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The Performance of Corporate Spin-offs and the Implications for their Technology Strategy

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SAMENVATTING

Deze doctoraatsthesis heeft tot doel meer inzicht te verwerven in de factoren die de performantie van corporate spin-offs (CSO) beïnvloeden. Een corporate spin-off of CSO is een nieuwe onderneming die gebaseerd is op activiteiten die oorspronkelijk ontwikkeld werden in een groter moederbedrijf. Een CSO is geconcentreerd rond een nieuwe bedrijfsactiviteit en heeft tot doel om nieuwe producten en services te ontwikkelen en te commercialiseren. In eerste instantie hebben we een literatuurstudie uitgevoerd, waaruit bleek dat de literatuur rond CSO niet consequent en coherent is. Verschillende onderzoekers hebben studies verricht rond corporate spin-offs, maar hierbij is zelden voortgebouwd op het werk van andere onderzoekers. In de literatuur konden we twee stromen identificeren, die we het 'legal' en het 'entrant' perspectief genoemd hebben. De studies in het 'legal' perspectief hebben zich gefocust op het linken van de antecedenten om een CSO op te richten met de performantie van CSO. De studies in het 'entrant' perspectief hebben zich eerder gefocust op de overdracht van kennis vanuit het moederbedrijf naar de CSO en de impact die deze kennisoverdracht heeft op de performantie van CSO. Deze studies hebben duidelijk geschept in verschillende factoren die de performantie van CSO kunnen beïnvloeden. We hebben deze inzichten geïntegreerd en een model ontwikkeld die de verschillende factoren en antecedenten die de performantie van CSO beïnvloeden, samenvatten.

We zijn vervolgens dieper ingegaan op de populatie van CSO. We hebben twee groepen CSO geïdentificeerd die we de 'restructuring-driven' en de 'entrepreneurial' spin-offs genoemd hebben. Restructuring-driven spin-offs worden geïnitieerd door het moederbedrijf, terwijl entrepreneurial spin-offs geïnitieerd worden door werknemers van een bedrijf die een opportuniteit willen exploiteren. In het geval we de performantie van beide groepen CSO vergelijken, valt op dat de entrepreneurial spin-offs een betere performantie vertonen dan restructuring-driven spin-offs. Verklaringen kunnen gevonden worden in de motivatie van oprichters van entrepreneurial spin-offs om hun eigen bedrijf op te starten en in het feit dat deze spin-offs zeer vaak vanuit een marktopportuniteit opgestart worden. Daarnaast hebben we ook gekeken naar de overdracht van kennis vanuit het moederbedrijf naar de twee groepen van spin-offs. Een overdracht van kennis

kan gebeuren op drie niveaus: op gebied van technologie, van productie of marketing. Zoals verwacht wordt vooral in het geval van restructuring-driven spin-offs veel kennis getransfereerd vanuit het moederbedrijf naar de spin-off. Hierbij wordt voornamelijk technologische en productie kennis getransfereerd dankzij de actieve steun van het moederbedrijf. Een belangrijke vraag die hieruit voorvloeit is of deze kennisoverdracht bijdraagt tot de performantie van CSO. We hebben dit onderzocht door de relatie tussen de technologische middelen, de technologische strategie en de performantie verder te bestuderen voor CSO.

Een CSO is een bedrijf dat wordt opgezet om een nieuwe technologie verder te ontwikkelen en naar de markt te brengen. Technologie speelt dus een belangrijke rol in deze bedrijven en heeft bijgevolg ook een belangrijke impact op de performantie van CSO. Een CSO moet vervolgens een strategie uitwerken die hen toelaat deze technologie te commercialiseren. De ontwikkelde strategie hangt nauw samen met de middelen die de CSO ter beschikking heeft. Enkel in geval er een samenhang bestaat tussen de technologische strategie en de technologische middelen, zal er een competitief voordeel kunnen verwezenlijkt worden. Deze studie gebruikt de ‘resource-based view of the firm’ om inzicht te creëren in de relatie tussen de technologische middelen, de technologische strategie en de performantie van CSO. Deze theorie stelt dat het succes van een onderneming bepaald wordt door de middelen waarover de onderneming beschikt. De oorsprong van de spin-off zal de middelen en de heterogeniteit van deze middelen beïnvloeden. Zo kan een gevestigd bedrijf besluiten om veel of weinig middelen mee te geven aan de CSO. CSO zijn echter niet de enige bedrijven die afkomstig zijn uit een groter moederinstituut. Ook universitaire spin-offs (USO) hebben een moederinstituut, namelijk een universiteit of een onderzoeksinstelling. Daarom hebben we ervoor gekozen om in het empirisch deel van deze doctoraatsthesis ook de groep van USO te beschouwen. USO worden vaak opgezet om een nieuwe technologie te gaan commercialiseren. USO vertonen echter ook een aantal verschillen met CSO, aangezien zij afspinnen uit zeer verschillende moederinstituten. Door het bestuderen van de relatie tussen technologische middelen, technologische strategie en performantie voor beide groepen van spin-offs, krijgen we een beter inzicht in deze relatie.

Doordat CSO en USO afkomstig zijn uit moederinstituten die elk hun eigen doelstellingen hebben, verwachten we verschillen te zien in de relatie tussen technologische middelen, technologische strategie en performantie voor beide groepen van spin-offs. De empirische data verzameld in dit doctoraat, bevestigt dit vermoeden. In eerste instantie verschillen CSO en USO in hun technologische middelen. USO hebben meer interne R&D middelen, ze gaan meer samenwerkingsverbanden aan op technologisch gebied, en ze transferen meer technologische kennis vanuit hun moederinstituut dan CSO. Deze bevinding suggereert dat het mogelijks eenvoudiger is voor USO om technologische middelen te transferen vanuit hun moederinstituut temeer daar het moederinstituut de oprichting van de USO vaak steunt. CSO transferen meer productie kennis vanuit hun moederbedrijf dan USO, maar het verschil is niet significant. De CSO in onze databank verkiezen om geen grote hoeveelheden productiekennis mee te nemen opdat dit hen niet zou hinderen om nieuwe, innovatieve oplossingen te bedenken.

Een fundamentele veronderstelling van de strategic management theory is dat een verschil in middelen leidt tot een verschillende strategie. Onze resultaten tonen aan dat het verband tussen de technologische middelen en de technologische strategie inderdaad verschilt voor CSO en USO. We vonden echter geen significant verschil in de technologische strategie van CSO en USO zelf. Onze hypothesen stelden dat USO een breder technologieplatform en een hogere graad van nieuwheid van technologie zou hebben in vergelijking met CSO, maar de resultaten van deze hypothesen waren niet significant. Meer duidelijkheid werd gecreëerd door het bestuderen van de relatie tussen de technologische strategie en performantie. In het geval van CSO vonden we dat de breedte van het technologieplatform negatief geassocieerd is met performantie terwijl de nieuwheid van de technologie positief geassocieerd is met performantie. Voor de groep van USO vonden we tegenovergestelde resultaten. In deze groep vonden we dat de breedte van het technologieplatform positief geassocieerd is met performantie, terwijl de nieuwheid van de technologie negatief geassocieerd is met performantie

Deze resultaten bevestigen het belang van de oorsprong van spin-off bedrijven. De technologieën die aan de basis liggen van USO, zijn vaak zeer nieuw en vergen aanzienlijk wat tijd vooraleer ze op de markt kunnen gebracht worden. De onderzoeksactiviteiten van grote bedrijven daarentegen, zijn vaak gericht om op korte

termijn een aantal concrete markteisen in te vullen. In het geval USO kiezen voor een hoog niveau van nieuwheid van technologie, betekent dit vaak dat het een tijd duurt vooraleer deze technologie op de markt kan verkocht worden. Aan de andere kant, een hoog niveau van nieuwheid van technologie kan de CSO toelaten om zich te differentiëren van het moederbedrijf, wat vaak een positieve invloed heeft op hun performantie. Een breed technologieplatform laat toe om verscheidene applicaties te ontwikkelen voor verschillende markten. Zeker in het geval van USO kan dit een goede strategie zijn doordat de oprichters van USO vaak geen business ervaring hebben en bijgevolg soms hun technologieën iets te weinig aanpassen aan de marktbehoeften. In dit geval kan het zeer nuttig zijn om een aantal alternatieven te hebben. CSO daarentegen worden vaak opgezet om antwoord te bieden aan een concrete marktopportuniteit. Bovendien hebben de oprichters van CSO vaak business ervaring doordat zij reeds in een bedrijfsomgeving gewerkt hebben. Voor hen kan het eerder vertragend werken om voor een breed technologieplatform te kiezen, aangezien zij de marktnoden goed kennen en begrijpen.

In deze doctoraatsthesis vinden we steun voor het contingency perspectief dat stelt dat de technologische strategie moet bepaald worden in overeenstemming met de technologische middelen om een goede performantie te bekomen. Uit onze resultaten blijkt dat in geval CSO en USO een gelijkaardige strategie volgen, dit hoogstwaarschijnlijk leidt tot een verschillende performantie. Dit komt doordat CSO en USO starten met verschillende technologische middelen en een verschillende kennisoverdracht. De resultaten van deze studie dragen dan ook bij tot de resource-based view of the firm literatuur, de organizational sociology literatuur en de institutional theory literatuur.

SUMMARY

This dissertation focuses on creating a deeper insight into the factors that account for the performance of corporate spin-offs (CSO). A CSO is a separate legal entity that is concentrated around activities that were originally developed in a larger parent firm. The entity is concentrated around a new business, with the purpose to develop and market new products or services based upon a proprietary technology or skill. We have first reviewed the literature on corporate spin-offs. We found that after two decades of studying corporate spin-offs, the literature remains fragmented with little efforts at accumulation, the empirical work infrequently build upon one another. We have identified two streams of literature on corporate spin-offs (CSO), which we have labelled the legal and entrant perspective on CSO. Most studies using the 'legal' definition of CSO have linked the antecedents to create a CSO to the performance of CSO and their parents. Most studies using the 'entrant' definition have focused on the knowledge relatedness between the CSO and the parent and its impact on performance. This large body of empirical works has provided some clarity in different aspects of the CSO phenomenon. We have integrated the existing literature on CSO and have introduced elements of the contingency model into one model of antecedents and characteristics of CSO by identifying the key dimensions that contribute to the performance of a CSO.

Next, we have examined the group of CSO more closely. We have identified two groups of corporate spin-offs namely restructuring-driven spin-offs and entrepreneurial spin-offs. Restructuring-driven spin-offs are initiated by the parent firm, while entrepreneurial spin-offs are initiated by one or more employees in order to exploit an opportunity. When we compare the two groups of CSO, we see that entrepreneurial spin-offs have a higher performance than restructuring-driven spin-offs. Explanations can be found in the entrepreneurial motivation of the founders of entrepreneurial spin-offs, and in the market pull from which these companies tend to be created. We have also examined the transfer of knowledge from the parent firm to the two groups of corporate spin-offs. A transfer of knowledge can take place on a production, technology and marketing level. As expected; restructuring-driven spin-offs transfer considerably more technological and production knowledge due to the active support of their parent

companies. An important question that comes to rise is whether this knowledge transfer contributes to the performance of CSO. We have examined this by looking more closely at the relationship between the technological resources of which the transfer of knowledge is a part, the technology strategy and performance of CSO and USO.

A corporate spin-off (CSO) is set up with the purpose to develop and market new technologies. As a consequence, technology may have a crucial role in explaining the performance of CSO. CSO need to develop a technology strategy in order to be able to commercialize their new technology. These technology strategies need to be set in conjunction with the technological resources of the spin-off to achieve a competitive advantage. This study uses the resource-based view of the firm to examine the relationship between the technological resources, the technology strategy and the performance of CSO. One of the fundamental tenets of the resource-based view is that competitive advantage stems from resource heterogeneity between firms (Barney, 1991). The origin of the spin-off might influence this resource heterogeneity since the effect of originating from a parent organization may influence the spin-off beyond formation. Therefore, we have chosen to also consider the group of university spin-offs (USO) in the empirical part of this study. Corporate and university spin-offs are similar in the sense that they both originate from a larger parent institute e.g. an established firm, a university or a research institute. They are both young companies, set up to commercialize a new technology. However, due to the nature of their parent, USO and CSO may also show significant difference. Considering both groups of spin-offs allows us to create a better understanding of the relationship between technological resources, technology strategy and performance.

We expected to see differences in the relationship between technological resources, technology strategy and performance for CSO and USO, due to the fact that they originate from different types of parent organizations. Indeed, empirical evidence shows that the relationship is indeed different for CSO and USO. First, CSO and USO differ in their technological resources. USO have more internal R&D sources, they collaborate more in R&D consortia, and they transfer more technological knowledge from their parent than CSO. This finding suggests that it might be easier for USO to transfer technological resources from their parent universities, which often support the

creation of a USO. CSO transfer more production knowledge from their parent company than USO, but the difference is not significant. The CSO in our sample tend to prefer not to transfer a large amount of production knowledge in order not to be hindered in coming up with new, innovative solutions.

A fundamental premise of strategic management theory is that differing resources may lead to different strategies. We found that the association between the technological resources and technology strategy is indeed different for CSO and USO. However, we did not find any significant differences in the technology strategy of CSO and USO itself. We hypothesized that USO would have a broader scope of technology and a higher level of newness of technology than CSO, but these hypotheses were not supported. More clarity was created by considering the relationship between the technology strategy and performance. In the case of CSO, we found that the scope of technology is negatively associated with performance while the newness of technology is positively associated with performance. For the sample of USO, we found contrasting results. For USO, the scope of technology is positively associated with performance, while the newness of technology is negatively associated with performance.

These results reinforce the importance of the organizational origin of spin-off companies. University inventions are typically rather embryonic and high risk, while the research activities of established firms are rather short term focused and related to market needs. A high level of newness may indicate for USO that it might take a long time before the technology is transformed into products that can be sold on the market. However, in case CSO, a high level of newness may allow them to differentiate themselves from their parent firm, having a positive impact on performance. A broad scope of technology allows changing market application in case the first pursued application turns out to be a dead end. Especially in case of USO, this strategy might be extremely valuable. Founders of USO frequently possess little business experience, which often results into developing products that are not adapted to the market needs. Having some alternatives might prove to be important. CSO on the other hand are often created in anticipation to a market need. Moreover, the founders have more business experience due to their previous working environment. A broad scope of technology may

deviate them from developing a few specific products that are well adapted to the market needs.

This study contributes to the literature by supporting the contingency perspective that posits that the technology strategy should be set in conjunction with the technological resources in order to achieve a competitive advantage. From our results we can conclude that CSO and USO may follow similar technology strategies while obtaining different performance. The same choice of technology strategy might have a different impact on performance due to the fact that CSO and USO start with different technological resources and a different knowledge inheritance. The findings of this study contribute to the resource-based view of the firm literature, the organizational sociology literature and the institutional theory literature.

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1 INTRODUCTION

1.1 Background

Spin-offs play an increasingly important role in the development and growth of emerging, high-technology industries such as the artificial intelligence, biotechnology, multimedia, personal computer, software, and telecommunication industries (Bell & McNamara, 1991). Spin-offs are widespread in industries such as semiconductors (Braun & MacDonald, 1978), disk drives (Christensen, 1993), and lasers (Klepper & Sleeper, 2000). In these high-technology industries, corporate spin-offs are not only legion, but also major innovators. In the semiconductor industry, many spin-offs can be traced back to one firm, namely Fairchild Semiconductor, that they have been dubbed Fairchildren (Klepper, 2001). Some researchers characterize corporate spin-offs as parasites running away with the knowledge created in the parent firm. They assume that the corporate spin-off can cause a lot of damage to their parent firm. Other researchers see corporate spin-offs as a way to innovate. To them, the Fairchildren have jumped from a sinking ship and breathe new life into the semiconductor industry. According to this vision, corporate spin-offs are companies that bring new innovations to the market and by doing this, rejuvenate an entire industry. A persistent question surrounding corporate spin-offs is: "What accounts for the performance of corporate spin-offs?"

Oakey (1995) has argued that two major sources of new high-technology firms are higher-education institutions and well-established industrial firms. In his study, Goldman (1984) found that 72 percent of the high technology companies in the Boston area in the early 1980s were based on technologies originally developed at MIT laboratories. As a result, the Route 128 economic infrastructure might not have existed in the absence of MIT and its spin-offs, even though most of these spin-off companies were not based on technologies formally licensed from MIT. Goldman's study points to the unique characteristics of corporate and university spin-offs in the sense that they originate from a larger parent institute e.g. an established firm, a university or a research institute. The effect of originating from a parent may influence the spin-off beyond formation, as

the transfer of rules, routines, and procedures from parent to progeny organizations can both constrain and empower the spin-off (Brittain & Freeman, 1986; Romanelli, 1991).

Researchers have suggested that entrepreneurial origin is an important source of resource differences, strategies, and performance (Knight, 1989; McGrath &MacMillan, 2000; Shrader & Simon, 1997). Routines and resources are transferred from old to new organizations through personnel migration (Aldrich & Pfeffer, 1976; Almeida & Kogut, 1999; Pfeffer & Leblebici, 1973). Organizational blueprints can transfer across firm boundaries, in a manner analogous to the reproduction and transmission of biological genes (Winter, 1991). These transfers may include unique insights and decision rules used to transform resources into action (Prahalad & Bettis, 1986), cognitive dimensions of competency (Fiol, 1991), and specific knowledge and information (Boeker, 1997). Since "what an organization knows at its birth will determine what it searches for, what it experiences, and how it interprets what it encounters" (Huber, 1991), one implication is that a spin-off's capability accumulation may be linked to its inherited knowledge and that the agent of transfer may have an impact on the efficacy of transfer.

1.2 Research Questions

A fundamental question in the field of strategic management is how firms achieve and sustain a competitive advantage (Teece et al., 1997). Our study will build on the resource-based view of the firm to study the dynamics that underlie the performance of corporate spin-offs. The resource-based view of the firm (Penrose, 1959; Rumelt, 1974; Wernefelt, 1984; Barney, 1991) is an appropriate framework for this study since a key tenet of the resource-based view is that competitive advantage stems from resource heterogeneity between firms and from the sustainability of this heterogeneity over time (Ahuja & Katila, 2004; Peteraf, 1993). Following this view, the starting point in creating a competitive advantage is to identify and classify a firm's resources, especially its technology (Grant, 1991). Indeed, Lee, Lee & Pennings (2001) found that technological resources are a very critical success factor for new ventures.

The resource view holds that the type, magnitude, and nature of a firm's resources are important determinants of its profitability (Amit & Schoemaker, 1993). Following

Amit and Schoemaker (1993) we define resources as stocks of available factors that are owned or controlled by the firm. Heterogeneity in a spin-off's resources has been related to the prior affiliation of the spin-off with its parent firm (Carroll et al., 1996; Helfat & Lieberman, 2002; Klepper & Simons, 2000). Therefore, entrepreneurial origin may have different survival implications for spin-offs (Agarwal et al., 2004). Stinchcombe (1965) argued that founding conditions have a disproportionate effect on young firms. Klepper & Sleeper (2005) found that in case of spin-offs, their differences can be traced directly to their parents, who provide them with distinctive knowledge and resources. Spin-offs inherit general technical and market-related knowledge from their parents that shapes their nature at birth. The overall research question of this study is:

"*What accounts for the performance of corporate spin-offs?*"

The main research question is approached by first reviewing the literature on corporate spin-offs. We have designed a model of antecedents and characteristics of corporate spin-offs by identifying the key dimensions that contribute to the performance of CSO. The model allowed us to formulate a number of more specific research questions. Technology proves to be a vital aspect in explaining the performance of corporate spin-offs. Technology's profound effect on the industrial landscape is pervasive and is felt in nearly every sector of the economy (Zahra, 1996a). By making technology a focal point in their strategies; large companies as Apple, Merck, Microsoft, and DEC have created an advantage by offering unique products, lowering costs, or both (Zahra, Nash & Bickford, 1995). These companies have understood the role of technology as the mainspring of differentiation in today's marketplace. Also new ventures like CSO, are found to play an increasingly important role in commercializing new technologies and often consider technological innovation their lifeblood (Acs & Audretsch, 1990).

It is often a basic requirement for strategy to capitalize on technology, because technology can act as a fundamental weapon for competition (Itami & Numagami, 1992). Technology strategy is one of the most important aspects of any firm's strategic posture (Zahra & Bogner, 1999). This dissertation wants to shed light on the way new ventures like corporate spin-offs, have designed their technology strategies to articulate their plans to develop and deploy technological resources to achieve superior performance. The main

focus of this dissertation is on corporate spin-offs. Corporate spin-offs form a unique group of new companies, since they originate from a larger parent firm. However, corporate spin-offs are not the only type of company that originate from a larger parent institute, also university spin-offs have a parent organization namely universities or research organizations. CSO and USO are both created to develop and market new products or services based upon a proprietary technology or skill. Therefore, the way they deploy their technological resources into a technology strategy is of vital importance to their success and survival.

Research question 1:
Which factors influence the performance of corporate spin-offs?

Research Question 2:
Do corporate and university spin-offs follow different technology strategies in order to achieve a competitive advantage?

1.3 Objectives

The overall objective of this dissertation is to create insight into the performance of corporate spin-offs. More specifically, this study aims at understanding the relationship between technological resources, technology strategies and performance of corporate and university spin-offs. The detailed objectives of the study are:

1) to review and analyze the literature on corporate spin-offs
2) to create insight into the population of corporate spin-offs
3) to extend the literature by examining the relationship between technological resources, technology strategies and performance of corporate and university spin-offs.

Our study has build on the resource-based view of the firm to study the dynamics that underlie the performance of spin-offs. The resource-based view of the firm (Penrose, 1959) complements the traditional Industrial Organization approaches by recognizing the competitive value of resources and how they combine with and influence the strategies pursued by the firm (Brush and Chaganti, 1999; Chandler and Hanks, 1994; Mosakowski, 1993). In other words, it is argued that firm strategies in conjunction with the firm's resource base determine firm performance (Barney and Zajac, 1994). Moreover, CSO and USO are unique in the sense that they originate from a larger parent institute. This implies that they will inherit knowledge and routines present in the parent firm. This inheritance differentiates them from independent ventures and it is interesting to see how this inheritance influences their strategy making.

1.4 Organization of the Dissertation

This first chapter has set forth the broad research problem and the specific research questions that will be examined in this dissertation. In Chapter 2, a review of the literature on corporate spin-offs is performed. We have attempted to integrate the different streams of literature on corporate spin-offs into one model that recognizes the role and importance of different factors to the performance of CSO. Chapter 3 discusses the theoretical framework that will be used to examine the research questions and develops the hypotheses to be tested in the empirical part of the study. Chapter 4 presents the research methodology. Issues related to research design, sample selection, data gathering and data analysis are explored and justified. Chapter 5 provides the descriptive statistics of the data, and more insight into the population of corporate spin-offs. Chapter 6 presents the research results. Chapter 7 discusses the theoretical and practical conclusions derived from the study, as well as the contributions and limitations of the study. Finally, Chapter 8 provides several areas for future research.

2 THE PERFORMANCE OF CORPORATE SPIN-OFFS: A MODEL OF ANTECEDENTS AND CHARACTERISTICS

Corporate spin-offs are widespread in technology-based industries such as semiconductors (Braun and MacDonald, 1978), disk drives (Christensen, 1993), and lasers (Klepper, 2002). In the semiconductor industry, many corporate spin-offs can be traced back to one firm alone, Fairchild Semiconductor (Klepper, 2001). The Thompson database reports 2106 announced CSO between 1980 and 2005, of which 1128 have been effectively completed. Despite these impressive figures, The Thompson database only lists those CSOS which are publicly announced, excluding employee-based spin-offs and spin-offs from private firms. We might thus expect far more CSO than those identified by the Thompson database. In fact, Cooper (1971) found that firms with less than 500 employees and small subsidiaries have about ten times as high spin-off rates as large firms. In a study on European corporate spin-offs, Moncada et al. (1999) found that CSO represented around 12.9 % of new firm formation in Europe. These figures indicate that, while precise estimates of CSO do not currently exist, we should expect them to be more prevalent than commonly acknowledged.

Corporate spin-offs are often the result of restructuring or reorganizations of the parent company. Activities that are not within the company's core-competencies and that do not meet minimum performance requirements are either closed down or spun-off. Moreover, sectors with high spin-off frequencies are often sectors that undergo a high level of cost-cutting activity. Deregulation seems to have been one of the driving factors in encouraging the emergence of CSO in the energy and telecommunications sector. Corporate spin-offs might also be formed when employees are not able to realize their ideas in the parent company. These employees want to exploit an unused potential based on their key-experience acquired within the parent company. Some of them are frustrated because the parent firm does not allow them to pursue an opportunity, so they decide to leave the parent firm. Others spot opportunities in the external environment and decide to pursue the opportunity themselves, rather then sharing it with the parent firm.

Several studies have looked at the phenomenon of corporate spin-offs and found that they create excess stock return for the parent firm and the corporate spin-off. For the parent firm, excess share price improvements of about 3% around the announcement date of the spin-off have been found (Daley et al., 1997; Schipper & Smith, 1983). But what accounts for the performance of CSO? Besides the motivation to create a CSO, also other factors come into play when considering the performance of CSO. Since CSO originate from a parent firm, one can expect a CSO to inherit certain resources and routines from its parent. Moreover, the strategy the CSO follows and its industry conditions will further influence its performance. In their attempt to better understand corporate spin-offs, scholars have singled out one motivation to create a CSO or limited characteristics of the CSO and investigated their impact on performance. In this chapter we propose a model that links the antecedents and characteristics of corporate spin-offs to their performance. The model recognizes the roles and importance of different factors to the performance of a CSO. This model allows us to understand under what conditions CSO add value to their shareholders and to their parent firms.

There is no consensus in the literature on the definition of corporate spin-offs. Therefore, this chapter starts with clarifying the confusion around the definition, followed by the development of our own definition of corporate spin-offs. Next, we develop a model that outlines the key characteristics of corporate spin-offs and the link with its performance. The interplay of antecedents and characteristics of CSO creates an understanding of the real contribution and performance of CSO. This model adds to the general understanding of the importance of the phenomenon corporate spin-offs. Last, we formulate our conclusion.

2.1 Definitions of Corporate Spin-Offs

Past research on the topic of corporate spin-offs (CSO) has been scattered. Scholars have used different definitions to identify corporate spin-offs. Table 1 provides an overview of the different definitions used in studies on corporate spin-offs. Studies on CSO seem to follow two sets of definitions, which we label the “legal” and the “entrant” perspective on CSO respectively.

The legal perspective		
Authors	**Definition**	**Data source**
Abarbanell J., Bushee B. & Raedy J., 2003	Corporate spin-offs create new firms with characteristics markedly different from the original firm	Securities Data Company (SDC) Platinum mergers and acquisitions database
Allen J., 2001	In a spin-off, a unit of a corporation is established as an independent company, and shareholders receive shares in the new entity on a pro rata basis.	The Standard and Poor's Quarterly Dividend Record
Allen J., Lummer S., McConnell J. & Reed D., 1995	In the typical corporate spin-off, a corporation (customarily called the parent) forms a new, separate corporation and ownership to a subset of the assets of the parent is transferred to the newly created corporate entity. The shares in the new corporation are then distributed on a pro rata basis to the shareholders of the parent firm.	The Standard and Poor's Quarterly Dividend Record.
Aron D.,1991	A spin-off is a form of corporate divestiture in which the original corporation is separated into two corporations, each with separately traded stock. The stock of the spun-off division is distributed on a pro rata basis to shareholders of the original corporation.	No empirical data
Daley L., Mehrotra V. & Sivakumar R., 1997	A spin-off occurs when a firm creates a subsidiary to hold a portion of its assets, and then distributes the shares of the subsidiary to its shareholders to create an independent company. Spin-offs differ from other modes of asset divestitures in that they do not involve any cash.	*Spin-off firms examined by Schipper and Smith (1983) *additional spin-offs by searching the Wall Street Journal *Supplemented by spin-off cases discussed in Kudla and Mclnish (1988) and Vijh (1994)
Desai H. & Jain P., 1999	A spin-off is a pro-rata distribution of the shares of the subsidiary to the parent's shareholders. A spin-off creates a new entity that trades independently of its former parent.	*Center for Research in Security Prices (CRSP) *The Dow Jones News Service (DJNS) *The Standard & Poor's Dividend Record
Dittmar A., 2004	A spin-off is a pro rata distribution of the stock of a subsidiary to existing shareholders of the firm. The subsidiary may be an existing division or a newly created subsidiary of the parent. At the time of the spin-off, the subsidiary becomes a freestanding company. No funds are raised in a spin-off, and neither firm revalues its assets.	* Security Data Company's (SDC) Worldwide Acquisitions database.

Gertner R., Powers E. & Schartstein D., 2002	In a spin-off, the parent company established one of its divisions as a new publicly traded company and distributes the shares of this company to the parent's existing shareholders. It is almost always structured as a tax-free transaction with no cash flow implications to the parent, spin-off or shareholders.	*Securities Data Corporation's Mergers and Acquisitions Database
Hite G. & Owers J., 1983	A spin-off results in the creation of an independent firm with a corresponding reduction in the asset base of the divestor. The assets divested may be transferred to a newly organized and incorporated firm whose shares are distributed to the original shareholders of the divestor firm. Alternatively, the divestor may transfer the stock of an incorporated subsidiary to its shareholders. In either case, the distribution of the unit's shares is on a pro-rata basis to the original stockholders.	Standard and Poor's Annual Dividend Record
Krishnaswami S. & Subramaniam V., 1999	A spin-off is a pro-rata distribution of the shares of a firm's subsidiary to the shareholders of the firm. There is neither a dilution of equity nor a transfer of ownership form the current shareholders. Spin-offs involve no cash transactions.	*Center for Research in Security Prices (CRSP) *Firms in the National Automated Accounting Research System whose annual reports disclose spin-offs *news wires and articles on Lexis-Nexis and the Wall Street Journal that report spin-off transactions by firms.
Mauer D. & Lewellen W., 1990	In a spin-off, a separate new corporate entity is created to hold the assets relinquished by the firm undertaking the transaction, and the equity ownership interest in those assets is distributed, typically on a pro rata basis, to the stockholders of the previous parent company.	No empirical data
McConnell J., OzbilginM. & Wahal S., 2001	Refer to Cusatis, Miles and Woolridge (1993) for the definition of CSO	To compile the sample, they mimic the steps of Cusatis et al. (1993) * Moody's Dividend Record * CRSP Monthly Master File *CCH Capital Changes Reporter

Mehrotra V., Mikkelson W. & Partch M., 2003	In a corporate spin-off, managers break up a company by allocating a segment of a firm's assets to a newly formed publicly traded company. Shares of the new company are distributed pro rata, as a stock dividend, to stockholders of the parent company.	* Initial list of spin-offs came from Daley, Mehrotra, and Sivakumar (1997) * Identified more recent spin-offs by searching The Wall Street Journal Index and obtaining a list of divestiture events from the Securities Data Corporation.
Parrino R., 1997	A spin-off is the separation of a firm's business through a pro rata distribution of the equity	Marriot Spin-off
Schipper K. & Smith A., 1983	A spin-off divides one firm into two; current shareholders receive a pro-rata distribution of separate equity claims on a subset of the original firm's net assets.	* National Automated Accounting Research System (NAARS) *stock distributions coded as spin-offs on the CRSP Daily Master File of ASE and NYSE firms *articles in the business press *Capital Changes Reporter
Seward J. & Walsch J., 1996	A spin-off divides the existing asset base of a corporation into two (or more) separate parts. The current shareholders receive a pro rata distribution of separate equity claims on the assets of each new corporate entity. There is no exchange of cash or financial securities for assets in this transaction.	The Dow Jones News Retrieval Service
Vijh A., 1994	A spin-off is a divestiture of a parent company that relinquished control of a subsidiary by simply distributing the subsidiary shares as a nontaxable stock dividend to current stockholders.	Center for Research in Security Prices (CRSP)
Woo C., Willard G. & Daellenbach U., 1992	A spin-off occurs when a firm distributes to its existing shareholders all of the common stock it owns in a controlled subsidiary, thereby creating a separate publicly-traded company (Rosenfeld, 1984)	*Standard and Poor's on-line news service *review of Kudla and McIninsh's study (1984)
Wruck E. & Wruck K., 2002	In a spin-off transaction, a parent firm's assets are divided between two corporations. Each corporation is a separate public company. Shares of the new company are distributed directly to parent firm shareholders. Most spin-offs are structured as a tax-free return of capital to shareholders.	The Securities Data Corporation Mergers and Acquisitions Database

The entrant perspective		
Author	**Definition**	**Data source**
Agarwal R., Echambadi R., Franco A. & Sarkar M., 2004	A spin-out is a distinctive class of entrepreneurial entrants that inherit knowledge form industry incumbents through their founders. Founded by former employees of an incumbent firm, these stand-alone entrepreneurial ventures compete in the same industry as the parent but have no equity relationships with any incumbent.	Disk/Trend Report (a market research publication that has covered the disk drive industry since 1977).
Chesbrough H., 2003a	A technology spin-off company is a particular type of spin-off company that is created for the purpose of commercializing one or more research discoveries outside the main business of the firm	Technology spin-off companies that commercialized technology out of one of Xerox's five research centers.
Ito K., 1995	A spin-off is defined as a firm that is partially owned by the parent, but independently managed and sometimes listed on the various stock markets.	* For the US firms, Moody's Investors Service for New York Stock Exchange firms * For Japanes firms, a list was compiled from the charts of Yakura and Ikushima (1986) for Tokyo Stock Exchange firms. In addition, books on the corporate history of large Japanese firms were examined.
Ito K. & Rose E., 1994	A spin-off results in the separation of a business unit from the parent firm, but the parent usually maintains ownership of some percentage of the spin-off's stock.	Japanese parent firms and their spinoff subsidiaries were identified, based on Toyokeizai (1990)
Klepper S., 2002	Spin-offs are stand-alone companies founded by employees of incumbent firms in the same industry	US automobile industry
Lindholm A., 1997a	A corporate spin-off is based on product ideas originating from the founder's earlier employment in private firms	The MIT Center for Policy Alternatives sample (the 'CPA' sample), identified and used by Utterback and Reitberger (1982) and Utterback et al. (1988).
Parhankangas A. & Arenius P., 2003	This study focuses on new business formation based on the business ideas developed within the parent firm being taken into a self-standing firm.	*The Talouselämä Journal

Sapienza H., Parhankangas A. & Autio E., 2004	A technology-related spin-off firm is a firm which exploits technological competencies developed internally within the parent firm and is active in industrial manufacturing or in technical services. A spin-off firm was considered independent if less than 50% of its stock was owned by other corporations.	*The Talouselämä business weekly database. *Additionally, managers of the largest Finnish industrial firms and VC were contacted to identify additional SO.
Sedaitis J., 1998	Spin-offs are defined as organizations where the controlling packet of stock (51% or more) was owned by one individual extant organization.	Case studies were made of nine different commodity markets and the client base across seven cities in the European former USSR.
Sorrentino M. & Williams M., 1995	No definition of CSO is mentioned	STR4, the corporate start-up database of the PIMS (Profit Impact of Market Strategy) project

Table 1: Overview of definitions of CSO

2.1.1 Legal Perspective on Corporate Spin-Offs

The "legal" definition of a CSO emphasizes the contractual basis of its founding as follows:

> *In a spin-off, the parent company establishes one of its divisions as a new publicly traded company and distributes the shares of this company to the parent's existing shareholders. It is almost always structured as a tax-free transaction with no cash flow implications to the parent, spin-off or shareholders (Gertner, Powers & Scharfstein, 2002: 2481).*

Following this definition, a CSO is a stand-alone company that did previously not have a capital structure and no debt allocation. Therefore, CSO form an ideal situation to look how certain variables (e.g. capital structure, management composition and assets) are put in place. Subsequent to the spin-off, the parent and the CSO trade as separate entities. This makes it possible to analyse their performance separately and examine the impact of certain variables, like the leverage choice (Mehrotra et al., 2003), change in focus (Desai & Jain, 1999), and institutional investor trading (Abarbanell et al., 2003) have on the performance of the CSO and/or the parent. Following the 'legal' definition,

the creation of a CSO does not change the equity ownership of the existing shareholders. Therefore, the design of internal governance and control mechanisms can be studied (Seward & Walsh, 1996). Moreover, CSO that qualify under IRS Section 355 Code[1] are the only way to divest assets on a tax-free basis.

For a spin-off to be a tax free transaction, the Internal Revenue Code section 355 demands that the parent and the subsidiary must be engaged in an active trade or business for at least five years prior to the ex-date and the spin-off must have a substantial business purpose, separate from simply saving on income taxes. The reason for the active business requirement is to prevent a corporation from investing its surplus funds in a new business or in the stock of a corporation conducting a business and then spinning that stock off rather than paying dividends (Kudla & McInish, 1984). The business purpose requirement also implies that the purpose for the spin-off is germane to the business of the corporations. There must be a corporate purpose rather than a shareholder purpose motivating the spin-off. The fact that the spin-off must be engaged in an active trade or business for at least five years prior to the spin-off date induces a certain degree of maturity of the spin-off business. A huge advantage of using the 'legal' definition is the relative ease of data collection since the Security Data Company's (SDC) Worldwide Acquisitions database uses this definition to describe CSO. Table 1 provides an overview of the data sources used in the diverse articles.

The use of the 'legal' definition of a CSO also has a few disadvantages. The legal definition does not consider the motive to set up a CSO. In particular, CSO set up for financial reasons can have a different effect on the performance of the firm and its parent, than CSO set up for incentive reasons. When collecting data, researchers have not taking the motivation into account. As a result, it is difficult to make reliable predictions about the growth ambitions of the corporate spin-offs. Next, the use of the legal definition leaves out a group of CSO, namely those that have been set up by employees based on knowledge gained while working in and for the parent firm. Also corporate spin-offs set

[1] Under Internal Revenue Code section 355, a spin-off is considered a tax-exempt distribution if after the spin-off the parent retains no more than a 20% interest in the voting power of all classes of voting stock and no more than a 20% interest in each class of nonvoting stock. In addition, the distribution may not be executed as a means of distributing dividends to the stockholders, and both corporations must be engaged in active business after the spin-off and for 5 years preceding the spin-off. Due to the strong tax incentive, most spin-offs involve the near-complete divestiture of the subsidiary. Thus, the parent allocates the assets and liabilities to a freestanding company.

up as private companies are not considered. To conclude, the use of the "legal" definition makes it easy to identify a certain group of CSO, but gives us little insight into the motives leading to their creation.

2.1.2 Entrant Perspective on Corporate Spin-Offs

A second group of studies views a corporate spin-off as a means for companies to explore new markets, new technology, or new methods of distribution (see table 1 for an overview). We label this group 'entrant' CSO. In these studies, it is less clear what a corporate spin-off exactly is. Authors use several, related definitions to define a CSO. Parhankangas and Arenius (2003) offered perhaps the most comprehensive definition of a CSO. To them,

> *"A CSO is a new business formation based on the business ideas developed within the parent firm being taken into a self-standing firm…" (Parhankangas and Arenius, 2003: 464).*

In the case of 'entrant' CSO, it is not always the parent who takes the initiative to create a CSO. A large number of the 'entrant' CSO is set up by employees of the parent firm. Employees of incumbent firms are in a position to start their own ventures using new knowledge created through incumbent investments (Agarwal et al., 2004). The potential for employee entrepreneurship results from incumbent firms being imperfect and permeable storehouses of knowledge which causes new organisations to emerge from other organizations (Stinchcombe, 1965). Scholars identified several reasons why employees found a CSO e.g. founders of CSO may have been frustrated with their prior employers' unwillingness to pursue ideas they perceived to be promising (Klepper, 2001), CSO may be triggered by change in leadership and the subsequent change in support for certain activities. Using the entrant CSO definition, researchers usually have a clear view of the motivation to set up a CSO.

In most studies, researchers have singled out one motive e.g. CSO set up to explore a new technology (Chesbrough, 2003a; Sapienza et al., 2004), new markets (Agarwal et al., 2004; Helfat & Liebermann, 2002), new methods of distribution, or new products/services. Unfortunately, these studies have not employed the same definition to

select ‘entrant’ CSO, making it difficult to compare findings across studies. Chesbrough (2003a) and Sapienza et al. (2004) select only the corporate spin-offs which are created to exploit technological competencies developed internally within the parent firm (see table 1 for the exact definition employed). Agarwal et al. (2004) select those corporate spin-offs who are started by individuals who were employees of existing firms in the industry (incumbent firms) in the year prior to the spin-outs’ formation. They do not impose the criterion that the corporate spin-offs need to be based on a technological competency. In their study, Helfat and Liebermann (2002) go one step further and divide the group of entrant CSO into parent spin-off and entrepreneurial spin-offs. In a parent spin-off, the parent firm retains a financial interest and representation in the board of directors. Entrepreneurial spin-offs are stand-alone companies founded by employees of incumbent firms in the same industry. So, these studies select different subgroups of corporate spin-offs.

Another source of disagreement is the fact that there is no consensus about the percentage of shares the parent firm still owns after spin-off. According to Ito (1995), a spin-off is defined as a firm that is partially owned by the parent, but independently managed and sometimes listed on the various stock markets. The parental ownership varies between 0 % and 100 % and the control exercised by the parent is flexible and differs in degree based on strategic, financial and human resources. Some studies poses more restrictive constraints by imposing that the parent firm can not own more that 49% of the stock (Sedaitis, 1998) or less than 50% of the CSO’ stock can be owned by other corporations (Sapienza et al., 2004). The different definitions and the different percentage of shares used, make it difficult to compare the results of the studies performed.

Another disadvantage of using the ‘entrant’ definition of CSO is the fact that there exists no publicly accessible database that uses the definition of ‘entrant CSO’. Researchers have therefore built their own database of entrant CSO (see table 1), focusing mostly on one particular industry (e.g. the disk drive industry (Agarwal et al., 2004), the US automobile industry (Klepper, 2002)) or a particular region (e.g. Japan (Ito & Rose, 1994), Sweden (Lindholm, 1997a) and Finland (Parhankangas et al., 2003)). Generalization is therefore not possible. To conclude, the use of the definition of ‘entrant

CSO' provides good insights into the motives to create a CSO, but does not allow a clear sampling of CSO.

2.1.3 Integrative Perspective on Corporate Spin-Offs

Going over the definitions and data sources summarized in table 1, one can notice that the group of CSO selected by the 'legal' and the 'entrant' perspective are almost two mutually exclusive groups. CSO in the 'legal' perspective will mostly be companies that are noted on the stock exchange market, while the 'entrant' perspective will rather select private owned companies. However, both types are labelled corporate spin-offs in the literature. To overcome this diversity, we propose the following definition of a CSO:

> *"A corporate spin-off is a separate legal entity that is concentrated around activities that were originally developed in a larger parent firm. The entity is concentrated around a new business, with the purpose to develop and market new products or services based upon a proprietary technology or skill."*

The proposed definition has the advantage of being comprehensive. It integrates the two existing streams of definitions of CSO. Our definition includes those 'legal' CSO who are set up around new businesses. It includes daughter firms, set up to commercialize new products or services and joint ventures, which are based on technology developed in the parent firm. Our definition also includes most of the 'entrant' CSO e.g. employee-based CSO where founders have left the parent firm due to a conflict or lack of support, but which are based on activities that were originally developed in the parent firm. Also CSO set up with support of the parent firm to explore new markets and new technologies are included.

Our definition excludes 'legal' CSO set up around existing business e.g. sales offices in foreign countries. All companies which are the result of external corporate venturing activities are also excluded e.g. spin-inns, since they are based on technology developed outside the parent firm. Forms of divestments like sell-offs or management buy-outs are excluded, since there are not concentrated around a new business. Our definition also excludes 'entrant' CSO that are not created with the purpose to develop and market new products or services based upon a proprietary technology or skill.

The definition takes the angle of new business creation and start-ups. Start-ups have been found to contribute significantly to an economy in terms of exports, employment, taxes paid, research and development, and innovations (Utterback et al., 1988) and play an important role in bringing new technologies to the market (Christensen, 1997; Henderson, 1993). Previous literature reports spin-off firms being important agents of knowledge transfer from established corporations to new businesses, hereby promoting the prosperity and well-being of regions, industry clusters and nations (Dorfman, 1983; Lindholm, 1997b, 2000; Pavitt, 1991). By preserving the relationship with its parent, the spin-off may combine the advantages of maintaining the entrepreneurship of a small firm and utilizing the existing assets of a large corporation (Teece, 1988). Spinning off businesses may benefit the parent firm by decreasing the administrative burden, releasing funds for the development of core businesses, and serving as a means for exploring new, revolutionary ideas at arm's length from main stream businesses (Ito and Rose, 1994). We see corporate spin-offs as a means to create new businesses to commercialize a new technology or to explore new market opportunities. This can happen with or without the support of the parent firm. Now that we stated what we understand under corporate spin-offs, we can start to explore the key characteristics of a CSO and the dimensions that contribute to its performance.

2.2 Key Characteristics of Corporate Spin-Offs

The bulk of the literature on corporate spin-offs has focused on one particular characteristic of a corporate spin-off and its relation to the corporate spin-off's performance. Most studies that use the 'legal' perspective on corporate spin-offs (CSO) have linked the antecedents to create a CSO to the performance of CSO and their parents (see table 1 for an overview of the studies). Studies using the 'entrant' perspective have mainly focused on the knowledge relatedness between the CSO and the parent and its impact on performance. Little attempt has been made to integrate the two streams of literature into one model. However, if we want to understand the performance of CSO, we need to have insight in the different characteristics that influence this performance. We will first discuss the studies that focus on the 'legal' perspective of CSO, the results

they have found concerning the relationship between the characteristics of the CSO and its performance. Next, we give an overview of the findings of the studies focusing on the "entrant' perspective. Then we will integrate both perspectives on CSO with existing literature to create an insight into the key characteristics of CSO and the way in which these characteristics influence its performance.

2.2.1 Legal Perspective on Corporate Spin-Offs

Studies employing the legal perspective of corporate spin-offs (CSO) are mainly published in financial journals e.g. Journal of Financial Economics, The Review of Financial Studies, and The Journal of Finance. Several of these studies have empirically analyzed the sources of shareholder gains around spin-offs (Cusatis et al., 1993; Daley et al., 1997; Desai and Jain, 1999; Hite and Owers, 1983; Krishnaswami and Subramaniam, 1999; Schipper and Smith, 1983; Seward and Walsh, 1996). Hite and Owers (1983) report an event-period excess return of 3.30 % surrounding first announcements and 7.00% over an extended period beginning fifty days before the first announcement and ending on the completion date when the spin-off becomes certain. Schipper and Smith (1983) document a two-day excess return of 2.84% and Daley et al. (1997) reports a two-day announcement date return of 3.4%. Researchers have attributed these potential sources of gains to several motivations to create the CSO. These motivations can be classified as follows: 1) focus and restructuring motivation; 2) financial motivation; 3) incentive motivation; and 4) tax and regulatory motivation. In the following paragraph, we will discuss each of the motivations.

Focus and restructuring motivation Practitioners and the popular press usually propose an information-related motivation for CSO. For instance, CEO of most firms engaged in CSO claim that the CSO improves the market value since investors are able to perceive value more clearly after the spin-off (Krishnaswami and Subramaniam, 1999). Creating a CSO can allow the parent firm to focus its activities and to reduce asymmetries that might exist due to the numerous activities of the parent firm. CSO enhances value because separating the divisions of a firm into individually operated and traded entities mitigates the information asymmetry in the market about the different divisions' profitability and operating efficiency (Krishnaswami and Subramaniam, 1999).

Even when there are no negative synergies between divisions, information asymmetry can itself be a sufficient motivation for corporations to engage in spin-offs.

Also Daley, Mehrotra, and Sivakumar (1997) document a significant improvement in operating performance in the year after the event for spin-offs that separate divisions that operate in different industries. Desai and Jain (1999) use two other methods to identify focus improving spin-offs, and report that the improved operating and financial performance following spin-offs is robust to the classification scheme. Hite and Owers (1983) classify firms based on the reasons given by the firms for the spin-off and find that the subsample where the motivation was improvement in focus exhibits the largest abnormal returns in the period from 50 days prior to the announcement to the completion date of the spin-of. Indirect evidence for the focus improvement motive is provided by Allen et al. (1995). They examine whether the abnormal returns around spin-offs is a consequence of the correction of a prior mistake. They show that when a spin-of is preceded by the acquisition of the division the positive abnormal returns around the spin-off represent the re-creation of value that was destroyed at the time of the earlier acquisition.

Financial motivation It is not uncommon for parent firm documents to state that a corporate spin-off would allow heterogeneous business units to establish capital structures that are better suited to the nature of their assets or growth prospects. At the moment of spin-off, a stand-alone company is created that did previously not have a capital structure. Therefore, spin-offs offer the possibility to examine how the capital structure is build, and what the parent's firm choice of leverage for the spin-off is. Dittmar (2004) found that parent firms choose lower leverage ratios (average debt to value) for the spin-offs. Lower leverage is attractive since low debt financing reduces the pressure to generate cash flow. However, spin-offs with more financial leverage were found to have a higher cash flow return on assets, lower variability of industry operating income and a greater proportion of fixed assets (Mehrotra et al., 2003).

Parent firms may spin off to expropriate wealth from debt holders by allocating most of the debt to one of the entities (Dittmar, 2004). Parrino (1997) finds that this may have occurred in the 1993 Marriot spin-off. The Marriot spin-off transferred wealth from bondholders to shareholders and caused the total value of the company's public securities

to decline. Conversely, Hite and Owers (1983) and Schipper and Smith (1983) found no evidence of widespread bondholder expropriation. Firms in need of external capital show a higher propensity to engage in spin-offs since the total amount of capital raised increases significantly in the two years following a spin-off (Krishnaswami and Subramaniam, 1999).

Incentive motivation CSO can be used to improve the managers' incentives (Glassman, 1988). The spin-off incentive policy exploits the fact that after a spin-off, the managerial productivity is much easier to evaluate than when the division belongs to the parent firm (Aron, 1991). The possibility of creating a CSO may motivate certain divisional managers to perform better, since they know that the division will be carefully examined to investigate a potential CSO. CSO can also be events through which top management is restructured. CSO can sometimes even serve as a mechanism of management dismissal, with the opportunity to manage a smaller, weaker firm serving as a "consolation prize" for managers leaving the parent firm (Wruck and Wruck, 2002).

The characteristics of the spin-off's top management team are important as they are significantly associated with the value created at the announcement of a spin-off (Wruck and Wruck, 2002). The study performed by Seward and Walsh (1996) confirms that a CSO facilitate the implementation of efficient internal governance and control mechanisms, but found no support for the fact that gains around spin-off announcements can be attributed to improvements in efficiency of governance practices. Further, Mehrotra et al. (2003) found no evidence that managerial incentives or governance characteristics affect the leverage ratios chosen for CSO. The pre-spin-off CEOs did not take on an unusually low or high level of financial leverage in the firms they managed following a spin-off. They found no support for agency theories that imply capital structure choices serve managers' private interests.

Tax and regulatory motivation Tax and regulatory factors can also form the basis to create a CSO. It can be a means to overcome legal obstacles which prevent the firm from accomplishing its objectives. A regulated firm may be able to spin-off a subsidiary in a fashion that results in either the parent or the subsidiary escaping the external constraint of regulation (Kudla & McInish, 1984). In some cases, significant tax benefits can be obtained by spinning off a CSO. A firm may also be able to spin-off an overseas

subsidiary to avoid paying U.S. taxes on the income from that division (Kudla & McInish, 1984). Although the benefits to firms from tax and regulatory motivations do exist, Schipper and Smith (1983) did not find any evidence to support this hypothesis. Mauer and Lewellen (1990) on the other hand, argue that an improvement in the value of the tax-timing option component of securities prices is a likely contributing factor to abnormal stock returns associated with CSO.

Scholars have tried to explain the excess stock return caused by CSO by studying the motivations to set up a CSO. We should be cautious in interpreting the findings of these studies, since these studies focus on the short term performance. McConnel et al. (2001) is one of the few studies who investigates whether a strategy of buying parents and subsidiaries after spin-off would have earned excess returns. They study parents and spin-offs over 7 years following the completion of the analysis reported by Cusatis et al. (1993). The conclusions they drew depend upon the performance benchmark employed. When compared with the matched firm benchmark used by Cusatis et al. (1993) and the Fama and French (1993) 3-factor model, the strategy does not beat the benchmark. When compared with size- and book-to-market-matched portfolios, the strategy does beat the benchmark.

The fact that most studies using the legal perspective on CSO apply a short time frame to test the performance of CSO and its parents has several limitations. First, no predictions can be made concerning the long term performance of CSO. The study of McConnell et al. (2001) does not find strong support for the existence of excess stock return on a long term basis. The authors however do not explain the potential causes of this finding. Second, most studies using the legal perspective on CSO would not be able to provide an explanation, since they do not take the resources of the CSO, the industry conditions of the CSO, or the potential ongoing relationship between the parent and the CSO into account.

2.2.2 Entrant Perspective on Corporate Spin-Offs

Studies using the entrant perspective on corporate spin-offs (CSO) are mainly published in journals like Strategic Management Journal, Research Policy, Journal of

Business Venturing, and Industrial and Corporate Change. These studies have mainly emphasized the relationship between parent and a CSO and its impact on the performance of a CSO. CSO form a distinct kind of start-ups in the sense that they originate from a parent firm. The initial stock of inherited knowledge (Huber, 1991) is likely to have long-term effects on the CSO. Whenever people leave one firm to found a new company, there is a transfer of resources and routines (Phillips, 2002). This implies that the CSO may have some advantages over start-ups that lack a parent firm. Insight into the relationship between a CSO and its parent is therefore necessary in order to explain the performance of CSO. The relatedness between a CSO and its parent can be twofold: 1) knowledge relatedness and 2) governance relatedness.

Knowledge relatedness Knowledge relatedness indicates the extent to which the knowledge bases of two firms overlap. Knowledge relatedness includes production, technology and marketing knowledge (Rumelt, 1974; Sapienza et al., 2004). Production knowledge involves the ability of spin-offs to meet variations in demand level and changes in customer specifications. CSO can learn techniques from the parent firm for efficient and effective customization of production. In case the CSO share some technological knowledge with its parent firm, it will be able to augment its technological knowledge base by learning from its parent. A solid technological knowledge base will allow the CSO to cut the development time from product idea to commercial product. To the extent that the CSO shares some knowledge with its parent firm about customer groups, distribution channels, and marketing strategies and expertise, it will be able to strengthen its marketing competencies by learning from its parent firm.

Past research on the relationship between knowledge relatedness and performance of CSO has been inconsistent. Sapienza et al. (2004) found that production and technological knowledge relatedness is related to growth, but marketing knowledge relatedness was not found significant. On the other hand, Davis et al. (1992) found that a high level of marketing relatedness is associated with high sales growth. Other studies have reported positive relationships between technological relatedness and sales growth (Doutriaux, 1992), between overall relatedness and profitability (Woo et al., 1992) and between production relatedness and return on assets (Davis et al., 1992). Sorrentino & Williams (1995) found no significant differences in the market shares achieved by high-,

medium-, and low-related CSO and conclude that relatedness does not affect CSO performance. However, Agarwal et al. (2004) found that a parent firm's capabilities at the time of a CSO's founding positively affect the spin-out's knowledge capabilities and its probability of survival. CSO have a higher survival edge in the market due to their entrepreneurial flexibility and their inherited knowledge.

Governance relatedness A CSO can also be related to its parent through its governance structure. Especially in the case where the CSO is supported by its parent firm or in the case the parent firm invests in the CSO, it is likely that one or more members of the board of directors are full-time employed by the parent firm. Moreover, in case of support, it is likely that the CEO of the CSO will be a person with strong social ties to the parent firm executives. These CEOs can coordinate the parent's interests more effectively than outside CEOs.

The board members and top management teams put in place can have a serious impact on the performance of the CSO. Chesbrough (2003a) has identified several Xerox' CSO and examined the impact Xerox had on them over time. He found that Xerox's own initial equity position was negatively correlated with the performance of its CSO. This was not due to their equity per se, but to Xerox's practices in managing its spin-offs. Xerox rarely invited outside members onto CSO boards when it had majority control and they usually inserted a Xerox manager into the CEO position. A balanced mix of insiders and outsiders in the board and the top management team can prove to be of vital importance. Also the network these members have and/or can build, can be important for the performance of the CSO (Sedaitis, 1998).

The entrant perspective gives an insight into the relationship between the CSO and its parent and the potential benefits of such a relationship. However, little attention is devoted to the motivation to set up a CSO, its industry conditions or the strategy the CSO has followed. Moreover, it is difficult to compare the results of the studies since they use different measures to capture performance e.g. sales growth (Davis et al., 1992; Sapienza et al., 2004), market share (Sorrentino & Williams, 1995), growth in revenues and market value (Chesbrough, 2003a). This might partly explain the inconsistence in the results found by different studies. However in order to create a full understanding, we need to

consider multiple characteristics of the CSO and look at their combined impact on performance.

2.2.3 Integrative Perspective on Corporate Spin-Offs

The legal and the entrant perspective on CSO offer a quite complementary perspective on CSO and its parents. The studies using the legal perspective are mostly connecting the motivation to set up a CSO to the short term performance of the CSO and its parent. Studies using the entrant perspective have devoted more attention to the relatedness between the CSO and its parent and its influence on the performance of the CSO. In this chapter, we are interested in explaining the performance of CSO by considering the different characteristics of a CSO that influence this performance. The relatedness is one aspect that can explain the performance of CSO, but there are other aspects to consider in order to fully understand if and why CSO perform well. The motivation to create a CSO will influence the resources the CSO receive by start-up and will also be determining for a potential ongoing relationship between parent and CSO. In an attempt to incorporate all variables that determine the performance of a CSO, we have developed a model of antecedents and characteristics of CSO (Figure 1).

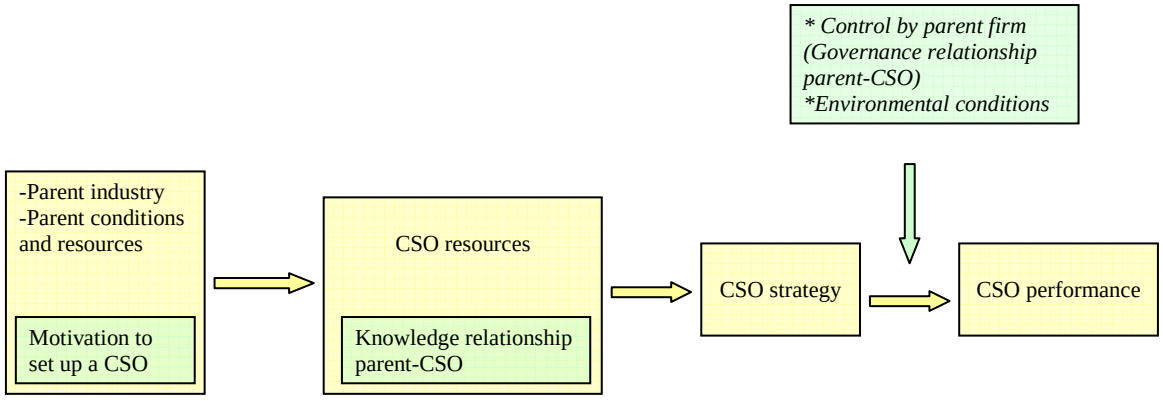

Figure 1: A model of antecedents and characteristics of corporate spin-offs

2.2.3.1 Parent Resource and Industry Conditions

Since a CSO is concentrated around activities originally developed in a parent firm, a first aspect to consider is the conditions of the parent firm. The conditions of the parent firm may seriously influence the motivation for a parent firm or an employee to set up a CSO. E.g. in case the parent firm is not doing well because profits and market share are declining, the parent firm may decide to focus on its core activities. A CSO can then become a means to get rid of certain activities. In case of focussing on core activities, certain activities within the parent firm will be terminated. An employee may consequently decide to continue with the activity by creating a CSO. CSO may be triggered by organizational crisis, change in leadership, or lack of upward mobility for employees (Brittain & Freeman, 1986; Garvin, 1983). Employees may become frustrated when they perceive their ideas and inventions are being shelved or killed due to resource constraints of the parent firm. The attitude and support the parent gives to explore new ideas can have a serious impact on the number of CSO created by employees. Recently, some scholars have looked at employee entrepreneurship in regard to CSO (Agarwal et al., 2004; Klepper, 2001).

Also the dynamics within a parent's industry can be the trigger to set up a CSO. Disruptive events in the parent industry often cause CSO to take place. E.g. in case the industry of the parent firm is altering huge changes, the parent firm may create a CSO to explore new technologies or new market opportunities. Studies in the legal perspective view have identified four motivations to create a CSO: 1) focus and restructuring motivation; 2) financial motivation; 3) incentive motivation; and 4) tax and regulatory motivation. However, in the literature on CSO, little attention has been devoted to use a CSO as a means to explore new markets, new technologies, new business models, or new production tools for the parent firm. To reduce the business risks associated with these activities, a parent firm could create a CSO to explore opportunities. This issue has been tackled by the literature on radical innovation.

A persistent theme in the academic literature on technological innovation is that established firms have great difficulties crossing the abyss created by a radical technological innovation that revolutionizes competition in their industry (Hill and Rothaermel, 2003). Hill and Rothaermel (2003) propose that the performance of an

established firm in response to a radical innovation will be higher if the firm establishes a loosely coupled, stand-alone division to commercialize new technology. Loosely coupled business units allow local adaptation and increased sensitivity to environmental changes. Without labelling the loosely coupled business units, the idea of CSO is obviously present. To the authors' knowledge, no scholars have investigated CSO in this regard.

The resources and industry conditions of the parent firm can seriously influence the motivation for a parent firm or an employee to set up a CSO. The motivation to create the CSO on the one hand, and the resources and industry conditions of the parent firm on the other hand, will impact the resources the CSO receives from its parent and the potential ongoing relationship between CSO and parent firm. E.g. in case the parent firm supports the CSO, one might expect the parent firm to provide the CSO with certain resources. However, if the parent firm is going in decline, it will probably give little resources to the CSO.

2.2.3.2 Resources

One of the main challenges for every new firm is to identify and assemble an initial resource base (Brush et al., 2001; Penrose, 1959). Corporate spin-offs are unique in the sense that they originate from an established firm. This implies that CSO may receive resources from the parent. Even in case there is no direct transfer of resources from the parent to the CSO, research has suggested that routines and resources transfer from old to new organizations through personnel migration (Almeida & Kogut, 1999; Pfeffer & Leblebici, 1973). In line with the resource-based view, we identify four dimensions of resources: financial, physical, human and organizational resources (Barney, 1991). Organizational resources are the systems, the routines and the relationships embedded in the company. They represent the ways in which firms combine and transform their other initial resources (Galunic & Rodan, 1998). Financial resources include all the different money resources that firms can use such as capital from the entrepreneurs, from equity investors and debtors. Physical resources include the physical technology used in the firm, a firm's plant and equipment, its geography and its access to raw materials. Human resources include the training, experience, judgment, intelligence, relationships, and insight of individual managers and workers in the firm.

The resource mobilization task is challenging in the case of CSO, since a CSO is concentrated around a new business, with the purpose to develop and market new products or services based upon a proprietary technology or skill. CSO need to overcome the scepticism of resource providers e.g. the parent or external parties, since the uncertainty and risk associated with the new venture is particularly heightened when the underlying product or technology is unproven (Aldrich & Fiol, 1994). The amount and quality of the resources received from the parent can be an important signal for external parties to invest in the CSO. Some CSO will start with a formal transfer of technology from the parent in the form of a license or a patent. The formality of the technology transfer will also depend upon the parent support to the spin-off and the knowledge relatedness between parent and spin-off. A parent firm may provide the CSO with some necessary financial resources, human and technological resources. Moreover, affiliation with a high-status organization as a parent firm may make it easier for CSO to raise financial and other resources needed to start new ventures (Agarwal et al., 2004).

The relationship between a CSO and its parent may extend beyond formation, e.g. transfer of rules, routines, and procedures from parent to CSO (Brittain & Freeman, 1986; Romanelli, 1991).The motivation to set up a CSO will heavily influence a potential ongoing relationship between the parent and the CSO. If the CSO is set up under hostile conditions, the chances for an ongoing relationship are very small. In case a CSO is created out of frustration by an employee, often the parent firm is not even aware of the fact that the CSO is created, so no ongoing relationship takes place. On the other hand, if the CSO is set up to explore a new market opportunity or a new technology, it is in the parent firm interest to keep a good ongoing relationship with the CSO.

The relationship with the parent firm will influence the resource base of a CSO. A constructive relationship with its parent will allow the CSO to get some necessary resources from its parent, even after start-up. A good relationship with the parent may allow to continue to use certain resources of the parent. Particular in industries that requires expensive machinery, this can be a huge saving cost and translate in a competitive advantage. The relationship with its parent can also impede a CSO to get the necessary resources e.g. a parent firm can oblige the CSO to use the resources the parent firm has been using although the CSO would be better off using other resources. The

sharing of resources will also be dependent upon the knowledge relatedness between CSO and parent. Related knowledge will contribute to the efficiency of communicating and transferring knowledge from the parent firm to the spin-off's knowledge base (Grant, 1996). The effect of lineage can both empower and constraint the CSO. Too much resources acquired from the parent may give the CSO not enough independence to build up its own resource base. Too few resources may constraint the CSO since it first need to focus on gathering the necessary resources. Depending upon the situation, a tight or loose relationship might be preferable.

2.2.3.3 Strategy

CSO need a strategy to develop their resources over time to progress through the different phases of development and create significant wealth (Penrose, 1959; Barney et al., 2001). We have defined CSO as separate legal entities that are concentrated around a new business, with the purpose to develop and market new products or services based upon a proprietary technology or skill. At start-up, CSO often do not have a clear view on the market they wish to enter. In many cases, the market does not yet exist or the customers still need to learn to use the new product. CSO tend to operate in dynamic environments where customer tastes, product-service technologies and competitive weapons often change unpredictably. As a consequence, they can not build their strategy based on a detailed competitive analysis. They will rather have to rely on strategic alliances and pre-commitments from stakeholders as a way to reduce and/or eliminate uncertainty and to erect entry barriers. This assumes a dynamic decision making environment which tend to lead to an effectuation process.

Effectuation processes take a set of means as given and focus on selecting between possible effects that can be created with that set of means (Sarasvathy, 2001).The process of effectuation allows the CSO to create one or more several possible effects irrespective of the generalized end goal with which it started. The process not only enables the realization of several possible effects (although generally one or only a few are actually realized in the implementation) but it also allows a decision maker to change his or her goals and even to shape and construct them over time, making use of contingencies as they arise (Sarasvathy, 2001). It differs from a causation process in that

a causation process takes a particular effect as given and focus on selecting between means to create that effect e.g. the Porter model in strategy is a causation model. However, in the journey of discovering a new technology and transforming this technology into a market-ready product, numerous hurdles need to be taken. Most of these hurdles are unpredictable and can not be foreseen. Therefore, we argue that CSO will follow effectuation processes in defining their strategies.

The CSO strategy will be influenced by its resource base and the relationship with its parent. The effect of originating from a parent may influence the spin-off beyond formation, as the transfer of rules, routines, and procedures from parent to progeny organizations can both constrain and empower the spin-off (Brittain & Freeman, 1986; Romanelli, 1991). Operating at the forefront of innovation, corporate spin-offs can capitalize on knowledge gained from discoveries made during the course of their founders' employment in established firms (Bhide, 2000). The prior employment affiliations may influence the initial resource base of the spin-off, but also the ability to build a strategy. Organizational blueprints can transfer across firm boundaries, in a manner analogous to the reproduction and transmission of biological genes (Winter, 1991). These transfers may include unique insights and decision rules used to transform resources into action (Prahalad & Bettis, 1986), cognitive dimensions of competency (Fiol, 1991), and specific knowledge and information (Boeker, 1997). While building their strategy, CSO will be constraint by the resources they have, the resources they need to acquire, the relationship with their parent firm and the external environment. The way CSO build their strategy has not been previously examined in the literature.

2.2.3.4 Environmental Conditions and Control by the Parent Firm

The effect of the external environment on a company's strategic choices is widely acknowledged in the literature (Boyd et al., 1993). CSO tend to operate in dynamic environments where markets and technologies often change unpredictably. Because product-market innovations are common in such firms, managers often find themselves dealing with a rather diverse array of customers, that is, with a heterogeneous market (Miller & Friesen, 1983). To cope with the very complex environment CSO often adopt a rather organic structure. Since CSO strive to be adaptive, their entrepreneurial efforts will

reflect the demands of their environments and their capacity to transform their resources. Different environments confront firms with different information processing tasks, which can have a varying complexity. The environmental conditions of a CSO e.g. dynamism, hostility and heterogeneity, will directly influence its strategy. Dynamism is characterized by the rate of change and innovation in the industry as well as the uncertainty or unpredictability of the actions of competitors and customers. Hostility represents the degree of threat to the firm posed by the multifacetedness, vigour and intensity of the competition and the downsizing and upswings of the firm's principal industry. Heterogeneity or complexity encompasses variations among the firm's markets that require diversity in production and marketing orientations (Miller and Friesen, 1983).

Also the control exercised by the parent will influence the way a CSO' strategy result in performance. An ongoing relationship with the parent can in some case impede the CSO to determine its own strategy. E.g. the parent firm may wish to only enter those markets that are of interest to the parent firm. However, the CSO might be better off entering other, non-related markets. Chesbrough (2003a) found that Xerox's practices in managing its equity position diminished the CSO' revenue growth and market value. In general, Xerox followed internal practices that promoted coordination with the CSO and its own internal resources. Xerox allocated capital to the CSO as part of the annual budget cycle. It recruited internal managers to serve as CEO of the CSO it controlled. Moreover, Xerox's practices restricted the scope of search activities conducted by the CSO.

The strategy of a firm reflects how well a firm is able to perform in the face of increased environmental challenge and complexity. It is dependent upon the resources acquired by the CSO, the relationship with the parent and the industry conditions of the CSO. In their attempt to explain the performance of CSO, scholars have devoted almost no attention to the environmental conditions of the CSO or the control exercised by the parent firm.

2.2.3.5 Performance

Research Based View-scholars have argued that firm-specific resources and capabilities, which are both rare and valuable, determine the competitive advantage of a

firm. When such resources are simultaneously not imitable (i.e. they cannot easily be replicated by competitors), not substitutable (i.e. other resources cannot fulfil the same function), and not transferable (i.e. they cannot be purchased in resource markets), those resources may produce a competitive advantage that is long lived (i.e. sustainable) (Barney, 1991). Resources are indeed important for a CSO to perform well. However, in examining the performance of CSO, we must take into account that they originate from a larger parent firm. Previous research has suggested that entrepreneurial origin is an important source of resource differences, strategies, and performance (Knight, 1989; McGrath &MacMillan, 2000; Shrader & Simon, 1997).

In this study, we have tried to incorporate all factors that influence the performance of a CSO (see figure 1 for a graphic representation). Most studies on CSO have singled out one variable to examine the influence of this variable on the performance of a CSO. A few recent studies have considered the interaction of several variables on performance. Thornhill and Amit (2000) make a distinction between a non-financial and a financial relationship and found that the non-financial dimension of the parent-CSO relationship has a higher impact on the success of the CSO than does the financial dimension. Tubke et al. (2004) has identified several factors influencing the CSO decision and the success of the CSO process.

McGrath, Venkatraman & MacMillan (1994) pointed out that in case of new ventures, traditional financial measures of performance such as return on investments, return on equity, net profits, and cash flows, lose part of their value because they monitor only some aspects. The studies on the 'legal' perspective of CSO have focused on the financial performance of CSO, often by measuring the excess stock return. However, by focusing on the excess stock return, one measures the short term performance of a CSO, usually measured after one year of start-up. However, not all CSO are public companies. In contrary, most CSO studied by the 'entrant' perspective studies are private companies. Therefore, these studies have introduced different measures to capture performance. Sapienza et al. (2004) use sales growth to measure performance, since they believe sales growth represents the outcome of all three types of knowledge overlap (technological, production, and marketing-related knowledge) to a greater extent than does patenting or new product introduction. Other studies use markets share, since market share can be

considered a measure of the firm's vitality, defined as its ability to face both market and competitive challenges in a dynamic environment (Sorrentino & Williams, 1995).

Measuring the performance of CSO shares many of the difficulties associated with evaluating the performance of small, entrepreneurial firms. Covin and Slevin (1989) identified three reasons for using subjective performance measures of small-firm performance over more objective, hard numerical data: 1) the inability and/or unwillingness of firms to provide financial data, 2) the difficulty of interpretation and comparison of data due to differing firm objectives, and 3) the influence of industry effects. Their solution to the problem of performance evaluation was to create a weighted average performance index for firms based upon the product of 'importance' scores and 'satisfaction' scores on a series of questions about various financial criteria (e.g. sales, cash flow, profit margin). A similar approach was used by Venkatraman (1990) who operationalized performance with three indicators, two of which reflect managerial satisfaction and a third that evaluates the performance of the competition.

2.3 Conclusion

In this chapter we propose a model that recognizes the role and importance of different factors to the performance of a CSO. This model allows us to better understand under what conditions CSO can add value to their shareholders and to their parent firms. To build this model, we have departed from a collection of studies on corporate spin-offs. We have assimilated the emerging findings from these studies within our model of "Antecedents and Characteristics of Corporate Spin-offs" (see figure 1). The accumulating findings point to three significant conclusions with respect to the performance of corporate spin-offs: 1) Identification of an additional motivation to create a CSO; 2) Break down of the relationship between CSO and its parent into different factors; 3) Recognition of the environment and the control exercised by the parent as key moderators.

1) Additional motivation to create a CSO The literature has identified four major motivations for a parent firm to create a CSO: focus and restructuring motivation; financial motivation; incentive motivation; and tax & regulatory motivation. We have

complemented the different motivations to set up a CSO as discussed in the literature, with the motivation to create CSO as a means to explore new markets, new technologies, new business models, or new production tools for the parent firm. To reduce the business risks associated with these activities, a parent firm could decide to create a CSO to explore opportunities. This would suggest that CSO could become an important part of a parent's firm strategy in exploring new opportunities. To the authors' knowledge, no scholars have investigated CSO in this regard.

2) *Different factors of the relationship CSO-parent* Due to the unique nature of CSO, we have added the parent industry, conditions and resources to the resource-strategy-performance framework in the setting of CSO. A hostile or friendly spin-off can have a serious impact on the resources, subsequent strategy and performance of a CSO. Moreover, besides the resources as identified in the Resource Based View, we also need to consider the knowledge relatedness with the parent as an important element in the resource base of a CSO.

3) *Recognition of the environment and the control exercised by the parent as key moderators* The importance of the external environment on the strategy of a company has been recognized in previous literature (Miller & Friesen, 1983; Zahra & Bogner, 1999). In this chapter, we extend the link between environment and strategy-making to the setting of corporate spin-offs. Moreover, in case of a CSO, also the control exercised by the parent firm moderates the relationship between strategy and performance.

3 THE TECHNOLOGY STRATEGY OF CORPORATE SPIN-OFFS

The previous chapter has reviewed the literature on corporate spin-offs (CSO). We have integrated the existing literature into a model of antecedents and characteristics of CSO. In this chapter, a part of this model is further developed. Hypotheses are derived to examine the relationship between resources, strategy and performance of CSO.

According to Itami and Numagami (1992), technology is the most fundamental of the core capabilities of a firm. Managing technology effectively requires a company to develop a strategy that guides its use of technological resources and skills (Adler, 1989). CSO are brought on the market to commercialize a new technology. Developing new technologies, even breakthrough ones, is rarely sufficient to survive and achieve market success (McGrath 1994). New ventures, therefore, need also to employ effective technological strategies that allow them to financially benefit from their innovations (McGee, Dowling, and Meggison 1995). Spin-offs need to develop a technology strategy in order to be able to commercialize their new technology. These technology strategies must be set in conjunction with the resources the spin-offs possess, in order to achieve a competitive advantage.

3.1 The Concept Technology

Before we start elaborating on the technology strategy of CSO, we first want to clarify what we understand under the concept ‘technology’. Technology is a systematic body of knowledge based on the principles of how natural things behave as they do and how they interact with artificial things (Itami & Numagami, 1992). It is a logical system which combines this body of knowledge. The purpose of technology is to produce artificial things to satisfy basic human needs. As Thompson (1967) said, technology is a set of knowledge and beliefs on causal relations and thus a system of logic. When the entire logic becomes a closed system, technology becomes complete as an instrument. Technology encompasses not only articulated knowledge, but also tacit knowledge. Technology evolves as a system by incorporating new variables of which people are

unaware but become cognizant through production and use experiences (Burgelman & Rosenbloom, 1989; Jaikumar & Bohn, 1986; Rosenberg, 1982; Habermeier, 1990). As such, technology is a logical system which has its own tendency toward perfection and systematization.

It is, however, different from science in the sense that, although science can remain in the abstract world, technology cannot and has to produce things to be used by people. Science is the establishment of facts and the development of quantitative rules or laws that relate those facts to each other (Allen, 1977). The goal of scientific activities is to enhance knowledge and understanding, or learning for its own sake. Technology, in contrast, is concerned with incorporating such knowledge into physical artifacts that benefit users (Ahuja & Katila, 2004). The output of science is information, but the output of technology has to be information to be embodied in products and services made available to society (Allen. 1977). Scientists care about contributions to knowledge per se, but technologists care about contribution to human life and markets (Bailyn. 1980). Thus, technology is very fundamentally oriented toward basic human needs.

3.2 The Concept Technology Strategy

The fundamental question in the field of strategic management is how firms achieve and sustain competitive advantage (Teece et al., 1997). The dominant paradigm in the strategy field during the 1980s was the competitive forces approach developed by Porter (1980). The competitive forces approach views the essence of competitive strategy formulation as ‘relating a company to its environment’. The key aspect of the firm’s environment is the industry in which it competes. The industry structure strongly influences the competitive rules of the game as well as the strategies potentially available to firms. In the competitive forces model, five industry-level forces (entry barriers, threat of substitution, bargaining power of buyers, bargaining power of suppliers, and rivalry among industry incumbents) determine the inherent profit potential of an industry or sub segment of an industry. The industry structure plays a central role in determining and limiting strategic action.

A second approach, referred to as a strategic conflict approach (e.g. Shapiro, 1989) is closely related to the first in its focus on product market imperfections, entry deterrence, and strategic interaction. The strategic conflict approach uses the tools of game theory and thus implicitly views competitive outcomes as a function of the effectiveness with which firms keep their rivals off balance through strategic investments, pricing strategies, signaling, and the control of information. Both the competitive forces and the strategic conflict approach appear to share the view that rents flow from privileged product market positions.

Another distinct class of approaches emphasizes building competitive advantage through capturing entrepreneurial rents stemming from fundamental firm-level efficiency advantages. These approaches have their roots in a much older discussion of corporate strengths and weaknesses; they have taken on new life as evidence suggests that firms build enduring advantages only through efficiency and effectiveness, and as developments in organizational economics and the study of technological and organizational change become applied to strategy questions. One strand of this literature is the resource-based perspective. The resource-based perspective emphasized firm-specific capabilities and assets and the existence of isolating mechanisms as the fundamental determinants of firm performance (Penrose, 1959; Teece, 1984). The resource-based approach sees firms with superior systems and structures being profitable not because they engage in strategic investments that may deter entry and raise prices above long-run costs, but because they have markedly lower costs, or offer markedly higher quality or product performance. This approach focuses on the rents accruing to the owners of scarce firm-specific resources rather than the economic profits form product market positioning.

Another component of the efficiency-based approach is the dynamic capabilities approach. The efficiency-based approach identifies the dimensions of firm-specific capabilities that can be sources of advantage, and explains how combinations of competences and resources can be developed, deployed and protected. This approach stresses exploiting existing internal and external firm-specific competences to address changing environments. The term ‘dynamic’ refers to the capacity to renew competences so as to achieve congruence with the changing business environment; certain innovative

responses are required when time-to-market and timing are critical, the rate of technological change is rapid, and the nature of future competitions and markets difficult to determine. The term ‘capabilities’ emphasizes the key role of strategic management in appropriately adapting, integrating, and reconfiguring internal and external organizational skills, resources, and functional competences to match the requirements of a changing environment.

Teece et al. (1997) distinguish models of strategy that emphasize the exploitation of market power from models of strategy that emphasize efficiency. From the resource-based perspective, firms are heterogeneous with respect to their resources/capabilities/endowments (Teece et al., 1997). The resource-based perspective focuses on strategies for exploiting existing firm-specific assets. Moreover, it also invites consideration of managerial strategies for developing new capabilities (Wernerfelt, 1984). Indeed, if control over scarce resources is the source of economic profits, then it follows that such issues as skill acquisition, the management of knowledge and know-how (Shuen, 1994), and learning become fundamental strategic issues. It is in this second dimension, encompassing skill acquisition, learning, and accumulation of organizational and intangible or invisible assets (Itami & Roehl, 1987) that lies the greatest potential for contributions to strategy. The resource view holds that the type, magnitude, and nature of a firm’s resources and capabilities are important determinants of its profitability (Amit & Schoemaker, 1993).

In the dynamic capabilities perspective, dynamic refers to the capacity to renew competences so as to achieve congruence with the changing business environment. The term capabilities emphasizes the key role of strategic management in appropriately adapting, integrating, and reconfiguring internal and external organizational skills, resources, and functional competences to match the requirements of a changing environment. In this chapter, we want to create insights in the technology strategy spin-offs will follow, based on their technological resources and their link with the parent institute. Therefore, we will use the resource-based perspective and not the dynamic capabilities perspective, since the latter perspective goes one step further. The dynamic capabilities perspective can be used to describe how a firm uses and adjust its resources to adapt to its changing environment. In this chapter however, we want to focus on how

firms deploy their resources to build their strategy, without considering the external environment.

The resource-based perspective offers an alternative perspective by recognizing the inter-connectedness of a firm's technological resources with its other assets. Following this view, the starting point in creating a competitive advantage is to identify and classify a firm's resources, especially its technology (Grant, 1991). Next, the company should determine its technological capabilities by determining which of its resources surpass those of the competition as well as what the company does better, technologically, than its rivals. This view holds that technology strategy is a component or subset of the company's resources and capabilities that provide the foundation for a distinctive competence from which a competitive strategy can be developed. The resource view further suggests that a competitive advantage is achieved by the accumulation, integration, and effective deployment of technological resources. Resources serve as a foundation for building enduring, multifaceted capabilities that enable the firm to develop and pursue effective strategies. When integrated and effectively used, these capabilities enable a firm to develop and introduce new products, goods, and services efficiently and quickly. These variables can give the firm a key advantage over its rivals, thereby ensuring superior financial performance.

3.2.1 Definition of the Concept Technology Strategy

Technology strategy is one of the most important aspects of any firm's strategic posture (Zahra & Bogner, 1999). It is often a basic requirement for strategy to capitalize on technology, because technology can act as a fundamental weapon for competition and can determine physical feasibility of alternative actions (Itami and Numagami, 1992).
A firm's choice of technology strategy will influence its current and future competitive position within an industry. In short, the technology strategy of a firm is a fundamental driver of its profitability and success.

In the literature, we can see an evolution in the definitions of technology strategy. First, the concept 'technology policy' was used. Technology policy embodied the choices companies make about acquiring, developing and deploying technology to help reach the

goals of their business strategy (Adler, 1989; Zahra & Covin, 1993). Next, Zahra used the concept 'technology strategy' in several studies e.g. technology strategy is the plan that guides the accumulation and deployment of technological resources and capabilities (Zahra, 1996b); technology strategy is the plan that guides a new venture's decisions on the development and use of technological capabilities (Zahra, 1996a); and technology strategy is the sum of a firm's choices on how to develop and exploit its technological resources (Zahra & Bogner, 1999). Narayanan (2001) extended the definition into:

> *Technology strategy can be defined as the revealed pattern in the technology choices of firms. The choices involve the commitment of resources for the appropriation, maintenance, deployment, and abandonment of technological capabilities. These technology choices determine the character and extent of the firms' principal technical capabilities and the set of available product and process platforms (Narayanan, 2001, pp. 250).*

Narayanan's definition of technology strategy captures two important points. First, technology strategy focuses on the kinds of technologies that a firm selects for acquisition, development, deployment, or divestment. Second, the definition uses the term revealed patterns, i.e. patterns that are not merely intended but also accomplished. Execution implies commitment of resources, commitments surrounding technology selection that define the technology strategy. In this thesis, we will define technology strategy as the plan that guides a spin-offs' decision on the development and use of its technological resources (Borch et al., 1999).

3.2.2 Dimensions of Technology Strategy

The technological choices of a new venture are usually clarified in its technology strategy, i.e. the plan that guides the accumulation and deployment of technological resources and capabilities (Zahra, 1996b). Scholars have attributed different dimensions to technology strategy. In earlier studies, the concept 'technology policy' was used. Zahra & Covin (1993) define technology policy as the set of organizational decisions

concerning (1) aggressive technological posture, (2) automation and process innovation, and (3) new product development. The first dimension refers to the firm's preference for or propensity to use technology proactively in positioning itself (Oster, 1990). The second dimension related to the level of automation of plants and facilities, the adoption of the latest technology in production, and capital allocations for new equipment and machinery (Hayes and Wheelwright, 1984). The third dimension refers to the intensity of a firm's product development activities (Zahra, 1991). Maidique and Patch (1988) define a technology policy as consisting of six dimensions: type of technology, desired level of competence, internal versus external sources of technology, R&D investment, timing of technology introductions, and R&D organization.

Next, Zahra & Sisodia (1994) defined several components of a technology strategy: a company's technological posture (whether it pioneers or follows technological change in its markets); technology sourcing (internal to the company or external through acquisitions, strategic alliances or licensing agreements); technology portfolio (the technologies emphasized or offered by the organization over time); and distinctive technological skills and resources (such as talented experts or staff). Zahra (1996b) identifies 6 key dimensions of technology strategy: pioneering, number of products introduced to the market, internal and external R&D sources, level of R&D spending, portfolio of applied and basic research projects, and use of patenting. In a later study, Zahra & Bogner (1999) identified 5 key dimensions of technology strategy: innovativeness; intensity of product upgrades; level of R&D spending; use of external technology sources; use of copyrights and patents.

Innovativeness implies that the firm will develop radically new product (or process) technologies and introduce them to the market ahead of the competition (Ali, 1994). Intensive product upgrades refers to the large number of revisions or extensions of the venture's existing products. R&D spending levels refers to the intensity of the venture's investment in internal R&D activities by building the facilities, expertise, and skills needed for continuous innovations (Adler, 1989; Dowling and McGee, 1994). External sources refer to the venture's use of strategic alliances, acquisitions, licensing agreements, and outright purchase of technology from outside sources (Adler, 1989;

Dowling and McGee, 1994). Last, ventures can use several approaches to protect their intellectual capital, including copyrights and trade secrets.

Narayanan (2001) classifies the technology choices made by a firm along two dimensions: scope and leadership. Scope decisions refer to the answer firms develop to the question: What technologies should we be in? Technology leadership refers to a firm's commitment to a pioneering goal in the development or exploitation of a technology as opposed to a more reactive goal.

In defining the dimensions of technology strategy, authors have not always made a clear distinction between the dimensions of technology strategy and the different technological resources. The definition of the concepts is clearly stated in most studies, but the dimensions of both concepts intertwine. The construct 'technological resources' refers to the firm-specific products and technology, while technology strategy is the plan that guides a new venture's decision on the development and use of its technological resources (Borch et al., 1999). The technology strategy must be set in conjunction with the technological resources the firm possess in order to achieve a competitive advantage. A similar technology strategy can lead to a different performance due to different resource endowments. A clear distinction between technological resources and technology strategy variables can therefore create more clarity in the impact of these variables on performance.

The need to link a firm's technological and strategic choices has been recognized for years in the literature (Zahra & Covin, 1993). Success in today's dynamic markets requires the effective use of a company's technological resources (Zahra & Sisodia, 1994). Whether embedded in products, processes, equipment or the know-how of employees, technological resources are of little value unless they are linked to a company's competitive strategy. Technological resources not only underlie a company's strategy, they can also guide the development of its competitive advantage (Kusunoki, 1997). Successful companies recognize the importance of this link for defining and building their technological skills and capabilities (Abetti, 1997).

When we look at the literature on technology strategy, technology strategy seems to be captured by two dimensions: scope and newness of the technology. The scope of a technology refers to the choice between focusing on a platform technology or a specific technology. A platform technology is a technology build on a broad technology platform, which can serve as a base for several products (Meyer et al., 1997). Some spin-offs develop one specific product, while others develop broad platforms which serve as the base architecture for a series of derivative products. Porter (1980, 1985) suggests that the breadth or scope of the venture's business shapes the firm's strategic choices, especially the technology strategy. Also Narayanan (2001) identifies scope as a dimension of technology strategy. The dimension scope of a technology is also implicitly comprised in several dimension of technology strategy previously stated in the literature: the product line breadth (Zahra & Covin, 1993), the intensity of product upgrades (Zahra & Bogner, 1999) and the number of products introduced in the market.

The newness of the technology refers to the innovativeness and uniqueness of the technology. The concept newness consists of two dimensions: technological innovation and the uniqueness of the technology. Technological innovation represents the intellectual component of the technology, which is largely intangible. Schoonhoven et al. (1990) distinguish between (1) innovation achieved through the creation of new knowledge, and (2) innovation created by knowledge synthesis, in which existing knowledge is combined in unique ways to create a new product. Hellmann & Puri (2000) make a distinction between innovators and imitators. An innovator is a firm that creates mainly new, proprietary knowledge. This new and proprietary knowledge could be licensed or sold on its own without translating it into products. An imitator, on the other hand, rather uses existing knowledge and focuses on making (minor) improvements to it or synthesizes several existing technologies in its own proprietary products. Technological innovation can be defined as a technology new to a given organization or to a given industry (Tornatzky et al., 1983). We will only consider technological innovation from the perspective of a given organization, seen the focus on spin-offs.

The uniqueness of the technology refers to the tacit character of the technology e.g. if it is difficult or easy to transfer and codify the technological knowledge in a systematic way (Subramaniam & Venkatraman, 2001). A complex and critical part of

technology know-how is the "softer" side, which goes beyond codified knowledge available in scientific papers, formulae, technical specifications, blueprints, strategy reports, and hardware and is held by individual employees in the form of tacit knowledge and competence assets (Kogut & Zander, 1992; Teece, 1988). In case a technology is unique, it will augment the newness of the technology. The dimension newness of a technology is also implicitly comprised in several dimension of technology strategy previously stated in the literature: the commodity-to-specialty products (Zahra & Covin, 1993), technological leadership (Narayanan, 2001), innovativeness (Zahra & Bogner, 1999) and pioneering (Zahra, 1996b).

3.2.3 Definition of the Concept Technological Resources

The resource based view of the firm is one of the most prominent theoretical perspectives in strategic management (Wernerfelt, 1984; Barney, 1991; Teece, Pisano & Shuen, 1997; Eisenhardt & Martin, 2000). Central to this perspective is the idea that firms differ in their resource positions, and that such resource heterogeneity is a source of performance differences across firms (Barney, 1991; Peteraf, 1993). The resource-based theory views a firm as a unique bundle of tangible and intangible resources and emphasizes the protection of firm core competencies comprising these resources. Several authors (Barney, 1991; Day and Wensley, 1988; Prahalad and Hamel, 1990; Wernerfelt, 1984) have expanded the seminal work of Penrose (1959). Resources enable a firm to conceive and implement strategies that improve efficiency and effectiveness (Barney, 1991). Firm competitive advantage is rooted in resources that are valuable and inimitable, and the firm's survival largely depends on how it creates new resources, develops existing ones, and protects its core competencies (Day and Wensley, 1988). For firm resources to hold the potential of sustained competitive advantage, they must have four attributes: (a) it must be valuable, in the sense that it exploit opportunities and/or neutralizes threats in a firm's environment, (b) it must be rare among a firm's current and potential competition, (c) it must be imperfectly imitable, and (d) there cannot be strategically equivalent substitutes for this resource that are valuable but neither rare or imperfectly imitable (Barney, 1991).

In the language of traditional strategic analysis, firm resources are strengths that firms can use to conceive of and implement their strategies (Porter, 1980). Amit & Schoemaker (1993) define the firm's resources as stocks of available factors that are owned or controlled by the firm. Resources are converted into final products or services by using a wide range of other firm assets and bonding mechanisms such as technology, management information systems, incentive systems, trust between management and labor and more. Resources are defined as those attributes of physical and knowledge-based assets that enable a firm to conceive and implement strategies that lead to differences in performance (Wernerfelt, 1984). Barney (1991) classifies resources into three categories: physical, human and organizational capital resources. *Physical resources* include the physical technology used in the firm, a firm's plant and equipment, its geography and its access to raw materials. *Human resources* include the training, experience, judgment, intelligence, relationships, and insight of individual managers and workers in the firm. *Organizational resources* include a firm's formal reporting systems, as well as informal relations among groups within a firm and between a firm and those in its environment. Organizational resources include the systems, the routines and the relationships embedded in the company. They represent the ways in which firms combine and transform their other initial resources (Galunic & Rodan, 1998). Organizational resources are intangible, immobile and inherently difficult to imitate and are therefore particularly important for providing competitive advantage. Organizational resources cannot easily be acquired by new ventures but are built over time.

'Technological resources' refers to the firm-specific products and technology (Borch et al., 1999) and can be seen as part of the physical resources. We will use the term 'technological resources' in this thesis since we are particularly interested in the technological resources and their influence on the technology strategy. Technology strategy can be defined as the plan that guides a new venture's decision on the development and use of its technological resources. Insights in the technological resources and technology strategy are important since the literature has demonstrated technology's growing importance in determining success in today's marketplace. In one industry after another, companies have used their technologies to create an enduring competitive advantage by offering new products or utilizing new processes, revising the

rules of competition, or redrawing their industry's boundaries (Utterback, 1994). Technology's profound effect on the industrial landscape is pervasive and is felt in nearly every sector of the economy.

3.2.4 Dimensions of Technological Resources

As previously stated, authors have not always made a clear distinction between the dimensions of technology strategy and the different technological resources. The construct 'technological resources' refers to the firm-specific products and technology, while technology strategy is the plan that guides a new venture's decision on the development and use of its technological resources (Borch et al., 1999). Based on the literature, in this study technological resources are classified as: internal R&D sources, collaboration in R&D consortia, technology transfer from the parent, and transfer of production knowledge from the parent.

Internal R&D sources This variable refers to the intensity of internal R&D activities (Adler, 1989; McCann, 1991) by building the facilities, expertise and skills needed for continuous innovation (Zahra & Bogner, 1999). Internal R&D ensures ownership and control of key knowledge which can enable the spin-off to profitably exploit its innovations. It also allows building proprietary research platforms which can lead to future success (Helfat, 1994). The development of internal technologies is important, since internal technologies are not widely accessible, in contrary to external technologies that are also accessible to other firms (Garud & Nayyar, 1994).

Collaboration in R&D consortia refers to the collaboration projects set up between spin-offs and universities or companies to jointly develop some parts of the technology. These partnerships can give the spin-off access to a large pool of technological resources and capabilities that can proof necessary to develop new products (Zahra & Bogner, 1999). Spin-offs often use external sources of technology to complement and enhance their internal technological capabilities. They may buy technologies from other companies, acquire technology-based businesses, and engage in licensing agreements to acquire or sell their technologies, or join technological alliances (McCann, 1991; Porter, 1980). Collaboration projects can offset weaknesses in the spin-

off's R&D, it can expedite product development and offer opportunities for learning (Dodgson, 1993). They can allow the firm to bundle its particular technological advantages with key product attributes (features) developed by other firms, and quickly bring a large number of new products to the market (Zahra & Bogner, 1999).

Internal R&D sources and collaboration in R&D consortia are technological resources inherent to each company involved in technology commercialization. CSO form a distinct group of young companies since they originate from a parent institute. Consequently, in considering the technological resources of CSO, we need to recognize the fact that a transfer of knowledge from the parent firm may have taken place. Heterogeneity in a spin-off's capabilities has been related to the prior affiliation and pre-entry knowledge of firms (Carroll et al., 1996; Helfat & Lieberman, 2002; Klepper & Simons, 2000). Research has suggested that routines and resources transfer from old to new organizations through personnel migration (Almeida & Kogut, 1999) Areas of knowledge relatedness critical to growth include technology, market or production relatedness (Rumelt, 1974; Sapienza et al., 2004). Due to the unique nature of CSO, we need to take the transfer of technology and production knowledge into account when discussing the technological resources.

Technology transfer from the parent refers to the degree in which the spin-off transfers technological knowledge from its parent firm. In case of technology transfer, a spin-off is able to augment its technological knowledge base by learning from its parent. A solid technological knowledge base will allow the spin-off firm to design products that offer greater technological performance than already available in the market and to cut the development time from product idea to commercial product (Sapienza et al., 2004). Parent firms may also formally transfer knowledge to the spin-offs firms i.e. in the form of a patent, a license, copyrights or trade secrets. Copyrights are among the spin-off's most values assets because they enhance its reputation and strengthen its bargaining power (Zahra & Bogner, 1999). Patenting helps to delay imitation by other firms and protects the venture's gains from R&D spending and product introductions (Teece, 1986). Levin et al. (1987) observe that patenting represents the most effective means of protecting spin-off's technological resources. Parent firms may transfer patents to the spin-off, since this can help the spin-off leverage its value.

Transfer of p*roduction knowledge from the parent* refers to the degree in which the spin-off transfers production knowledge from its parent firm. Spin-offs can learn production techniques from the parent firm in order to realize efficient and effective customization of production. This knowledge can allow them to meet changes in customer specifications (Sapienza et al., 2004). The suitability of the production related resources held by the parent firm greatly increases the likelihood of spin-offs being able to produce products on a commercial scale by the time of the separation from the parent firm (Parhankangas, 1999).

3.3 Corporate Spin-Offs versus University Spin-Offs

Previous studies have examined young companies and the impact of their technology strategy on performance (Zahra, 1996a; Zahra, 1996b; Schrader & Simon, 1997). These studies have split up the group of young companies into corporate ventures and independent ventures. Corporate ventures are defined as ventures owned by established firms, while independent ventures are ventures created by individual entrepreneurs. Independent ventures can be seen as all ventures that are not owned by their parent firm. These independent ventures form a heterogeneous group of companies on itself. They can be divided into different subgroups e.g. university spin-offs, corporate spin-offs, and independent start-ups.

In the previous chapter, we have reviewed the literature on corporate spin-offs (CSO). We have made the distinction between the definition of a corporate spin-off from a legal perspective and from an entrant perspective. Next, we have developed our own definition of corporate spin-off. A corporate spin-off was defined as “a separate legal entity that is concentrated around activities that were originally developed in a larger parent firm. The entity is concentrated around a new business, with the purpose to develop and market new products or services based upon a proprietary technology or skill”. The advantage of using this definition is that it emphasizes the ‘new’ character of the CSO. Especially in the legal perspective, CSO can be based on a mature technology that exists already for quite some time. In this thesis, we wish to focus on those CSO which are set up around new businesses.

Corporate spin-offs are not the only group of new companies that originate from a larger parent institute. Also university spin-offs (USO) originate from larger parent institutes e.g. universities and research centers. Roberts & Wainer (1968) and Cooper (1971, 1973) were among the first to study the spin-off phenomenon. The study of Roberts examined spinouts from MIT laboratories and academic departments while Cooper's work focused on corporate spinouts in what was to become Silicon Valley. Apart from a small number of studies (e.g., Louis et al., 1989; Roberts and Malone, 1996), the majority have focused on a single university or on a very small number of institutions. Early research on university spin-offs was mainly US focused, but there has been a recent upsurge in European research on European university spin-offs (e.g. special issue of Research Policy, volume 34, 2005).

In the US, legislative initiatives such as the Bayh-Dole Act of 1980 helped to accelerate the rate of diffusion of new technologies from universities and federal laboratories to firms. Also in European countries, legislation was enacted to stimulate the commercialization of university-based research and technology. Licensing has traditionally been the dominant route for the commercialization of technology invented at universities and research institutes (Shane, 2004). Most university technologies are licensed to existing companies, since established firms have a variety of advantages in commercializing university technologies. For instance, they have market knowledge, relationships with customers, distribution systems and related products, all of which facilitate the creation and sale of new technology products and services (Lowe, 2002). As a result, established companies can often make money by commercializing technologies that do not justify the expense of creating a new firm.

In his study on USO, Shane (2004) found that USO tend to be founded to exploit technologies that are radical, tacit, early stage and general-purpose. Radical technologies tend to provide the basis for the creation of university spin-offs, while incremental technologies are more likely to be licensed by established companies. Research has shown that, when a university technology is at a very early stage of development, and so is 'unproven', it cannot be licensed easily to established firms. As a result, early stage inventions tend to lead to the formation of spin-offs (Doutriaux and Barker, 1995). USO often need to overcome cultural obstacles since spin-off companies are often observed to

be diluting academic work and potentially risking the university's reputation (Blair & Hitchens, 1998). University spin-offs generate several problems for the achievement of the traditional academic goals of the creation and dissemination of knowledge.

3.3.1 Definitions of University Spin-Offs

While going through the literature on university spin-offs (USO), one can notice that there is no universal definition of a university spin-off. Some authors define USO in a broad sense (e.g. Smilor et al., 1990), other authors prefer a more narrow definition (Lockett & Wright, 2005). Roberts (1991) has defined USO as companies founded by anyone who has studied or worked at the university. Smilor et al. (1990) define university spin-off companies in two ways: (a) the founder was a faculty member, staff member, or student who left the university to start a company or who started a company while still affiliated with the university; and (b) a technology or technology-based idea developed within the university. Shane (2004) uses a more narrow definition of university spin-off namely a university spin-off is a new company founded to exploit a piece of intellectual property created in an academic institution. Lockett & Wright (2005) define university spin-outs as new ventures that are dependent upon licensing or assignment of the institution's intellectual property for initiation. They exclude all companies not based on technology assigned/licensed from the university, such as companies that may be established by graduates or university researchers that are not directly related to intellectual assets created from research funded by government or industry.

Roberts' definition of university spin-offs includes a wide range of new companies. It includes companies founded by people who attended or worked at a university many years earlier. This means that the factors leading to the formation and development of the new companies are distantly related to the university, at best. According to Shane's definition, university spin-offs are a subset of all start-up companies created by the students and employees of academic institutions. Companies established by current of former members of a university, which do not commercialize intellectual property created in academic institutions, are not included in his definition. This in line with the distinction made by The Association of University Technology

Managers between “start-ups” and “spin offs”. The first group of companies is based on know-how developed at the university or research institute without formal transfer of technology, whereas the “spin-offs” are established with a formal transfer of technology.

In this study, we will define a university spin-off as “a new company that is formed by a faculty, staff member, or doctoral student who left the university (research organization) to found a company or start a company while still affiliated with the university, and/or a core technology (or idea) that is transferred from the parent organization” (Roberts and Malone, 1996; Smilor et al., 1990; Steffenson et al., 1999). In this way, CSO and USO are both young companies set up to commercialize a new technology. An independent start-up can be defined as all new companies which are not based on a core technology or idea developed in a parent firm. These companies do not have a clear link with a parent organization. In the empirical part of this dissertation, we will focus on two groups of new product-based companies, CSO and USO. Past research has devoted limited attention to single out these two subgroups of independent ventures.

3.3.2 Technology Strategy of Corporate and University Spin-Offs

This dissertation wants to create a better understanding of the technology strategy of corporate spin-offs. The technology strategy must be set in conjunction with the resources the spin-off posses in order to achieve a competitive advantage. The resource inheritance of corporate spin-offs can be traced directly to their parents, who provide them with distinctive, but limited, knowledge (Klepper & Sleeper, 2005). CSO inherit general technical knowledge from their parents that shapes their nature at birth. Researchers have suggested that entrepreneurial origin is an important source of resource differences, strategies, and performance (Knight, 1989; McGrath &MacMillan, 2000; Shrader & Simon, 1997). Organizational blueprints can transfer across firm boundaries, in a manner analogous to the reproduction and transmission of biological genes (Winter, 1991). These transfers may include unique insights and decision rules used to transform resources into action (Prahalad & Bettis, 1986), cognitive dimensions of competency (Fiol, 1991), and specific knowledge and information (Boeker, 1997). Since “what an organization knows at its birth will determine what it searches for, what it experiences,

and how it interprets what it encounters" (Huber, 1991: 91), one implication is that a spin-off's capability accumulation may be linked to its inherited knowledge and that the agent of transfer may have an impact on the efficacy of transfer.

CSO are not the only group of new ventures that inherited knowledge from their parents. Also USO transfer knowledge from their parent institutes e.g. universities or research centers. CSO and USO are similar in the sense that they both originate from a larger parent institute e.g. an established firm, a university or a research institute. They are both young companies, set up to commercialize a new technology. However, due to the nature of their parent, we expect USO and CSO to also show significant differences. Studying the technology strategy of both CSO and USO makes it possible to gain a richer understanding of the phenomenon. We have not performed an extensive literature study on USO, since Mustar et al. (2006) have recently done this in an excellent way.

In the following paragraphs, we will develop the hypotheses on the technological resources, the technology strategy and the performance of CSO and USO. The hypothesized differences between the samples of CSO and USO are grounded in well-established theory on institutional isomorphism (DiMaggio and Powell, 1983; Zucker, 1977).

3.4 Hypotheses Development

3.4.1 Hypotheses Development: Technological Resources of CSO and USO

In the following paragraphs, we will develop hypotheses on the technological resources of CSO and USO.

3.4.1.1 Internal R&D Sources

Internal R&D sources refer to the intensity of internal R&D activities (Adler, 1989; McCann, 1991). Internal R&D sources are important because technological knowledge usually develops in a path-dependent way (Dosi, 1988), and the knowledge gained at any one point in time can become a foundation for later R&D efforts. University spin-offs (USO) originate from universities or research institutes. Universities

typically have the aim to perform research at the cutting edge of the field. From their very nature, universities are typically more focused on performing fundamental research, while companies execute more applied research. While working for their parent organization, the main focus of the founders of the USO has been on technology related work. Moreover, most people working at research positions at the university really like to perform research and wish to continue performing research, after founding the spin-off. We therefore expect a USO to put a lot of emphasis on the internal R&D sources, since this is what they are most familiar with.

A corporate spin-off (CSO) on the other hand can originate from all possible departments of a large established firm. The founders of the CSO can previously been employed in a technical department, but also in a production or marketing department. In any case, during their employment at the parent firm, they will have had some contact with the more commercial side of the business. Therefore, we expect CSO to have more attention for the commercial side and moderate the attention devoted to internal R&D sources. Therefore:

H1: USO will have more internal R&D sources than CSO

3.4.1.2 Collaboration in R&D Consortia

Collaboration in R&D consortia represents the formation of collaborative arrangements between two or more firms to conduct research and development. Collaborative arrangements involve two or more firms in which the partners hope to learn and acquire from each other the technologies, products, skills and knowledge that are not otherwise available (Narayanan, 2001). The partners may range from suppliers and customers to competitors, unrelated firms or organizations in the public sector. Access to external sources of technology can also help spin-offs to safeguard themselves against competence destroying changes in their industry (Tushman and Anderson 1986) by licensing technologies from other firms, instead of relying solely on internal R&D (Link and Tassey 1987).

University spin-offs set up to commercialize a new technology, are often founded by people who previously did a Ph.D. at the university. These people have attended scientific conferences during their Ph.D. and build up a network within the scientific community. This network may allow them to build R&D collaborations with other universities and research institutes quite easily. They know other Ph.D. students and professors at these respective universities. Moreover, they are quite familiar with the way a university works. CSO on the other hand are not so familiar with the university environment. In some cases, their parent firms may have had some collaboration projects with universities, but in general, the founders of CSO are not so familiar with the way universities work.

Universities are of course not the only institution with which USO or CSO can have R&D collaborations. A lot of collaboration projects for technical development take place between companies. The network of the CSO will rather be situated in the business world. CSO will have more links or access to other companies than USO. Therefore, we expect CSO to have more collaboration projects with other companies than USO. However, it is important to consider the conditions of spin-off firms at founding. The more they collaborate with other companies and universities, the more complex it becomes to arrange the issues concerning the intellectual property rights. It is possible to divide the technology into different aspects and set up collaborations with universities to further develop each aspect. However, it is more difficult to do the same with companies. Since the ultimate goal of a company is to generate profits, a company wants to see the potential benefits of engaging in a partnership. Universities are more interested in extending their scientific knowledge on a certain technological component. Moreover, collaborations with universities are often not that costly as collaborations with companies due to the profit orientation of companies. En plus, universities are not interested in bringing products to the market, while companies are. Since at founding, spin-off companies do not possess over numerous resources to exchange with other companies, we expect them to rather collaborate with universities than with companies. Seen the contacts and familiarity of USO with universities, we hypothesize that USO will have more R&D collaborations than CSO. Therefore:

H2: USO will have more collaboration in R&D consortia than CSO

3.4.1.3 Technology Transfer from the Parent

Technology transfer from the parent refers to the degree to which the spin-off transfers technological knowledge from its parent firm. The transfer of technology from the parent to the spin-off can be formal (e.g. patents and licenses) or informal. Strong intellectual property protection can be important for spin-off companies because it may be the only competitive advantage available to the spin-off at the time of the company' creation. When a new firm is founded, it does not have advantages based on superior manufacturing or marketing and distribution, which allow it to out-compete other firms (Teece, 1986). The existence of strong intellectual property protection may enable the founder of the spin-off to build the value chain for the new firm before competitors have copied its new technology. The formal transfer of technology from the parent to a CSO or USO will be highly dependent upon the fact if the parent supports the spin-off or not. For example, in case the CSO is set up by employees who are unhappy with the current way of doing at the parent firm, they can transfer technological knowledge to the spin-off company, but there will probably be no patents or licenses transfer. Having no formal transfer of technology does not mean that the importance of technology transfer from the parent can not be high.

A CSO is often created in response to a market pull. This makes it easier to be more precise in the technology that needs to be transferred. Most USO on the other hand, are brought on the market under a technology push. Most academics create new technologies as a byproduct of their research activities, not because they are asked to come up with technical solutions to specific customer problems (Shane, 2004). This requires that they need to transfer more technological knowledge since they do not yet know what specific technological aspects they will need to bring products to the market. Moreover, in case of USO, the technology may be more radical in nature, which implies that a greater amount of technological knowledge needs to be transferred in other to transform the radical technology into a market ready product. In case of a technology push, strong intellectual property protection can prove to be of vital importance. In recent

years, universities have put a lot of effort in setting up technology transfer offices in order to create value out of the technologies developed within the universities. We therefore hypothesize that:

H3: Technology transfer from the parent will be more prevalent in the case of USO than CSO

3.4.1.4 Transfer of Production Knowledge from the Parent

Transfer of production knowledge from the parent refers to the degree in which the spin-off transfers production knowledge from its parent firm. Academia has a large numbers of people with excellent research skills who have a comparative advantage in the invention of new technology (Shane, 2004). However, academia lacks people with product development skills. Production machinery is more likely to be found in a private company than in a university (Lindholm, 1997a). Production knowledge the USO may inherit from its parent can be the skill of using certain laboratory equipment which might prove useful in the production process. Companies on the other hand do posses production units, and especially in case the CSO originates from a production unit, we expect the transfer of the production knowledge to be high. Most founders of CSO have at least had limited contact with the production units of the parent firm. In case the CSO is supported by the parent, it might be possible for the CSO to continue using certain machinery after the spin-off. Therefore:

H4: The transfer of production knowledge will be higher in case of a CSO than a USO

3.4.2 Hypotheses Development: Relationship between Technological Resources and Technology Strategy

Effective management of a company's technological resources requires the development and implementation of a sound technology strategy (Zahra & Sisodia, 1994). Studies on the technology strategy of companies have mainly focused on large companies. Limited research (Zahra & Bogner, 1999; Zahra, 1996b) has been conducted on the technology strategy of young companies. This study focuses on two groups of new product-based companies: corporate spin-offs and university spin-offs. Corporate spin-offs and university spin-offs offer a unique setting since they both have a link with their parent organization. However, both spin-offs can be created for very different purposes. University spin-offs are often put on the market as a technology push, while corporate spin-offs will rather approach the market from a market-pull perspective. These two different dynamics can lead to the execution of different technology strategies. Research indicates that a firm's history matters (e.g. Stinchcombe, 1965) and that the pre-organizational contexts and efforts vary across newly founded firms (Teece et al., 1997).

In the previous paragraph, we have developed hypotheses that make the different resource endowments of CSO and USO obvious. A USO is more likely to emphasize internal R&D sources, and collaborations in R&D consortia. USO will have more chance to a formal technology transfer. CSO on the other hand have the possibility to transfer production knowledge from their parent. Since the CSO and USO are likely to emphasize different technological resources, we might expect the technology strategy, that is set in conjunction with the technological resources, to also differ for both groups of spin-offs. As defined earlier, technology strategy consists of two dimensions: scope and newness of the technology. The scope of the technology may vary from a narrow scope to a broad scope. The newness of a technology may differ from a low level of newness to a high level of newness.

3.4.2.1 Internal R&D Sources

Internal R&D ensures the venture's ownership and control of key knowledge (Zahra & Bogner, 1999). More internal R&D sources may lead to a broader exploration of the possibilities of a certain technology and has the potential to lead to a broader product scope. In case the internal R&D sources are very limited, the R&D people will have little space to experiment with new technological opportunities. Limited resources will often lead to copying rivals' technologies and using incremental innovation to enhance customers' value (Ali, 1994). More internal resources on the other hand, can create the possibility to experiment with and try out several innovative technologies. A high amount of internal R&D sources may allow investing more time and resources in developing a unique technology, which is difficult to imitate. This may allow the spin-off to leads its industry in creating new technologies, which requires radical product or process innovations (Ali, 1994). Being a pioneer demands extensive investments in R&D (Ali, 1994).

H5a: A high amount of internal R&D sources is positively associated with a broad scope of technology

H5b: A high amount of internal R&D sources is positively associated with a high level of newness of technology

3.4.2.2 Collaboration in R&D Consortia

It can be advantageous for spin-offs to gain and seek access to a larger, more diverse pool of technological capabilities through external linkages and partnerships (Tyler and Steensma, 1995). Developing certain technologies into market-ready products can be a very demanding task, especially for young companies who do not possess a broad resource base and huge financial means. In order to lower the development time and the development cost of the technology, young companies often seek to collaborate with other partners. Collaborative arrangements can be particularly useful for spin-offs to pool resources, to share risk of technological development and to leverage its own capabilities (Narayanan, 2001). Spin-offs can collaborate with universities and/or

companies. The choice of a collaboration partner will depend upon the requirements necessary to develop the technology. Seen the nature of the research performed at universities and established firms, a spin-off will rather approach a university to collaborate in case they want to deepen their knowledge of certain basic components of the technology. Collaboration with established firms typically focuses on shorter term projects which are clearly defined. External sources can give the ventures quick access to multiple technologies (Dodgson, 1993).

Spin-offs often use external sources of technology to complement and enhance their internal technological capabilities. They may buy technologies from other companies, acquire technology-based businesses, and engage in licensing agreements to acquire or sell their technologies, or join technological alliances (Dussauge et al., 1992; McCann, 1991; Porter, 1980). Spin-offs can combine technologies secured from external sources with internal resources to offer radically new products or upgrade existing ones. This bundling of external and internal technologies can enhance the spin-off's capacity to introduce highly differentiated products quickly and economically (McGrath, 1994).

H6a: Collaboration in R&D consortia will be positively associated with a broader scope of technology

H6b: Collaboration in R&D consortia will be positively associated with a high level of newness of technology

3.4.2.3 Technology transfer from the parent

Corporate and university spin-offs originate from a larger parent institute and are created to commercialize a new technology. The idea to commercialize this technology started while working for a parent firm or university. The chance of some technology being transferred from the parent organization to the spin-off is therefore quite high. This transfer of technology can be formal or informal. The formality of technology transfer will be dependent upon the support of the parent firm, but also upon the technology itself. Some technologies e.g. biotechnology leads itself more to being patentable than other technologies e.g. software. Patents and copyrights can give the venture some control over

the fate of its discoveries which it can exploit through licensing agreements or other means. They may also enhance the venture's reputation, strengthen its bargaining power with venture capitalists, and obtain the funds necessary to support internal R&D (Bell and McNamara, 1991). Patents and copyrights are useful also in joining strategic alliances, while protecting the venture's intellectual property, which increases the new venture's ability to gain market share and achieve growth.

A large amount of technology transfer from the parent may indicate that the technological activities of the spin-off are not yet focused. In case the spin-off pursues a specific technological opportunity, there may be less need to transfer a large amount of technological knowledge. A large transfer of technological knowledge may also point to a more radical technology. Since a radical technology is often still in development at the moment of start up, it is less clear what specific technological components will be necessary to transform the technology into a market-ready product. Therefore, more technological knowledge than strict necessary may be transferred to the spin-off. Moreover, in case patents and licenses are taken, we might expect the technology to be radical. There is less interest in protecting an incremental technology. Therefore:

H7a: Transfer of technology from the parent is positively associated with a broad scope of technology

H7b: Transfer of technology from the parent is positively associated with a high level of newness of technology

3.4.2.4 Transfer of production knowledge from parent

In case production knowledge and/or production equipment is available for spin-offs, the spin-off may have the tendency to adapt/adjust their technology to the available knowledge and equipment. The spin-off may have the tendency to exclude the technology that does not match the transferred production knowledge, and focus on those specific technologies that do match. Transfer of production knowledge may point to the fact that the technology is rather incremental and it is more obvious which production knowledge is required to produce the product. The transfer of a large amount of

production knowledge from the parent to the spin-off might prevent the spin-off to come up with new, innovative solutions. In case the familiarity with the production technology is high, it might hinder innovative thinking.

H8a: Transfer of production knowledge from the parent is negatively associated with a broad scope of technology

H8b: Transfer of production knowledge from the parent is negatively associated with a high level of newness of technology

3.4.3 Hypotheses Development: Technology Strategy of CSO and USO

In the following paragraphs, we will develop hypotheses on the technology strategy of CSO and USO.

3.4.3.1 Scope of Technology

A broad scope of technologies, or platform technologies as practitioners often call them, provide a good basis for starting a spin-off company because they allow founders to change market applications if the first application that they pursue turns out to be a dead end (Tornatzky et al., 1995). This flexibility is important to the survival of new companies, which have no existing products to fall back on should an application for a new technology prove to be unviable. Second, a broad scope of technologies allows spin-offs to diversify risks and amortize their costs across different market applications, both of which are important to the establishment of successful new firms. It provides the new firm with potential market applications that are achievable at different points in time: some in the short term, others in the medium term, and still others in the long term (Nelson, 1991). This flexibility allows the founders of the spin-offs to match the pursuit of market applications to resource assembly over time and so better manage the firm creation process.

From their very nature, universities are typically more focused on performing basic research, while companies execute more applied research. Basic research includes more fundamental research, which heighten the changes of creating a broader scope of

technology. Since USO will rather collaborate with other universities and put more emphasis on internal R&D sources, we expect USO to rather focus on a broad scope technologies. In his study, Nelson (1991) found that university spin-offs tend to exploit general-purpose technologies, or basic inventions with broad applications in many fields of use. CSO are often started under a market pull, they see a market opportunity and develop the new technology in order to fulfill this market need. Due to their previous working experience in their parent firm, they will have build up technological skills and production knowledge. This will encourage them to focus on a more narrow scope of technology in order to address the identified market opportunity. Therefore:

H9: USO will have a broader scope of technology than CSO

3.4.3.2 Newness of Technology

University spin-offs tend to be founded to exploit technologies that are radical, tacit, early stage and general-purpose, which provide significant value to customers, represents major technical advances and have strong intellectual property protection. Several academic studies show that radical technologies tend to provide the basis for the creation of university spin-offs, while incremental technologies are more likely to be licensed by established companies (Shane, 2004). Many university inventions lead to the formation of spin-offs because they are early stage technologies that are little more than 'proof of concepts' when the researcher discloses the invention to the university technology-licensing office. Research has shown that, when a university technology is at a very early stage of development, and so is 'unproven', it cannot be licensed easily to established firms. As a result, early stage inventions tend to lead to the formation of spin-offs (Doutriaux and Barker, 1995). Roberts (1991) found that most university spin-offs lack prototypes of their products at the time of spin-off even if they have achieved proof of principle in the laboratory.

Corporate spin-offs are also created to commercialize a new technology. Due to their previous working experience, we might expect CSO to rather engage in incremental technologies in order to get the products out as fast as possible in order to generate

revenues. The transfer of production knowledge may further enhance the focus on incremental technologies. Therefore:

H10: USO will have a higher level of newness of technology than CSO

3.4.4 Hypotheses Development: Relationship between Technology Strategy and Performance

Technology's growing importance in determining success in today's marketplace has been widely recognized in the literature (Zahra, 1996a). In one industry after another, companies have used their technologies to create an enduring competitive advantage by offering new products or utilizing new processes, revising the rules of competition, or redrawing their industry's boundaries (Utterback, 1994). Technology strategy is important for new ventures' market survival and financial success since poor technological choices can undermine the success of ventures (McCann, 1991). Consequently, some companies have designed technology strategies to articulate their plans to develop and deploy technological resources to achieve superior performance (McCann, 1991). Having a good product or a sophisticated technology alone does not always guarantee success in the marketplace (Bell and McNamara, 1991; McGrath, 1994). Schrader & Simon (1997) found that success is less a function of the different resources independent and corporate ventures have, but more a function of what strategies the firms choose based upon their resources. Technology strategy must therefore be part of a comprehensive strategy to manage that technology as an ongoing, living resource (Zahra & Bogner, 1999).

3.4.4.1 Scope of Technology

The scope of technology will influence the venture's performance (Grant, 1996). The breadth of a portfolio depends on the company's technology posture, risk orientation, environmental perceptions, financial resources and the capacity to manage the portfolio's complexity (Zahra, 1996a). A broad portfolio enables a company to pursue many market opportunities, reduces its vulnerability to rivals' technologies, and permits it to capitalize

on the convergence of different technologies in creating new markets. A broad technology platform may encompass several promising applications, which can lead to a large number of products. A large number of products is not always conducive to short-term profitability, but it entails the ability to augment the long term performance of spin-offs. A broad portfolio however can tax the company's organization, resources and management. Intense product development and introductions require significant resource commitments, often without a guarantee of success. A broad scope of technology may imply that the attention is scattered over many products and potential product applications. This may make it more difficult to single out a few technologies and develop them into market-ready products. Spin-offs need to carefully determine the breadth of the product portfolio, based on an examination of customers' needs and their company's resources, capacity, and risk-taking orientation (Zahra, 1996a).

Spin-offs are often created to commercialize a new technology. In the initial phase of developing the technology, it is not always clear what the potential applications may be. Therefore, a broader scope of technology may heighten the chances of developing some successful applications. Therefore:

H11: A broad scope of technology will be positively associated with performance

3.4.4.2 Newness of Technology

A high level of newness of technology may allow a spin-off to break the technological competences and power of established competitors and realize extreme growth. Being at the forefront of innovation may guarantee a long time success (Tushman and Anderson, 1986). A high level of newness of technology can allow a company to fulfill a unique place in the technology and market needs of certain customers. Developing and introducing radically new products may be a proactive, aggressive attempt to push out the edge of the technological frontier in an industry (Kerin et al., 1992). However, developing radical technologies may be risky because it demands extensive investments in R&D, market development and customer education (Ali, 1994).

Even in case the company succeeds in bringing the technology to the market, it is not sure that the company will be able to reap the fruits of their breakthrough technology. Radical new technologies usually take longer to develop than incremental technologies. A high level of newness of technology may therefore lead to longer development times and consequently to a lower short-term performance. An incremental technology on the other hand, may allow using existing technological knowledge and production knowledge to transform the technology more rapidly into a market-ready product. Once products are on the market or a technology can be proven, revenues can be generated by selling the product or technology or by licensing the technology out.

On the other hand, a high level of newness may enhance performance by creating a period of monopoly where the ventures can position themselves and protect their products from imitation (Zahra et al., 1995). Pioneering can preempt the competition and strengthens the position of spin-offs. Therefore:

H12: A high level of newness of technology will be positively associated with performance

3.4.5 Hypotheses Development: Performance of CSO and USO

Rapid growth seems to be a prominent characteristic of CSO and USO. Corporate spin-offs are estimated to produce an above average net employment growth of at least 8% (Moncada et al., 1999), while the average American university spin-off generates approximately $10 million in economic value (Cohen, 2000). The technology strategy CSO and USO follow, may lead to a different performance due to the fact that they start with different resources and a different knowledge inheritance. Entrepreneurial origin combined with prior founder affiliation is found to have different survival implications for spin-offs (Agarwal et al., 2004; Phillips, 2002). According to Stinchcombe (1965), founding conditions “imprint” an organization on various levels—including its structure, strategy, technology, routines, and culture (Sastry & Coen, 2000)— and continue to have long-term effects. Differences in initial endowments may position firms on heterogeneous developmental paths (Shane & Stuart, 2002). These heterogeneous

resource positions may explain why firms perform differently (Henderson and Cockburn, 1994; Iansiti and Clark, 1994; Knott, 2003: Zott, 2003). Since CSO and USO differ in their technological resources and their technology strategy, we expect them to also differ in performance.

USO originate from universities who are traditionally more occupied with research on radical technologies. USO tend to exploit basic technologies with broad applications in many fields of use (Nelson, 1991). They are often created under a market push. A broad scope of technologies allows the founders to change market applications if the first application they pursue turns out to be a dead end (Tornatzky et al., 1995). This flexibility may be important for the performance of new companies, since they have no existing products to fall back on in case an application for a new technology proves to be unviable. Moreover, a broad scope of technology combined with a high level of newness of technology allows the spin-off to diversify risks and amortize their costs across different market applications that are achievable at different points in time (Shane, 2004). CSO are often created from a market pull, they spot an opportunity and decide to go after it. CSO tend to have a more narrow scope of technology and a focus on more incremental technologies. This focus may allow them to transform the technology faster into market-ready products. Moreover, CSO often understand better the pressure to take their technologies quickly to the market and create the revenues and cash flow necessary to survive. This technology strategy may lead to a short term advantage, but may prove difficult to sustain on a longer term. Therefore:

H13: USO will have a higher performance than CSO

4 RESEARCH METHODOLOGY

In Chapter 4, issues related to the research methodology are being discussed. The main focus of this chapter is to provide an overview of the methodology used to carry out the study. First, the choice of research design is being discussed. Next, the sampling and data gathering procedures are presented. Then, the data analysis technique is being discussed, followed by the operationalization of the variables and constructs.

4.1 Research Design

The choice of a research design should be dictated by the nature of the research questions this study wants to address. In case the problem evolves from the literature, indicating that there exist a substantial body of knowledge on which the researcher can build, a quantitative study is preferable. In case there exist little information on the topic and the research problem still needs a considerable amount of exploration, a qualitative study may be more appropriate. The selection of a certain research design is also likely to be influenced by various characteristics of the researcher e.g. training, experiences and psychological attributes (Creswell, 1994). In this dissertation, we want to address the following research questions:

Research question 1:

Which factors influence the performance of corporate spin-offs?

Research Question 2:

Do corporate and university spin-offs follow different technology strategies in order to achieve a competitive advantage?

To tackle these research questions, this study adopts a survey design associated with the quantitative approach.

4.2 Sampling Procedure

It is difficult to compare the performance of CSO found in several studies, since these studies have used different databases to identify CSO. Studies focusing on the legal perspective of CSO mostly use data compiled from the Security Data Company database. As a consequence, these studies single out only part of the CSO, namely those CSO that were announced publicly and added to the SCD database. Studies focusing on the entrant perspective of CSO have compiled their own databases since there exist no databases that contain variables of relatedness between a CSO and its parent. These self-composed databases tend to be focused on certain geographic areas, which makes comparison of the results obtained by these studies difficult. The advantage of these samples is that they contain CSO from public and private firms.

To identify corporate and university spin-offs in Flanders, we used the HITO database as a starting point. This database is a comprehensive database containing almost all research-based start-ups founded in Flanders between 1991 and 2002. A research-based start-up is defined as a new venture, that has its own R&D activities and develops and commercializes new products or services based upon a proprietary technology or skill. For information about the compilation of the HITO database, the response rate and the possible bias, we refer to Heirman (2004), chapter 2.4. Research-based start-ups form a heterogeneous group of companies on itself. They can be divided into different subgroups e.g. university spin-offs, corporate spin-offs, and independent start-ups. A corporate spin-offs has been defined as “a separate legal entity that is concentrated around activities that were originally developed in a larger parent firm. The entity is concentrated around a new business, with the purpose to develop and market new products or services based upon a proprietary technology or skill.” A university spin-off has been defined as “a new company that is formed by a faculty, staff member, or doctoral student who left the university or research organization to found the company or started the company while still affiliated with the university, and/or a core technology (or idea) that is transferred from the parent organization” (Roberts and Malone, 1996; Smilor et al., 1990; and Steffenson et al., 1999). An independent start-up can be defined as all new companies which are not based on a core technology or idea developed in a parent

firm. These companies do not have a clear link to a parent organization. We use the corporate and university spin-offs identified in this database to address our research questions.

4.3 Data Collection

A quantitative approach can consist of two types of research instrument: experiments and surveys. In this study, a survey was used to gather the appropriate information. Survey questionnaires provide a large amount of information about specific issues in a most efficient manner (Churchill, 1992). They are valuable as a research tool for their flexibility and versatility (Mouly, 1978). Once the researcher has decided that a survey based research instrument is appropriate, a choice has to be made as to whether the questionnaire is to be personal, telephone, or mail based (Kinnear and Taylor, 1996). In the first round of data collection performed to compile the HITO database, all firms were visited by two researchers to conduct a personal interview with the founder. After the interview, the structured information was put into a database and the case history was written down in an interview report. The structured questionnaire and the manual for the database can be found in Heirman (2004), Appendix II and III.

The HITO database comprised some data on technological resources. However, no data was available on the transfer of knowledge from the parent to the spin-off. Therefore, a new questionnaire was designed to collect the necessary data and complete the missing data. After the identification of the corporate and university spin-offs in the HITO database, each of the companies was contacted by telephone. The founders were targeted since they typically possess the most comprehensive knowledge on the transfer of knowledge that had been taken place between the parent firm and the spin-off. The questionnaire was used to measure the constructs as presented in paragraph 4.5. In some cases, open ended interview questions were added. This information is mainly used in the interpretation of the results.

4.4 Data Analysis Technique

4.4.1 Factor Analysis

Principal components analysis (PCA) is performed a to check the validity of the constructs and measures. The primary use of PCA is data reduction with a view of defining the underlying structures and constructs. PCA procedures are based on the initial computation of a complete table of intercorrelations among the variables. The correlation matrix is then transformed through estimation of a factor model to obtain a factor matrix containing factor loadings for each variable on each derived factor. The loadings of each variable on the factors are then interpreted to identify the underlying structure of the variables (Hair et al., 2006).

To test the appropriateness of the PCA, we performed the Kaiser-Meyer-Olkin Measure of Sampling Adequacy (MSA) test and the Bartlett test of sphericity. The Measure of Sampling Adequacy is a measure to quantify the degree of intercorrelations among the variables and the appropriateness of factor analysis (Hair et al., 2006). This index ranges from 0 to 1, reaching 1 when each variable is perfectly predicted without error by the other variables. The MSA value should be above 0.50 in order to proceed with the principal components analysis. The Bartlett test of sphericity is a statistical test for the presence of correlations among the variables. It provides the statistical probability that the correlation matrix has significant correlations among at least some of the variables (Hair et al., 2006).

The eigenvalues or the scree test can be used to assist in selecting the number of factors. The eigenvalues should be greater than 1.0, since a value lower than 1.0 means that the factor explains less information than a single item would have explained. We performed a VARIMAX rotation to achieve a simpler, theoretically more meaningful component pattern. Orthogonal rotation methods are the preferred method when the research goal is data reduction. The VARIMAX method has proved to be successful as an analytical approach to obtain an orthogonal rotation of factors (Hair et al., 2006). Next, the factor loadings in the VARIMAX matrix need to be analyzed. A factor loading represents the correlation between an original variable and its factor. For samples with 100 respondents, factor loadings of 0.55 and above are significant (Hair et al., 2006).

4.4.2 Partial Least Squares Method

To test the hypotheses and the proposed framework, we will use the Partial Least Squares method. Partial least squares is one of the structural equation modeling (SEM) techniques. Wold (1974) developed the fixed-point estimation technique for structural variables with latent variables as an alternative to the LISREL program. In partial least squares, the set of model parameters is divided into subsets estimated by use of ordinary multiple regressions that involve the values of parameters in other subsets (Fornell & Bookstein, 1982). An iterative method provides successive approximation for the estimates, subset by subset, of loadings and structural parameters (Fornell & Bookstein, 1982). The Maximum Likelihood estimation used in the LISREL program (Jöreskog and Sörbom, 1989) is based on factor construct concept that requires significantly more statistical specification than PLS and thus places more demands on the data. PLS, on the other hand, is based on a component construct concept. PLS requires minimal demands on measurement scales, sample size, normality of the data and residual distribution (Wold, 1985). While both techniques (LISREL and PLS) will provide acceptable parameter estimates, two-stage least squares requires the use of single measures for all dependent variables. In contrast, PLS permits multiple measures of both dependent and independent variables (Birkinshaw et al., 1995).

PLS provides a clear advantage over regression for two reasons: (1) it considers all path coefficients simultaneously to allow the analysis of direct, indirect, and spurious relationships; and (2) it estimates the individual item weightings in the context of the theoretical model rather than in isolation (Birkinshaw et al., 1995). PLS is most appropriate when sample sizes are small, when assumptions of multivariate normality and interval scaled data cannot be made, and when the researcher is primarily concerned with prediction of the dependent variable (Fornell and Bookstein, 1982). PSL requires only that the basic assumptions of least-squares estimation are satisfied. The estimation is distribution-free, does not pose identification problems, can be used with small samples, and permits the same freedom with respect to measurement scales as ordinary regression (Cool et al., 1989). These advantages have encouraged PLS applications in an increasing number of fields, including economics, education, chemistry and marketing (Cool et al., 1989). Generally, PLS results are presented in two stages. In the first stage, the researcher

ensures that the measures used as operationalizations of the underlying constructs are both reliable and valid. Once convinced of the adequacy of the measurement model, the researcher can then proceed to interpret the resulting model coefficients **(**Birkinshaw et al., 1995). In the result section, we will elaborate on the assessment of the measurement and the structural model.

4.5 Constructs and Variables

In this section, we will discuss the operationalization of the constructs and variables. Whenever possible, measures were adopted from previous studies. New measures were constructed where existing measures were not available and to facilitate multiple measurement of the constructs. Principal components analysis and Cronback alpha reliability coefficients were used to confirm the unidimensionality and inter-item reliability of the constructs.

The independent variables are the technological resources

- internal R&D sources
- collaboration in R&D consortia
- technology transfer from the parent company
- transfer of production knowledge from the parent company

The technology strategy variables are

- scope of technology
- newness of technology

Performance is operationalized as

- annual growth in revenues
- annual growth in employees

4.5.1 Venture Origin

An important variable for this study is the venture origin. A corporate spin-off is defined as a separate legal entity that is concentrated around activities that were originally developed in a larger parent firm. The entity is concentrated around a new business, with the purpose to develop and market new products and services based upon a proprietary technology or skill. A university spin-off is defined as a new company that is formed by a faculty, staff member, or doctoral student who left the university (or research organization) to found the company or start the company while still affiliated with the university, and/or a core technology (or idea) that is transferred from the parent organization. The database comprises 48 corporate spin-offs and 73 university spin-offs.

4.5.2 Technological Resources

Based on the literature, we classified the technological resources as internal R&D sources, collaboration in R&D consortia, technology transfer from the parent and transfer of production knowledge from the parent. All technological resources are measured at the moment of founding.

Internal R&D sources refer to the intensity of internal R&D activities by building the facilities, expertise and skills necessary for continuous innovation. This construct was operationalized as the number of people working in R&D to the total number of people working in the spin-off.

Collaboration in R&D consortia refers to the collaboration projects set up between a corporate or university spin-off on the one hand and universities or companies on the other hand to jointly develop some technology components. Spin-offs can use partnerships to complement and enhance their internal technological capabilities. They can collaborate with universities, research institutes and companies. This construct was measured using three items in which we probed to the number of partnerships developed in order to develop the first product, the number of partnerships the spin-offs is engaged in for technology development with other companies and with universities and research

institutes. The items were based on measures used by Lee et al., (2001) and Heirman (2004).

Technology transfer from the parent company refers to the degree in which the spin-off transfers technological knowledge from its parent firm. The degree of transfer of technology was measured using statements about the relatedness between the technological competencies of the spin-off and those of the parent firm. These items were derived from the studies conducted by Parhankangas et al., (2003) and Sapienza et al., (2004).

Transfer of production knowledge from the parent company refers to the degree in which the spin-off transfers production knowledge from its parent firm. The transfer of production knowledge was operationalized in terms of the compatibility of the production facilities of the parent firm to the needs of the spin-off venture. These items were derived from the studies conducted by Sorrentino & Williams (1995), Parhankangas et al., (2003) and Woo et al., (1992).

4.5.3 Technology Strategy

Based on the literature, we identified two dimensions of technology strategy, the scope of technology and the newness of technology. The technology strategy variables are measured at the moment of founding.

The scope of technology refers to the choice of a company to focus on a technology platform or a specific technology. The scope of technology measures to what extent the technology is being developed with the purpose of one specific technology or in contrast for a broad platform of technologies with many applications. This item was based on measures used by Meyer et al., (1997) and Heirman (2004).

The newness of technology entails the innovativeness and uniqueness of the technology the spin-off would like to commercialize. Schoonhoven et al., (1990) make a

distinction between innovation achieved through the creation of new knowledge and innovation created by knowledge synthesis, in which existing technological knowledge is combined or synthesized in unique ways to create a new product. The uniqueness of the technology captures the degree to which capable competitors can copy the technological developments of the spin-off. This measure was based upon the study performed by Zander & Kogut (1995).

4.5.4 Performance

Performance is a complex and multi-dimensional concept that is difficult to cover with any single measure. The most commonly used objective measures of success include growth measures and profitability measures. Several scholars have argued that traditional accounting-based indicators of profitability are inappropriate for young companies (Shane & Stuart, 2002). Traditional financial measures like return on investments, return on equity, net profits and cash flow, lose part of their value in case of spin-offs since these measures only monitor certain aspects and thus do not completely explain the wealth creation realized by spin-offs (McGrath, Venkatraman & MacMillan, 1994). Profitability, such as return on investment, may not be an appropriate performance indicator for new business ventures, because many of them are still in the stage of product development (Lee et al., 2001). Abnormal return and market valuation from the stock market are not useful for this study, since most of our spin-offs are not enrolled on the stock market.

Sales, on the other hand, is often a preferred measure of firm growth and financial performance of new ventures (Ardishvili et al., 1998; Hoy et al., 1992) because it is relatively accessible, it applies to (almost) all sorts of firms, and it is relatively insensitive to capital intensity and degree of integration (Delmar et al., 2003). Sales growth indicates the market acceptance of a venture's products. Spin-offs that are able to grow their revenues at a faster rate in their early years are offering goods and services that customers quickly choose to buy (Chesbrough, 2003a). These spin-offs are more likely to turn profitable sooner, to consume less cash and are more likely to achieve a profitable liquidity event for their investors (Bhide, 1992). Growth in sales has been used in several studies on CSO (Parhankangas & Arenius, 2003; Sapienza et al., 2004; Agarwal et al.,

2004; Zahra, 1996b). Sales growth was operationalized as total sales revenue in Euro in 2005, controlling for total sales revenue at founding.

The performance of spin-offs can also be measured on a non-financial basis. Growth in employees is a good indicator of the speed by which a new venture is able to grow. In the case of spin-offs, it is possible that assets and employment grow before any substantial sales and revenues are generated or profitability is obtained. Arguments have been offered for employment as a much more direct indicator of organizational complexity than sales (Delmar et al., 2003). Resource-based scholars value employment-based measures as a highly suitable indicator of firm growth e.g., Hanks et al. (1993) and Brüderl & Preisendörfer (2000) did not focus so much on financial measures of performance, but on exponential growth in employment. Employment growth was operationalized as the employment in 2005, controlling for the total employment at founding.

4.5.5 Control Variables

The age of the spin-off, the size, the start capital, the technology domain and the experience of the founding team were included as control variables. The age was measured as the number of years the spin-off already existed as an independent entity. In practice, we counted the number of months that had elapsed between the official spin-off date and the time of the interview. Next, we divided this number of months by 12 in order to obtain the age of the spin-off. The size of the spin-off was measured as the number of founders of the spin-off, according to Roberts (1991). The start capital of the spin-off is the total capital represented in the company during the first year of activities. To categorize spin-offs in different technological domains, we used the International Patent Classification System. This system distinguishes eight classes namely (A) Human Necessities; (B) Performing Operations, Transporting; (C) Chemistry, Metallurgy ; (D) Textiles, Paper; (E) Fixed Constructions ; (F) Mechanical Engineering, Lighting, Heating, Weapons, Blasting; (G) Physics; and (H) Electricity. The experience of the founding team was measured by the number of years of experience in R&D and the number of years of experience in a commercial function (marketing or sales; business development).

Theme	Name of variable	Description	Level of measure-ment	Source (where applicable)	Coding	
					Value	Meaning
Venture origin	Institutional link	The spin-off is classified as a corporate spin-off (CSO) or a university spin-off (USO)	Nominal	Roberts & Malone, 1996 Smilor et al., 1990 Steffenson et al., 1999	1 0	CSO USO
Technological resources	Internal R&D sources	Employees in R&D divided by total number of employees	Interval		Ranges from 0 to 1	
	Collaboration in R&D consortia	Partnerships - to develop first product - with other companies for technology development - with universities and research institutes in R&D projects and technology exchange programs	Ordinal	Lee et al., 2001; Heirman, 2004	1 2 3	No partners One partner Two or more partners
	Technology transfer from the parent company	The technological competencies - are based upon the core technologies of the parent firm - complement those of the parent firm - are based upon the technological strengths of the parent firm	Ordinal	Parhankangas et al., 2003; Sapienza et al., 2004	Likert-scale ranging from 1 (strongly disagree) to 7 (strongly agree)	
	Transfer of production knowledge from the parent company	The spin-off - is able to use the production facilities of the parent firm - shares production facilities with the parent firm	Ordinal	Sorrentino & Williams, 1995; Parhankangas et al., 2003; Woo et al., 1992	Likert-scale ranging from 1 (strongly disagree) to 7 (strongly agree)	

Technology strategy	Scope of technology	Broadness of the technology at founding	Ordinal	Meyer et al., 1997 Heirman, 2004	Likert-scale ranging from 1 (specific product) to 5 (platform technology)
	Newness of technology	- The extent to which new technological knowledge was created - The extent to which technological knowledge was synthesized - The ease by which the technology can be copied	Ordinal	Schoonhoven et al., 1990 Zander & Kogut, 1995	- Likert-scale ranging from 1 (new technological knowledge) to 5 (existing technological knowledge) -Likert-scale ranging from 1 (no synthesis) to 5 (elaborate synthesis) - Likert-scale ranging from 1 (strongly disagree) to 7 (strongly agree)
Performance	Growth	- Annual revenue growth - Annual employee growth	Ratio	Lee et al., 2001; Delmar et al., 2003	

Table 2: Overview of the constructs and the variables

4.5.6 Principal Components Analysis

The primary goal of performing the PCA is to confirm that the items of the technological resources do indeed produce the four constructs we deduced from the literature. Table 3 shows the results of the PCA carried out on the statements relating to the technological resources. The overall MSA value falls in the acceptable range (above .50) with a value of .606. The Bartlett test shows that nonzero correlations exist at the significance level of .0001. Three components were extracted which accounted for 66.944 % of the variance. However, if we examine the communalities, we observe 2 variables that have a communality lower than 0.50. Also the factor loading of the variable "internal R&D sources" is problematic, since it does not attain the required 0.55. However, we distracted four technological resources from the literature. Therefore, we have performed a second principal components analysis by increasing the number of factors to four. The results from this second PCA are shown in Table 4. The MSA value (0.606) and the Bartlett test ($p<0.0001$) are satisfactory. The communalities of the variables are all higher than 0.50. The eigenvalue of component 1 is 0.901 which is quite close to 1. Therefore, we can consider including this component. The four components account for 76.953% of the variance and are in accordance to the four technological resources identified in the literature. In addition, the reliability of the components is highly satisfactory.

Statements	Component 1	Component 2	Component 3	Communality
Internal R&D sources	**0.452**	-0.283	-0.268	0.357
Number of partnerships to develop first product	-0.049	0.147	**0.777**	0.628
Number of partnerships with other companies for technology development	-0.047	0.042	**0.746**	0.561
Number of partnerships with universities and research institutes in R&D projects and technology exchange programs	0.298	-0.037	**0.756**	0.661
Our technological competencies are based on the core technologies of the parent firm.	**0.872**	0.169	0.125	0.805
Our technological competencies and those of our parent firm complement each other.	**0.570**	0.370	-0.001	0.461
The technology we have developed is based on the technological strengths of our parent firm.	**0.852**	0.255	0.150	0.814
Our company is able to use the production facilities of the parent firm	0.186	**0.901**	0.089	0.855
Our company and the parent firm share production facilities	0.198	**0.917**	0.057	0.883
Eigenvalue	3.057	1.685	1.283	
% of variance explained	33.967	18.727	14.250	

Table 3: Principal Components Analysis relating to the technological resources

Notes. [(a)] Cumulative % of variance explained is 66.944%
[(b)] KMO Measure of Sampling Adequacy = 0.606
[(c)] Barlett's Test of Sphericity = χ^2 = 309.023, $p < 0.0001$

Statements	Component 1: Internal R&D sources	Component 2: Collaboration in R&D consortia	Component 3: Technology transfer	Component 4: Transfer of production knowledge	Communality
Internal R&D sources	**0.939**	-0.075	0.084	-0.041	0.895
Number of partnerships to develop first product	0.031	**0.813**	-0.105	0.218	0.720
Number of partnerships with other companies for technology development	-0.334	**0.688**	0.061	-0.028	0.680
Number of partnerships with universities and research institutes in R&D projects and technology exchange programs	0.085	**0.781**	0.250	-0.011	0.590
Our technological competencies are based on the core technologies of the parent firm.	0.187	0.131	**0.867**	0.115	0.817
Our technological competencies and those of our parent firm complement each other.	-0.127	-0.055	**0.685**	0.252	0.552
The technology we have developed is based on the technological strengths of our parent firm.	0.068	0.130	**0.898**	0.167	0.856
Our company is able to use the production facilities of the parent firm	-0.017	0.097	0.217	**0.917**	0.898
Our company and the parent firm share production facilities	-0.028	0.061	0.237	**0.926**	0.917
Eigenvalue	0.901	1.283	3.057	1.685	
% of variance explained	10.009	14.250	33.967	18.727	
Cronbach's alpha		0.669	0.791	0.912	

Table 4: Second Principal Components Analysis relating to the technological resources

Notes. [(a)] Cumulative % of variance explained is 76.953%
[(b)] KMO Measure of Sampling Adequacy = 0.606
[(c)] Barlett's Test of Sphericity = $\chi^2 = 309.023$, $p < 0.0001$

5 THE POPULATION OF CORPORATE SPIN-OFFS

This chapter first presents descriptive statistics on the population of corporate spin-offs (CSO) and university spin-offs (USO). Next, we take a more detailed look at the population of CSO in our database. We identify two groups of CSO, namely restructuring-driven spin-offs and entrepreneurial spin-offs. Finally, we provide descriptive statistics and insights into the two groups of CSO.

5.1 Descriptive Statistics of Corporate and University Spin-Offs

Spin-offs are important agents of knowledge transfer from established corporations and universities to new businesses, promoting the prosperity and well-being of regions, industry clusters and nations (Roberts & Wainer, 1968; Dorfman, 1983; Pavitt, 1991; Lindholm, 1997b; Parhankagas & Arenius, 2003). University and corporate spin-offs are on average, high performing companies. In a study on European corporate spin-offs, Moncada et al. (1999) found that CSO represented around 12.9 % of new firm formation in Europe. At the European level, corporate spin-offs are estimated to produce an above average net employment growth of at least 8% (Moncada et al., 1999). According to the Association of University Technology Managers, from 1980 to 1999, American university spin-offs generated $33.5 billion in economic value added (Cohen, 2000). Thus, the average American USO generated approximately $10 million in economic value. Further, the indirect effects of the economic impact of USO may even be larger than their direct effects (Shane, 2004). While there does not exist any research that estimated the indirect effects of USO on local economic development, there does exist some case study evidence. For example, Goldman (1984) found that 72 percent of the high technology companies in the Boston area in the early 1980s were based on technologies originally developed at MIT laboratories. As a result, the Route 128 economic infrastructure might not have existed in the absence of MIT and its spin-offs, though most of these spin-off companies were not based on technologies formally licensed from MIT.

In comparison to other types of start-ups, corporate spin-offs combine considerably lower failure rates with the high growth of a new company. A failure rate of 15% for corporate spin-offs has been found in a French study (Moncada et al., 1999, p.33). Also the survival rate of USO is extremely high. Of the 3376 USO founded between 1980 and 2000, 68 percent remained operational in 2001 (Pressman, 2002). This number is much higher than the average survival rate of new firm in the United States (Shane, 2004). Also in countries outside the United States, USO tend to have a high survival rate. Between 1960 and 1993, about 240 direct USO companies have been generated from Chalmers University of Technology. In 1993, 87% of these were still in business or had been acquired, and the remaining 13% had been lost through bankruptcy or termination (Lindholm, 1997b).

Currently, there exist several databases that contain partial lists of corporate and university spin-offs. The Thompson database reports 2106 announced CSO between 1980 and 2005, of which 1128 have been effectively completed. Yet, the Thompson database only lists those CSO that are publicly announced, excluding employee-based spin-offs and spin-offs from private firms. Therefore, we might expect far more CSO than those identified by the Thompson database to exist. For example, we do not know how many CSO are created by medium sized companies, even though Cooper (1971) found that firms with less than 500 employees and small subsidiaries have about ten times as high spin-off rates as large firms. In line with these findings, Bruno and Tyebjee (1984) found in a study of high-tech start-ups, that for the most recent employer, 42% of the respondents had been at a company with less than 400 employees, and 23% at a firm with more than 1000 employees.

Also more and more universities in the US and other countries have become active in spinning off new firms. Since the passage of the Bayh-Dole Act in 1980 until 2000, 3376 academic spin-off companies were established in the USA (Pressman, 2002). USO are important economic entities because they create jobs, particularly for highly educated people (Shane, 2004). According to the Association of University Technology Managers, from 1980 to 1999, spin-offs from American academic institutions generated 280 000 jobs (Cohen, 2000). At an average of 83 jobs per spin-off, this rate of job creation shows that the average USO creates more jobs than the average small business

founded in the US. Estimating the total population of university spin-offs is not an easy task since it if difficult to identify the academics who took the 'from profs to profits' route (Piccaluga, 1992), and to measure the exact degree of university 'leakage' through informal channels (Birley, 1992). In this respect, Chrisman et al. (1995) argue that any attempts at measurement will underestimate the extent of faculty entrepreneurship.

A survey of 100 of the 1989 'Inc 500" fastest growing private companies found that 71% had replicated or modified an idea encountered through previous employment (Bhide, 1994). While there does not yet exist studies that estimate the whole population of corporate and university spin-offs, we expect them to be a considerably large group of companies. In the next section, we will provide descriptive statistics of our sample of Flemish corporate and university spin-offs. Our database comprises 48 corporate spin-offs and 73 university spin-offs. Next, we will discuss the age of the spin-offs, the size, the start capital, the industry sector and the experience of the founding team.

5.1.1 Age

The age of a corporate spin-off can be defined in several ways. The most traditional way to define the age of a spin-off is to measure the period between the time of the interview and the year of the establishment of the spin-off. Another way to measure the age of a corporate spin-off is to count the years from the initiation of the idea, or the number of years the founders of the spin-off were already working on the technology. In this way, the pre-spin-off period is not neglected. In most cases, the spin-off has been operating for several years within the parent firm prior to the foundation of the spin-off. However, it is often very difficult to state the exact start date from the project. Therefore, we measured age as the number of years the corporate spin-off already exist as an independent entity, so the number of years that had elapsed since the official spin-off date. Figure 2 illustrate the age distribution of our sample of CSO and USO. From Table 5 we can conclude that the average age of CSO is higher than the average age of USO.

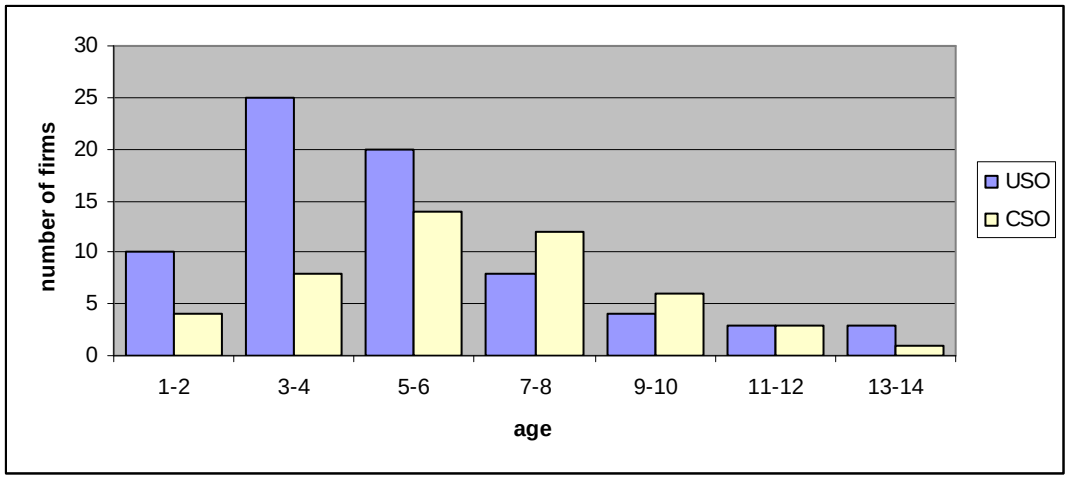

Figure 2: Age of corporate and university spin-offs

	USO	CSO
Mean	5.143	6.149
Median	4.500	6.000
Std. Deviation	3.061	2.842
Minimum	1.000	0.420
Maximum	13.500	14.000

Table 5: Descriptive statistics of the age of CSO and USO

5.1.2 Size

The number of founders of a corporate spin-off may influence the amount of knowledge that can be transferred from the parent company to the spin-off. Whenever personnel leave one organization to found a new organization, there is a transfer of resources and routines (Phillips, 2002). Founders are constrained by their organizational experiences and consequently, constrained by the characteristics of the founder's previous organization, population and employment (Hannan and Freeman, 1989; Phillips, 2002). A spin-off with more founders is more likely to transfer resources and routines from the parent organization. Moreover, Roberts (1991) found that the size of the founding team affects the success of a firm. Therefore, the size of the spin-off was measured as the number of founders of the spin-off. Figure 3 illustrates the number of

founders of our sample of CSO and USO. In Table 6 we can see that on average, USO start with a higher number of founders than CSO.

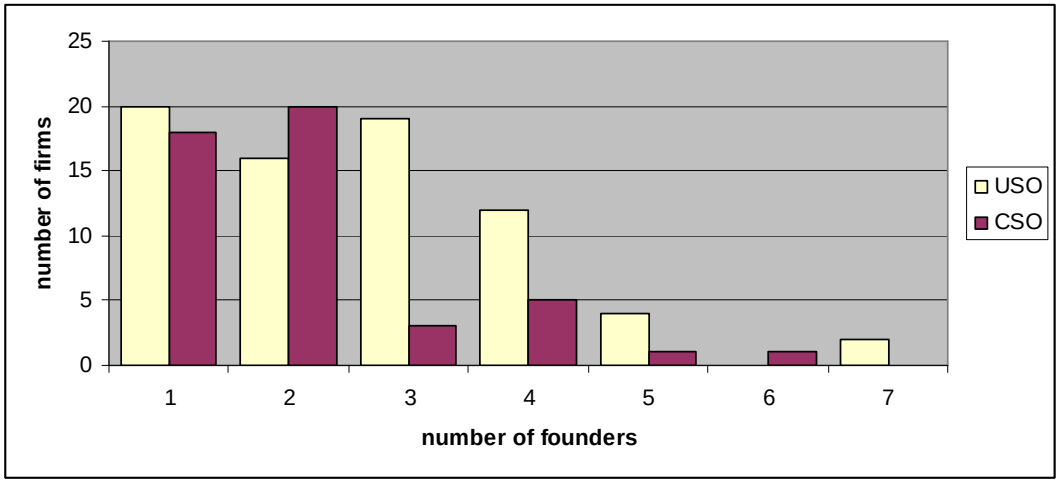

Figure 3: Number of founders of corporate and university spin-offs

	USO	CSO
Mean	2.600	2.020
Median	3.000	2.000
Std. Deviation	1.441	1.211
Minimum	1.000	1.000
Maximum	7.000	6.000

Table 6: Descriptive statistics of the number of founders of CSO and USO

5.1.3 Start Capital

Previous research suggests that the amount of initial capital invested is positively related to new venture survival and success (Cooper et al., 1994). Insufficient financial resources are often cited as a primary reason why new ventures fail. Firms with greater financial resources can invest more in product/services development, production facilities, and marketing strategies. Start capital is measured as the total amount of capital present in the spin-off during the first year of activities, including capital from the founders, equity

investors and debtors. From Table 7 we can conclude that USO tend to have a higher start capital than CSO.

	USO	CSO
Mean	1 155 301.129	337 412.830
Median	274 750.000	61 973.370
Std. Deviation	2 265 230.274	828 207.067
Minimum	3000.000	6197.340
Maximum	15 000 000.000	5 000 000.000

Table 7: Descriptive statistics of the start capital of CSO and USO

5.1.4 Industry

The industry class of each corporate spin-off was defined based on the International Patent Classification System (IPC), which classifies patents in eight technical areas, namely (A) Human Necessities, (B) Performing Operations, Transporting, (C) Chemistry, Metallurgy, (D) Textiles, Paper, (E) Fixed Constructions, (F) Mechanical Engineering, Lighting, Heating, Weapons, Blasting, (G) Physics, (H) Electricity. For analytical purposes, the technology domain of spin-off firms were aggregated in four classes namely Medical Related, Micro-Electronics, Software and Other. For more information on the classification of the technology domain of CSO and USO, we refer to Heirman (2004), Appendix VI. We controlled for industry effects because industries might vary in their performance (including profitability and growth), technological opportunities, regimes of appropriation and opportunities to capitalize on particular market niches. The industry representation of USO is more or less equally divided over the four distinguished classes of technology domains (Figure 4). In the case of CSO, we get another picture, CSO are well represented in software and other industry sectors. In comparison to USO, CSO are less well represented in the Medical Related and Micro-Electronics industry (Figure 5).

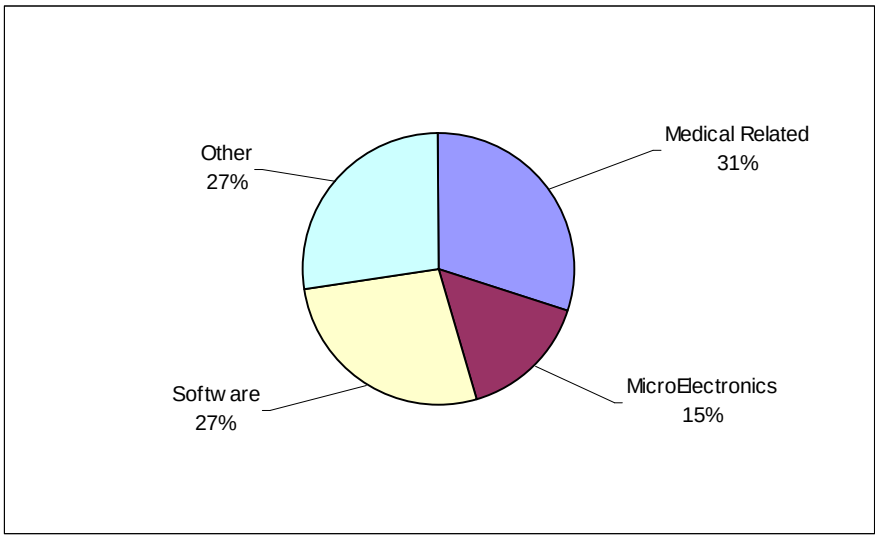

Figure 4: Industry sector of university spin-offs

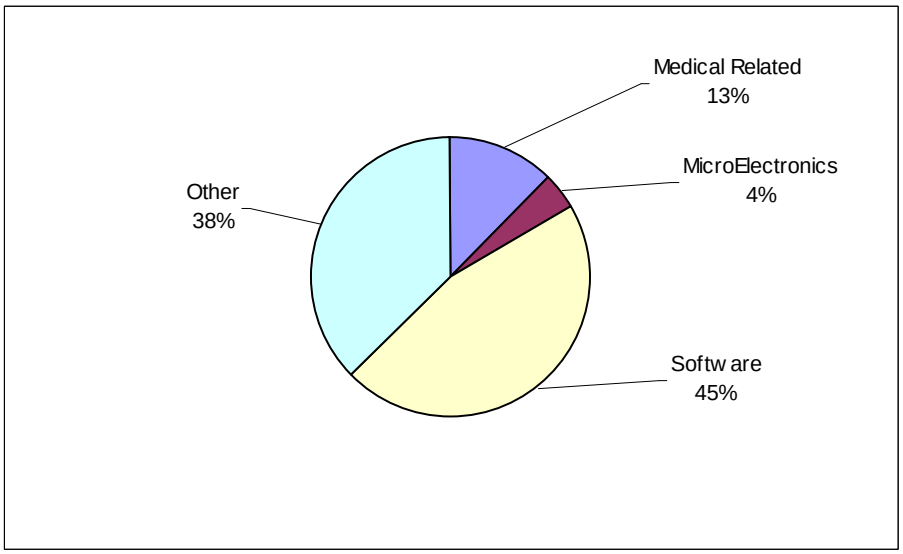

Figure 5: Industry sector of corporate spin-offs

5.1.5 Experience of the Founding Team

Founders of a spin-off can have business and technical experience. Relevant technical experience can prove of vital importance in order to develop a technology but also the appropriate business experience can matter. Having experience in bringing products to the market and in transforming technologies into market-ready products can be crucial for the survival of a spin-off. The founder's skills and experience are found to be related to new firm success (Cooper et al.1994). Technical experience was measured as the cumulated numbers of years of R&D experience of all the founders. Business experience was measured as the cumulated numbers of years the founders had worked in a commercial function (marketing or sales, business development). Table 8 and Table 9 illustrates the business and technical experience of CSO and USO. As expected, the founders of CSO have an average more business experience, while the founders of USO possess more technical experience.

	USO	CSO
Mean	3.070	6.020
Median	0.000	0.000
Std. Deviation	5.841	10.267
Minimum	0.000	0.000
Maximum	20.000	47.000

Table 8: Business experience of the founding team of CSO and USO

	USO	CSO
Mean	20.541	11.415
Median	16.000	9.000
Std. Deviation	19.292	11.627
Minimum	0.000	0.000
Maximum	100.000	38.000

Table 9: Technical experience of the founding team of CSO and USO

5.2 Corporate Spin-Offs in Flanders: A Detailed Look

In the literature, several classifications of corporate spin-offs can be found. Most studies on corporate entrepreneurship and corporate spin-offs have taken the established firm as a point of departure. These studies start with the assumption that established firms support entrepreneurial actions taking place within their organization (Sharma & Chrisman, 1999; Covin & Miles, 1999). However, most established firms are not willing to support entrepreneurial initiatives. Therefore, other studies have looked at entrepreneurial spin-offs that are created by employees who wish to pursue business ideas that are not supported by the parent company (Agarwal et al., 2004). Established firms with abundant, but underexploited knowledge are especially fertile grounds for spin-off formation (Agarwal et al., 2004). As Stinchcombe (1965) puts it, the potential for employee entrepreneurship results from parent firms being imperfect and permeable repositories of knowledge and causes new organization to emerge from other organizations. In this dissertation, we will take the main driver to create a corporate spin-off as the basis to classify the different types of corporate spin-offs. In case the established firm is the main driver to create the CSO, we will label it a restructuring-driven spin-off. In case the corporate spin-off is initiated by an employee, we will label it an entrepreneurial spin-off. The labels are in accordance with previous literature (Tubke et al., 2004; Lindholm, 2001; Parhankangas et al., 2003).

5.2.1 Restructuring-Driven Spin-Offs

Restructuring-driven spin-offs are CSO that are initiated by the parent firm. They are often undertaken as a consequence of restructuring and refocusing activities within the parent firm (Tubke et al., 2004). The parent firm wishes to focus on certain core activities and consequently decide to dispose of certain other activities. This disposal is often the trigger to create a CSO, e.g., the established firm may decide that certain technological activities will no longer be pursued and that it might be better to create a separate entity to further develop and commercialize these technologies. In this case, the

parent firm gives active support to create the corporate spin-off and often a transfer of resources takes place.

An example of a restructuring-driven spin-off from our database is the following company that is active in the construction of machinery. This company was contacted by a nearby hospital to develop a new transport system for hospital beds. This was a rather unusual request for the company, since their core activities are concentrated around the manufacturing of cranes. Nevertheless, the company decided to start with the developments of this new transport system and soon a prototype was available that could be tested in hospitals. The director of the hospital who requested the new transport system, was extremely enthusiastic and shared his enthusiasm with other colleagues. Consequently, other colleagues began to be interested in purchasing the same transport system for their hospital beds. The CEO was put for a dilemma: Would he continue the development of hospital beds within the current company although these developments did not fit with the core activity of the company, or should he create a separate company to house these activities? Seen the large amount of potential interested customers, he decided to create a spin-off to further commercialize the transport system for hospital beds. Today, this new company has an established reputation in the hospital transportation industry.

Restructuring-driven spin-offs can also be created to get a faster and more direct access to attract money in order to be able to commercialize certain technologies. These restructuring-driven spin-offs often have a formal connection with their parent firm through a license or shareholder structure. E.g. a company active in the sport industry has created a spin-off in order to be able to commercialize a certain technology faster. This company had met another company active in time measure systems. The latter company was specifically interested in further developing a particular technology of the first company. Consequently, the CEO of the first company decided to create a corporate spin-off to house this technology. This allowed to further develop the technology, while creating the opportunity for the second company to invest in the newly created company. In this way, both companies could cooperate optimally and the speed of development of the technology was much higher.

Restructuring-driven spin-off can also be used to commercialize radical technologies. Little attention has been devoted to examine the possibility to create a corporate spin-off to commercialize new technologies, to explore and develop new market opportunities or to develop new production systems. Nevertheless, CSO may be an elegant solution for established firms to reduce the risks associated with these activities. Established firms often experience difficulties in managing radical innovation projects since these projects deviate from the daily business of the firm. In case business units need to downsize, radical innovation projects are often the first to be killed. However, each established firm needs innovations if it wants to stay competitive on the long term. In our database of corporate spin-offs, we did not found a CSO that was created by an established firm to commercialize a radical technology.

5.2.2 Entrepreneurial Spin-Offs

Entrepreneurial spin-offs are initiated by one or more employees in order to exploit an opportunity they have spotted while working for their parent firm. The parent firm does not always embrace these opportunities. In many cases, the employee does not get the option to pursue the opportunity, especially not if the opportunity is not in line with the strategy of the parent firm. Consequently, some employees decide to create a CSO to pursue the opportunity themselves. In this case, the employees often do not receive support from the parent firm to create the CSO. In some case, the employees may even experience resistance from the parent firm to set up the CSO.

Entrepreneurial spin-offs are often created by employees, who leave their parent firm since the parent firm does not allow them to pursue certain opportunities. An important trigger for entrepreneurial spin-offs is the recognition of a market opportunity. Here, we can mention a researcher that had developed a new drug for a large pharmaceutical company. The next step in the development process of the drug was the synthesis of the prototype of the drug. This step was being outsourced by the parent company. However, the researcher was convinced that it might be more opportune to perform the synthesis within the company itself. He had a discussion with the management to explore the possibility of creating a department to do the synthesis within

the company. The management argued that performing the synthesis within the company was not in line with its core activities and did not fit the strategy. As a consequence, the researcher resigned and started his own company to perform the synthesis of drugs.

In some cases, the employee does not communicate the spotted opportunity with its employer, but decides to create a new company to pursue the opportunity himself. The sales manager of a large chemical company found out that there existed a huge need for a particular type of synthetic powder. He decided not to communicate this opportunity with his parent company, but to leave the parent company to pursue this opportunity himself. Through his network of customers, the manager was able to perform an thorough analysis of the market demand for this synthetic powder. He quickly discovered that there existed a huge market for such powders. Consequently, the sales manager resigned and started his own synthetic powder manufacturing company.

Entrepreneurial spin-offs can also be created in response to restructuring activities within the parent firm. Restructuring activities often include that certain activities will no longer be continued. In 1991, a French telecom company started to commercialize a new decode system for electronic data exchange. The company spent more than 250.000 Euro to marketing and sales in order to realize the commercialization of this decode system. After a first evaluation in 1993, the decode system turned out to be a commercial failure, so the telecom company decided to get the decode system off the market. An employee of the telecom company got informed about the termination of the commercialization of the decode system. He really believed in the market opportunities of the decode system, and decided to buy the IP rights of the decode system from the telecom company. He started his own company in 1994 to further develop and commercialize the decode system.

A similar motivation to create an entrepreneurial spin-off is the case where a parent company is taken over by another company. In this case, it often happens that employees can no longer identify themselves with the culture of the new company. They therefore decide to set up their own company based on their previous working experience. This happened in a company that was active in the research, development and manufacturing of optica for high-power lasers. After the acquisition of the company, the new parent firm decided to terminate all research activities in Belgium and to transfer all research activities to the new headquarters in the United States. The researchers in

Belgium could choose between a research position in the United States or a job as sales representative in Belgium. A couple of researcher refused to become sales representatives and began to explore the possibilities to continue the research projects in another company. The result was a new company that carries on some of the research activities that were initiated in the previous parent company. This new company is a direct competitor of the American firm.

In some cases, an employee decides to create a corporate spin-off since he no longer wishes to work for a parent firm, but prefers to work on an independent basis. These employees are real entrepreneurs who feel the desire to create their own company and to become self-employed. They often rely on experience they build up while working for the parent firm. In the late nineties the board of directors of a Flemish IT-company decided to expand the company, seen the success of the company. This expansion would mostly take place through the acquisition of smaller IT companies. The CEO of the IT company did not share the enthusiasm of the board of directors to acquire these companies. Subsequently, during a particular acquisition, the board of directors decided to continue with the acquisition without the approval of the CEO. As a result of this acquisition, there was a shift in responsibilities within the new company. From now on, the CEO had to share his responsibilities with a managing director. This new situation quickly led to frictions, so the CEO decided to resign and start a new career as self-employed software consultant.

5.2.3 Descriptive Statistics of the Flemish Corporate Spin-Offs

Our database consists of 20 restructuring-driven spin-offs and 28 entrepreneurial spin-offs. Table 10 provides the descriptive statistics of the age, size, start capital and experience of the founding team for the two groups of CSO. The average entrepreneurial spin-off is slightly older than the restructuring-driven spin-off. Entrepreneurial spin-offs also tend to have more founders than restructuring-driven spin-offs. However, the start capital of restructuring-driven spin-offs tend to be significantly higher than the start capital of entrepreneurial spin-offs. This may be explained by the fact that restructuring-driven spin-offs are supported by their parent firm and therefore often receive financial

resources from the parent firm. The founders of entrepreneurial spin-offs have an average more business experience, but less technical experience than the founders of restructuring-driven spin-offs.

		Mean	Median	Std. Deviation	Min	Max
Age	Entrepreneurial spin-offs	6.71	6.75	2.91	1.83	14.00
	Restructuring-driven spin-offs	5.37	5.33	2.61	0.42	9.17
Number of founders	Entrepreneurial spin-offs	2.11	2.00	1.13	1.00	6.00
	Restructuring-driven spin-offs	1.90	1,50	1.33	1.00	5.00
Start capital	Entrepreneurial spin-offs	110407.10	18592.22	274271.60	6197.34	1214678
	Restructuring-driven spin-offs	410328.20	99157.41	527038.50	6197.34	5000000
Business Experience of the founding team	Entrepreneurial spin-offs	6.74	0.00	11.63	0.00	47.00
	Restructuring-driven spin-offs	5.05	0.00	8.27	0.00	30.00
Technical Experience of the founding team	Entrepreneurial spin-offs	10.24	10.00	10.52	0.00	32.00
	Restructuring-driven spin-offs	13.00	8.50	13.09	0.00	38.00

Table 10: Descriptive statistics of the age, size and start capital of entrepreneurial and restructuring-driven spin-offs

Figure 5 has indicated that the industry sectors of the CSO in our sample are not evenly distributed in the four classes of technology domains. CSO are less well represented in the Medical Related and the Micro-Electronics industry. Therefore, we have taken several industry sectors together and made a distinction between two classes: (1) Software & Micro-Electronics, and (2) Other Industry Sectors. Table 11 gives an overview of the entrepreneurial and restructuring-driven spin-offs according to their industry sectors.

	Software and microelectronics	Other Industry Sectors
Entrepreneurial spin-offs	13	15
Restructuring-driven spin-offs	11	9

Table 11: Industry sector of entrepreneurial and restructuring-driven spin-offs

5.3 Performance of the Two Groups of Corporate Spin-Offs

5.3.1 Growth in Revenues and Employees

In order to get a better insight into the performance of corporate spin-offs, we have compared the performance of the entrepreneurial spin-offs with the restructuring-driven spin-offs. Figure 6 demonstrates the growth in revenues and employees for both groups of corporate spin-offs. We can clearly see that entrepreneurial spin-offs demonstrate a higher growth in revenues and employees. A possible explanation can be found in the motivation of the employees working in entrepreneurial and restructuring-driven spin-offs. The founders of entrepreneurial spin-offs possess the entrepreneurial drive to set up and run their own company. They consciously choose to become an entrepreneur and create their own company. They look forward to the challenge of it. On the other hand, founders of restructuring-driven spin-offs often do not have a choice. In case they were working on the project and/or technology that is being spun off, they are requested to join the spin-off. These employees often do not have an entrepreneurial

drive. Consequently, they do not feel the drive to grow, but prefer to take few risks and keep the company financially healthy.

An alternative explanation can be found in the fact that entrepreneurial spin-offs are rather created from a market pull, in comparison to restructuring-driven spin-offs. The entrepreneurs spot a market opportunity they can not pursue within the parent company and decide to exploit the opportunity themselves. At the time the employees create the spin-off, he is convinced of the market opportunity. From our data, we can conclude that the entrepreneur is capable of estimating the right value of the opportunity. This allows them consequently to grow. The creation of a restructuring-driven spin-off is not always connected to a market opportunity. Restructuring-driven spin-offs are often created because of parent firm wants to focus on certain core activities and thus terminate certain other activities. In these cases, no market opportunity lies at the basis for the creation of the spin-off. This is often being translated in a lower performance for restructuring-driven spin-offs.

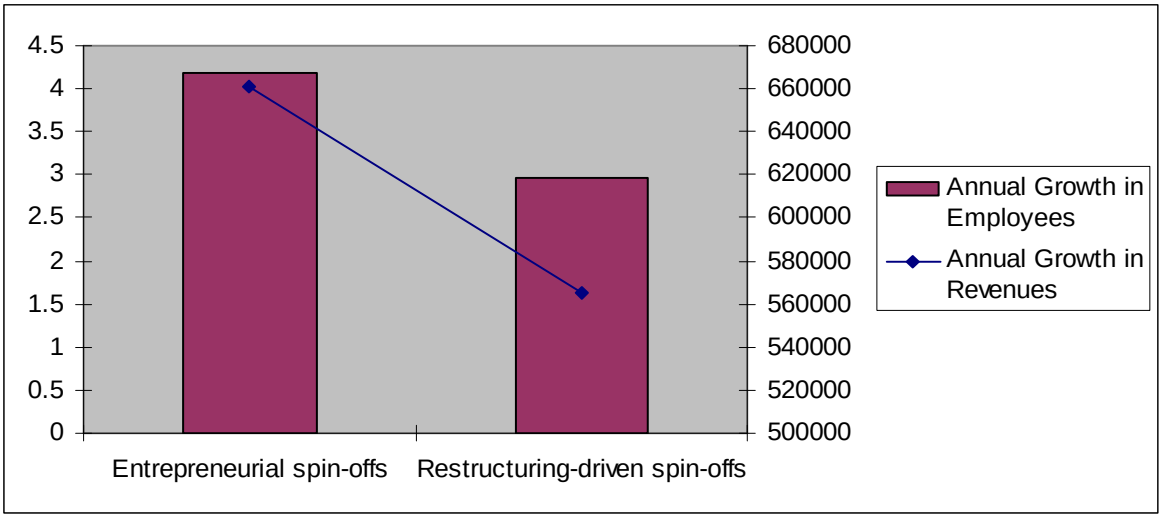

Figure 6: Growth in revenues and employees of entrepreneurial and restructuring-driven spin-offs

5.3.2 Growth in Cash Flow

Growth in revenues and employees are important indicators to measure the performance of entrepreneurial and restructuring-driven spin-offs. However, it can also be interesting to look at the liquidity of these spin-offs. Liquidity refers to the ability of a company to pay its debts as they become due. Liquidity measures the company's possibility to fulfill short-term obligations. We use cash flow as a measure for the company's liquidity. In contrast to static liquidity measures such as the current and quick ratio, cash flow is a more dynamic measure that captures the ongoing liquidity of a company's operations (Kamath, 1989). The cash flow takes the timing of incomes (e.g. revenues, financial income…) and charges (remunerations, trade debtors…) into account.

Figure 7 shows that during the first year the cash flow of restructuring-driven spin-offs is higher than for the entrepreneurial spin-offs. We can explain this by the fact that restructuring-driven spin-offs are often set up with support of their parent company. This support often entails that financial resources are being transferred from the parent company to the spin-off. Once the CSO are independent entities, the financial support disappears what explains the decline in cash flow during the second and third year. On the long term, we see a moderate increase in cash flow for the restructuring-driven spin-offs. Entrepreneurial spin-offs on the other hand often start with little cash flow. They do succeed in generating cash flow fairly quickly and especially after the fourth year, they experience a high increase in cash flow. The first years are often used to explore the market and to build up a client base. But once they are launched, this group of spin-offs experiences a high growth in cash flow. Again we can attribute this high growth to the market pull under which the entrepreneurial spin-offs are created. Moreover, the founders of these spin-offs often have a real entrepreneurial spirit, that allow the discovery of better opportunities that in its turn can translate into a higher cash flow.

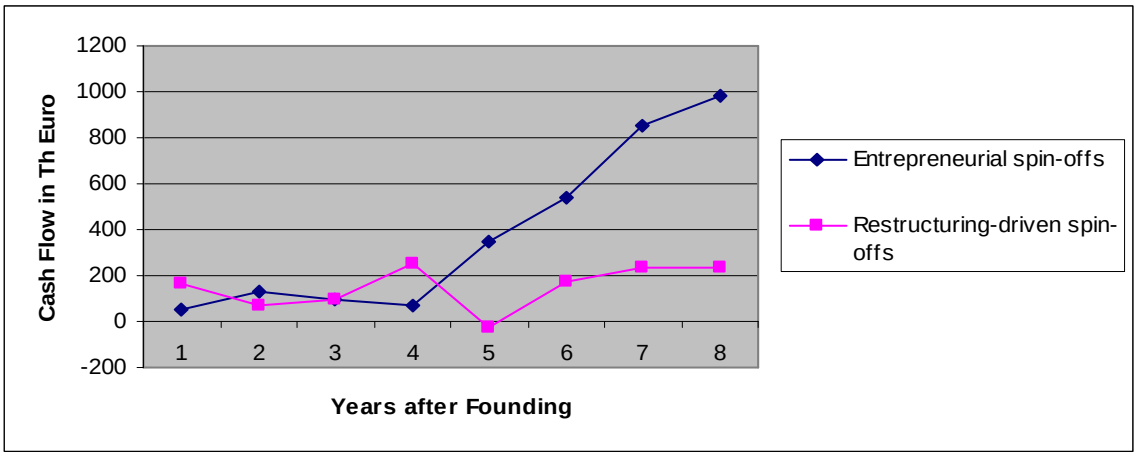

Figure 7: Liquidity of entrepreneurial spin-offs and restructuring-driven spin-offs

5.3.3 Knowledge Transfer from the Parent Institute

An important characteristic of a corporate spin-off is the link between the corporate spin-off and its parent company. The support a CSO receives from its parent company can have a huge impact on the performance of the CSO. Past research has found that the initial transfer of knowledge from the parent to the CSO can have long-lasting effects on the performance of CSO (Huber, 1991). If employees leave the parent firm to create a CSO, some kind of knowledge transfer takes place (Phillips, 2002). This implies that CSO have an advantage over other start-ups who do not have a parent company. So it is important to create an insight into the relation between a CSO and its parent company.

A knowledge based relationship refers to the way in which the knowledge base of both companies overlap. This overlap can take place on a production, technology and marketing level (Rumelt, 1974; Sapienza et al., 2004). The transfer of production knowledge from the parent firm can be valuable in helping spin-offs to realize production systems and techniques and to adjust them to customer needs. The transfer of technological knowledge from the parent to the spin-off may allow the spin-off to possess a more solid technological knowledge base. This can help the spin-off to shorten the development time from product idea to commercial product. A transfer of marketing knowledge from the parent firm allows the corporate spin-off to better focus on certain customer groups and distribution channels, and create more efficient marketing strategies.

Several researchers have examined the relationship between a CSO and its parent firm. The results from these studies have been inconsistent. In their study, Sapienza et al. (2004) found that a transfer of production and technological knowledge does have an influence on the growth of CSO. They did not find any support for the impact of the transfer of marketing knowledge on performance. On the other hand, Davis et al. (1992) find that a transfer of marketing knowledge is associated with a higher sales growth. Sorrentino & Williams (1995) found no significant difference between the market share of high, medium and low related corporate spin-offs and conclude that the relationship between a corporate spin-off and its parent company has no effect on performance. Agarwal et al. (2004) show that the capacities of the parent company do have a positive effect on the knowledge and survival chances of corporate spin-offs.

Table 12 illustrates the descriptive statistics of the knowledge transfer of entrepreneurial and restructuring-driven spin-offs. Table 13 shows the results from the Mann-Whitney U-test in which we have tested the difference in transfer of production, technological and marketing knowledge for restructuring-driven and entrepreneurial spin-offs. From the results we can conclude that the transfer of production and technological knowledge differs significantly for both groups of spin-offs. The restructuring-driven spin-offs transfer considerably more technological knowledge and production know-how. This result is not surprising, since restructuring-driven spin-offs are often set up with active support of their parent company, which makes the transfer of knowledge easier and more acceptable. When we look at the transfer of marketing knowledge, we can conclude that entrepreneurial spin-offs transfer on average slightly more marketing knowledge than restructuring-driven spin-offs, but the difference is not significant.

	Mean		Median		Std. deviation	
	Entrepreneurial spin-offs	Restructuring-driven spin-offs	Entrepreneurial spin-offs	Restructuring-driven spin-offs	Entrepreneurial spin-offs	Restructuring-driven spin-offs
Technology transfer from the parent F Tech 1	2.71	4.79	1.00	6.50	2.305	2.723
Technology transfer from the parent F Tech 2	2.81	5.86	1.00	7.00	2.337	1.703
Technology transfer from the parent F Tech 3	2.33	5.07	1.00	6.50	1.932	2.495
Transfer of production knowledge from the parent F Prod 1	1.67	3.36	1.00	1.00	1.713	2.872
Transfer of production knowledge from the parent F Prod 2	1.38	3.60	1.00	2.00	1.203	2.794
Transfer of marketing knowledge from the parent F Mark 1	2.45	1.75	1.00	1.00	2.259	1.865
Transfer of marketing knowledge from the parent F Mark 2	1.30	1.50	1.00	1.00	1.342	1.732
Transfer of marketing knowledge from the parent F Mark 3	2.10	1.92	1.00	1.00	1.774	1.730

Table 12: Descriptive statistics of the knowledge transfer of entrepreneurial and restructuring-driven spin-offs

	Transfer of technological knowledge			Transfer of production knowledge		Transfer of marketing knowledge		
	F Tech 1	F Tech 2	F Tech 3	F Prod 1	F Prod 2	F Mark 1	F Mark 2	F Mark 3
Mann-Whitney U	82.50	40.00	59.50	101.00	83.50	98.50	116.00	119.00
Wilcoxon W	313.50	271.00	290.50	332.00	314.50	176.50	326.00	329.00
Z	-2.306	-3.721	-3.087	-2.022	-2.787	-1.056	-0.371	-0.045
Asymp. Sig. (2-tailed)	0.021	0.000	0.002	0.043	0.005	0.291	0.711	0.964

Table 13: Mann-Whitney U-test for the knowledge transfer of entrepreneurial and restructuring-driven spin-offs

5.3.4 Relationship between Knowledge Transfer and Performance

Corporate spin-offs are a unique group of new ventures since they are based upon activities that were originally developed in a larger parent firm. This allows them to transfer unique knowledge from the parent firm into the CSO. An important question that comes to rise is whether this knowledge transfer contributes to the performance of CSO. In Chapter 3 we have developed several hypotheses regarding the transfer of technological and production knowledge from the parent firm to the CSO. In the result section, these hypotheses are tested using the partial least squares method. The interpretation is written down in the conclusion section.

6 RESULTS

This chapter presents the results of the empirical tests of the hypotheses, formulated in Chapter 3. First, the hypotheses on the technological resources of CSO and USO are tested. Next, the relationship between the technological resources, the technology strategy and the performance is tested. Then, we look at the performance of CSO and USO. Finally, we provide a summary of the results of the hypotheses tests.

6.1 Technological Resources of CSO and USO

Hypothesis 1 through hypothesis 4 predicted the differences in technological resources of CSO and USO. We predicted that USO will have more internal R&D sources, will collaborate more in R&D consortia and transfer more technology than CSO. CSO on the other hand will transfer more production knowledge. Table 14 contains the descriptive statistics of the measures of the technological resources of CSO and USO.

	Minimum	Maximum	Mean CSO	Mean USO	Std. Deviation CSO	Std. Deviation USO
Internal R&D sources FTERD_FTE	0	1	0.42	0.57	0.359	0.375
Collaboration in R&D consortia NPD1	1	3	1.39	1.64	0.754	0.804
Collaboration in R&D consortia REc3PBLRD1	1	3	1.21	1.65	0.512	0.699
Collaboration in R&D consortia Rec3PBLt1	1	3	1.45	1.33	0.751	0.653
Technology transfer from the parent F Tech 1	1	7	3.23	5.37	2.591	1.819
Technology transfer from the parent F Tech 2	1	7	3.69	4.82	2.553	1.965
Technology transfer from the parent F Tech 3	1	7	3.11	5.16	2.459	1.897

Transfer of production knowledge from the parent F Prod 1	1	7	2.29	2.82	2.420	2.571
Transfer of production knowledge from the parent F Prod 2	1	7	2.17	2.28	2.281	2.351

Table 14: Descriptive Statistics of the technological resources of CSO and USO

We then performed a Mann-Whitney U-test to examine if the difference for CSO and USO is significantly different. As the results in Table 15 show, CSO and USO do significantly differ in their technology transfer, their internal R&D sources and in two of the three collaboration items. No significant difference was found for the transfer of production knowledge.

	Technology transfer			Transfer of production knowledge		Collaboration in R&D consortia			Internal R&D sources
	F Tech 1	F Tech 2	F Tech 3	F Prod 1	F Prod 2	NPD1	Rec3 PBLt1	REc3PB LRD1	FTERD_ FTE
Mann-Whitney U	501.50	709.00	501.50	810.50	912.00	1238.0	1481.0	1040.00	1363.50
Wilcoxon W	1096.50	1304.00	1096.50	1405.50	1507.00	2228.00	3966.0	2121.00	2539.50
Z	-3.933	-2.169	-3.912	-1.582	-.625	-1.944	-.949	-3.728	-1.984
Asymp. Sig. (2-tailed)	.000	.030	.000	.114	.532	.052	.342	.000	.047

Table 15: Mann-Whitney U-test for the technological resources of CSO and USO

6.2 Technology Strategy of CSO and USO

Strategies must be set in conjunction with the spin-off's resources in order to achieve a competitive advantage. Barney and Zajac (1994) argue that firm performance is determined by the firm's strategy and the firm's resources base. The better the fit between a firm's strategy and its resources, the better the firm's performance (Edelman et al., 2005). To best capture the theoretical interdependencies between resources, strategies and spin-off performance, we analyzed the data using the partial least square (PLS) technique. The partial least square technique is one of the structural equation modeling (SEM) techniques that was developed by Wold (1974) as an alternative to the LISREL program. Generally, PLS results are presented in two stages. In the first stage, the researcher ensures that the measures used as operationalizations of the underlying constructs are both reliable and valid. Once convinced of the adequacy of the measurement model, we can then proceed to interpret the resulting model coefficients **(**Birkinshaw et al., 1995).

6.2.1 Assessment of the Measurement Model: Reliability and Validity

The acceptability of the measurement model was assessed by looking at the reliability of individual items, the internal consistency between items expected to measure the same constructs, and the discriminant validity between constructs. The tables displayed, are the results obtained from the CSO sample.

6.2.1.1 Item reliability

Individual item reliability was determined by examining the loadings of measures on their corresponding constructs. A rule of thumb employed by many researchers is to accept items with loadings of 0.7 or more (Hulland, 1999), which implies that there is more shared variance between construct and its measure than error variance. Since loadings are correlations, this implies that more than 50 percent of the variance in the observed variable is due to the construct.

	Internal R&D sources	Collaboration in R&D consortia	Technology transfer	Production knowledge transfer	Scope of technology	Newness of technology	Perfor-mance	Age	Expe-rience	Start capital	Size	Techno-logy domain
FTERD_FTE	1	0	0	0	0	0	0	0	0	0	0	0
NPD1	0	0.9349	0	0	0	0	0	0	0	0	0	0
PBLt1	0	0.5271	0	0	0	0	0	0	0	0	0	0
BLRD1	0	0.7346	0	0	0	0	0	0	0	0	0	0
F Tech 1	0	0	0.9157	0	0	0	0	0	0	0	0	0
F Tech 2	0	0	0.9000	0	0	0	0	0	0	0	0	0
F Tech 3	0	0	0.9534	0	0	0	0	0	0	0	0	0
F Prod 1	0	0	0	0.9793	0	0	0	0	0	0	0	0
F Prod 2	0	0	0	0.9828	0	0	0	0	0	0	0	0
TechScopeFou	0	0	0	0	1	0	0	0	0	0	0	0
Know1New	0	0	0	0	0	0.7682	0	0	0	0	0	0
KnowSynth	0	0	0	0	0	0.8157	0	0	0	0	0	0
Tacit_7	0	0	0	0	0	0.8507	0	0	0	0	0	0
Age	0	0	0	0	0	0	0	1	0	0	0	0
ExpCom	0	0	0	0	0	0	0	0	1	0	0	0
TotalCap0	0	0	0	0	0	0	0	0	0	1	0	0
N_Founders	0	0	0	0	0	0	0	0	0	0	1	0
TechDomain	0	0	0	0	0	0	0	0	0	0	0	1
YFTEGrowth	0	0	0	0	0	0	0.9705	0	0	0	0	0
YRevGrowth	0	0	0	0	0	0	0.8733	0	0	0	0	0

Table 16: Item reliability of the respective constructs

Table 16 presents the item reliability of the respective constructs for the sample of CSO. We can see that one of the measures for the construct collaboration in R&D consortia has an item reliability of 0.5271, which is less than the required 0.7. All other measures show an item reliability that is higher than the required 0.7. In practice, it is common to find that at least several measurement items have loadings below the 0.7 threshold. These measures should be carefully examined, since they may add little explanatory power to the model while attenuating the estimates of the parameters linking the constructs (Nunnally, 1978). In practice, items with loadings of less than 0.5 should certainly be dropped. In further analyses, we have dropped the variable with the lower item reliability.

6.2.1.2 Convergent Validity

When multiple measures are used for an individual construct, the researcher should be concerned not only with individual measurement item reliability, but also with the extent to which the measures demonstrate convergent validity. Traditionally, researchers using PLS have generally reported one or both of two measures of convergent validity (also referred to as composite reliability): Cronbach's alpha and the internal consistency measure developed by Fornell and Larcker (1981). Fornell and Larcker argue that their measure is superior to alpha since it uses the item loadings obtained within the nomological network (or causal model). Low internal consistency can result from a variety of underlying causes, including poor construct definition and/or construct multidimensionality. Nunnally (1978) suggests 0.7 as a benchmark for 'modest' composite reliability. From Table 17 we can conclude that the constructs demonstrate convergent validity. For the construct Internal R&D sources, Scope of technology and the control variables, we only use one measure to capture the construct. This implies that the convergent validity for these constructs is 1.

	Composite Re
Internal R&D sources	1
Collaboration in R&D consortia	0.7867
Technology transfer	0.9455
Production knowledge transfer	0.9809
Scope of technology	1
Newness of technology	0.8531
Performance	0.9200
Age	1
Experience	1
Start capital	1
Size	1
Technology domain	1

Table 17: Composite reliability of the constructs

6.2.1.3 Discriminant Validity

The traditional methodological complement to convergent validity is discriminant validity, which represents the extent to which measures of a given construct differ from measures of other constructs in the same model. In a PLS context, one criterion for adequate discriminant validity is that a construct should share more variance with its measures than it shares with other constructs in a given model. To assess discriminant validity, Fornell and Larcker (1981) suggest the use of Average Variance Extracted (i.e. the average variance shared between a construct and its measures). This measure should be greater than the variance shared between the construct and other constructs in the model. This can be demonstrated in a correlation matrix which includes the correlations between different constructs in the lower left off-diagonal elements of the matrix, and the square roots of the average variance extracted values calculated for each of the constructs along the diagonal. For adequate discriminant validity, the diagonal elements should be significantly greater than the off-diagonal elements in the corresponding rows and columns. Table 18 demonstrate that this is the case for our constructs.

	Internal R&D sources	Collaboration in R&D consortia	Techno-logy transfer	Production knowledge transfer	Scope of technology	Newness of technology	Perfor-mance	Age	Expe-rience	Start capital	Size	Techno-logy domain
Internal R&D sources	1											
Collaboration in R&D consortia	0.2945	0.7509										
Technology transfer	0.3948	0.2650	0.9233									
Production knowledge transfer	0.2216	0.2372	0.7064	0.9811								
Scope of technology	-0.0616	0.3042	0.3040	0.0958	1							
Newness of technology	0.2514	0.3571	0.5844	0.5041	0.6183	0.8123						
Performance	0. 1477	0.3373	0.0279	0.0279	-0.0170	0.1961	0.9232					
Age	0.035	0.0883	0.1882	0.2121	-0.074	0.1385	0.2999	1				
Experience	-0.0441	-0.0958	-0.1547	0.0363	0.0176	0.0953	0.2959	-0.0521	1			
Start capital	0.0029	0.1313	0.2622	-0.0286	0.0779	-0.0031	0.0099	-0.1595	-0.0666	1		
Size	-0.3118	0.0096	-0.0593	0.015	0.1888	0.1368	0.138	-0.0051	0.0628	-0.1884	1	
Technology domain	-0.0013	0.2966	-0.1134	-0.1344	0.0834	-0.1821	-0.0361	-0.0887	-0.0527	0.086	-0.0172	1

Table 18: Discriminant validity of the constructs

6.2.1.4 Goodness of Fit

LISREL and other covariance structure analysis modeling approaches involve parameter estimation procedures which seek to reproduce as closely as possible the observed covariance matrix. In contrast, PLS has as its primary objective the minimization of error (or, equivalently, the maximization of variance explained) in all endogenous constructs. The degree to which any particular PLS model accomplished this objective can be determined by examining the R^2 values for the dependent (endogenous) constructs.

	R Square
Internal R&D sources	0
Collaboration in R&D consortia	0
Technology transfer	0
Production knowledge transfer	0
Scope of technology	0.2560
Newness of technology	0.3986
Performance	0.2429
Age	0
Experience	0
Start capital	0
Size	0
Technology domain	0

Table 19: R^2 values of the dependent constructs

6.2.2 Assessment of the Structural Model

The assessment of the structural model involves estimating the path coefficients and the R^2 value. Path coefficients indicate the strengths of the relationships between the independent and dependent variables, whereas the R^2 value is a measure of predictive power of a model for the dependent variables (Ko et al., 2005). The sign of the path coefficients indicates the direction of the relationship. Smart PLS 2.0 was chosen using a bootstrap resampling method to determine the significance of the paths within the structural model. The bootstrap technique represents a nonparametric approach for estimating the precision of the PLS estimates. The bootstrap technique is considered more efficient than the jackknife technique (Efron & Tibshirani, 1993). Table 20 represents the significance of the paths using the bootstrap technique, while Table 21 illustrates the path coefficients. The variance explained, the sign and significance of the path coefficients, and examination of the measurement loadings can be used to assess the model specification (Milberg et al., 2000). Figure 8 shows the relationship between the technological resources, the technology strategy and performance. The tests of the hypotheses will be discussed in the next paragraph.

	Original Sample	Sample Mean	Standard Dev	T Statistics
Internal->scope	-0.3077	-0.3094	0.1111	2.7684
Internal->newness	-0.0122	-0.0087	0.0727	0.1673
Collaboration->scope	0.3197	0.3152	0.1115	2.868
Collaboration->newness	0.2113	0.2105	0.1037	2.0387
Technology ->scope	0.5558	0.5645	0.0971	5.7216
Technology ->newness	0.4204	0.441	0.1089	3.86
Production->scope	-0.3045	-0.316	0.114	2.6708
Production->newness	0.1597	0.1444	0.1033	1.5461
Scope->Performance	-0.1856	-0.1762	0.1139	1.6291
Newness->Performance	0.2327	0.2112	0.1342	1.7335
Age->Performance	0.2931	0.3	0.0793	3.6959
Experience->Performance	0.2936	0.3058	0.0831	3.5335
Start capital->Performance	0.1142	0.1177	0.0713	1.6014
Size->Performance	0.1467	0.1519	0.1048	1.4001
Tech domain->Performance	0.0559	0.0458	0.1148	0.4871

Table 20: Significance of the path coefficients using the bootstrap technique

	Internal R&D sources	Collaboration in R&D consortia	Techno-logy transfer	Production knowledge transfer	Scope of technology	Newness of technology	Perfor-mance	Age	Expe-rience	Start capital	Size	Techno-logy domain
Internal R&D sources	0	0	0	0	-0.3077	-0.0122	0	0	0	0	0	0
Collaboration in R&D consortia	0	0	0	0	0.3197	0.2113	0	0	0	0	0	0
Technology transfer	0	0	0	0	0.5558	0.4204	0	0	0	0	0	0
Production knowledge transfer	0	0	0	0	-0.3045	0.1597	0	0	0	0	0	0
Scope of technology	0	0	0	0	0	0	-0.1856	0	0	0	0	0
Newness of technology	0	0	0	0	0	0	0.2327	0	0	0	0	0
Performance	0	0	0	0	0	0	0	0	0	0	0	0
Age	0	0	0	0	0	0	0.2931	0	0	0	0	0
Experience	0	0	0	0	0	0	0.2936	0	0	0	0	0
Start capital	0	0	0	0	0	0	0.1142	0	0	0	0	0
Size	0	0	0	0	0	0	0.1467	0	0	0	0	0
Technology domain	0	0	0	0	0	0	0.0559	0	0	0	0	0

Table 21: Path coefficients

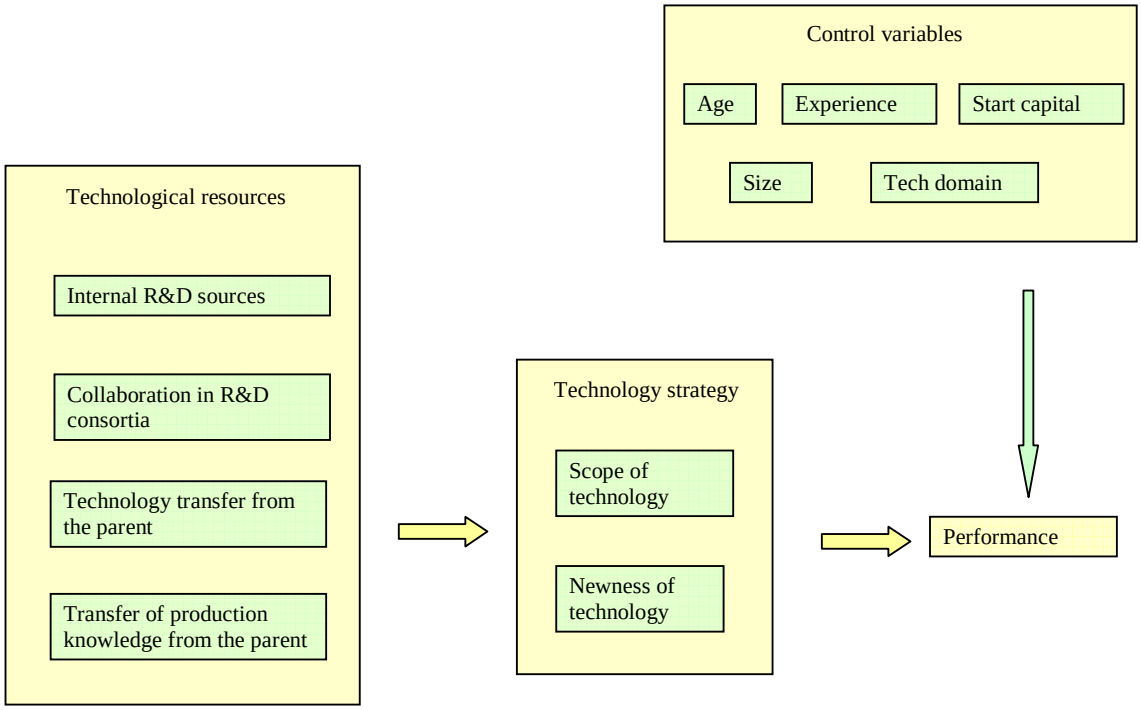

Figure 8: The relationship between technological resources, technology strategy and performance

6.2.3 Analysis of the Hypotheses on Technology Strategy

We developed several hypotheses on the relationship between the technological resources and the technology strategy of CSO and USO. CSO and USO must both set their technology strategy in conjunction with their technological resources in order to achieve performance. From the tests performed in paragraph 6.1 we can conclude that the technological resources of CSO and USO are indeed different. Since CSO and USO have different technological resources, there exist a high probability that their technology strategy will also differ since their strategy is set up in concurrence with the resources. We have therefore performed the analyses for the sample of CSO and USO separately. This allows us to create a deeper understanding of the co-alignment of technological resources, technology strategy and performance for the two groups of spin-offs. Table 22 presents the path coefficients of the proposed model. For each type of spin-off, two models were tested: a base model (including only control variables) and a full model (including control variables plus the technological resources, technology strategy and performance variables).

	CSO		USO	
	Base model	Full model	Base model	Full model
Internal R&D sources ->scope		-0.3077***		0.1821**
Internal R&D sources ->newness		-0.0122		0.2898***
Collaboration ->scope		0.3197***		0.2963***
Collaboration ->newness		0.2113**		0.1865***
Technology transfer ->scope		0.5558***		0.1016
Technology transfer ->newness		0.4204***		0.5168***
Production ->scope		-0.3045**		0.0035
Production ->newness		0.1597		-0.0856
Scope ->Performance		-0.1856*		0.2716***
Newness ->Performance		0.2327*		-0.1514*
Age ->Performance	0.3372***	0.2931***	0.2313***	0.1895**
Experience ->Performance	0.3154***	0.2936***	-0.0054	-0.0475
Start capital ->Performance	0.1128	0.1142	0.5932***	0.6065***
Size ->Performance	0.1464	0.1467	0.177	0.1773*
Tech domain ->Performance	-0.0063	0.0559	-0.1251	-0.1219
R^2	0.2190	0.2429	0.4082	0.4507

Table 22: Results of the PLS analysis (* p< 0.10, ** p< 0.05, *** p< 0.01)

6.2.3.1 The Base Model

The control variables we considered are (1) the age of the spin-off; (2) the experience of the founding team; (3) the start capital of the spin-off; (4) the size of the spin-off; and (5) the technology domain of the spin-off. The control variables could not be bundled in one overall construct, since they each represent a distinct construct. Indeed, if we perform the analyses by putting all control variables in one overall construct, the item reliability of the measures is very low. Only age has a high item reliability. We have therefore separated the control variables into different constructs.

An experienced, well-balanced team is preferably present to guide the commercialization of a new technology. The necessary experience may be two folded, (1) the team needs technical experience in order to develop the technology into a market ready product and (2) the team needs business experience to bring the product on the market according to the customer's needs. The experience of the founding team was measured by two items e.g. the number of years of technical experience and the number of years of business experience. In both groups of spin-offs, the item reliability of technical experience is very low (e.g. 0.0414 and 0.1557), while the item reliability of business experience is very

high (e.g. 0.9912 and 0.9836 for CSO and USO respectively). Therefore, we have omitted the item technical experience from the construct experience and performed the analyses with business experience only.

For the sample of CSO, the control variables age and experience have a strong and significant influence on performance ($p< 0.01$). Also in the sample of USO, age has a strong and significant influence on performance. Surprisingly, experience is not significantly related with performance, not even on a 0.1 level. In case of USO, experience does not seem to contribute to performance. For USO, also start capital contributes significantly to performance ($p< 0.01$).

6.2.3.2 The Full Model

In the full model, we have included the control variables, the technological resources, the technology strategy and the performance variables. Both in the case of CSO and USO, the full model yields a higher explained variance of performance than the base model. The difference in R^2 values of the base and the full model allows us to examine the substantive impact of adding the technological resources and technology strategy variables to the model. The effect size f^2 can be calculated as $(R^2_{full} - R^2_{excluded})/(1-R^2_{full})$. This indicator provides the substantive impact of adding the constructs. Cohen (1988) suggested 0.02, 0.15 and 0.35 as operational definitions of small, medium and large effect size respectively. The f^2 of the performance of CSO is 0.032, while the f^2 of performance of USO is 0.077. Thus, the technological resources and the technology strategy prove to have a substantial effect on the performance of CSO and USO.

The relationship between the technological resources and the technology strategy

In hypothesis 5a we predicted a positive and significant relationship between the internal R&D sources and the scope of the technology. In case of USO, we found a path coefficient of 0.1821 ($p< 0.05$), indicating strong support for this hypothesis. Surprisingly, in case of CSO we found a negative, but highly significant relationship between the internal R&D sources and the scope of technology (path coefficient of -0.3077, $p< 0.01$). In hypothesis 5b predicted a positive and significant relationship between the internal R&D sources and the newness of the technology. In case of USO, strong support was found (path coefficient of 0.2898, $p< 0.01$). In case of CSO, no significant result was found.

Hypothesis 6a and 6b predicted a positive and significant relationship between the collaboration in R&D consortia and the scope and newness of technology. In both cases, we found strong support for the hypotheses with path coefficients of 0.3197 ($p<0.01$) and 0.2113 ($p<0.05$) in case of CSO, and path coefficients of 0.2963 ($p<0.01$) and 0.1865 ($p<0.01$) in case of USO.

In hypothesis 7a we predicted a positive and significant relationship between the transfer of technology from the parent and the scope of technology. For the sample of CSO, we found strong support for this hypothesis with a path coefficient of 0.5558 ($p<0.01$). However, in case of USO, we found no support for this hypothesis. For hypothesis 7b, in which we predicted a positive and significant relationship between the transfer of technology from the parent and the newness of technology, we found strong support for both groups of spin-offs. In the sample of CSO, we found a path coefficient of 0.4204, at a significance level of $p<0.01$. The USO sample has a path coefficient of 0.5168 that was significant at $p<0.01$.

Hypothesis 8a predicted a negative and significant relationship between the transfer of production knowledge from the parent and the scope of technology. In case of CSO, this hypothesis was supported with a path coefficient of -0.3045 ($p<0.05$). The hypothesis was not supported in the sample of USO. Hypothesis 8b predicted a negative and significant relationship between the transfer of production knowledge from the parent and the newness of technology. In both groups of spin-offs, the hypothesis was not supported.

The relationship between the technology strategy and performance

In hypothesis 11, we predicted a positive and significant relationship between the scope of technology and performance. In the case of CSO, this hypothesis is not confirmed as the path coefficient is -0.1856 at a significance level of 0.10. We found a significant, but negative relationship between the scope of technology and performance for the sample of CSO. Hypothesis 11 was strongly supported in the case of USO, with a path coefficient of 0.2716 ($p<0.01$).

Hypothesis 12 predicted a positive and significant relationship between the newness of technology and performance. For the group of CSO, this hypothesis was confirmed with a path coefficient of 0.2327 ($p<0.10$). However, this hypothesis was not confirmed for the group of USO as the path coefficient is -0.1514 at a significance level of 0.10. We found a significant, but negative relationship between the newness of technology and performance for the sample of USO.

6.2.3.3 Technology Strategy of CSO and USO

We have also formulated hypotheses concerning the technology strategy followed by CSO and USO. In hypothesis 9 and 10 we predicted that USO will have a broader scope of technology and a higher level of newness of technology than CSO. Table 23 contains the descriptive statistics of the technology strategy variables.

	Minimum	Maximum	Mean CSO	Mean USO	Std. Deviation CSO	Std. Deviation USO
Scope of technology TechScopeFounding	1	5	3.18	3.40	1.752	1.637
Newness of technology Know1New	1	5	3.20	3.05	1.400	1.386
Newness of technology KnowSynthesis	1	7	2.88	2.58	1.364	1.379
Newness of technology Tacit	1	5	3.82	3.52	1.740	1.881

Table 23: Descriptive statistics of the technology strategy of CSO and USO

Next, we performed a Mann-Whitney U-test to examine if the technology strategy of CSO and USO is significantly different. Table 24 shows that CSO and USO do not differ significantly in their technology strategy. Our hypotheses are not confirmed.

	TechScopeFounding	Tacit	Know1New	KnowSynthesis
Mann-Whitney U	1209.000	783.000	1249.000	1156.000
Wilcoxon W	2029.000	2268.000	3394.000	3301.000
Z	-0.627	-0.960	-0.554	-1.175
Asymp. Sig. (2-tailed)	0.530	0.337	0.580	0.240

Table 24: Mann-Whitney U-test for the technology strategy of CSO and USO

6.3 Performance of CSO and USO

Our last hypothesis predicted that USO would have a higher performance than CSO. Table 25 gives an overview of the descriptive statistics of the performance of CSO and USO.

		Mean	Median	Std. Deviation	Min	Max
Annual Growth in Revenue	CSO	550576.056	190476.190	1131079.931	-105217.391	6336142.000
	USO	292139.810	82191.781	606102.691	-109090.909	3500000.000
Annual Growth in Employees	CSO	2.932	1.153	5.078	-5.000	18.000
	USO	3.115	1.350	4.758	-6.000	19.377

Table 25: Descriptive statistics of the performance of CSO and USO

Table 26 shows the results of the Mann-Whitney U-test. We can see that the annual growth in revenue differ significantly for both groups of spin-offs. CSO have an annual growth rate that is significantly higher than that of USO. The annual growth in employees of CSO and USO does not differ significantly, although the descriptive statistics do indicate that USO tend to grow slightly faster in employees. These results contradict our hypothesis.

	Annual Growth in Revenue	Annual Growth in Employees
Mann-Whitney U	1224.000	1598.000
Wilcoxon W	3639.000	2726.000
Z	-1.905	-0.511
Asymp. Sig. (2-tailed)	0.057	0.609

Table 26: Mann-Whitney U-test for the performance of CSO and USO

6.4 Summary of the Results

The results of the hypotheses tests of this study is summarized in Table 27. Hypotheses 1, 2 and 3 were supported, indicating that USO have more technological resources than CSO. Only hypothesis 4 on the transfer of production knowledge, was not supported. We found mixed support for hypotheses 5a till 8b. Moreover, we also found differences in support for the two groups of spin-offs. We found no support for hypothesis 9 and 10, implying that the technology strategy of CSO and USO does not differ significantly. Contrary to hypothesis 11, the scope of technology was negatively associated with performance for the group of CSO. Hypothesis 12 was supported in case of CSO. Interestingly, we found that in the case of USO, hypothesis 11 was supported, while for hypothesis 12 the newness of technology was negatively associated with performance. Finally, hypothesis 13 was not supported. The results are discussed more in-depth in Chapter 7.

Hypothesis	Description	Results	
		CSO	USO
1	USO will have more internal R&D sources than CSO	Supported	
2	USO will have more collaboration in R&D consortia than CSO	Supported	
3	Technology transfer from the parent will be more prevalent in the case of USO than CSO	Supported	
4	The transfer of production knowledge will be higher in case of a CSO than a USO	Not supported	
5a	A high amount of internal R&D sources is positively associated with a broad scope of technology	Not supported: contrasting result	Supported
5b	A high amount of internal R&D sources is positively associated with a high level of newness of technology	Not supported	Supported
6a	Collaboration in R&D consortia will be positively associated with a broader scope of technology	Supported	Supported
6b	Collaboration in R&D consortia will be positively associated with a high level of newness of technology	Supported	Supported
7a	Transfer of technology from the parent is positively associated with a broad scope of technology	Supported	Not supported
7b	Transfer of technology from the parent is positively associated with a high level of newness of technology	Supported	Supported
8a	Transfer of production knowledge from the parent is negatively associated with a broad scope of technology	Supported	Not supported
8b	Transfer of production knowledge from the parent is negatively associated with a high level of newness of technology	Not supported	Not supported
9	USO will have a broader scope of technology than CSO	Not supported	
10	USO will have a higher level of newness of technology than CSO	Not supported	
11	A broad scope of technology will be positively associated with performance	Not supported: contrasting result	Supported
12	A high level of newness of technology will be positively associated with performance	Supported	Not supported: contrasting result
13	USO will have a higher performance than CSO	Not supported	

Table 27: Summary of the results

7 CONCLUSION

This dissertation has sought to shed light on the group of corporate spin-offs (CSO). We have developed a model of antecedents and characteristics of corporate spin-offs by identifying the key dimensions that contribute to the performance of CSO. Next, we have empirically tested the relationship between technological resources, technology strategy and performance. In this chapter, the results of this study and their implications for theory and practice are discussed. Also the limitations of the study are presented.

7.1 Discussion of the Empirical Results

One of the fundamental tenets of the resource-based view is that competitive advantage stems from resource heterogeneity between firms and from the sustainability of this heterogeneity over time (Ahuja & Katila, 2004; Barney, 1991; Helfat, 1994). The aim of this empirical study was to explore the relationship between the technological resources, the technology strategy and performance of CSO and USO. We expect to observe differences in this relationship for CSO and USO, due to the fact that they originate from different types of parent organizations and therefore will count on different resources. After all, intimate knowledge about technology and markets is being transferred across organizations from a parent to a spin-off. When employees leave to start new ventures, they walk out with tacit knowledge. This initial stock of inherited knowledge (Huber, 1991) is likely to have long-term effects on a spin-off. We formulated several hypotheses which will be discussed more in-depth in the following paragraphs.

7.1.1 Technological Resources of CSO and USO

Our first hypotheses centered on whether there are differences in the technological resources of CSO and USO. Empirical evidence shows that CSO and USO do indeed differ in their technological resources. Hypotheses 1 to 3 are confirmed, USO have more internal R&D sources, they collaborate more in R&D consortia, and they transfer more technology from their parent than CSO. The fact that USO have more technological resources than CSO suggest that it might be easier for USO to transfer the technological resources from their parent universities. Indeed, USO are often supported by their parent university to

commercialize their technologies. Some CSO especially restructuring-driven spin-offs, also receive support from their parent company, but entrepreneurial spin-offs often do not. This might make it more difficult to transfer technological resources. Hypothesis 4 predicted that the transfer of production knowledge would be higher in case of a CSO than a USO. This hypothesis was not supported. Contrary to expectations, the CSO in our sample did not transfer a large amount of production knowledge. A possible explanation is that CSO may prefer not to transfer a large amount of production knowledge to make sure that the spin-off is not hindered in coming up with new, innovative solutions.

7.1.2 Relationship between Technological Resources and Technology Strategy

A fundamental premise of strategic management theory is that differing resources may lead to the selection of different strategies (Barney, 1991). Specific hypotheses regarding the relationship between technological resources and technology strategy are developed. Hypotheses 5a and 5b predicted a positive and significant relationship between the internal R&D sources and the scope and newness of technology. In case of USO, both hypotheses are supported. However, in case of CSO, the hypotheses are not supported. For CSO, the relationship between internal R&D sources and the newness of technology is not significant, while the relationship between internal R&D sources and the scope of technology is significant but negative. A possible explanation may be that CSO are often set up in anticipation of a market opportunity. In order to respond to this market opportunity, specific technologies need to be developed. A high amount of internal R&D sources may allow a more focused approach to rapidly develop these specific technologies, hereby promoting a more narrow scope of technology.

Hypotheses 6a and 6b predicted a positive and significant relationship between the collaboration in R&D consortia and the scope and newness of technology. Both in case of CSO and USO, the hypotheses were confirmed. Collaborating with universities and other companies is positively related to the technology strategy of spin-off companies. Collaboration projects offer possibilities to work on different aspects of technology, and hereby entail the possibility of broadening the scope and increasing the level of newness of technology. This finding conforms to Zahra's study (1996a) who also found that the use of external technology sources is well justified.

Hypotheses 7a and 7b predicted a positive and significant relationship between the transfer of technology from the parent and the scope and newness of technology. The transfer

of technological skills leads to knowledge and expertise in certain technological domains. If the founders of the spin-off transfer a lot of technology skills to the spin-off, this can allow them to focus their technology around certain assets and further build on the skills being transferred. In case of CSO, these hypotheses are confirmed. In case of USO, the transfer of technology has a very significant and positive relationship with the newness of technology. However, it has no significant relationship with the scope of technology. An explanation can be found in the fact that technology that is being transferred from universities can be two-fold. On the one hand, it can be a broad technology platform on which researchers have been working. In this case, the USO might be set up with the goal of developing several products from this platform. On the other hand, research at universities may also be focused on a very specific niche technology. In case the knowledge of this niche technology is being transferred to a USO, a huge transfer of technology may take place, while the scope of technology will be rather narrow.

Hypotheses 8a and 8b predicted a negative and significant relationship between the transfer of production knowledge from the parent and the scope and newness of technology. Weak support is found for the relationship between the transfer of production knowledge and the technology strategy. For the sample of CSO, we only found support for the relationship between the transfer of production knowledge from the parent and the scope of technology. This relationship proved to be significant and negative, as predicted. In the case of USO, we found no support for the hypotheses. This may be explained by the fact that universities are organizations where typically production know-how plays a much smaller role than in the case of CSOs.

7.1.3 Relationship between Technology Strategy and Performance

The effect of originating from a parent organization may influence the spin-off beyond formation, as the transfer of rules, routines, and procedures from parent to progeny organizations can both constrain and empower the spin-off (Brittain & Freeman, 1986; Romanelli, 1991). USO and CSO follow a different trajectory before they are spun off and the motivation to create the spin-off often differs. The most straightforward way for a university to commercialize its technology is through licenses to existing companies (Shane, 2004). Several academic studies show that radical technologies tend to provide the basis for the creation of university spin-offs, while incremental technologies are more likely to be licensed by established companies. Most USO are brought to the market under a technology

push. Established firms are typically less involved in performing fundamental research. Therefore, CSO are more likely to be created to commercialize incremental technologies. Moreover, CSO are often created in response to a market opportunity.

Hypothesis 11 predicted a positive and significant relationship between the scope of technology and performance, while hypothesis 12 predicted a positive and significant relationship between the newness of technology and performance. In contrast to the expectations, the scope of technology is negatively associated with performance for CSO. The results did support hypothesis 12; we found a positive and significant relationship between the newness of technology and performance for the sample of CSO. When we look at the results of the USO sample, we see that hypothesis 11 is supported, but that in this case the newness of technology is negatively associated with performance. An explanation may be found in the organizational origin of the spin-off companies.

Spin-offs inherit general technical knowledge from their parents that shapes their nature at birth (Klepper & Sleeper, 2005). Universities are often occupied by performing research that is on the leading edge of technology. When a USO is created, often the technology still needs considerable development time in order to turn the technology into a market-ready product. University inventions are typically quite embryonic and high risk (Shane, 2004). A strategy of a high level of newness of technology in combination with a radical technology may lead to long development times. Moreover, the market for this technology may not yet be ready or even exist. This may explain the negative relationship between the newness of technology and performance in the case of USO.

Researchers working at universities often have little business experience. They frequently start developing specific products based on the technology without probing to the market needs. Later on, they sometimes come to the conclusion that the product is not well adjusted to the customer's needs or that the market is not yet ready. Therefore, in case of USO, it might be better to keep a broader scope of technology and to develop several products at the same time. A broad platform of technology allows USO to change market application in case the first application they pursue turns out to be a dead end (Tornatzky et al., 1995). Moreover, it heighten the chances that some products may be brought on the market at several points in time: some in the short term, others in the medium term, and still others in the long term (Nelson, 1991). This may explain the positive relationship between the scope of technology and performance in the case of USO.

Established firms are seldom occupied by performing research on the leading edge of the field. Most of the time, their research activities are more short term focused and related to

the customer and market needs. The founders of CSO often have business experience and are more experienced in addressing customer needs. Therefore, it might be beneficial for them to focus on few specific products since they can position them better in the market. CSO experience less the necessity to keep a broad scope of technologies. They seem to be capable of selecting the right market applications. Developing a broad scope of technology may only delay the CSO in getting its products on the market. This may explain the negative relationship between the scope of technology and performance in the case of CSO.

Abetti (2002) found that the best strategy for a CSO is to practice technological innovations that attack new market niches where the parent lacks core competencies or is uninterested. CSO need to be able to differentiate themselves from their parent firm in order to succeed (Klepper & Sleeper, 2005). The similarities can not remain too high. Therefore, a certain degree of newness of technology is required. This may explain the positive relationship between the newness of technology and performance for CSO.

The results of hypothesis 11 and 12 reinforce the importance of the organizational origin. The initial inheritance of CSO and USO play a major role in the effect its technology strategy has on performance. CSO originate from a business environment, which is more focused on applied technologies. USO on the other hand originates from universities which are more focused on basic research and radical technologies. Therefore, the initial stage of the technology the CSO and USO start with often differs. An average, a USO start with a technology that is more radical than the technology of a CSO. Consequently, if USO choose a high level of newness, it will probably take a long time before any products can be brought to the market. In the case of a USO, a high level of newness might not be the best choice to create revenues during the first years of existence. However, if CSO choose a high level of newness, this may have advantages for them since they start with a more incremental technology. A higher level of newness might help to differentiate themselves from their parent firm and acquire their own market niche. CSO need to differentiate themselves from their parents in order to succeed (Klepper & Sleeper, 2005). A broad scope of technology may imply that the USO has more potential to develop a least some technologies that can be commercialized. In case of CSO, the technologies are already more adapted to the market needs, which implies that it might be more efficient to focus on a few products and thus have a more narrow scope of technology.

7.1.4 Technology Strategy of CSO and USO

Hypothesis 9 predicted that USO will have a broader scope of technology than CSO, while hypothesis 10 predicted that USO will have a higher level of newness of technology than CSO. Both hypotheses were not supported, no significant difference was found. The previous working environment has an influence on the technological resources and strategy of spin-offs and the transfer of routines and culture from the parent organization (Phillips, 2002). The results suggest that even if CSO and USO select the same technology strategy, the execution of this strategy will differ due to the differences in resource inheritance. In case CSO and USO choose the same technology strategy; e.g., a broad scope of technology and a high level of newness of technology, this technology strategy will have a different relationship with performance. This may explain why we found no significant difference between the technology strategy of CSO and USO.

7.1.5 Performance of CSO and USO

Zahra and Covin (1993) have underscored the importance of a company's technology strategy for achieving superior performance. Hypothesis 13 predicted that USO will have a higher performance than CSO. This hypothesis was not supported. The annual growth in revenues is significantly higher for CSO than for USO. The annual growth in employees did not differ significantly for CSO and USO, but the descriptive statistics did indicate that USO tend to grow slightly faster in employees. Our results are in line with Lindholm (2001) who found that CSO outperform USO in terms of revenue growth. However, our results contradict those found by Zahra et al., (2006) who concluded that USO experienced significantly higher revenue growth rates than CSO. In an earlier study, Lindholm (1997b) found that CSO demonstrate a higher growth in employment than USO, which also contradicts our findings. The corporate spin-offs in our sample have an average employment growth of 2.93% which is lower than the average employment growth of at least 8% found at a European level. A possible explanation might be found in the fact that the average age of the Flemish CSO is 6 years, compared to the average of 22 years in the European study.

Based upon the technology strategy CSO and USO follow, we predicted that USO would have a higher performance than CSO. However, a technology strategy of a broad scope and a high level of newness is likely to take a longer period of time before being able to generate revenues, especially in the case of USO, who tend to start with a radical technology. The average age of USO in our sample is 5 years, which may be too short to reap

the benefits of following such a technology strategy. CSO on the other hand tend to be set up in response to a market opportunity. Their strategy proves to be more successful in order to realize growth in revenues during the first years of existence. Moreover, corporate spin-offs are likely to bring in routines and processes and links with customers that enable them to better overcome liabilities of newness (Phillips, 2002). In addition to having technological and marketing knowledge, corporate spin-off founders are likely to benefit from their previous employer's contacts and from network ties (Higgins & Gulati, 2003).

Our findings support the contingency perspective that posits that the technology strategy should be set in conjunction with the technological resources in order to achieve a competitive advantage. It is the unique exploitation of resources through appropriate strategies that yields the productive value for the firm (Penrose, 1959; Edelman et al., 2005). The imprinting effect of technological resources can affect performance over time. It is the internal co-alignment between technological resources and technology strategy that drives the performance of spin-off companies.

7.1.6 Influence of the Control Variables

The control variables we included in this study are (1) the age of the spin-off; (2) the experience of the founding team; (3) the start capital of the spin-off; (4) the size of the spin-off; and (5) the industry sector of the spin-off. In all scenarios, age has a significant and positive relationship with performance. This result is in line with expectations. The older the spin-offs are, the more time they have had to develop their technology, to identify customers, to bring their products on the market and consequently generate revenues. A spin-offs' focus on technology commercialization is expected to increase as they approached adolescence. Moreover, as they age, spin-offs are expected to become less similar from their parent organization, leading to a greater diversity in the innovations they pursue and consequently leading to higher performance (Klepper, 2001).

An interesting finding is the fact that start capital has a very strong and significant relationship with the performance of USO, while the relationship between start capital and performance is not significant for CSO. It makes sense that start capital is very influential for the performance of USO, since USO tend to focus on radical technology, which often takes a long time to develop. In order to bridge this development time, a large amount of start capital may prove to be of vital importance. Start capital may be less important for CSO, since they

tend to focus on technologies which can be brought faster to the market. This allows them to generate revenues more rapidly.

We also considered the size of the founding team. Although Eisenhardt & Schoonhoven (1990) found that the size of the founding team influences the performance of new firms, we only found a significant relationship between the size of the founding team and performance for USO in the full model. We also took the experience of the founding team in consideration. Klepper (2001) found that the main reason a number of new firms became leaders of their industry appears to have been due to the backgrounds of their founders. Having founders with industry experience had enduring effects on firm performance, suggesting that founders of new firms left strong imprints on their organizations (Klepper, 2002). In the case of CSO, experience has a significant and positive relationship with performance. However, experience has no significant relationship with the performance of USO.

An explanation can be found in the background and previous working experience of the founders of CSO and USO. Founders of USO tend to be individuals from within the university community, who have usually worked for the university on a research project for several years before founding the spin-off. While working on these research projects, they enhanced their technical experience. In most cases, the heart of these researchers in really located on the technical side and consequently they possess little business experience. In contrast, the founders of CSO have been less focused on performing fundamental research and more focused on performing applied research in a more commercial environment. Therefore, the founders of CSO often understand better the pressure to take their technologies quickly to the market and the necessity to have commercial experience to guide this process. CSO managers are likely to have better and more extensive marketing expertise due to their previous working experience. Moreover, CSO founders and managers may also be better connected to other companies' networks which may allow them to draw formally and informally upon market expertise or even hiring consultants or other professionals to lead or manage these activities. Having experience in bringing products to the market and in transforming technologies into market-ready products can be really important for the survival of a spin-off.

From Table 8 and Table 9 we can conclude that the founding team of USO on average has less business experience and more technical experience than CSO. The fact that the founding team of USO in our sample does not possess a lot of business experience may be responsible for its low impact on performance. An alternative explanation may be that since

USO often commercialize a technology that is radical, this technology needs quite some development time before being brought to the market. Therefore, business experience is of less importance since the technology is too immature to start developing potential market applications.

7.2 Theoretical and Empirical Contributions of the Dissertation

Several new ventures have contributed significantly to the national economy (Cooper 1993). This has inspired researchers to identify the key determinants of their performance (Carter et al., 1994; Chandler & Hanks 1994; McDougall et al., 1992). In this study, we have focused on a specific group of new ventures namely the group of corporate spin-offs. First, we have performed an extensive literature study on CSO, since the literature on CSO infrequently builds upon one another, with little efforts at accumulation. In order to gain insight into the key dimensions that contribute to the performance of CSO, we have designed a model of antecedents and characteristics of CSO.

Technology's growing importance in determining success in today's marketplace has been widely recognized in the literature (Zahra, 1996a). In one industry after another, companies have used their technologies to create an enduring competitive advantage by offering new products or utilizing new processes, revising the rules of competition, or redrawing their industry's boundaries (Utterback 1994). Whether founded by entrepreneurs or established corporations, spin-offs consider technological innovation their lifeblood (Acs and Audretsch, 1990) and use their technological resources to create a competitive advantage (Ng, Pearson & Ball, 1992). Developing new technologies, even breakthrough ones, is rarely sufficient to survive and achieve market success (McGrath 1994). New ventures, therefore, need also to employ effective technological strategies that allow them to financially benefit from their innovations (McGee, Dowling, and Meggison 1995). In his study, Zahra (1996a) found that the payoff from technology strategy dimensions varies from one environment to the other. We have extended this argument by stating that the payoff from technology strategy dimensions also varies according to the inheritance from the parent institute.

Success in today's competitive environment requires a company to pursue a coherent technology strategy to articulate its plans to develop, acquire, and deploy technological resources to achieve superior financial performance (Zahra, 1996a). There must be a fit between the resources and the strategy that the spin-off follow (as well as for any type of

firm) in order to achieve a competitive advantage. Strategies must be established by taking into account the resources that the firm possesses to have a positive impact on performance. Most spin-offs have resource constraints that might influence their technology strategy choices. Zahra (1996b) found that independent ventures and corporate ventures follow different paths in their technology strategy to achieve success. This study contributes to the literature by demonstrating that CSO and USO need to follow different strategies in order to achieve a competitive advantage. The same choice of technology strategy has a different impact on performance for CSO and USO due to the fact that they start with different technological resources because of their inheritance.

Previous studies have focused mostly on the characteristics of a single group of spin-offs (e.g., USO or CSO). Few studies have examined the two groups together, making it difficult to explore the differences between CSO and USO. Our results indicate that it is opportune for CSO to have a high level of newness of technology. This allows them to distinguish themselves from their parent firm. It is beneficial for them to have a rather narrow scope of technology. CSO tend to be aware of the market needs and therefore it is more interesting for them to focus on a few technologies and to bring these to the market. USO on the other hand, tend to profit more from a lower level of newness of technology and a broader scope of technology. This may be explained by the fact that USO usually start with a more radical, leading edge technology. It often takes longer to transform a radical technology into a market ready product. Therefore, a large amount of start capital is necessary to bridge this period of time. USO also need a broader scope of technology. Due to their limited market experience, their technological developments are less market oriented. A broader scope of technology heighten the chances that one of the technologies will be suited to be transformed more quickly into a product that addresses customer needs.

The findings of this study contribute to the resource-based view of the firm literature. Following this view, the starting point in creating a competitive advantage is to identify the firm's resources. Next, a company should determine its strategy by determining which of its resources surpasses those of the competition as well as what the company does better than its rivals. In other words, it is argued that a firm's strategies in conjunction with the firm's resource base determine firm performance (Barney & Zajac, 1994). In this disseration, we have explored the relationship between the technological resources, the technology strategy and performance. We have created additional insights into the co-alignment between technological resources and technology strategy in order to achieve firm performance. Our work contributes to the development of the internal contingency perspective by suggesting

that resource bundles when appropriately channeled through strategic choices, determine firm performance (Venkatraman and Camillus, 1984).

The findings of this study also contribute to the organizational sociology literature and the institutional theory literature. Corporate and university spin-offs are unique in that they originate from a larger parent institute. Organizational sociologists have long considered the effects of the transfer of resources and routines from old to new organizations (Phillips, 2002). They have attempted to establish a framework for understanding new organizations as the progeny of parent organizations. Models and metaphors from biological evolution are increasingly being used in the analysis of organizations (Aldrich 1999), business strategy (Barnett and Burgelman 1996), and industrial competition (Nelson 1995). Studies have posited that some amount of a parent organization's "blueprint" would carry over to the new organization through the experiences of the founders of the spin-off companies (Hannan & Freeman, 1986; Romanelli, 1991). Spin-offs inherit general technical and market-related knowledge from their parents that shape their nature at birth (Klepper & Sleeper, 2005). Yet, some areas remain underdeveloped. While past efforts have emphasized the source of progeny, there have been few attempts to assess empirically the consequences of transferring resources and routines from parent organizations to their progeny. In our study, we consider the transfer of technology and production knowledge from the parent to the spin-off and its relationship with technology strategy and performance.

7.3 Managerial Implications

This study is particularly interesting for founders of CSO and USO. Our results give insights into the relationship between the technological resources, the technology strategy and performance. If the founders of a USO wish to commercialize a radical, new-to-the-world technology, they should take into account that it will probably take several years before they will be able to generate any revenues. Therefore, they will need sufficient start capital in order to bridge this period of time. Founders of CSO on the other hand, need to take into account that they need to differentiate their technology and products from their parent in order to survive; e.g., a CSO in our sample stayed in the same technological area and competed against its parent. After a few years, the CSO went bankrupt since the parent firm outperformed them. Our results indicate that on average, CSO tend to perform well. This implies that when employees of established firms spot an opportunity, they should not be

afraid to pursue that opportunity since chances are high that they will develop this opportunity into a successful business.

The insights of this study can be useful for technology transfer officers at universities or managers of incubator centers. Our study sheds light on the relationship between technological resources, technology strategy and performance. This might help technology transfer officers to decide which technological resources they will provide the CSO or USO, since they now better understand the impact the availability of certain technological resources may have on the spin-off's strategy and performance. Moreover, the insights of our study will allow them to defend to their board of directors why certain USO or CSO will take several years to become profitable or why they gave away certain technological resources.

Established firms often face difficulties in commercializing radical technological innovations. In order to commercialize these radical technologies, often unfamiliar roads have to be taken by the parent firm. This frequently leads to discussions between the manager of the radical project and the management team of the established firm. Therefore, established firms have tried to find solutions by setting up incubators, opening research centers who are removed from the traditional activities. Another option, which is less explored by established firms, is to create a corporate spin-off to commercialize this radical technology. CSO can be an ideal solution to commercialize a radical technology. On the one hand, the CSO has the freedom to walk on certain paths and to try out several options. On the other hand, the CSO inherit the routines and cultures of their parent firm, which might make it easier to reintegrate the CSO after a few years, once the technology has been proven.

7.4 Limitations of the Study

Several limitations exist in terms of the generalizability and interpretation of the results of this dissertation. First, the sample was taken from one region e.g. Flanders. Our focus on this small geographic area allows us to reduce the influence of non-measured variance and culturally induced variation. The trade-off, however, is that one might question the external validity of this region and our findings. However, we have little reason to believe that the Flemish region would not be comparable to most emerging and developing high technology regions.

A second limitation of this study is that we collected data solely from CSO and USO. It might have been interesting to also collect data at the parent organizations. This would allow

to test the direct impact of the parent on the transfer of technology and production knowledge. Moreover, it could be interesting to see the impact the parent has on the technology strategy in case the parent continues to have a formal relationship with the spin-off e.g. through a seat in the board of directors. Future research might benefit form collecting data from both sides; however, such an approach is very difficult and time-consuming to execute.

Although this study has speculated on the causal relationships among the constructs, the cross-sectional design of this study prevents direct tests of causality. The direction of the relationships cannot be empirically verified in this study. Therefore, it is possible that relationships may take place in the opposite direction. In future research, the data of this study can be used as a starting point to compile a longitudinal dataset to address the issues of causality, and to explore the dynamics of the relationship between technological resources and technology strategy.

We found that CSO demonstrate higher performance than USO. However, our data does not allow us to look at the effectiveness of the technology strategy on a long term. We feel at least 10 to 15 years should be bridged before we can make a judgment on the effectiveness of choosing a technology strategy of a broad scope and a high level of newness of technology. The average age of the USO in our dataset (e.g., 5 years) is too young to test the full effect of such a technology strategy. It might be that USO that do succeed in commercializing this strategy become very profitable and solid companies. Future research might create more clarity in this issue.

Understanding the factors that determine the success and long-term performance of CSO and USO is an important topic of discussion in the literature. Potential factors relate to the history, external environment, management, resources, networks and capabilities of these spin-offs (Zahra et al., 2006). The theoretical framework developed in this dissertation has attempted to incorporate all factors that influence the performance of CSO. Now that a deeper insight is created in the relationship between technological resources, technology strategy and performance, future research might consider testing the complete theoretical framework by including environmental variables and considering the parent-spin-off relationship.

8 FUTURE RESEARCH AREAS

The findings of this dissertation suggest several additional avenues for future study. First of all, it would be interesting to further examine the relationship between the CSO/USO and its parent. Second, a longitudinal study that tracks the changes in technology strategy over time, will add to our understanding of the dynamics of the technology strategy of spin-off companies. Third, this study has concentrated on the formal technology strategy. Future research might instead benefit from emphasizing the informal technology strategy. Fourth, more work is needed on the role of spin-offs in an open innovation setting. Finally, more attention should be devoted to capture the regional differences in samples.

8.1 Relationship Parent –CSO/USO

Oakey (1995) has argued that two major sources of new high-technology firms are higher-education institutions and well-established industrial firms. In this dissertation, we have focused on corporate and university spin-offs. Corporate and university spin-offs are unique in the sense that they originate from a larger parent institute e.g. an established firm, a university or a research institute. The effect of originating from a parent may influence the spin-off beyond formation, as the transfer of rules, routines, and procedures from parent to progeny organizations can both constrain and empower the spin-off (Brittain & Freeman, 1986; Romanelli, 1991). These transfers may include unique insights and decision rules used to transform resources into action (Prahalad & Bettis, 1986), cognitive dimensions of competency (Fiol, 1991), and specific knowledge and information (Boeker, 1997). Since "what an organization knows at its birth will determine what it searches for, what it experiences, and how it interprets what it encounters" (Huber, 1991), one implication is that a spin-off's capability accumulation may be linked to its inherited knowledge and that the agent of transfer may have an impact on the efficacy of transfer.

In this study, we have collected data from the CSO and USO companies, but not from the parent institutions. Collecting data at the parent institutions would allow to examine the relationship between the parent and the CSO/USO company more closely. In future research, it would be interesting to examine the influence of originating from a parent on the performance of the spin-off. Potential research questions are: What is the role of the parent in creating the spin-off? In case of active support from the parent, is there a more efficient

transfer of technology, know-how and IP rights to the spin-off? Or is active support from the parent rather constraining in creating the spin-off? An equity ownership by the parent may give a strong signal of involvement and potential access to resources, but under which conditions is equity ownership by the parent beneficial for the spin-off?

Moreover, collecting data at the parent institution may allow to take the characteristics of the parent firm into account. E.g. are large companies/universities better than small ones in generating successful spin-offs? Is the experience of the parent in spinning off firms an important determinant for their success? What is the impact of the motivation of a parent to create a CSO/USO on the technology strategy and performance of a CSO/USO? Collecting data from both the parent institutions and the spin-offs may be useful in answering these questions.

8.2 Dynamics of Technology Strategy

Spin-offs tend to operate in dynamic environments where customer tastes, product-service technologies and competitive weapons often change unpredictably. As a consequence, they can not build their strategy based on a detailed competitive analysis. They will rather have to rely on strategic alliances and pre-commitments from stakeholders as a way to reduce and/or eliminate uncertainty and to erect entry barriers. This assumes a dynamic decision making environment which implies that the technology strategy will change over time. Moreover, technology strategies must be set in conjunction with the resources the spin-offs possess, in order to achieve a competitive advantage. These resources also change during the lifetime of the spin-off.

In this study, we have looked into the technological resources and technology strategy at founding and we have examined their relationship with the short term performance of spin-off companies. We have chosen to look at short term performance, since technology strategy is likely to make a difference on short term performance. Long term, successful (or even poor) performance may cause companies to alter their strategies which would, later, influence performance. CSO and USO use their technological resources and their technology strategy to make profits. These profits may allow them to do more R&D or expand their product offering which can improve their performance later. This is an ongoing cycle. In future research, the data of this study can be used as a starting point to compile a longitudinal dataset that will allow to examine the technology strategy of spin-offs on a longitudinal basis.

Potential research questions are: How do spin-offs change their technology strategy in accordance to the industry there are operating in? What triggers a change in technology strategy?

In a longitudinal study, one could examine how companies approach and organize alliances in order to further develop new technologies or to approach new markets. Alliances have become an increasingly popular mechanism to supplement and complement a firm's internal R&D efforts (Hagedoorn, 2002). While alliances have been mainly used as a mechanism to enter new/foreign markets in the past (Doz & Hamel, 1997), they are now increasingly applied as organizational structures to explore new technologies/products and/or improve existing technologies/products (Koza & Lewin, 1998). A longitudinal dataset would also allow to examine how CSO and USO build up their reputation and compete to create the next technology standard.

8.3 Formal/Informal Technology Strategy

In this study, technology strategy was captured by two dimensions: scope and newness of technology. The scope of a technology refers to the choice between focusing on a platform technology or a specific technology. The newness of technology refers to the innovativeness (intellectual component) and uniqueness (tacit component) of the technology. These two dimensions are part of the formal technology strategy. An interesting area for future research would be to also consider the informal technology strategy. This would allow to include knowledge conversion and learning effects.

The literature suggests that spin-offs often encounter great difficulties in transforming their technologies into products and goods that can be quickly commercialized (Roberts, 1991; Shane, 2004). Invention and discovery require different skills from those needed for successful technology commercialization. The spin-offs' ability to transform their discoveries (e.g. innovative technology) into products depends on their prior experiences. The corporate or university parent may transfer valuable experience, routines and procedures to their progeny spin-offs (Moray & Clarysse, 2005). CSO and USO need the competence to convert their technology into market ready products and services or more specifically, spin-offs need to develop a knowledge conversion capability. Knowledge conversion means envisioning, conceiving and articulating ways in which this knowledge can be used and then integrating and embedding this knowledge into new products, goods and services that create value. It is

not enough to possess technological knowledge, this knowledge must also be translated into products that customers need and value (Schoonhoven et al., 1990). It would be interesting to examine how CSO and USO apply their knowledge conversion capability as part of their technology strategy.

Another interesting venue for future research would be to expand the uniqueness of technology to include more information on the intellectual property rights. Since CSO and USO originate from a parent institute, a transfer of knowledge and technology is most likely to take place. Some spin-offs start with a formal transfer of technology from a university or corporation in the form of a license of a patent. Others may not have formal transfer agreements at their start-up phase. Gaining more insights into the difficulties CSO and USO experience in transferring technological knowledge to their companies can add to a better understanding of the development of their technology strategy, since the IP strategy of a company is part of its technology strategy.

8.4 Role of Corporate and University Spin-Offs in Open Innovation Models

The traditional model of innovation developed by large companies used to be characterized as the 'closed innovation' process. Innovation projects started as new ideas that emerged in the central R&D lab, and the best ones received additional development resources until a new product could be launched. It was a fully integrated innovation pipeline from basic scientific research to the development and commercialization of new products and businesses. In the last decade, an increasing number of large firms have abandoned the closed innovation system in favor of an open innovation model. More and more, large established firms tend to use more flexible innovation strategies in which they rely heavily on externally sourced technology (Chesbrough, 2003b). By combining resources and capabilities, companies using an open innovation model expand their individual resource base and can thereby develop new technologies and products/services beyond their reach. Open innovation redefines the boundary between the firm and its surrounding environment, making the firm more porous and embedded in loosely coupled networks of different actors, collectively and individually working together commercializing new knowledge.

Open Innovation has been considered so far from the perspective of large, technology user established firms (Chesbrough, 2003b). However, Open Innovation is also about

technology transactions between at least two actors (firms) and these transactions can only continue to take place when both parties can benefit from it. In future research, it would be interesting to explore in what way large established firms include corporate and university spin-offs in building their knowledge networks. Potential research questions are: While setting up open innovation models, do large established firms consider including corporate and university spin-offs? What is the role of these corporate and university spin-offs in open innovation models? What is the impact of open innovation models on the growth of corporate and university spin-offs? How can corporate and university spin-offs benefit from technology cooperation with large established firms? How can they avoid opportunistic behavior from the latter?

8.5 Regional Characteristics of the Sample

The sample of the study was taken from one region in Belgium, namely Flanders. By focusing on this small geographic area, non-measured variance is being reduced. However, this focus also includes some unique characteristics to the CSO and USO of this sample. In our sample of CSO, none of the CSO were the result of an active corporate venturing policy of the parent company. All CSO were set up in anticipation to a spotted opportunity. The reason for this is that there are almost no large established firms in Flanders that possess an active corporate venturing policy. The past few years, some established firms have started by creating a corporate venturing process, but in Flanders, no CSO have been spun off yet. Established firms tend to keep their CSO in this process for several years, before spinning them off. Therefore, it was not possible to examine the impact such an active corporate venturing process has on the technology strategy and performance of CSO. This situation may be very different in case a sample of CSO from the United States would be considered. In the US, several multinational firms have had an active corporate venturing process e.g. Xerox.

Also the USO sample has some unique characteristics. In Belgium, people tend to go to university after graduating from high school. It is no custom to first go to industry, start working for several years, and then come back to university to study. In contrary, only in rare exceptions do people come back from industry to start an education at the university. The same scenario is the case for doctoral students. Doctoral students tend to be hired a few months after graduating from university. This implies that most doctoral students do not

possess any business experience while performing their PhD. Consequently, in case these PhD students create a USO, they possess little business experience to transform their technologies into a market ready product. Again, this may be very different in case a sample of USO from the US would be considered. In the US, it is not that strange to quit your job at the age of 40 and to start a PhD. This implies that these people may possess an elaborate number of years of business experience.

In the past, researchers have had the tendency to homogenize their samples. Future research could benefit from considering the distinctive characteristics of certain regions. This would create more insight into the impact of certain factors unique to the region of the companies on the results obtained in several studies.

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APPENDIX

In our conclusion, we have posited that the initial stage of technology of USO is more radical than that of CSO. Consequently, due to a different inheritance, a similar technology strategy may have a different impact on performance. We performed an additional analysis to test our interpretation of the results. We considered the whole sample of CSO and USO, and added a dummy variable (1=CSO; 0=USO). The results from the PLS analysis confirm our interpretation.

	Performance
Scope->Performance	0.1604
Newness->Performance	-0.1629
Dummy*Scope->Performance	-0.3325*
Dummy*Newness->Performance	0.4415*
Age->Performance	0.2332***
Experience->Performance	0.1024
Start capital->Performance	0.4840***
Size->Performance	0.0931
Tech domain->Performance	-0.0081
R^2	0.3279

Table 28: Results of the PLS analysis (* p< 0.10, ** p< 0.05, *** p< 0.01)