital as predictors of new venture performance. *Journal of Business Venturing*, 9, 371-395.
- Corduras, A., Urbano, D., Rojas, A. & Martínez, S., (2008). The relationship between university support to Entrepreneurship with entrepreneurial activity in Spain: A Gem data based analysis. *International Advance Economics Research*, 14, 395-406.
- Covin, J. G., Slevin, D. P., & Covin, T. J. (1990). Content and performance of growth-seeking strategies: A comparison of small firms in high- and low-technology industries. *Journal of Business Venturing*, 5, 391-412.
- Creswell, J. W., Plano Clarck, V. L., Gutmann, M., & Hanson, W., (2003). Advanced mixed methods research designs. In *Handbook on mixed methods in the behavioral and social sciences*, ed. A. Tashakkori and C. Teddlie, 209-40. Thousand Oaks, CA: Sage.
- Creswell, J. W., & Plano Clark, V. L., (2007). *Designing and Conducting Mixed Methods*. Research Sage
- Crook, T.R., Todd, S.Y., Combs, J.G., Woehr, D.J., Ketchen, D.J., (2011, May). Does human capital matter? a meta-analysis of the relationship between human capital and firm performance. *Journal of Applied Psychology*, 96, 3, 443-456.
- Curran, J., Blackburn, R., (2001). *Researching the Small Enterprise*. Sage, London.
- Dahlstrand, Å.L. (1997). Growth and inventiveness in technology-based spin-off firms, *Research Policy*, 26, 3, 331-344.
- Dahlqvist, J., Davidsson, P., & Wiklund, J., (2000). Initial Conditions as Predictors of New Venture Performance: A Replication and Extension of the Cooper et al. study. *Enterprise & Innovation Management Studies*, 1, 1.
- Davidsson, P., (1991). Continued entrepreneurship: Ability, need, and opportunity as determinants of small firm growth. *Journal of Business Venturing*, 6, 6, 405-429.
- Davidsson, P., (2004). *Researching Entrepreneurship*. Springer, New York.
- Davidsson, P., Achtenhagen, L., & Naldi, L., (2007). Research on small firm growth: A review. Working paper. Brisbane: Brisbane Graduate School of Business, Queensland University of Technology.

- Davidsson, P., Steffens, P., & Fitzsimmons, J., (2005). Growing profitable or growing from profits: Putting the horse in front of the cart. *Paper presented at the Academy of Management Meeting*, Honolulu.
- Davig, W., Brown, S., (1992). Incremental decision making in small manufacturing firms. *Journal of Small Business Management*, 30, 2, 53–60.
- Davila, A., Foster, G., & Gupta, M., (2003). Venture capital financing and the growth of startup firms. *Journal of Business Venturing*, 18, 6, 689-708.
- Deakins, D., Sullivan, R., Whittam, G., (2002). Developing support for entrepreneurial learning: evidence from start-up support programs. *International Journal of Entrepreneurship and Innovation Management*, 2, 4/5, 323.
- Dean, B.V., (1986). The project-management approach in the “systematic management” of innovative start-up firms. *Journal of Business Venturing*, 1, 2, 149–160.
- Degroof, J. J., & Roberts, E. B., (2004). Overcoming weak entrepreneurial infrastructures for academic spin-off ventures, *Journal of Technology Transfer*, 29, 3/4, 327–352.
- Delmar, F., Davidsson, P., & Gartner, W. B., (2003). Arriving at the high-growth firm. *Journal of Business Venturing*, 18, 2, 189-216.
- Delmar, F., & Wiklund, J., (2008). The effect of small business managers’ growth motivation on firm growth: A longitudinal study. *Entrepreneurship Theory and Practice*, 32, 3, 437–457.
- Dencker, J. C., and Gruber, M., (2015). The effects of opportunities and founder experience on new firm performance. *Strategic Management Journal*, 36, 7, 1035–1052.
- Dietz, J. S. (2000). Building a social capital model of research development: the case of the experimental program to stimulate competitive research. *Science and Public Policy*, 27, 2, 137-145.
- Dietz, J. S. & Bozeman, B., (2005). Academic careers, patents, and productivity: industry experience as scientific and technical human capital. *Research Policy*, 34, 349-367.
- Di Gregorio, D., & Shane, S., (2003). Why do some universities generate more start-ups than others? *Research Policy*, 32, 209-227.
- Djokovic, D., & Souitaris, V., (2008). Spinouts from academic institutions: a literature review with suggestions for further research”. *Journal of Technology Transfer*, 33, 225–247.
- Douglas, E., (2013). Reconstructing entrepreneurial intentions to identify predisposition for growth. *Journal of Business Venturing*, 28, 5, 633–651.

- Doutriaux, J., (1984). Academic entrepreneurial firms revisited: 1980-1984. *Frontiers of Entrepreneurship Research*, 521-537.
- Doutriaux, J., (1987). Growth pattern of academic entrepreneurial firms. *Journal of Business Venturing*, 2, 4, 285.
- Druilhe, C., & Garnsey, E., (2004). Do Academic Spin-Outs Differ and Does it Matter? *Journal of Technology Transfer*, 29, 269–285.
- Ebben, J., Johnson, A., (2006). Bootstrapping in small firms: an empirical analysis of change overtime. *Journal of Business Venturing* 21, 851–865.
- Eisenhardt, K. M., & Schoonhoven, C. B., (1990). Organizational growth: Linking founding team, strategy, environment, and growth among U.S. semiconductor ventures, 1978-1988. *Administrative Science Quarterly*, 35, 504-529.
- Ensley, M. D., & Hmieleski, K. M., (2005). A comparative study of new venture top management team composition, dynamics and performance between university-based and independent start-ups, *Research Policy*, 34, 7, 1091-1105.
- Entrepreneurship, National Commission on, High-Growth Companies: “Mapping America’s Entrepreneurial Landscape, July 1, (2001). Available at <http://dx.doi.org/10.2139/ssrn.1260389>
- Etzkowitz, H., (2003). Research groups as ‘quasi-firms’: the invention of the entrepreneurial university. *Research Policy*, 32, 1, 109–121.
- Etzkowitz, H., (2004). The evolution of the entrepreneurial university. *International Journal of Technology & Globalisation*, 1, 1, 64-77.
- European Commission, (1995). Green Paper on Innovation,
- European Commission “Towards a European research area science, technology and innovation” (EC publication 22572). Luxembourg: Office for publications of the European Commission, (2007)
- European Commission, Directorate-General for Research and Innovation, (2014). State of the Innovation Union 2010-2014.
- Evans, D., (1987). Tests of Alternative Theories of Firm Growth. *Journal of Political Economy*, 95, 4, 657-74
- Feindt, S., Jeffcoate, J., & Chappell, C., (2002, August). Identifying Success Factors for Rapid Growth in SME E-commerce. *Small Business Economics*, 19, 1, 51-62.
- Floren, H., (2003). Collaborative approaches to management learning in small firms. *The Journal of Workplace Learning*, 15, 5, 203–216.
- Fombrun, C.J., & Wally, S., (1989). Structuring small firms for rapid growth. *Journal of Business Venturing*, 4, 2, 107–122.

- Franklin, S., (2001). Academic and surrogate entrepreneurs in university spin-out companies. *Journal of Technology Transfer*, 26, 1-2, 127-144.
- Freel, M., S., & Robson, P. J. A., (2004). Small firm innovation, growth and performance – Evidence from Scotland and northern England. *International Small Business Journal*, 22, 6, 561–575.
- Freeman, J., Carroll, G. R., & Hannan, M. T. (1983). The liability of newness: Age dependence in organizational death rates. *American Sociological Review*, 48: 692-710.
- Fried, V. H., Bruton, G. D., & Hisrich, R. D., (1998). Strategy and the board of directors in venture-backed firms. *Journal of Business Venturing*, 13, 493–503
- Friedman, J., & Silberman, J., (2003). University technology transfer: do incentives, management, and location matter? *Journal of Technology Transfer*, 28, 1, 17–30.
- Fuller-Love, N., & Esyllt, T., (2004). Networks in small manufacturing firms. *Journal of Small Business and Enterprise Development*, 11, 2, 244–253.
- Garnsey, F., (1998). A Theory of the Early Growth of the Firm. *Industrial and Corporate Change*, 7, 3, 523-556.
- Garnsey, E., Stam, E., & Heffernan, P., (2006). New firm growth: exploring processes and paths. *Industry and Innovation*, 13, 1–20.
- Gartner, W. B., & Shaver, K. G., (2012). Nascent entrepreneurship panel studies: progress and challenges. *Small Business Economics*, 39, 3, 659-665.
- George, G., Zahra, S. A., & Wood, D. R., (2002). The effects of business-university alliances on innovative output and financial performance: a study of publicly traded biotechnology companies. *Journal of Business Venturing* 17, 6, 577–609.
- Georgellis, Y., Joyce, P., & Woods, A., (2000). Entrepreneurial action, innovation and business performance: the small independent business. *Journal of Small Business and Enterprise Development*, 7, 1, 7–17.
- Gimeno, J., Folta, T., Cooper, A., & Woo C., (1997). Survival of the fittest? Entrepreneurial human capital and the persistence of underperforming firms. *Admin. Science Quarterly*, 42, 750–783.
- Ghobadian, A., Mole, K., & O'Regan, N., (2003). New process technologies: barriers to adoption in small firms. *International Journal of Manufacturing Technology and Management*, 5, 5/6, 549.
- Gompers, P. A., Lerner, J., & Scharfstein, D., (2010). Performance persistence in entrepreneurship and venture capital. *Journal of Financial Economics*, 96, 1, 18–32.

- Grant, R., (1996). Toward a knowledge-based theory of the firm. *Strategic Management Journal Winter special issue*, 109–122.
- Grandi, A. & Grimaldi, R., (2003, Dec). Exploring the Networking Characteristics of New Venture Founding Teams. *Small Business Economics.*, 21, 4, 329-341.
- Granovetter, M., (1985). Economic Action and Social Structure: the Problem of Embeddedness, *American Journal of Sociology*, 91, 481-510.
- Gray, C., (2002). Entrepreneurship, resistance to change and growth in small firms. *Journal of Small Business and Enterprise Development*, 9, 1, 61–72.
- Gray, C., & Gonsalves, E., (2002). Organizational learning and entrepreneurial strategy. *The International Journal of Entrepreneurship and Innovation*, 3, 1, 27–33.
- Greiner, L.E., (1972). Evolution and revolution as organizations grow, *Harvard Business Review*, 50, 37–46.
- Greiner, L.E., (1998). Evolution and revolution as organizations grow, *Harvard Business Review*, 76, 3, 55–68.
- Greve, A., 1995. Networks and entrepreneurship: An analysis of social relations, occupational background, and use of contacts during the establishment process. *Scandinavian Journal of Management*, 11, 1, 1-24.
- Goodstein, J., Gautum, K. & Boeker, W., (1994). The effects of board size and diversity on strategic change, *Strategic Management Journal*, 15, 241-50.
- Gubeli, M. H., & Doloreux, D., (2005). An empirical study of university spin-off development. *European Journal of Innovation Management*, 8, 3, 269–282.
- Gupta, V., MacMillan, I. C., & Surie, G., (2004). Entrepreneurial leadership: Developing and measuring a crosscultural construct. *Journal of Business Venturing*, 19, 2, 241–260.
- Hallen, B., & Eisenhardt, K., (2012). Catalyzing strategies and efficient tie formation: How entrepreneurial firms obtain investment ties. *Academy of Management Journal*, 55, 1, 35–70.
- Hanson, G. H., (2000). Firms, workers, and the geographic concentration of economic activity. *The Oxford handbook of economic geography*, 477-494. New York: Oxford University Press.
- Harmon, B., & Ardishvili, A., (1997). Mapping the university technology transfer process. *Journal of Business Venturing*, 12, 6, 423.
- Harrison, R.T., Leitch, C., (2010). Voodoo institution or entrepreneurial university? Spin-off companies, the entrepreneurial system and regional development in the UK. *Regional Studies*, 44, 9, 1241–1262.

- Hart, P. E., & Oulton, N., (1996). Growth and size of firms". *Economic Journal*, 106, 438, 1242-1252.
- Hayter, C.S., (2011). In search of the profit-maximizing actor: motivations and definitions of success from nascent academic entrepreneurs". *Journal of Technology Transfer*. 36, 340–352.
- Hayter, C.S., (2013). Harnessing University Entrepreneurship for Economic Growth: Factors of Success Among University Spin-offs. *Economic Development Quarterly*, 27, 18, 19-28,
- Hayton, J.C., & Zahra, S.A., (2005). Venture team human capital and absorptive capacity in high technology new ventures. *International Journal of Technology Management*, 31, 3/4, 256–274.
- Heirman, A., & Clarysse, B., (2004). How and why do research-based start-ups differ at founding? A resource-based configurational perspective. *Journal of Technology Transfer*, 29, 247–268.
- Heirman, A., & Clarysse, B., (2005). The imprinting effect of initial resources and market strategy on the early growth path of start-ups". *Academy of Management Proceedings*, A1–A6.
- Hill, J., Nancarrow, C., Wright, L.T., (2002). Lifecycles and crisis points in smes: a case approach. *Marketing Intelligence and Planning*, 20, 6, 361–369.
- Hindle, K., & Yencken, J., (2004). Public research commercialisation, entrepreneurship and new technology based firms: an integrated model, *Technovation*, 24, 10, 793-803.
- Hodgkinson, G.P., & Healey, M.P., (2008). Cognition in organizations. *Annual Review of Psychology*, 59, 5,387–417.
- Hull, L., & Arnold, R., (2008). New Zealand firm growth as change in turnover. Wellington, NZ: Ministry of Economic Development.
- Hyvonen, S., Tuominen, M., Eralinna, L., (2004). Effects of market related assets on innovativeness and operational performance in SMEs. *International Journal of Entrepreneurship and Innovation*, 5, 3, 167.
- Ivankova, N.V., Creswell, J. W. & Sheldon, L. S., (2006, Feb.). Using Mixed-Methods Sequential Explanatory Design: From Theory to Practice. *Field Methods*, 18, 1, 3-20.
- Jensen, R., & Thursby, M., (2001). Proofs and prototypes for sale: The tale of university licensing. *American Economic Review*, 91, 1, 240–259.
- Jack, S.L. (2010). Approaches to studying networks: Implications and outcomes, *Journal of Business Venturing*, 25, 1, 120-137.

- Jain, S., George, G., & Maltarich, M., (2009). Academics or entrepreneurs? Investigating role identity modification of university scientists involved in commercialization activity, *Research Policy*, 38, 6, 922-935.
- Jones, O., & Macpherson, A., (2006). Inter-organizational learning and strategic renewal in SMEs: extending the 4i network. *Long Range Planning*, 39, 2, 155–175.
- Jo, H., & Lee, J., (1996). The relationship between an entrepreneur's background and performance in a new venture. *Technovation*, 16, 4, 161–171.
- Jovanovic, B., (1982). Selection and the Evolution of Industry. *Econometrica*, 50, 649-670.
- Kakati, M., (2003). Success criteria in high-tech new ventures. *Technovation*, 23, 5, 447–457.
- Karnani, F., (2012). The university's unknown knowledge: tacit knowledge, technology transfer and university spin-offs findings from an empirical study based on the theory of knowledge". *Journal of Technology Transfer*. DOI 10.1007/s10961-012-9251-1
- Kaulio, M.A., (2003). Initial conditions or process of development? Critical incidents in the early stages of new ventures. *R and D Management*, 33, 2, 165–175.
- Kazanjian, R.K., (1988). Relation of dominant problems to stages of growth in tech *Academy of Management Journal*, 31, 2, 257–279.
- Kent, C. A., (1982). Entrepreneurship in economic development, *Encyclopedia of entrepreneurship*, 237–256, New York: Prentice-Hall.
- Kickul, J., Gundry, K.L., Barbosa, S. L., & Whitcanack, L., (2009). Intuition versus analysis? Testing Differential Models of Cognitive Style on Entrepreneurial Self-Efficacy and New Venture Creation Process. *Entrepreneurship, Theory and Practice*, 439-453.
- Kirchhoff, B.A., Phillips, B.D. 1988: The Effect of Firm Formation and Growth on Job Creation in the United States. *Journal of Business Venturing*, 3, 4, 261 – 272.
- Klofsten, M., & Jones-Evans, D., (2000). Comparing Academic Entrepreneurship in Europe-The Case of Sweden and Ireland, *Small Business Economics*, 14, 4, 299.
- Knockaert, M, Clarysse, B, & Wright, M., (2010a). The extent and nature of heterogeneity of venture capital selection behaviour in new technology-based firms. *R&D Management* 40, 4, 357-371
- Knockaert, M., Foo, M. D., Erikson, T., & Cools, E., (2015). Growth intentions among research scientists: A cognitive style perspective. *Technovation*, 38, 64–74.
- Knockaert, M., Ucbasaran, D., Wright, M., & Clarysse, B., (2011, July). The Relationship Between Knowledge Transfer, Top Management Team Composition,

and Performance: The Case of Science-Based Entrepreneurial Firms. *Entrepreneurship Theory and Practice*, 777- 803

- Knockaert, M., Wright M., Clarysse, B., Lockett, A., (2010b). Agency and similarity effects and the VC's attitude towards academic spin-out investing. *Journal of Technology Transfer*, 35, 567–584.
- Koberg, C. S., Uhlenbruck, N., & Sarason, Y. (1996). Facilitators of organizational innovation: The role of life-cycle stage. *Journal of Business Venturing*, 11, 133-149.
- Kogut, B., (2000). The network as knowledge: generative rules and the emergence of structure. *Strategic Management Journal*, 21, 405–425.
- Koryak, O., Mole, K. F., Lockett, A., Hayton, J. C., Ucbasaran D. & Hodgkinson, G. P., (2015). Entrepreneurial leadership, capabilities and firm growth. *International Small Business Journal*, 33, 1, 89–105.
- Krabel, S. & Mueller, P. (2009). What drives scientists to start their own company?: An empirical investigation of Max Planck Society scientists, *Research Policy*, 38, 6, 947-956.
- Krishnaswami, S. & Subramaniam, V. (1999). Information asymmetry, valuation, and the corporate spin-off decision, *Journal of Financial Economics*, 53, 1, 73-112.
- Kumar, M. S., (1984). Growth, Acquisition and Investment, Cambridge: Cambridge University Press.
- Lau, C. M., & Busenitz, L. W., (2001). Growth intentions of entrepreneurs in a transitional economy: The People's Republic of China. *Entrepreneurship Theory and Practice*, 26, 5–20.
- Lant, T. K., Milliken, F. J. & Batra, B., (1992, Nov). The role of managerial learning and interpretation in strategic persistence and reorientation: An empirical exploration. *Strategic Management Journal*, 13, 8, 585–608.
- Lee, C., Lee, K., & Pennings, J. M. (2001). Internal capabilities, external networks, and performance: A study on technology-based ventures. *Strategic Management Journal*, 22, 615-640.
- Lee, D., & Tsang, E., (2001). The effects of entrepreneurial personality, background and network activities on venture growth. *Journal Of Management Studies*, 38, 4, 583-602
- Lee, G. K. (2006, August). Directions of new venture growth in their beginning years. In *Academy of Management Proceedings*, 1, J1-J6.
- Lee, Y. S. (1996). Technology transfer and the research university: a search for the boundaries of university industry collaboration. *Research Policy*, 25, 6, 843–863.

- Leitch, C., & Harrison, R., (2005). Maximising the potential of university spin-outs: the development of second order commercialisation activities. *R&D Management* 35, 257–292.
- Leitch, C., Hill, F., Neergaard, H., (2010). Entrepreneurial and Business Growth and the Quest for a “Comprehensive Theory”: Tilting at Windmills? *Entrepreneurship, Theory and Practice*, special issue, 249-260.
- Lerner, M., Brush, C., & Hisrich, R., (1997). Israeli women entrepreneurs: an examination of factors affecting performance. *Journal of Business Venturing* 12, 4, 315–339.
- Liao, J., & Welsch, H. (2003). Social capital and entrepreneurial growth aspiration: A comparison of technology- and non-technology-based nascent entrepreneurs. *Journal of High Technology Management Research*, 14, 149-170.
- Linn, S.C., & Rozeff, M.S. (1985). The Effect of Voluntary Spin-Offs on Stock Prices: The Agency Hypothesis. *Advances in Financial Planning and Forecasting*, 265-292.
- Locke, E., & Latham, G. P., (2002). Building a practically useful theory of goal setting and task motivation: A 35 year odyssey. *American Psychologist* 57, 9, 705–717.
- Love, J., & Roper, S., (2015). SME innovation, exporting and growth: a review of existing evidence. *International Small Business Journal*, 33, 1, 28–48.
- March, J.G., (1991). Exploration and exploitation in organizational learning. *Organization Science*, 2, 1, 71–87.
- Laukkanen, M., (2003). Exploring academic entrepreneurship: drivers and tensions of university-based business. *Journal of Small Business and Enterprise Development*, 10, 4, 372 - 382.
- Lechner, C., & Dowling, M., (2003). Firm networks: external relationships as sources for the growth and competitiveness of entrepreneurial firms. *Entrepreneurship & Regional Development*, 1-26.
- Lawton Smith, H. & Ho, K. (2006). Measuring the performance of Oxford University, Oxford Brookes University and the government laboratories’ spin-off companies. *Research Policy*, 35, 10, 1554-1568.
- Lindholm, D. A., (1997a, Oct). Growth and inventiveness in technology-based spin-off firms. *Research Policy*. Oct97, 26, 3, 331-345.
- Lindholm, D. A., (1997b, Oct). Entrepreneurial spin-off enterprises in Goteborg, Sweden. *European Planning Studies*, Oct97, 5, 5
- Littunen, H., & Tohmo, T., (2003). The High Growth in New Metal-Based Manufacturing and Business Service Firms in Finland. *Small Business Economics*, 21, 2, 187.

- Livingstone, P. (2007). To spin-out or not to spin-out. That's not the only question facing innovators. *R&D Magazine*, 13-13.
- Leitch, C. M., & Harrison, R. T., (2005). Maximising the potential of university spin-outs: the development of second-order commercialisation activities, *R&D Management*, 35, 3, 257-272.
- Leitch, C., Hill, F., & Neergaard, H., (2010) Entrepreneurial and business growth and the quest for a 'comprehensive theory': Tilting at windmills? *Entrepreneurship Theory and Practice*, 34, 2, 249–260.
- Link, A. N., & Scott, J. T., (2005). Opening the ivory tower's door: An analysis of the determinants of the formation of U.S. university spin-off companies. *Research Policy*, 34, 7, 1106-1111
- Link, A. N., & Scott, J. T., (2007). The economics of university research parks. *Oxford Review of Economic Policy*, 23, 4, 661-674.
- Littunen, H., (2000). Networks and local environmental characteristics in the survival of new firms. *Small Business Economics*, 15, 1, 59–71.
- Littunen, H., & Tohmo, T., (2003). The high growth in new metal-based manufacturing and business service firms in finland. *Small Business Economics*, 21, 2, 187-200.
- Löfsten, H., & Lindelöf, P., (2002). Science parks and the growth of new technology-based firms-academic-industry links, innovations and markets. *Research Policy*, 31, 859-876.
- Lockett, A. (2005). Edith Penrose's Legacy to the Resource-Based View, *Managerial & Decision Economics*, 26, 2, 83-98.
- Lockett, A., Hayton, J., Ucbasaran, D. et al., (2015). Entrepreneurial leadership, capabilities and firm growth *International Small Business Journal* 33, 1, 89–105.
- Lockett, A., Siegel, D., Wright, M. & Ensley, M.D., (2005). The creation of spin-off firms at public research institutions: Managerial and policy implications. *Research Policy*, 34, 7, 981-993.
- Lockett, A., Wiklund, J., Davidsson, P., et al. (2011). Organic and acquisitive growth: Re-examining, testing and extending Penrose's growth theory. *Journal of Management Studies*, 48, 1, 48–74.
- Lockett, A., Wright, M. (2005). Resources, capabilities, risk capital and the creation of university spin-out companies". *Research Policy*, 34, 7, 1043–1057.
- Lockett, A., Wright, M., & Franklin, S., (2003). Technology transfer and universities, spin-out strategies. *Small Business Economics*, nº.20 (2), 185.
- Lotti, F. Santarelli, E. Vivarelli, M. (2009, Jan). "Defending Gibrat's Law as a long-run regularity. *Small Business Economics*, 32, 1, 31-44.

- Lumpkin, G. T., & Dess, G. G. (1996). Clarifying the entrepreneurial orientation construct and linking it to performance. *Academy of Management Review*, 21, 1, 135–172.
- Mayring, P., (2000). Qualitative Content Analysis. *Forum: Qualitative Social Research*, 1, 2, Art. 20.
- McQueen, D. H., & Wallmark, J. T. (1982). Spin-off companies from Chalmers University of Technology. *Technovation*, 1, 4, 305–315.
- McClelland, D. C. (1961). *The achieving society*. New York: The Free Press.
- McClelland, D. C. (1965). Need of achievement and entrepreneurship: A longitudinal study. *Journal of personality and Social Psychology*, 1, 4, 389.
- Meyers, A. D., & Pruthi, S., (2011). Academic entrepreneurship, entrepreneurial universities and biotechnology. *Journal of Commercial Biotechnology*, 17, 349 – 357.
- Mole, K.F., Ghobadian, A., O'Regan, N., Liu, J., (2004). The use and deployment of soft process technologies within UK manufacturing SMEs: an empirical assessment using logit models. *Journal of Small Business Management*, 42, 3, 303–324.
- Montañez, B. Y. (2006). Factores condicionantes de la creación de spin-off universitarias: un estudio exploratorio, III Jornada de Pre-comunicaciones a Congresos de Economía y Administración de Empresas, 29 junio, Barcelona.
- Moreno, A. M., & Casillas, J. C., (2007). High-growth SMEs versus non-high-growth SMEs: A discriminant analysis. *Entrepreneurship & Regional Development*, 19, 1, 69-88.
- Markman, G. D., Gianiodis, P. T., Phan, P. H. & Balkin, D.B., (2005). Innovation speed: Transferring university technology to market. *Research Policy*, 34, 7, 1058-1075.
- McDougall, P. P., Covin, J. G., Robinson, R. B., Jr., & Herron, L. (1994). The effects of industry growth and strategic breadth on new venture performance and strategy content. *Strategic Management Journal*, 15, 537-554.
- McGee, J. E, Peterson, M, Mueller, S., L, & Sequeira. J.M., (2009). Entrepreneurial self-efficacy: Refining the measure. *Entrepreneurship Theory and Practice*, 33, 4, 965–988.
- Mcpherson, A., Holt, R. (2007). Knowledge, learning and small firm growth: A systematic review of the evidence. *Research Policy* 36, 172–192
- Miron, D. & D.C. McClelland, (1979). The impact of achievement motivation training on small business. *California Management Review*, 21, 13-28.

- Morgan, D. (1998). Practical strategies for combining qualitative and quantitative methods; Applications to health research. *Qualitative Health Research*, 8, 362-376.
- Munari, F., Toschi, L., (2010). Do venture capitalists have a bias against investment in academic spin-offs? Evidence from the micro- and nanotechnology sector in the UK. *Industrial and Corporate Change*, 20, 2, 397-432
- Mustar, P., Renault, M., Colombo, M. G., Piva, E., Fontes, M., Lockett, A., Wright, M. Clarysse, B., Moray, N., (2006). Conceptualising the heterogeneity of research-based spin-offs: A multi-dimensional taxonomy. *Research policy*, 35, 2, 289-308.
- Mustar, P., Clarysse, B., Wright, M., (2007). University spin-off firms in Europe: what have we learnt from ten years experience?. *Position Paper, Prime General Conference, Pisa, Italy, 2007*.
- Müller, K., (2010). Academic spin-off's transfer speed—Analyzing the time from leaving university to venture, *Research Policy*, 39, 2, 189-199.
- Ndonzuau, F. N., Pirnay, F. & Surlemont, B., (2002). A stage model of academic spin-off creation. *Technovation*, 22, 5, 281-289.
- Nerkar, A., & Shane, S. (2003). When do start-ups that exploit patented academic knowledge survive? *International Journal of Industrial Organization*, 21, 9, 1391-1410.
- Nicolaou, N. & Birley, S. (2003). Academic networks in a trichotomous categorisation of university spinouts, *Journal of Business Venturing*, 18, 3, 333-359.
- Nicholls-Nixon, C. L., Cooper, A. C., & Woo, C. Y., (2000). Strategic experimentation—understanding change and performance in new ventures. *Journal of Business Venturing*, 15, 5, 493-521.
- Olofson, C., & Wahlbin, C. (1984). Technology-based new ventures from technical universities: A Swedish case. *Frontiers of entrepreneurship research*, Wellesley, MA: Babson College.
- Ortín, P., Salas, V, Trujillo, M. V., & Vendrell, F., (2007). El spin-off universitario en España como modelo de creación de empresas intensivas en tecnología. Dirección general de política de la pequeña y mediana empresa. Spanish 'Ministerio de industria, turismo y comercio'.
- Ortín P. & Vendrell, F. (2010, Oct). Why do university spin-offs attract more venture capitalists? *Venture Capital*, 12, 4, 285-306
- Ortín, P. & Vendrell, F., (2014) "University spin-offs vs. other NTBFs: Total factor productivity differences at outset and evolution, *Technovation*, 34, 101-112.

- O' Cass, A., & Sok, P., (2013). The role of intellectual resources, product innovation capability, reputational resources and marketing capability combinations in SME growth. *International Small Business Journal*.
- O'Shea, R., Allen, T. J., O'Gorman, C. & Roche, F. (2004). Universities and Technology Transfer: A Review of Academic Entrepreneurship Literature, *Irish Journal of Management*, 25, 2, 11-29.
- O'Shea, R.P., Allen, T.J., Chevalier, A. & Roche, F., (2005). Entrepreneurial orientation, technology transfer and spinoff performance of U.S. universities. *Research Policy*, 34, 7, 994-1009.
- O'Shea, R. P., Allen, T. J., Morse, K. P., O'Gorman, C. and Roche, F. (2007), Delineating the anatomy of an entrepreneurial university: the Massachusetts Institute of Technology experience. *R&D Management*, 37, 1-16.
- Park, S. H., Chen, R., & Gallagher, S. (2002). Firm resources as moderators of the relationship between market growth and strategic alliances in semiconductor start-ups. *Academy of Management Journal*, 45: 527-545
- Parker, C., Winter, T., & Tabernacle, D., (2003). Learning by stealth: introducing smaller retailers to the benefits of training and education in barnet. *International Journal of Retail and Distribution Management*, 31, 9, 470-476.
- Parker, S. C. Storey D. J. & van Witeloostuijn A., (2010). "What happens to gazelles? The importance of dynamic management strategy. *Small Business Economics*, 35, 203-226.
- Patton, D., & Marlow, S., (2002). The determinants of management training within smaller firms in the UK. What Role Does Strategy Play? *Journal of Small Business and Enterprise Development*, 9, 3, 260-270.
- Perren, L., (2002). The entrepreneurial process of network development in small biotechnology firms: the case of Destiny Pharma Ltd. *International Journal of Entrepreneurship and Innovation Management*, 2, 4/5, 390.
- Penrose, E. (1959). The theory of the growth of the firm. New York: Oxford University Press.
- Pérez Pérez, M., & Martínez Sánchez, A., (2002). The development of university spin-offs: early dynamics of technology transfer and networking. *Technovation*, 23, 823-831.
- Perkmann, M., Tartari, V., McKelvey, M., et al., (2013). Academic engagement and commercialization: A review of the literature on university-industry relations, *Research Policy* 42, 423- 442,
- Pettersen, I. B., & Tobiassen, A. E., (2012). Are born globals really born globals? The case of academic spin-offs with long development periods. *Journal of International Entrepreneurship*, 10, 117-141.

- Pinch, S. & Sunley, P., (2009, Oct). Understanding the role of venture capitalists in knowledge dissemination in high-technology agglomerations: a case study of the University of Southampton spin-off cluster. *Venture Capital*, 11, 4, 311–333.
- Pirnay, F., Surlemont, B. & Nlemvo, F. (2003). Toward a Typology of University Spin-offs. *Small Business Economics*, 21, 355–369.
- Pisano, G., (1990). The R&D boundaries of the firm; An empirical analysis. *Administrative Science Quarterly*, 35, 153-176.
- Pitelis, C., (2002). The Growth of the Firm: The Legacy of Edith Penrose. *Oxford University Press*, Oxford.
- Powell, W. W., (1990). Neither market nor hierarchy: Networks forms of organization. *Research in Organizational Behavior*, 12, 295-336.
- Powers, J. B., & McDougall, P. P., (2005a). University start-up formation and technology licensing with firms that go public: A resource-based view of academic entrepreneurship. *Journal of Business Venturing*, 20, 3 , 291–311.
- Powers, J. B., & McDougall, P. P., (2005b). Policy orientation effects on performance with licensing to start-ups and small companies. *Research Policy*, 34, 7, 1028–1042.
- Pries, F., & Guild, P., (2007). Commercial exploitation of new technologies arising from university research: start-ups and markets for technology. *R&D Management* 37, 4, 319-328.
- Quintas, P., Wield, D., Massey, D., (1992). Academic-industry links and innovation: Questioning the science park model. *Technovation*, 12, 161–175.
- Rae, D., Carswell, M., (2001). Towards a conceptual understanding of entrepreneurial learning. *Journal of Small Business and Enterprise Development*, 8, 2, 150-158.
- Rauch, A., Wiklund, J., Lumpkin, G.T., & Frese, M., (2009). Entrepreneurial Orientation and Business Performance: An Assessment of Past Research and suggestions for the Future. *Entrepreneurship, Theory and Practice*, 761-787.
- Reagans, R. & Zuckerman, E., W., (2001). Networks, diversity and productivity: The social capital of corporate R&D teams. *Organizations Science*, 12, 4, 502-517.
- RedOTRI, (2010). Indicadores en transferencia de conocimiento. *Cuadernos técnicos RedOTRI*, 2010.
- RedOTRI survey, (2011). Informe de la encuesta de investigación y transferencia de conocimiento de las universidades españolas, 2011.
- Roberts, E. B., (1991). Entrepreneur in High Technology—Lessons for MIT and Beyond. *Oxford University Press*, New York.

- Roberts, E. B., & Hauptman, O., (1986). The process of technology transfer to the new biomedical and pharmaceutical firm. *Research Policy*, 15, 3, 107–119.
- Roberts, E., & Malone, D., (1996). Policies and Structures for Spinning Off New Companies from Research and Development Organizations. *R&D Management*, 26, 1.
- Robinson, K. C., & McDougall, P. P. (2001). Entry barriers and new venture performance: A comparison of universal and contingency approaches. *Strategic Management Journal*, 22, 659-685.
- Rodeiro, D., (2008). La creación de empresas en el entorno universitario español y la determinación de su estructura financiera. Doctoral Thesis. Universidad de Santiago de Compostela.
- Rodeiro Pazos, D., Fernández López, S., Otero González, L., & Rodríguez Sandiás, A. (2012). A resource-based view of university spin-off activity: new evidence from the Spanish case. *Revista Europea de Dirección y Economía de la Empresa*, 21, 3, 255-265.
- Rumelt, R., 1974. Strategy, Structure, and Economic Performance. *Harvard Business School Press*, Boston, MA.
- Rumelt, R., 1984. Towards a strategic theory of the firm. *Competitive Strategic Management*, Prentice-Hall, Englewood Cliffs (NJ).
- Rothaermel, F. T., & Thursby M. C., (2005). Incubator firm failure or graduation?: the role of university linkages. *Research Policy*, 34, 7, 1076–1090.
- Rothaermel, F.T. Shanti, D.A. & Jiang, L. (2007). University entrepreneurship: a taxonomy of the literature. *Industrial and Corporate Change*, 16, 4, 691–791.
- Roure, J. B., & Maidique, M. A., (1987). Linking prefunding factors and High-Technology venture success: An exploratory study. *Journal of Business Venturing*, 1, 295-306.
- Ruiz, J. Solé, F. & Veciana, J. M., (2004). Creación de Empresas y Universidad (1st ed.). Cádiz: Fundación Universidad Empresa de la Provincia de Cádiz.
- Sandberg, W. R. (1986). New venture performance: The role of strategy and industry structure. Lexington, MA: Lexington Books.
- Sandberg, W. R., & Hofer, C. W., (1987). Improving new venture performance: The role of strategy, industry structure, and the entrepreneur. *Journal of Business Venturing*, 2, 5-28.
- Saxenian, A., (1990). Regional networks & the resurgence of Silicon Valley. *California Management Review*, 33, 89-111.

- Saxenian, A., (1994). Regional advantage: Culture and competition in Silicon Valley and Route 128. *Cambridge, MA*: Harvard University Press.
- Scott, M., & Bruce, R., (1987). Five stages of growth in small business. *Long Range Planning*, 20, 3, 45–52.
- Sadler-Smith, E., Spicer, D.P., Chaston, I., (2001). Learning orientations and growth in smaller firms. *Long Range Planning*, 34, 2, 139-158.
- Sapienza, H. J., Parhankangas, A., & Autio, E., (2004). Knowledge relatedness and post-spin-off growth. *Journal of Business Venturing*, 19, 6 , 809-829.
- Sexton, D.L., Upton, N.B., Wacholtz, L.E., McDougall, P.P., (1997). Learning needs of growth-oriented entrepreneurs. *Journal of Business Venturing*, 12, 1, 1–8.
- Sexton, D. L., (1986). Role of Entrepreneurship in Economic Development, Entrepreneurship, Intrapreneurship, and Venture Capital, *Heath and Company*, 27–39.
- Shane, S., & Scott, M., (2002). University technology transfer to entrepreneurial companies. *Journal of Business Venturing*, 17, 6, 537-552.
- Shane, S. & Stuart T. (2002). Organizational endowments and the performance of university start-ups. *Management Science*, 48, 1, 154–170.
- Shane, S. A. (2004a). *Academic entrepreneurship: University spinoffs and wealth creation*. Edward Elgar Publishing.
- Shane, S. (2004b). Encouraging university entrepreneurship? The effect of the Bayh–Dole Act on university patenting in the United States, *Journal of Business Venturing*, 19, 1, 127-151,
- Shane, S., & Venkataraman, S., (2000). The promise of entrepreneurship as a field of research. *Academy of management review*. 25, 1, 217-226.
- Shepherd, D., & Wiklund, J., (2009). Are we comparing apples with apples or apples with oranges? Appropriateness of knowledge accumulation across growth studies. *Entrepreneurship Theory and Practice*, 33, 1, 105–123.
- Siegel, R., Siegel, E., & Macmillan, I. C., (1993, March) Characteristics distinguishing high-growth ventures. *Journal of Business Venturing*, 8, 2, 169-180.
- Siegel, D. S., Waldman, D. A., & Link, A. N., (2003a). Assessing the impact of organizational practices on the relative productivity of university technology transfer offices: an exploratory study". *Research Policy* 32, 1, 27–48.
- Siegel, D. S., Waldman, D. A., Atwater, L. E., & Link, A. N. (2003b). Commercial knowledge transfers from universities to firms: improving the effectiveness of university–industry collaboration, *Journal of High Technology Management Research*, 14, 1, 111-133.

- Sirmon D.G., Hitt M.A., Ireland R. D. and Gilbert B. A., (2011). Resource Orchestration to Create Competitive Advantage : Breadth, Depth, and Life Cycle Effects. *Journal of Management*, 37, 1390-1412.
- Smallbone, D. Leig R. & North, D., (1995). The characteristics and strategies of high growth SMEs, *International Journal of Entrepreneurial Behaviour & Research*, 1, 3, 44 – 62.
- Smilor, R. Gibson, D. V. & Dietrich, G. B. (1990). University Spin-out Companies: Technology Start-ups from UT-Austin, *Journal of Business Venturing*, 5, 1, 63-76.
- Smith, K. G., Gannon, M. J., (1987). Organizational effectiveness in entrepreneurial and professionally managed firms. *Journal of Small Business Management*, 25, 3, 14–21.
- Smith, A.J., Boocock, G., Loan-Clarke, J., & Whittaker, J., (2002). IIP and SMEs: awareness, benefits and barriers. *Personnel Review*, 31, 1, 62–85.
- Soetano, D. P., van Geenhuizen M., (2009). Social networks and competitive growth of university spin-off firms: a tale of two contrasting cities. *Tijdschrift voor Economische en Sociale Geografie*, 100, 2, 198–209.
- Spender, J. C., (1989). *Industry recipes: the nature and source of management judgement*. Basil Blackwell, Oxford.
- Spender, J. C., & Grant, R. M., (1996). Knowledge and the Firm: Overview. *Strategic Management Journal*, Winter, Special Issue, 17, 5-9.
- Stankiewicz, R., (1986). *Academic Entrepreneurs: Developing University-Industry Relations*, London: Frances Pinter Publishers.
- Stankiewicz, R., (1994). Spin-off companies from universities, *Science and Public Policy*, 21, 2, 99-107.
- Starr, J. A., & MacMillan. I. C., (1990). Resource cooptation via social contracting: Resource acquisition strategies for new ventures. *Strategic Management Journal*, 11, 79–92.
- Steffensen, M., Rogers, E., & Speakman, K. (2000). Spin-offs from research centers at a research university. *Journal of Business Venturing*, 15, 1, 93–111.
- Sternberg, R. J., (1997). *Successful Intelligence*. Plume, New York.
- Sternberg, R. J. (2004). Successful intelligence as a basis for entrepreneurship. *Journal of Business Venturing*, 19, 189–202.
- Stinchcombe, A. L., (1965). *Organizations and Social Structure*. *Handbook of Organizations*. Chicago: Rand McNally. 153–193.

- Storey, D. J., (1982). Impact on the local economy. *Entrepreneurship and the new firm*, 9, 167–180.
- Storey, D. J., (1988). The role of small and medium-sized enterprises in european job creation: Key issues for policy and research. *Small and medium size enterprises and regional development*, 140–160.
- Storey, D. J., (1994). Understanding the small business sector. *Employment*, 160–203, London: Routledge.
- Sutton, J., (1997). Gibrat's Legacy, *Journal of Economic Literature*, 35, 1, 40-59.
- Tashakkori, A., & Teddlie, C. (1998). Mixed methodology: Combining qualitative and quantitative approaches. *Applied Social Research Methods*, 46. Thousand Oaks, CA: Sage.
- Teece, D. J., Pisano, G., & Shuen, A., (1997). Dynamic capabilities and strategic management. *Strategic Management Journal*, 18, 509–533.
- Teruel Carrizosa, M., (2006). *Firm growth, persistence and multiplicity of equilibria: an analysis of Spanish manufacturing and service industries*. Doctoral Thesis. Universitat Rovira i Virgili. Departament d'Economia.
- Terziovski, M., (2002). The relationship between networking practices and business excellence: a study of small to medium enterprises (SMEs). *Measuring Business Excellence*, 7, 2, 78–92.
- Tiler, C., Metcalfe, S., Connell, D., 1993. Business expansion through entrepreneurship: the influence of internal and external barriers to growth. *International Journal of Technology Management*, 15–52.
- Tjosvold, D., & Weicker, D., (1993). Cooperative and competitive networking by entrepreneurs: a critical incident study. *Journal of Small Business Management*, 31, 1, 11–21.
- Unger, J. M., Rauch, A., Frese, M., & Rosenbusch, N., (2011). Human capital and entrepreneurial success: A meta-analytical review. *Journal of Business Venturing*, 26, 3, 341–358.
- Urbano, D. & Guerrero, M., (2013). Entrepreneurial Universities: Socioeconomic Impacts of Academic Entrepreneurship in a European Region. *Economic Development Quarterly*, 40-55.
- Van Auken, H. (2005). Differences in the usage of bootstrap financing among technology-based versus nontechnology-based firms. *Journal of Small Business Management*, 43, 93–103.
- Van Geenhuizen, M. & Soetanto, D. P. (2009). Academic spin-offs at different ages: A case study in search of key obstacles to growth. *Technovation*, 29, 10, 671-681.

- Vanacker, T., Manigart, S., Meuleman, M., & Luc Sels, L., (2011, Dec). A longitudinal study on the relationship between financial bootstrapping and new venture growth. *Entrepreneurship & Regional Development*, 23, 9–10, 681–705.
- Veld, C., & Veld-Merkoulova, Y. V., (2004). Do spin-offs really create value? The European case. *Journal of Banking & Finance*, 28, 5, 1111-1135.
- Veld., C., & Veld-Merkoulova, Y. V., (2009). Value creation through spin-offs: A review of the empirical evidence. *International journal of management reviews*, 11, 4, 407–420.
- Vincett, P. S., (2010). The economic impacts of academic spin-off companies, and their implications for public policy. *Research Policy*, 39, 6, 736-747.
- Vissa, B., & Chacar, A. S., (2009). Leveraging ties: The contingent value of entrepreneurial teams' external advice networks on Indian software venture performance. *Strategic Management Journal*, 30, 11, 1179–1191.
- Vohora, A., Wright, M. & Lockett, A. (2004). Critical junctures in the development of university high-tech spinout companies, *Research Policy*, 33, 1, 147.
- Wagner, J., (1992). Firm size, firm growth, and the persistence of chance: Testing Gibrat's Law with establishment data for Lower Saxony, 1978–1989. *Small Business Economics*, 4, 125–132.
- Walter, A., Auer, M., Ritter, T., (2006). The impact of network capabilities and entrepreneurial orientation on university spin-off performance. *Journal of Business Venturing*, 21, 541– 567.
- Walter, A., Parboteeah, K. P., Riesenhuber F., & Hoegl, M., (2011). Championship Behaviors and Innovations Success: An Empirical Investigation of University Spin-Offs. *Journal of Production, Innovation and Management*, 28, 586–598.
- Wasserman, N., (2006). Stewards, agents, and the founder discount: Executive compensation in new ventures. *Academy of Management Journal*, 49, 5, 960-976.
- Watts, G., Cope, J., & Hulme, M., (1998). Ansoff's matrix, pain and gain growth strategies and adaptive learning among small food producers. *International Journal of Entrepreneurial Behaviour and Research*, 4, 2, 101–111.
- Weinstein, A., Nicholls, J. A. F., & Seaton, B., (1992). An evaluation of SBI marketing consulting: the entrepreneur's perspective. *Journal of Small Business Management* 30, 4, 62–71.
- Wennberg, K., Wiklund, J., & Wright, M., (2011). The effectiveness of university knowledge spillovers: Performance differences between university spinoffs and corporate spinoffs. *Research Policy*, 40, 1128– 1143.
- Wennekers, S. & Thurik, R. (1999). Linking entrepreneurship and economic growth. *Small Business Economics*, 13, 1, 27–55.

- Wernerfelt, B., (1984, Jun). A Resource-Based View of the Firm. *Strategic Management Journal*, 5, 2, 171-180.
- West, G. P., & Meyer, G. D., (1998). To agree or not to agree? Consensus and performance in new ventures. *Journal of Business Venturing*, 13, 395-422.
- Westhead, P., & Storey, D., (1994). An Assessment of Firms Located On and Off Science Parks in the United Kingdom. London: HMSO.
- White, S. B., & Reynolds, P. D., (1996). Government programs and high growth new firms". *Frontiers of Entrepreneurship Research*, 621-635.
- Wiklund, J., & Shepherd, D., (2003). Aspiring for, and achieving growth: The moderating role of resources and opportunities. *Journal of Management Studies*, 40, 8, 1919-1941.
- Wiklund, J., Davidsson, P., & Delmar, F., (2003). What do they think and feel about growth? An expectancy-value approach to small business managers' attitudes towards growth. *Entrepreneurship Theory & Practice*, 26, 247-270.
- Winborg, J., & Landström, H., (2001). Financial bootstrapping in small businesses: Examining small business managers' resource acquisition behaviors. *Journal of Business Venturing*, 16, 235-54.
- Winter, S. G., (2003). Understanding dynamic capabilities. *Strategic Management Journal*, 24, special issue, 991-995.
- Wood, M. S., (2009). Does One Size Fit All? The Multiple Organizational Forms Leading to Successful Academic Entrepreneurship, *Entrepreneurship: Theory & Practice*, 33, 4, 929-947.
- Wright, M., Clarysse, B., & Mosey, S., (2012, Oct). Strategic entrepreneurship, resource orchestration and growing spin-offs from universities. *Technology Analysis & Strategic Management*, 24, 9, 911-927.
- Wright, M., Lockett, A., Clarysse, B. & Binks, M. (2006). University spin-out companies and venture capital. *Research Policy*, 35, 4, 481-501.
- Wright, M., Piva, E., Mosey, S., & Lockett, A., (2009). Academic entrepreneurship and business schools. *Journal of Technology Transfer*, 34, 560-587.
- Wright, M., & Stigliani, I., (2013, Feb). Entrepreneurship and growth. *International Small Business Journal*, 31, 1, 3-22
- Wright M., Vohora, A. & Lockett A., (2004). The Formation of High-Tech University Spinouts: The Role of Joint Ventures and Venture Capital Investors. *Journal of Technology Transfer*, 29, 287-310.

- Wyer, P., & Mason, J., (1998). An organisational learning perspective to enhancing understanding of people management in small businesses. *International Journal of Entrepreneurial Behaviour and Research*, 4, 2, 112–128.
- World Economic Forum, 2011. Global Competitiveness Index 2011. Retrieved from <http://www.weforum.org/issues/global-competitiveness>.
- Young, G., Sapienza, H., Baumer, D., (2003). The influence of flexibility in buyer-seller relationships on the productivity of knowledge. *Journal of Business Research*, 56, 6, 443–451.
- Zacharakis, A., Meyer, D., & DeCastro, J., (1999). Differing perceptions of new venture failure: a matched exploratory study of venture capitalists and entrepreneurs. *Journal of Small Business Management* 37, 3, 1–14.
- Zahra, S., & Bogner, W. (1999). Technology strategy and software new ventures' performance: Exploring the moderating effects of the competitive environment. *Journal of Business Venturing*, 15, 135-173.
- Zahra, S., & Pearce, J., (1989, June). Boards of Directors and Corporate Financial Performance: A Review and Integrative Model. *Journal of Management*, 15, 2, 291-334.
- Zahra, S., Van de Velde, E., & Larraneta, B., (2007). Knowledge conversion capability and the growth of corporate and university spinoffs. *Industrial and Corporate Change*, 16, 4, 569–608.
- Zhang, F., (2009). The performance of university spin-offs: an exploratory analysis using venture capital data" *Journal of Technology Transfer*, 34, 255–285.
- Zollo, M., & Winter, S., (2002). Deliberate learning and the evolution of dynamic capabilities. *Organization Science*, 13, 3, 339–351.

## ANNEX I

### INTERVIEW PROTOCOL

*Los textos en azul representan posibles ejemplos para aclarar la pregunta en caso de que haya dudas en su interpretación y como ayuda al entrevistado.*

#### The Founding Process

*P: ¿Quiénes fueron los actores que promovieron la creación de la empresa?*

*P: ¿Cuáles fueron las motivaciones de los promotores: oportunidad o necesidad?*

*P: ¿Cuáles fueron los acontecimientos o decisiones acertadas que desde el inicio hasta la actualidad*

- Considera que han sido fundamentales / decisivos para la compañía?*
- han impulsado el crecimiento?*

#### Industry Structure

*P:: ¿Qué posición ocupan en el sector? Hábleme de su modelo de negocio y el de la competencia, en qué se basan las empresas y la suya para que su producto/servicio se venda más...*

*P: ¿Cuál es su principal ventaja competitiva?*

*P: ¿Cuál es el crecimiento del sector? ¿Es un sector maduro?*

*P: ¿Cuáles son los principales obstáculos o barreras que limitan o impiden el crecimiento?*

Composició TMT, CA, CD en cada etapa Cambios en el accionariado y en el comité de dirección desde la creación.

*P: ¿Quién compone el Consejo de Administración/comité de dirección? ¿Qué perfil tienen? En cada etapa... especialmente en la etapa final ¿Quién propone los miembros del CA(redes)?*

*P: ¿Cuál ha sido/es el papel de los siguientes actores?*

- Profesor con dedicación exclusiva a la empresa, tiempo parcial, sólo accionista sin gestión?*
- Universidad? Capital Riesgo?*
- Surrogate entrepreneur, privileged testimonies (TTO's, teachers...)*

*P: ¿Qué % tiene en la actualidad cada uno?*

*P: A su juicio y si no tuviera ninguna restricción alguna ¿cómo tendría que estar formado el CA para que la empresa tuviera más opciones de crecimiento?*

*P: ¿Cree que todos los componentes tienen la misma involucración, compromiso? ¿Cree que hay conflictos e intereses entre los miembros del Board-TMT?*

*P: ¿Qué sistemas de incentivos/modelo de retribución tienen los componentes del TMT/CA? ¿La dedicación del TMT/board es a tiempo completo / parcial?*

*P: ¿Cómo se realiza la toma de decisiones en su empresa? ¿Analítica o intuitiva? ¿individual o consensuada? ¿qué ventajas o inconvenientes tiene? ¿Quién manda?*

*P: ¿Cómo gestionan el riesgo los componentes del TMT / Board? Cuando hay que tomar decisiones que pueden comportar grandes beneficios pero también riesgos ¿considera que sus directivos están más dispuestos a asumir estos riesgos o son más bien conservadores? ¿Qué nivel de aversión al riesgo tienen?*

*P: ¿En qué medida considera importante la composición y actuación del CA en el crecimiento de la compañía?*

Visión sobre el crecimiento del TMT, Board

*P: ¿A su juicio considera su empresa “de éxito”? ¿Por qué? ¿Considera satisfactorio su nivel de crecimiento? ¿Se han cumplido sus expectativas? ¿Querría crecer/haber crecido mucho más y ha puesto los recursos para ello?*

*P: ¿Cuáles cree que son las claves del crecimiento de su empresa? ¿Cuáles cree que son las variables que más han influido en su caso? Coméntelas*

#### *INTERNOS*

- *Recursos Financieros*
- *Recursos Humanos / Directivos*
- *Recursos Comerciales*
- *Conocimientos*
- *Tenemos una estrategia para crecer*
- *Nuestro modelo de negocio*
- *Creación de una ventaja competitiva*
- *Hemos entendido que crecer es una necesidad*
- *Presencia de la universidad en la empresa. ¿Por qué? ¿Qué ha aportado al crecimiento?*
- *Presencia del TMT en la empresa*
- *Presencia del académico en la empresa*
- *Presencia de un emprendedor externo en la empresa*
- *Presencia del VC en la empresa*
- *Presencia del sector en la empresa*
- *Composición del TMT / Board*
- *Red de contactos. De quien son estos contactos*

#### *EXTERNOS*

- *Había una oportunidad en el sector*
- *El sector es ha crecido y hemos crecido con él*
- *Ayuda de la universidad/TTO*
- *Ayuda del VC*

*Hemos crecido porque*

- *Hemos visto una oportunidad*
- *Hemos tenido la habilidad de crecer*
- *Hemos tenido la necesidad de crecer*

### **Crecimiento desde el punto de vista cognitivo**

*P: ¿si a usted le dijeran que el crecimiento de una empresa es sencillo y fácil y que no tiene riesgos que les diría al respecto?*

- *Crecer es un proceso sencillo y fácil*
- *Crecer no tiene riesgos*

*P: Qué ventajas e inconvenientes ve en el crecimiento?*

*P: ¿En qué medida considera que su empresa ha crecido lo que ha querido o ha crecido lo que ha podido? Hemos crecido lo que hemos querido / Hemos crecido lo que hemos podido. Razone la respuesta.*

## Universidad

*P: ¿Qué tipo de tecnología ha transferido desde la universidad?*

- *Novedosa*
- *Codificada o tácita*
- *Con protección de patentes o no*
- *Tecnología de aplicación amplia o estrecha*

*P: ¿En qué ha consistido el apoyo de la Universidad en las distintas etapas de la empresa?*

- *Porcentaje*
- *Inversión*
- *Grado de intervención*
- *Exigencia de resultados*

*P: ¿Cómo valoraría este apoyo? ¿Qué ventajas considera que ha disfrutado por la relación con la universidad comparado con haber desarrollado la empresa sin el apoyo de la universidad?*

*P: ¿Qué problemas o inconvenientes ha tenido?*

*P: ¿En qué ámbitos considera que le ha ayudado? Tecnología, comercial, crecimiento, financiero, RRHH, operaciones.*

## Venture Capital

*P: ¿Qué opina sobre las empresas de capital riesgo? ¿Aceptaría tener como socio a una?*

*P: En caso de que tenga VC en el capital ¿En qué medida ha ayudado a su empresa a crecer?*

En caso de que tenga un socio Industrial en el capital

*P: ¿En qué medida ha ayudado a su empresa a crecer?*

En caso de que tenga un Surrogate Entrepreneur en el capital

*P: ¿En qué medida ha ayudado a su empresa a crecer?*

## Académico

*P: ¿Qué dedicación ha tenido a la empresa en cada etapa?*

*P: ¿Hasta qué punto se siente emprendedor o docente?* Estrategias de protección: buffering and delegating

*P: ¿Siendo usted académico por qué creó la empresa? ¿Cuáles eran sus objetivos personales?*

- *Difusión de la tecnología*
- *Desarrollo tecnológico*
- *Ganar dinero*
- *Servicio a la sociedad*
- *Reconocimiento entre colegas de la universidad, sociedad*

*P: ¿Hasta qué punto considera que los ha conseguido?*

## Estrategia de Crecimiento

*P: Por supuesto que a todas las empresas les gusta crecer, pero... ¿a toda costa? ¿Qué inconvenientes o problemas ve el crecimiento? ¿hasta qué punto su empresa ha sufrido estos problemas? ¿Qué afirmación responde mejor a sus objetivos? ¿Hasta*

*qué punto prefiere una empresa que pueda gestionar con facilidad o una empresa con el máximo crecimiento?*

*P: ¿hay algún documento de planificación estratégica y sus objetivos? ¿Por qué estos objetivos? ¿Cuáles han sido las motivaciones? ¿Hay objetivos de crecimiento de ventas, cuota de mercado...? ¿Se han conseguido?*

*P: ¿Cómo se realiza la comercialización? ¿Qué estrategia comercial sigue?*

*P: ¿Dónde cree que está el punto fuerte de su empresa? ¿Y el más débil?*

- Técnico
- Financiero
- Comercial-Marketing
- Operaciones

## Tecnología

*P ¿Cómo se ha transferido el know-how de la universidad?*

*P: ¿Hasta qué punto la universidad colabora en el desarrollo de la tecnología desde que se ha creado la SO?*

*P: ¿La tecnología transferida permite su aplicación inmediata en productos o servicios comercializables? ¿se amplía con múltiples aplicaciones? ¿o ha desarrollado concretamente una aplicación comercializable?*

*P: La estrategia de explotación de la tecnología está orientada a vender la tecnología o a fabricar productos con esta tecnología (markets of technology/product markets)*

## Orientación emprendedora

*P: ¿Cree que su organización tiene una importante cultura emprendedora? ¿En qué ámbitos?*

- *el comportamiento emprendedor es un principio fundamental*

- *la gente es muy dinámica*
- *la innovación se enfatiza continuamente*
- *la gente quiere tomar riesgos*
- *la gente está deseando llegar los primeros al mercado*

*P: ¿Han desplegado alguna medida para formentar la innovación y el espíritu emprendedor en su organización?*

## Network Capability

*P: ¿Considera importante fomentar y dedicar recursos a establecer relaciones con socios estratégicos? ¿Con qué tipo de socios?*

- *Comercial*
- *Competencia*
- *Proveedores de producto*
- *Proveedores de tecnología*
- *Financieros*
- *Universidad*
- *Instituciones /gobierno*

*P: ¿Hasta qué punto considera que éstas relaciones han influido en el crecimiento de la empresa?*

## Network Type

*P: ¿Qué redes de contactos utiliza en la actualidad o ha utilizado recientemente?*

*Cite entre 4 ejemplos*

*P: Para cada ejemplo (un ejemplo tiene que ser la universidad y el VC, si no lo cita, sacarlo):*

- *Densidad de la red: ¿Se conocen entre ellos? ¿Cuánta gente tiene contacto en la organización?*
- *Heterogeneidad: ¿son muy diferentes los integrantes de esta red?*

- *Agujeros estructurales: ¿Considera que la competencia-clientes-proveedores tiene acceso a esta red? ¿tiene el mismo nivel de confianza, relación?*
- *Intensidad del enlace:*
  - *Su relación con esta red es “de plena confianza, dándoles y recibiendo toda la información”*
  - *Frecuencia: diaria, semanal, mensual...*
- *Contenido del enlace: qué información se intercambian?*

## Nivel de confidencialidad de los datos para la tesis

*Citas?*

*Citas anónimas?*

*Nombre de la empresa?*

ANNEX II

PRE-CODIFICATION MATRIX. INITIAL CODES.

Personal code
Literature review code
Interview code

GROWTH FROM THE MANAGERS PERSPECTIVE		
Themes	Interview Questions	Initial Code
The Founding Process	<p>P: ¿Quiénes fueron los actores que promovieron la creación de la empresa?</p> <p>P: ¿Cuáles fueron las motivaciones de los promotores: oportunidad o necesidad?</p> <p>P: ¿Cuáles fueron los acontecimientos o decisiones acertadas que desde el inicio hasta la actualidad</p> <p>- Considera que han sido fundamentales / decisivos para la compañía?</p> <p>- han impulsado el crecimiento?</p>	<p>Need, Opportunity, risk taking, opportunity costs, Entrepreneurial Orientation (EO), Entrepreneurial Experience (EE), Industry Experience (IE), Academic Experience (AE), role identity conflict, team cohesion, surrogate entrepreneur</p> <p>-----</p> <p>growth triggers/catalysts</p> <p>age and size</p> <p>-----</p> <p>Sources of resources: Internal vs. External</p> <p>Mode of funding / Level of investment</p> <p>Type of strategy to access missing resources</p> <p>Resources availability conditions strategy</p> <p>SO type: incumbent backed, necessity SO or opportunity SO</p> <p>-----</p> <p>type of company: growth due to company type changes or being same type (consulting, services, distribution, manufacturing)</p> <p>status of individuals involved (teacher / student)</p>
Industry Structure	<p>P: ¿Qué posición ocupan en el sector? Hábleme de su modelo de negocio y el de la competencia, en qué se basan las empresas y la suya para que su producto/servicio se venda más...</p> <p>P: ¿Cuál es su principal ventaja competitiva?</p> <p>P: ¿Cuál es el crecimiento del sector? ¿Es un sector maduro?</p> <p>P: ¿Cuáles son los principales obstáculos o barreras que limitan o impiden el crecimiento?</p>	<p>Industry Growth, Industry Structure, Strategic Decisions, External Growth Barriers (financial, marketing, human, management...)</p> <p>multiple and external licenses</p> <p>business model</p>
TMT, board composition	<p>P: ¿Quién compone el Consejo de Administración/comité de dirección? ¿Qué perfil tienen? En cada etapa... especialmente en la etapa final ¿Quién propone los miembros del CA(redes)?</p> <p>P: ¿Cuál ha sido/es el papel de los siguientes actores?</p> <p>P: ¿Qué % tiene en la actualidad cada uno?</p> <p>P: A su juicio y si no tuviera ninguna restricción alguna ¿cómo tendría que estar formado el CA para que la empresa tuviera más opciones de crecimiento?</p> <p>P: ¿Cree que todos los componentes tienen la misma involucración, compromiso? ¿Cree que hay conflictos de intereses entre los miembros del Board-TMT?</p> <p>P: ¿Qué sistemas de incentivos/modelo de retribución tienen los componentes del TMT/CA? ¿La dedicación del TMT/board es a tiempo completo / parcial?</p> <p>P: ¿Cómo se realiza la toma de decisiones en su empresa? ¿Analítica o intuitiva? ¿individual o consensuada? ¿qué ventajas o inconvenientes tiene? ¿Quién manda?</p> <p>P: ¿Cómo gestionan el riesgo los componentes del TMT / Board? Cuando hay que tomar decisiones que pueden comportar grandes beneficios pero también riesgos ¿considera que sus directivos están más dispuestos a asumir estos riesgos o son más bien conservadores? ¿Qué nivel de aversión al riesgo tienen?</p> <p>P: ¿En qué medida considera importante la composición y actuación del CA en el crecimiento de la compañía?</p>	<p>Teacher FTE</p> <p>Teacher PTE</p> <p>Teacher SHA</p> <p>Teacher Board</p> <p>University</p> <p>VC</p> <p>TTO</p> <p>initial TMT size</p> <p>initial TMT composition</p> <p>team dynamism</p> <p>team homogeneity/heterogeneity</p> <p>Sources of resources: Internal vs. External</p> <p>Sources of incorporations to TMT: social networks of board chair</p> <p>Friends</p> <p>Family</p> <p>University Coleagues</p> <p>-----</p> <p>risk view</p> <p>founder decision taking</p> <p>knowledge gaps</p> <p>social capital gap</p> <p>board incorporations ability</p>

**PRE-CODIFICATION MATRIX. INITIAL CODES.**

Personal code  
 Literature review code  
 Interview code

GROWTH FROM THE MANAGERS PERSPECTIVE		
Themes	Interview Questions	Initial Code
TMT, Board, growth vision	<p>P: ¿A su juicio considera su empresa “de éxito”? ¿Por qué? ¿Considera satisfactorio su nivel de crecimiento? ¿Se han cumplido sus expectativas? ¿Querría crecer/haber crecido mucho más y ha puesto los recursos para ello?</p> <p>P: ¿Cuáles cree que son las claves del crecimiento de su empresa? ¿Cuáles cree que son las variables que más han influido en su caso? Coméntelas</p>	Team Cohesion Team Heterogeneity TTO help and vision Research staff quality Entrepreneur University culture multiple and external licenses outside management, joint ventures with other companies, previous faculty consulting experience Financial Resources Management, Human Resources, TMT Commercialization Resources Knowledge We have a growth strategy Bussiness model change Competitive advantage creation We are Growth Oriented. Growth is a Need Surrogate entrepreneur External presence in board (University, VC, private Equity) Previous company activities in the industry TMT / Board Composition Networks. Social Capital External aid from government External aid from university Industry dynamism and growth
Growth from a cognitive view	<p>P: ¿sí a usted le dijeran que el crecimiento de una empresa es sencillo y fácil y que no tiene riesgos que les diría al respecto?</p> <p>P: Qué ventajas e inconvenientes ve en el crecimiento?</p> <p>P: ¿En qué medida considera que su empresa ha crecido lo que ha querido o ha crecido lo que ha podido?</p>	Growth Aspiration. Growth Intention. Risk taking Need of achievement ----- We have growth because • We had an opportunity • We had the ability to grow • We needed to grow
University	<p>P: ¿Qué tipo de tecnología ha transferido desde la universidad?</p> <p>P: ¿En qué ha consistido el apoyo de la Universidad en las distintas etapas de la empresa?</p> <ul style="list-style-type: none"> <li>• Porcentaje</li> <li>• Inversión</li> <li>• Grado de intervención</li> <li>• Exigencia de resultados</li> </ul> <p>P: ¿Cómo valoraría este apoyo? ¿Qué ventajas considera que ha disfrutado por la relación con la universidad comparado con haber desarrollado la empresa sin el apoyo de la universidad?</p> <p>P: ¿Qué problemas o inconvenientes ha tenido?</p> <p>P: ¿En qué ámbitos considera que le ha ayudado? Tecnología, comercial, crecimiento, financiero, RRHH, operaciones.</p>	University support Newness of technology transferred Tacit or codified technology Patents Wide or narrow use of technology
Venture Capital	<p>P: ¿Qué opina sobre las empresas de capital riesgo? ¿Aceptaría tener como socio a una?</p> <p>P: En caso de que tenga VC en el capital ¿En qué medida ha ayudado a su empresa a crecer?</p>	ability to attract VC VC influence on board VC active role
Industry Partner	<p>P: ¿En qué medida ha ayudado a su empresa a crecer?</p>	Industry Partner * knowledge * abilities * resources
Surrogate Entrepreneur	<p>P: ¿En qué medida ha ayudado a su empresa a crecer?</p>	Surrogate entrepreneur * knowledge * abilities * resources

**PRE-CODIFICATION MATRIX. INITIAL CODES.**

Personal code
Literature review code
Interview code

GROWTH FROM THE MANAGERS PERSPECTIVE		
Themes	Interview Questions	Initial Code
Academic	P: ¿Qué dedicación ha tenido a la empresa en cada etapa? P: ¿Hasta qué punto se siente emprendedor o docente? Estrategias de protección: buffering and delegating P: ¿Siendo usted académico por qué creó la empresa? ¿Cuáles eran sus objetivos personales? P: ¿Hasta qué punto considera que los ha conseguido?	Academic objectives * knowledge sharing * Technological development * Earn money * A service to society * Colleagues recognition
Growth Strategy	P: Por supuesto que a todas las empresas les gusta crecer, pero... ¿a toda costa? ¿Qué inconvenientes o problemas ve el crecimiento? ¿hasta qué punto su empresa ha sufrido estos problemas? ¿Qué afirmación responde mejor a sus objetivos? ¿Hasta qué punto prefiere una empresa que pueda gestionar con facilidad o una empresa con el máximo crecimiento? P: ¿hay algún documento de planificación estratégica y sus objetivos? ¿Por qué estos objetivos? ¿Cuáles han sido las motivaciones? ¿Hay objetivos de crecimiento de ventas, cuota de mercado...? ¿Se han conseguido? P: ¿Cómo se realiza la comercialización? ¿Qué estrategia comercial sigue? P: ¿Dónde cree que está el punto fuerte de su empresa? ¿Y el más débil?	Functional area of intended growth • Technical • Financial • Sales-Marketing • Operations ----- Internationalisation Acquisitions Focus Strategy in a single product Leaner HR structure Objectives: Exploitative vs. Explorative / Ambition to grow or not Strategy influences growth Resources availability conditions strategy Product or services company Market for technology (licensing) or Market for products ----- Growth Triggers/Catalysts
Technology	P: ¿Cómo se ha transferido el know-how de la universidad? P: ¿Hasta qué punto la universidad colabora en el desarrollo de la tecnología desde que se ha creado la SO? P: ¿La tecnología transferida permite su aplicación inmediata en productos o servicios comercializables? ¿se amplía con múltiples aplicaciones? ¿o ha desarrollado concretamente una aplicación comercializable? P: La estrategia de explotación de la tecnología está orientada a vender la tecnología o a fabricar productos con esta tecnología (markets of technology/product markets)	Kind of technology, Transfer process, Degree of Development, TT Type, Type of innovation Narrow focused Explorative and exploitative activities (March, 1991)
Entrepreneurship Orientation	P: ¿Cree que su organización tiene una importante cultura emprendedora? ¿En qué ámbitos? seando llegar los primeros al mercado P: ¿Han desplegado alguna medida para fomentar la innovación y el espíritu emprendedor en su organización? Percepción EO en base a: • el comportamiento emprendedor es un principio fundamental • la gente es muy dinámica • la innovación se enfatiza continuamente • la gente quiere tomar riesgos • la gente está deseando llegar los primeros al mercado	EO decrease over time

**PRE-CODIFICATION MATRIX. INITIAL CODES.**

Personal code
Literature review code
Interview code

GROWTH FROM THE MANAGERS PERSPECTIVE		
Themes	Interview Questions	Initial Code
Network Capability	P: ¿Considera importante fomentar y dedicar recursos a establecer relaciones con socios estratégicos? ¿Con qué tipo de socios? P: ¿Hasta qué punto considera que éstas relaciones han influido en el crecimiento de la empresa?	Personal Social network/Professional network Relationship with parent after-startup Contacts with industry and finance Sources of resources: Internal vs. External Ability to build relationships (networks) affect growth Firms are dependant on networking of board members * Commercialization * Competitors * Product supplier * Technology partner * Financial * University * Government and Private and Public institutions
Network Type	P: ¿Qué redes de contactos utiliza en la actualidad o ha utilizado recientemente? Cite entre 4 ejemplos P: Para cada ejemplo (un ejemplo tiene que ser la universidad y el VC, si no lo cita, sacarlo):	Cohesion

## ANNEX III

The screenshot displays the EdEt 2.1.99.1 software interface. The main window shows a text document with several paragraphs of text, some of which are highlighted in yellow and pink. The left sidebar contains a codebook with a hierarchical structure of codes. The right sidebar shows a list of codes associated with the highlighted text segments.

**Codebook (Left Sidebar):**

- Codes:
- Fold
- [-] catalonian HGASO characteristics
  - no patents. tacit knowlegde
  - Initial industry activities before
  - [-] TMT composition
    - Core team has worked tog
    - Initial team of researchers
    - Experienced industry man:
    - Academics not in the TMT
  - Product / Services
  - [-] University support
    - Facilities/Equipment
    - Credibility. Technical com
  - Scarce academic, research opp
  - Compromiso personal, dedica
  - Financial support government
  - Conservative Financial Strateg
- [-] Variables
  - Intrapersonal variables
  - Company variables
  - External variables
- [-] Team incorporations
- [-] Growth triggers/catalists
  - Adquisitions
  - Big technical improvement
  - Industry Partnership
  - Big financial support
  - TMT incorporations
  - Agressive strategy implement
  - Internationalization
  - Growth strategy

**Text Document (Main Window):**

15 tampoc té el temps per dedicar-s'hi. Jo m'hi jugava la pell. Va ser una de les claus per que el Cidem recolzes i ens dones una subvenció important i va ser per això.

16 Tecnoquiralt no tenia cap patent, sinó que aquestes eren dels clients. L'empresa està composta encara per quatre socis fundadors. Miquel Ramblas, jo i dos professors més.

17 La TT és el coneixement d'aquests professors. El Miquel volia que un extern (jo) portes l'empresa. Els professors es van mantenir al marge de la gestió de l'empresa. Sempre hem pensat que aquesta combinació es una part clau en l'èxit d'Enantia perquè els clients ens han vist com a algú que tenint el coneixement universitari (aporten com a coneixement científic), ens veuen com a gent d'empresa.

18 El Miquel va posar com a condició que la universitat tingues una part d'accions, que va cedir gratuïtament un 10% a la Universitat. D'aquesta manera es justifica una mica la col·laboració dels professors. Legalment queda coberta una possible col·laboració. De fet la universitat ha cobrat dividends de PharmaSint.

19 La filosofia d'Enantia és anar més enllà de l'empresa de serveis i començar a fer recerca per ell mateix i no per una empresa externa. Enantia com que donava serveis ja tenia uns ingressos i va decidir que una part d'aquests diners els invertiria en desenvolupar tecnologia pròpia. Estimem que 15% es reinverteix en tecnologia pròpia de la qual surten patents (pròpies) que es transfereixen o exploten o es venen. Te una part de risc. Ho vam començar a fer des del segon any. Va també bé perquè ens serveix de buffer per compensar períodes de temps amb menys feina, donant prioritat als ingressos dels clients. També fidelitzem als treballadors i els podem mantenir treballant. Tenim una plantilla estable.

20 La part de serveis té èxit perquè la gent ens veu perquè tenim un coneixement absolutament actualitzat però una gestió d'empresa privada i això internacionalment ho valoren molt: fas projectes més basats amb objectius, estas a sobre del timing, procures industrialitzar el projecte, focalitzar-lo, etc.

21 De fet la segona persona que vam incorporar al staff directiu, en Joan Feixes, també venia de la industria privada. A mi m'agrada més la part científica que la part de gestió així que quan va entrar ell el vaig posar més en la part comercial, financera i administrativa (té un mba) i es va incorporar fa 9 anys, al tercer any d'Enantia.

22 Des de fa 1,5 anys vaig cedir amb ell la direcció general i jo em quedo com a director tècnic. Tecnoquiralt tenia 4 persones tres que van entrar i jo com a DG.

23 E. Sector. factors que limiten el creixement.

24 Treballem pel sector farmacèutic. Eren anys bons. El gran obstacles és la limitació de preus amb els genèrics, ha baixat molt la inversió. Nosaltres creixem molt mes a nivell internacional.

25 E. Heu necessitat una gran inversió per muntar Enantia?

26 No, Parc Científic de Barcelona ha permès que nosaltres puguem muntar l'empresa amb molt poca inversió perquè tenim un equipament instrumental d'altíssim valor que fins i tot moltes empreses privades no es poden permetre. Això es comparteix. Es molt car de lloguer però no requereix inversió. Mai ens ho haguéssim pogut permetre. Son inversions de milions d'euros.

27 E. Comercialització?

28 És evident que és una barrera. Vam néixer amb una petita cartera de clients i als tres anys vam incorporar al Joan que tenia una experiència comercial, multinacional nordamericana i tenia formació (mba). Ens coneixien totes les empreses de Catalunya però per internacionalitzar-nos vam posar una persona amb molta experiència industrial. Té un 5% de l'empresa, necessari per a poderlo incorporar en l'equip ja que sinó no haguéssim pogut. Ells es va comprometre a permanència.

**Codebook (Right Sidebar):**

- catalonian HGASO c
- TMT composition,
- Academics not in the
- catalonian HGASO c
- no patents. tacit kno
- catalonian HGASO c
- no patents. tacit kno
- TMT composition,
- Experienced industry
- Core team has work
- Academics not in the
- Growth triggers/cat
- Agressive strategy in
- catalonian HGASO c
- University support,
- Credibility. Technica
- TMT composition,
- Team incorporations:
- Variables,
- Intrapersonal variab
- Knowledge, Ability
- Variables,
- External variables,
- Industry evolution
- catalonian HGASO c
- University support,
- Variables,
- External variables,
- University,
- Intrapersonal variab
- Variables, Ability,
- Team incorporations:
- Growth triggers/cat
- Internationalization

## ANNEX IV - "Growth factors"

### Intrapersonal variables

These variables are intrapersonal and affect to each of the individuals who compose the TMT. Because of the particular condition of academics, the composition and strength of these variables can present substantial differences when it is compared to a non-academic venture.

*Knowledge.* Although there are different ways to grow a company, the academic himself has very limited knowledge on them, but they usually know a success story. The founder has previous knowledge of at least a model or experience he/she desires to imitate.

*Motivation to grow,* Entrepreneur shows a motivation to grow the firm. We consider that different issues influence the motivation to grow a company.

*Need (Achievement, Economic, Job)*

*Opportunity (perceived)*

*Risk taking*

*Role identity conflict*

*Time scarcity/priorities*

*Ability,* The entrepreneur shows to have the ability to perceive what to do, i.e., he has to show strategic thinking abilities to realize and to find external resources, the right allocation and orchestration of these resources, a proper decision making in each stage of the company. Besides, and especially in the early stages it is an important asset if he has abilities in doing actions himself which are oriented to growth

TMT variables. Literature has commonly agreed that TMT-board composition influence on performance. The company's TMT-board composition changes over time, and the incorporations (and exits) from this group improves the knowledge, motivation and ability to growth the company. This TMT is formed by existent and new managers. How this decision is made and how networks are used is important.

*Decisions* on TMT composition and incorporations. How and which factors and contexts influence are this decisions to be taken.

*Networks* how networks influence these incorporations, how networks influence the type of human resource to incorporate and how social capital influences the quality of these incorporations.

### Company variables

*Resources and knowledge accumulation.* The accumulation of resources and knowledge are important for the company development. How the TMT detects the need of each type of resources, and how this search and incorporation process takes place will influence growth (*RBV / KBV theories*)

*Network and social capital.* Network and social capital theories refer to how networks provide access to resources. Which sort of networks are used,

how they have been developed and what sort of resources have helped to incorporate are important for the development of the company.

*Strategy and how managers organize and structure the company for growth*

How these resources and knowledge are combined to produce intended outputs. How their visualize the company strengths, its competitive advantage and how they decide to compete in the industry.

External variables. This group of variables has obviously an influence on each company's growth. Governmental policies may favor to an specific type of HGASO, the particular industry characteristics can hamper or favor growth and the type of aid obtained from University may have influenced ASO growth.

*Government and institutions policies*

*University policies and support*

*Industry structure and evolution*