NTNU – Trondheim
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The Relation Between Funding Sources and Growth for Research-Based Spin-Offs

A Case Study of 15 Energy-Related Start-Ups

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4. Bedømmelse

Kandidatene skal ha *individuell* bedømmelse
Kandidatene skal ha *felles* bedømmelse ☒

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Preface

This is a master thesis prepared as the final product in the course TIØ 4912 – Strategy and international business development. The authors are currently pursuing their degree in Industrial Economics and Technology Management at the Norwegian University of Science and Technology.

As an extension of a theoretical study the authors performed in autumn 2012, this master thesis is the result of an empirical case study of 15 energy-related start-ups originating from research. As the interviewees have given out sensitive information, the names of both interviewees and case companies are confidential. The companies are listed with letters A-O.

Several people have contributed to this thesis. The authors wish to a great extent to thank our academic advisor Roger Sørheim for invaluable and inspirational guidance. Additionally, the authors would like to express their gratitude to Einar Rasmussen at Bodø Graduate School of Business for sharing his research and insightful suggestions. The authors are thankful for the support provided by the Research Council of Norway (RCN), notably Mads Skjelstad who provided the authors with initial data from the FORNY program. Lastly, the authors wish to thank all the respondents from the selected case firms for valuable knowledge-sharing and the time set aside for us.

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Abstract

The important role that research-based spin-offs (RBSOs) plays in promoting economic growth and pushing technological development has been widely acknowledged. The main constraint this type of new venture faces is the difficulty to raise capital in the early stages of development. This thesis seeks to further investigate this challenge, and aims at exploring the impact of funding sources on the subsequent performance of RBSOs. Further, the paper examines how the entrepreneurs' perceptions and preferences influence the choice of funding sources. Moreover, the paper intends to map how the value-adding activities of each funding source can compensate for deficiencies in the entrepreneur's initial capabilities, and consequently investigate how this can impact the subsequent performance of RBSOs.

To achieve these objectives, an extensive literature study was performed, and further development of existing theory to suit the needs of the paper was accomplished. This resulted in the development of a typology of RBSOs, the specification of a comprehensible stage-model for RBSOs and a meticulous theoretical analysis of each funding sources. Together, these provided the necessary framework to compensate for the complexity surrounding RBSOs. Further, a secondary data collection was performed from a sample of FORNY-supported firms that were situated in the prominent Norwegian energy sector and started within the time frame 1995-2005. A representative selection of 15 firms was subsequently investigated through in-depth case interviews, granting the authors an extensive and comprehensive data foundation. Most importantly, this sample included both successful and unsuccessful firms, existing and discontinued firms, hence giving consistent output on subsequent performance of the case firms.

In light of the theoretical framework, an analysis of the empirical results was performed through the formulation of a conceptual scenario model of "best practice" for each type of RBSO. The analytical model indicated several more or less distinct patterns relating use of funding source at different stages to subsequent performance. Notably, some critical social resources needed to overcome critical junctures were identified for the different types of RBSOs. One important finding was that among the RBSOs that struggled to surpass the entrepreneurial commitment juncture, those that acquired external competence were shown to perform substantially better. Further, the previous experience and acquired competence of the entrepreneurial team was shown to greatly influence the choice of funding sources, and more experience led to higher acceptance towards private equity investors. Moreover, empirical evidence revealed a surprisingly high number of RBSOs that had an exquisite desire for independence and correspondingly low growth ambitions, a finding that led to an interesting debate around willingness to grow vis-à-vis actual performance of the RBSOs.

Sammendrag

Forskningsbaserte oppstartsbedrifter (RBSO) spiller en stor rolle i arbeidet med å skape økonomisk vekst og promotere teknologisk utvikling. Som en liten bedrift i en dynamisk kontekst er utfordringene mange og store. For mange er den største å skaffe tilgang til finansielle midler, spesielt i de tidligste utviklingsfasene. Denne masteroppgaven ønsker å drøfte nettopp denne utfordringen og vil utforske sammenhengen mellom bruk av ulike finansielle kilder og påfølgende ytelse til RBSOene. Samtidig vil forfatterne gjennom oppgaven se nærmere på holdninger gründere har og hvordan disse påvirker selve valget av finansieringsform. Videre forsøker oppgaven å finne sammenhenger mellom de ressursene som finnes i selskapet på oppstartstidspunktet og de som blir gjort tilgjengelige av finansielle tilbydere gjennom såkalte «verdiskapende aktiviteter», og se dette i sammenheng med den påfølgende ytelsen.

For å nå målene satt for oppgaven ble relevant litteratur nøye studert. Basert på dette ble det utviklet flere modeller tilpasset oppgavens målsetninger. Dette inkluderte både en typologi av RBSOer, en fasemodell over bedriftsutviklingen og en grundig analyse av tilgjengelige finansielle kilder. Til sammen utgjorde modellene et rammeverk tilpasset de dynamiske omgivelsene til RBSOer. Videre ble en empirisk case studie gjennomført basert på et utvalg av bedrifter som hadde fått støtte gjennom FORNY-programmet og som jobbet mot energibransjen. Et representativt utvalg på 15 bedrifter ble deretter analysert gjennom intervjuer og sekundærdata, hvilket ga forfatterne et bredt datagrunnlag. Dette utvalget inkluderte selskaper med ulik grad av suksess, og selskaper som både eksisterte eller som var oppløst.

Den empiriske analysen ble gjennomført med grunnlag i det teoretiske rammeverket og konseptuelle scenarier ble formulert for å finne en mulig «beste-praksis» for hver type RBSO. Denne analytiske modellen antydet flere mer eller mindre tydelige mønstre som relaterte valg av finansieringskilde i de ulike utviklingsfasene med bedriftens resultat. Spesielt tydelig viste det seg at enkelte ressurser var sentrale for å overkomme de kritiske holdepunktene og disse ble identifisert for hver type RBSO. Et viktig resultat var blant annet at de selskapene som kom seg forbi «gründer engasjement» holdepunktet ved å ansette ekstern kompetanse ble vist til å yte bedre. Videre viste det seg at gründerens erfaring påvirket valget av finansieringskilde i stor grad, der de med høyere erfaring valgte en bredere blanding av finansieringskilder og var generelt mer aksepterende til eksterne finansieringskilder. De empiriske resultatene viste også at en overraskende stor andel av selskapene hadde et bestemt ønske om å være uavhengige, noe som førte til en interessant debatt rundt vekstambisjon i forhold til påfølgende ytelse av disse RBSOene.

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1 Introduction

The creation of new firms to commercialize academic research has been acknowledged among scholars as an important mechanism to foster economic growth and answer future global challenges (Wright et al., 2007). However, in order to achieve this, a Research-Based Spin-Off (RBSO) has to overcome many obstacles. One of the main constraints this type of new venture faces is the difficulty to raise capital in the early stages of development (Knockaert et al., 2009). The demanding process of transforming research into commercial products and services does indeed require a significant amount of initial funding, thus often resulting in negative cash flows over several years. Moreover, this constraint is largely related to the information asymmetry and high uncertainty that surround RBSOs in particular, originating both in technological and organizational aspects (Wright et al., 2007).

The majority of studies focusing on financing of new technology-based ventures have a supply-side focus, thus taking the investor's perspective (Rasmussen and Sørheim, 2012b). However, the choices made concerning funding of RBSOs are primarily done by the entrepreneurs, and highly influenced by their perceptions and preferences (Riding et al., 2012). Hence, adopting a demand-side perspective when assessing financial sources is often more purposeful, as financing preferences vary according to for example the entrepreneurs' growth goals and desired ownership. Further, RBSOs are not a homogeneous group, and largely differ both in the nature of the products and services developed as well as the entrepreneurs' initial social capital and network (Mustar et al., 2008).

To answer the "financing gap" and stimulate commercialization of research, Norwegian policy makers have spent considerable funds through different initiatives and support infrastructures (Rasmussen and Rice, 2012). Notably, the FORNY program was specifically set in place to fund the establishment of support infrastructure and fuel the creation of RBSOs. However, there is limited empirical evidence examining the subsequent performance of FORNY-supported firms (Rasmussen et al., 2012). A recent evaluation performed by Borlaug et al. (2009) documented disappointing growth rates for Norwegian RBSOs, but did not account for the different faiths of discontinued firms nor related performance to the actual time of development of each firm. Rasmussen et al. (2012) declared that researchers are requesting more systematic and consistent empirical work in the field. In fact, most of the existing literature on RBSOs is based on studies of a small number of prestigious and successful research institutes (Rasmussen et al., 2012).

This thesis aims at contributing with precise and in-depth knowledge of RBSOs in Norway. In particular, the authors wish to address the financial constraints that are especially hard to overcome for this type of firm. The thesis seeks to explore the impacts of funding sources on the subsequent performance of RBSOs in Norway. To achieve this, an in-depth case study was performed on a relatively large sample of firms, including discontinued firms with similar long periods of time spent on development. The sample of case firms was narrowed down to the most prominent industry in Norway, namely the energy sector, due to the scope of the thesis and to achieve the desired meticulousness. The authors found it purposeful to adopt a demand-side perspective, and as such especially intend to examine how the entrepreneurs' perceptions and preferences influence choices made concerning financing. Further, the thesis aims at exploring the link between the entrepreneurs' initial social capital and network, and the value-adding resources of the each source of funding. Above all, the authors wish to incorporate throughout the thesis the particularly dynamic and complex aspects of the development of RBSOs, in order to investigate how initial conditions and the acquiring of a mix of funding sources over time ultimately affect the performance of the venture. To achieve this, the authors formulated a set of research questions.

Q1: *How does choice of funding sources impact the subsequent performance of RBSOs?*

Q2: *How do the entrepreneurs' perceptions and preferences influence the choice of funding sources?*

Q3: *How does the link between the entrepreneurs' initial capabilities and the value-adding resources of each funding source impact the subsequent performance of RBSOs?*

The thesis unfolds along the following lines. First, a brief overview of the context surrounding Norwegian energy-related RBSOs will be given. Second, the research methodology used will be presented, and limitations to keep in mind for the rest of the thesis will be recognized. Thirdly, a theoretical framework will be developed through an extensive literature study and further development of existing theory to compensate for the rather fragmented literature. Further, empirical findings will be presented in a narrative way. The previous parts will then form the basis for an analysis of the empirical results in light of the theoretical framework that will attempt to answer the research questions through the development of a conceptual model of "best practice" for RBSOs. Finally, conclusions are drawn, implications for both RBSOs and policymakers are emphasized, and areas for further research are discussed.

2 Context

The purpose of this thesis is to thoroughly examine the situation for energy-related RBSOs in Norway in particular. It is therefore highly relevant to define what characterizes Norway as a context. In order to do so, the authors wish to describe the Norwegian context departing from a holistic perspective and moving down to particularities specific to the Norwegian RBSO environment. Hopefully, this brief review will help the reader better understand the analysis of the empirical evidence that will be performed later on. Hence, firstly an overview of the main characteristics of the Norwegian business and industry context will be given. Further, the efforts around innovation and more specifically the funding environment for new ventures will be examined. Thereafter, a short review of the different actors involved in the commercialization of publicly supported research in Norway will be given, followed by a brief overview of the research environment.

2.1 Business and industry context

Norway escaped relatively unscathed from the recession induced by the 2008-2009 financial crises, and the economy currently continues to grow despite the current economic turbulence in the euro area (OECD, 2012). The wealth created by the energy sector through the development of Norway's abundant natural resources has led to sustained growth for the Norwegian economy (Finansdepartmement, 2013). As such, the Norwegian context stands out in the global setting. The following part will attempt to map the main characteristics that distinguish the Norwegian economy.

The discovery of oil and gas in the North Sea led to substantial changes in the Norwegian economy, which went from being almost exclusively built on agriculture, fishing and industry in 1970 to nearly a third being built on offshore industrial activity in 2006. The petroleum sector stands out as very capital intensive, employing a relatively low share of the labor force but generating around 30% of total value added in 2006. Oil and gas exports accounted for more than 50% of the export value from Norway in 2005 (OECD, 2008). The dominant position of the petroleum sector is not unique, but the high level of technology and large supplier industry together with a high level of interdependence with other sectors is distinctive. Moreover, Norway is a significant producer of renewable energy, with over 99 % of the electricity production covered by hydropower. In addition, wind power, wave power and bio-energy from wood constitute abundant resources. Despite the limited solar energy resources, the Norwegian solar industry is also globally present, as it is for example one of the largest manufacturers of solar grade silicon and solar cells (OECD, 2012). An important feature for Norway is the many initiatives set in place

by the government to promote the development of renewable energy, notably incentives for oil and gas industry to invest in renewable R&D projects (Energidepartementet, 2012).

As the domestic market is fairly limited, Norwegian Industries is characterized by a high degree of international focus (OECD, 2012). This leads to large parts of the Norwegian business being based on export. Unfortunately, the Norwegian industry faces major challenges in the upcoming years. High labor cost levels and strong "real exchange rate" characterizes the Norwegian business context, this despite the creation of the Government Pension Fund in 1990 with the implicit goal of investing oil and gas revenues abroad to prevent this.

Lastly, Norwegian business comprises mostly small companies (less than 100 employees), with 99.5% of firms counting for approximately 50% of the overall value creation and counting for 60% of private sector employment (Handelsdepartement, 2012). Beside these, there are only a few large companies of international size, mostly linked to the energy and offshore supply industries, aquaculture, telecommunications, shipping and financial sectors, with high share of state ownership.

To summarize, the general Norwegian economic context is favorable and the prospects for the future are good. Nevertheless, to sustain long-term growth and prepare itself for the already started decline in oil reserves ("life after oil"), Norway depends on continued innovation both in existing and towards new industry sectors, an area where Norway's performance is mixed compared to other OECD countries (OECD, 2010).

2.2 Innovation policy and funding of new ventures in Norway

The innovation inputs in Norway have been considered weak when benchmarking several standard innovation indicators with other OECD countries, and the outputs have been considered even weaker, especially when compared to other Nordic countries. For instance, the R&D spending as a percentage of GDP is markedly lower than the other Nordic countries and below the OECD average (OECD, 2008). The somewhat broader European Innovation Scoreboard also showed that Norway performed rather poorly. However, some argue that much of the R&D in Norway is performed through knowledge-intensive offshore-related engineering activities that are not accounted for in the innovation indicators (OECD, 2008).

The Norwegian equity market is considered relatively underdeveloped, only equivalent to about 15 % of the GDP compared to the European average of around 25 %. A very high proportion of this equity is held by the corporate sector, while private equity investors only account for 5 % (OECD, 2008). The low level

of private equity is partly due to the high level of state ownership in the Norwegian industry and is to some extent compensated by the various government policies initiated. However, some argue that the Norwegian government undertakes insufficient initiatives to provide sufficient capital for new ventures in the early stages. Claims have been made that the lack of available soft capital to gear and help relief some of the risk for private equity investors is the main reason for the low level of private equity investments (NVCA, 2010). Some further claim that the clue to overcoming the weak innovation inputs in Norway lies in strengthening the private equity market by increasing the competent capital base available to Norwegian entrepreneurs (NVCA, 2010).

Due to a low level of industry R&D expenditure and a low share of high technology firms, the Norwegian government considers fostering academic entrepreneurship to be particularly important (Rasmussen and Gulbrandsen, 2012). This has resulted in a large number of governmental schemes aimed at accomplishing this goal, administered by the RCN, Innovation Norway (IN) and SIVA. Similarly to private equity investors, these entities evaluate start-ups and help finance those they judge have a chance to succeed. However, the policy instruments set in place have been criticized for being dysfunctional, with insufficient coupling with industry, and too much complexity and bureaucracy. (Rasmussen et al., 2007)

The FORNY program (administered by the RCN) is considered the main support mechanism for the commercialization of publicly funded research in Norway, and aims at both establishing an efficient infrastructure to promote it, and directly fund the creation of RBSOs to increase both the number and the quality. For further reading about the theoretical rationale, the declared objectives, the different schemes and a brief evaluation of the performance of the FORNY program, see Appendix 1.

2.3 Commercialization actors and research environment

There have been significant reforms in the research environment in Norway in the past 10 years, with new legislation bringing intellectual property into line with international practice and considerable efforts made to strengthen the public research institutions' (PRIs) commercialization capabilities (OECD, 2008). In fact, having limited R&D spending in the Norwegian business in general has resulted in relatively many RBSOs. Other countries such as Finland and Sweden for instance, that have higher R&D spending, have directed their focus more towards collaboration between university and industry in order to commercialize research. To support the commercialization of research, three Norwegian government agencies have the following key roles:

- **Research Council of Norway** combines the role of traditional research council with that of an innovation agency, providing funds to all from basic research at PRIs to R&D in more established companies.
- **Innovation Norway** handles the role of business and regional development on behalf of several ministries, providing funds through a large specter of loan, grant and advice initiatives.
- **SIVA** controls much of the innovation infrastructure, operating science parks and providing incubation to new ventures.

Moreover, these agencies use intermediary organizations such as technology transfer organizations (TTOs) that focus specifically on creating spin-off ventures and licensing from research. In Norway, these organizations are often shared infrastructure between universities, colleges and research institutes (Rasmussen and Rice, 2012). Rasmussen et al. (2007) found that TTOs operate rather differently in the various regions in Norway, and criticize the unclear role distribution between the government agencies, TTOs and science parks, referring to often parallel activities between the different stakeholders.

The majority of the R&D done in Norwegian universities is done in the four largest universities: UiO (Oslo), NTNU (Trondheim), UiB (Bergen) and UiT (Tromsø) (Rasmussen and Rice, 2012). A relatively limited part of the R&D is performed by colleges, somewhat illustrated by the fact that only around 10 % of patents originate from these PRIs (Rasmussen et al., 2007). Together, the universities and colleges stand for approximately a quarter of all R&D in Norway (OECD, 2008). Further, Norway is a country with a relatively large research institute sector, comprising 61 PRIs in 2005. The most important research institutes are the geographically spread SINTEF institutes (accounting for 60 % of patents in Norway), IRIS (Stavanger), NGI (Oslo) and CMR (Bergen) (Rasmussen et al., 2007).Especially technical research institute

perform a significant amount of R&D, as these have long had the mission to support the industry with R&D development and innovation, particularly through applied research. About a quarter of the R&D activity in Norway is done by the research institutes (OECD, 2008).

3 Method

This thesis is an attempt to contribute to the research on RBSOs by formulating implications for RBSOs through an analysis of existing literature and funding alternatives within the field of academic entrepreneurship, and correlating this with findings from an empirical study. The theoretical background for this thesis is partly based on a literature study previously performed by the authors that examined the available funding sources for academic spin-offs. This master thesis will extend this work and further empirically investigate some of the topics that required enlightenment. The research questions for this study formed the starting point for the work performed throughout this thesis. For the attentive reader, these were introduced in chapter 1.

For the literary review, journal articles served as the main source, but the reference database additionally included books, reports, undergoing research papers and online information pages. For the empirical case study, interviews constituted the primary source, supplemented with secondary data such as news releases and general available information about the firms. In the following, the methods used both in the theoretical and the empirical study will be reviewed.

3.1 The literature study

Research on RBSOs is a relatively narrow and new field. For instance, a small group of authors are highly influential and frequently cited. Commonly, the need for more empirical research and consistence is called for. For this literary review, a large number of sources were reviewed as the basis for the evaluation. The sources not used directly in the text have served as general inspiration. Although the main interest have been funding of RBSOs, it was necessary to include references on broader topics as well as the research field is somewhat fragmented.

Literature search

Several of the research papers on the field have studied the financial situation of RBSOs from the viewpoint of the financial source (e.g. the VC screening properties, contribution of value-adding activities). As previously emphasized, this master thesis intends to turn the viewpoint around and will examine the financial sources from the RBSO's perspective. To achieve this, two main streams of literature were scrutinized – literature on academic and technology-based ventures, and literature on the different financial alternatives available to these types of firms.

The gathering of literary sources was performed in two steps. Initial collection was done through articles provided by the academic supervisor and through a general online search. Search engines such as Google Scholar, Scopus and BIBSYS ASK (university library resource offered by NTNU) were mainly employed, together with online databases available through the university (ProQuest Entrepreneurship, SpringerLink, Wiley Online Library, ScienceDirect and Jstor). The authors initiated with general searches aimed at getting an overview of the literature, and followed up with a narrower search oriented towards the specific topics of this thesis. As will be reviewed later in the thesis, there are several terms for this kind of venture. The most common terms used to describe the appropriate form of new venture were *research-based/academic/university spin-offs* and *NTBFs*, and these were the keywords mainly employed in searches. For the second stream of literature on financial sources, the commonly used search phrases were: *(corporate) venture capital, business angel, government programs, strategic alliances* and *debt.*

After the initial collection of literary sources was completed, new sources were found in two ways. Firstly, a new set of keywords based on the reviewed literature was made and applied. Secondly, literature was found through a snowballing effect from reading through the literature in the first step of the search. New articles, books and reports were found by reviewing other works from highly cited authors, the most common journals and references that particularly addressed the topic for this thesis.

Authors and journals

Along the collection of background literature, a limited set of authors emerged as central for this thesis. All had a substantial set of published works and subsequent citations in other works. Within the entrepreneurship literature, these are all renowned names, and their research has been key contributions to the RBSO literature. As a result, most of the other works this thesis is based on will be to a large degree influenced by these few authors.

When it comes to the national affiliation, the literature on RBSOs is mainly centered in the UK (e.g. Mike Wright and Andy Lockett) the US (e.g. Scott Shane and Josh Lerner) and in the UK (e.g. Mike Wright and Andy Lockett). The scope of the thesis was narrowed down to the Norwegian context, but contributions from the US and UK authors are significant to the research field and were to certain degree considered generalizable. The contextual constraint did however impact the thesis. For example, the Norwegian market is fairly small, and as a result, Norwegian companies often have to internationalize their operations and thereby are dependent on collaboration with international partners.

As a measure of the quality of the works used as references in this thesis, the authors started out wanting to focus on renowned journals that were highly ranked by indexes such as Thomson Reuters's ISI Web of Knowledge. This however proved difficult as several of the articles found through the snowballing method were published in journals less known, but nevertheless had relevant findings for this thesis. As already emphasized, the research concerning the topic for this thesis is recent and small in scale, and consequently, the authors found it necessary to include literature from lesser known journals as well.

3.2 The Case study

The choice of study-type had initially to be determined. This involved chosing between a quantitative and a qualitative study. Firstly, the literature study pointed out that RBSOs are rather heterogeneous (Mustar et al., 2006), a finding that was accounted for when assessing study design. A quantitative study could have explained several aspects surrounding these differences, as well as provided a statistical overview of these ventures; a qualitative study on the other hand could more in depth uncover the differences between the individual firms. Secondly, a quantitative study depends on a certain number of respondents. In the beginning of the decision process around type of study, there was some uncertainty as to how many RBSOs would want to participate, as well as the fact that the authors did not receive contact information to the companies. This made it difficult to predict how large the final sample would be. A qualitative approach on the other hand gives room for smaller subsets. Thirdly, the scope of the thesis included finding the relation between funding sources and the subsequent performance of the RBSOs, which was assumed to be a somewhat subjective perception. As a result, a qualitative approach was ultimately chosen as it could provide a deeper explanation to the research questions that were formulated. Further, the limited time available for a master thesis conclusively favored the qualitative study, as the gathering of a sufficiently large quantitative database was considered too lengthy.

The second decision was subsequently to decide what kind of qualitative study should be performed. Yin (2009) differentiated between five different forms of qualitative studies: Experiment, Survey, Archival analysis, History and Case Study. For this thesis, three "how"-research questions were formulated. Furthermore, in order to attempt to answer these questions, the authors considered that there was no need to control behavioral events. The study did however focus on contemporary events. According to Yin (2009), this could be answered through Surveys, Archival analysis or Case Study. The scope of the thesis was however to uncover a process and reasoning behind choices taken. Archival analysis individually will answer this to some extent, but not enough to fully disclose the findings. The basis for

evaluation is highly individual and a survey will not necessarily portray the different points of view. The case study is preferred in examining contemporary events, but in cases where relevant behaviors cannot be manipulated. Its unique strength is its ability to deal with a full variety of evidence (Yin, 2009). This aspect was considered to make room for interviews which were to pinpoint the heterogeneity of RBSOs. As a result, case study was picked as the method of choice for this thesis.

It is important to note that there are shortcomings when it comes to case studies as well as other study forms. For one, there is no rigid structure or given research design used and as a result the process of the investigator can be sloppy or investigator bias can influence the results. Furthermore, case studies can provide little bases for scientific generalization and they can be time-consuming. Lastly, in order to generalize the results of the case study, a rich theoretical framework must be provided, which also is very time-consuming (Yin, 2009). Firstly, in order to compensate for the potential lack of structure, the authors appointed a similar approach to be used in all the cases. Secondly, to compensate for the time-constraint posed by the short time-frame of a master thesis, the interviews of case firms that were situated in other parts of the country were to some degree selected and compiled in a two-week time-frame in order to decrease time spent on interviews.

Further, Yin (2009) opened for combining different forms of qualitative studies as part of the research design, something the authors included in their considerations. Especially in the data-gathering stages of the study, this was treated as important as the initial list of potential cases consisted of an overwhelming number of 436 potential cases that needed to be reduced. The aim of screening cases is to make sure that the cases are properly identified prior to the data collection (Yin, 2009). It is evident that attempting to contact all the 436 cases would have been very time-consuming, and the qualitative study forms such as archival analysis of articles in newspapers, journals and online portals could give important information to help limiting the number of cases. Therefore, the authors chose to perform a preliminary qualitative archival analysis before the primary qualitative study was performed, an analysis that will be presented in detail in the next section.

The next step was to determine what type of case study design was to be used. According to (Yin, 2009) there are four types of case-study design. Firstly, case studies can have both single- and multiple-case designs. When having the choice and resources, multiple-case designs may be preferred over single-case designs, and the analytical benefits from having two or more cases may be substantial (Yin, 2009). For one, by having several sources of evidence, the study results could be considered as more robust. In this study, it is clear that the heterogeneity of the case firms leads to impacting differences in the sample

characteristics. A single-case study would have given a thorough analysis of one company, but would not necessarily contribute to an overall understanding of RBSOs. Another important benefit reach through multiple-case studies is the possibility of direct replication. Conclusions derived from the evidence can be considered more powerful than those coming from a single case (Yin, 2009) and therefore, a multiple-case study was evidently chosen.

The second decision to be made when designing a case study concerns the units of analysis – between holistic and embedded case studies. Holistic case design are used when there is only one unit of analysis, while embedded case design are used when there are several units of analysis (Yin, 2009). The aim of this thesis is to relate many aspects surrounding RBSOs to several variables. Hence, the choice of embedded case design was rather given.

Ultimately, interviews served as the primary basis for performing the empirical study. A major purpose of this kind of case study might simply be to corroborate certain facts that you already believe are established. Usually, interviews will follow a certain set of questions (Yin, 2009). However, as established, a qualitative and embedded case design was chosen, and a perfect replication is often not the best approach to performing this type of study. Central to the cases in the selection was that they were largely heterogeneous, and questions posed to one case would not necessarily apply to another case. In addition, the roles the interviewees were often different as will be explained in the next section, and therefore the interviewees would commonly have different knowledge of the process. It was considered important to have a common evaluation basis for all cases (Yin, 2009). Consequently, the interview design itself became an important source of debate, where the focus was on how to replicate the case interviews while still account for the large differences among the cases. The discussion ended up in the incorporation of semi-structured interviews. Firstly, by allowing the conversation to flow, the interviewee would have the freedom to argue for their experiences on his or her own terms. Secondly, by having a preliminary overview of the topics to discuss during the interview, all aspects would be accounted for (Bryman, 2008).

The screening process

After correspondence with RCN, the authors received data from all 436 start-ups that had received start-up funding through the FORNY-program in the time-frame 1995 to 2011. Variables that were given through the data sheet were year of establishment, key figures for 2011 for those still in existence and the incubator from which they emerged from. As this list was considered too extensive for a thorough inspection of each unit, the authors made the decision to narrow down the number of cases through several steps.

While the list received from the RCN formed a valid starting point, the data sheet was somewhat fragmented and several misstatements were found. The authors therefore decided to validate the accuracy of the variables. Through the online database *Brønnøysundregisteret*, all units were consequently looked up. Variables such as start-up year, year the business was shut down and current address were checked. In addition, the field of business was reviewed with available information either through the online database, financial databases or through the company home page in those cases where those existed. Particularly when evaluating the companies that had been out of commission for a few years, this was rather challenging. In some cases, the field of business assigned from the RCN did not match the information available online, and as a result, some data were reassigned by the authors. The first step in narrowing down the list was based on this general evaluation of all companies, in particular based on the area of business. The decision on which business area to continue to focus on was thoroughly discussed.. The decision landed on the prominent energy sector in Norway, as it can be considered the currently most important and value-creating sector. Furthermore, this decision was sound as both authors have a solid technological background from the energy and environment field.

Moreover, most of the firms are based on high-tech research, and as a result, there are various degrees of technology readiness across the different business areas. High-tech ventures evidently have a much longer time-to-market than other start-ups. Based on the previous work in gathering secondary data, the authors validated all the start-up years. The second step was therefore to exclude the youngest companies, as the older companies would have had time to develop their technology closer to something commercial or in some cases already reached the market with their products or services. Companies founded from 2006 and later were subsequently excluded. The business field restriction together with the start-up year constraint resulted in a list of 54 companies that were given further inspection.

After the selection, the authors where coupled with a researcher and a scholar that had written papers based on a similar data source. Through a meeting, the authors were supplemented with a list of FORNY firms that received funding earlier than 2006. Compared to the initial data sheet, this list included several new variables that were later integrated. For one, the incubator from which the RBSOs emerged from was verified through this new list. Additionally, in the cases where the outcome of some of the companies was blurry, this new list provided some new clues as to what had occurred with them. After the data was optimized, the authors also added information available through a renowned financial database, *Profforvalt.no* (license provided by NTNU), and further cross-checked the data through a public financial database, *Purehelp.no*.

Moreover, a thorough secondary data collection was performed for all the 54 companies through a general internet search and a database-search of historical articles in newspapers. Particularly for the companies in the sample that were discontinued, this archival analysis gave important data. At this point of time, the information gathered was quite large, and in addition to the extensive data sheet of benchmarking variables, a profile of each of the 54 companies was written in order to unite all information gathered. Moreover, the business area of each venture within the energy sector was split into three industrial sectors: *Oil and Gas, Renewable Energy and Energy* (as some firms had operations in both industrial fields). The extensive data search additionally resulted in some specification of the initial sample of firms, and the sample was reduced to 38 cases, mostly due to wrongful match with desired business area. For instance, some of the initial companies purely targeted environmental technologies, thus not specifically addressing the energy sector.

A case study of 38 units was however still considered too extensive by the authors. Through the previous stages of narrowing down the selection of case firms, it became clear that the information that was available online or through databases was insufficient for many of the firms, especially the firms that discontinued early., The thorough secondary data collection gave some indications to what had happened to most of the companies, but the information as a total was still quite fragmented. In order to perform an ultimate selection of case firms, it was therefore decided to develop a short set of questions to acquire consistent information about essential elements. These elements mainly investigated the companies' origin and their development processes, along with the use of financial sources. There were three companies whom the authors were unable to gather contact information on, as they had been dissolved before the Norwegian online company register *Brønnøysundregisteret* was established, and no information beyond the company name was found. Mainly, founders or current CEO

were the targets for this enquiry. In some cases however, the only available person was another member of the management. While a large share of the firms was willing to participate, there were also companies the authors were not able to reach through phone calls. The authors received answers from 27 companies. Contact through email was attempted with the remaining eight, but with unfruitful results.

During the previous phone conversations, some indicated that they would not like to participate further in the study, and as a result, an additional eight was excluded from the list. A meeting was set in place for the remaining 18 companies. Mainly, founders still affiliated with the venture were the main target for the final interviews, but the authors ended up interviewing a wide variety of key persons in the case firms. This was considered a strength rather than a weakness, as this thesis focus both on technological and business aspect of new ventures, and differing backgrounds provided a more diverse and broad perspective around the central topics discussed. In two cases, the meetings were cancelled in the last minute by the contact. Furthermore, case interview of four of the companies were compiled in two meetings. One of these meetings involved two separate business units that were presently gather in one operating company (for the rest of this thesis considered as company E), while the other meeting was discussed with the person responsible for both commercialization processes of the two units. Thereby, the final selection of cases consisted of 15 companies

3.3 The cases

The RBSOs in the final selection were situated in the four largest cities in Norway and mostly operated in the petroleum industry. The renewable industry was also relatively well represented with four firms, and differed to a large extent both in size and type of technologies. Under the selection process, the geographical location was not emphasized as the authors desired a representative selection of cases. However, the spread among the four actual cities turned convenient, although not surprising as the largest research environments are situated here. The distribution between universities and research institutions was equally not emphasized, but turned out rather even. A highly relevant fact for this thesis was that four of the companies in this sample had discontinued. An overview of all the cases is given in Table 1. To remind the reader, company E is a distinctive case as company was established in 2011 to incorporate two of the units in the original selection.

Table 1 - Summary of the cases

Company A-O	Location (area)	Origin	Start-up year	Status	Contact person	Business Area
A	Trondheim	University	2004	In Existence	Founder, CTO	Petroleum
B	Trondheim	University	2005	Discontinued	Founder	Petroleum
C	Trondheim	Research Institution	2001	In Existence	CEO	Petroleum
D	Trondheim	University	2002	In Existence	CTO	Petroleum
E	Stavanger	Research Institution	2004	In Existence	Business Controller	Petroleum
F	Stavanger	Research Institution	1997	Discontinued	Founder	Petroleum
G	Stavanger	University	2004	In Existence	Board Leader	Petroleum
H	Stavanger	Research Institution	2003	In Existence	Board Leader	Petroleum
I	Bergen	Research Institution	2000	Discontinued	Founder	Petroleum
J	Bergen	Research Institution	1997	Discontinued	Founder	Petroleum
K	Oslo	Research Institution	1998	In Existence	Founder, CEO	Renewable Energy
L	Oslo	University	1996	In Existence	Founder, CEO	Renewable Energy
M	Oslo	University	1999	In Existence	Founder	Petroleum
N	Oslo	Other	2000	In Existence	Founder	Renewable Energy
O	Oslo	Other	2004	In Existence	Founder	Renewable Energy

3.4 Limitations to the thesis

As with all scientific studies, there are several limitations to this work that are important to emphasize. For instance, the validity of the gathered literature for the theoretical study was mostly evaluated by the authors' subjectivity. As a result, there might be several biases to the contents. Also, since the literature on this field is still new and rather fragmented, a small number of authors are highly influential. In fact, several other studies have included the works of these authors in their works as well. Additionally, through the snowballing search for literature several of the articles used were published in less renowned journals. These were still added to the final reference database as their contents were considered relevant to this thesis. As a result, there might be some bias associated with the reference articles.

Furthermore, the final selection of firms ended in 15 cases. This is a large number in order to replicate an interview design considering the limited scope of a master thesis. As previously mentioned, the authors chose a semi-structured interview form, as the different roles the interviewees would lead to large difference in knowledge about the RBSOs, and that diversity in answers was desired. However, with a rigid structure on the interview, it is clear that the representative for the RBSO might not mention all the relevant facts that the authors sought for. Further, some questions were not appropriate for all companies. For example, a question about present performance would not be particularly relevant for companies that were discontinued.. A protocol for all the topics that needed to be investigated was made beforehand the interviews, but the sequence was not given. Each author had individual responsibility for making sure that particular topics were discussed. It is also important to note that in order for the author to replicate the exact quotation made by the interviewee, the meetings were recorded. Despite the authors emphasizing on the fact that the interviews were anonymized, it is possible that the interviewees have held back certain opinions.

A known shortcoming lies within the role the interviewee had in the case RBSO. Only one representative for each company was interviewed. This could lead to an interviewee bias as there were individual viewpoints that may not have been representative for the RBSO. This bias is particularly relevant when the personal preferences and perceptions around funding sources were investigated. Further, as the selection of cases was consciously made based on the start-up time of the firms there was a long time-span from when decisions were made to today. Evidently, this is an important weakness as many interviewees made clear that some of the topics discussed were blurry to them. Moreover, as a last important note, the authors would like to emphasize the limitations given by the short time frame of a

master thesis. While a relevant literary study was conducted during autumn 2012, it is evident that a more extensive study over a longer time period would lead to much more ample and conclusive evidence.

4 Literature study

As mentioned, research on RBSOs is a relatively new field, but has gained importance in recent years as policymakers increasingly emphasize the role of RBSOs to promote innovation (Rasmussen et al., 2012). There are several studies examining formation and development processes (Rasmussen et al., 2011, Clarysse et al., 2011), the social and technological capabilities of RBSOs (Heirman and Clarysse, 2007, Shane and Cable, 2002) and the financial obstacles for RBSOs (e.g Politis et al., 2012, Carpentier and Suret, 2006). Moreover, several studies have examined the performance of RBSOs in terms of impact, and Rasmussen et al. (2012) identified two dominant perspectives. Some studies explored the impacts in terms of contribution to economic development. Another set of studies examined the impacts in terms of dissemination of applicable research to society. Furthermore, this literature review identified a stream of research that attempted to link the initial context and resources of RBSOs to subsequent performance. These studies were shown to investigate a large number of factors, but Rasmussen et al. (2012a) claimed that the relations between the different factors were insufficiently studied, and that the contexts were often too specific. Lastly, some studies have examined the different funding sources available to RBSOs, notably soft funding (e.g. Rasmussen and Sørheim, 2012a), business angels (e.g. Sørheim and Landström, 2001, Politis, 2008) and venture capitalists (e.g. Zhang, 2007, Wright et al., 2006).

The following is a presentation of the relevant literature for this thesis. When considered necessary, the authors have developed theoretical frameworks in order to compensate for lack of consistent theory. As emphasized, this is to a large extent due to the rather fragmented literature surrounding RBSOs. Firstly, a thorough theoretical background on RBSOs will be presented. Thereafter, a meticulous presentation and analysis of the different funding sources available to RBSOs will be given. Ultimately, this will result in a solid framework that will form the basis for structuring the empirical results procured and subsequently analyzing these findings.

4.1 RBSOs

Historically, technology from research institutions has majorly been commercialized through licensing. In recent years, commercialization through creation of independent business entities has emerged as a viable solution to the same purpose. The American Bayh-Doyle act from 1980 was a pioneering legislation that gave the proprietary rights of technology developed in research institutions to the institutions themselves rather than the researcher. As a response to the many successful high-tech firms

that originated from research in the USA, similar legislation was later implemented in most countries as policy makers and institutions realized the potential value creation (Lerner, 2004). Indeed, RBSOs have been shown to represent an overall wealth creation as start-ups increase employment and contribute with significant societal gains through the introduction of revolutionary products and services. (Utterback et al., 1988).

4.1.1 The rationale behind formation of RBSOs

Established firms possess several advantages in commercializing technology; their market knowledge, customer relationships, distribution systems and related product portfolio. As a result, licensing of research-based technology to established firms has traditionally been the way of commercializing, as the additional expense of creating a new firm could not be justified (Shane, 2004). However, during the last fifteen years, the number of RBSOs has increased substantially in many European countries (Mustar et al., 2008). This leads us to explore the rationale behind the formation of new firms from university technology or ideas, despite the presented disadvantages with regards to established firms.

Shane (2004) presented a set of reasons that leads to the formation of spin-offs instead of licensing. First, he claims that the radical nature of university technology or ideas is often the main basis for the formation of a spin-off. Radical technology or ideas challenge the existing firms' organization and position in the market, often perceived as a threat. The tacit nature of the knowledge also leads to difficulties communicating the value of the technology or idea, often resulting in disbelief and rejection from the managers of established firms. Further, the technology or ideas developed at universities are often early stage and "unproven". For established firms, it is often difficult to see the applicability of new technology, and they are often reluctant to invest resources in discovering this due to their often short term focus and profit-oriented goals (Shane, 2004).

Profit prospect is moreover a reason for the formation of new firm, as it often motivates inventors to become entrepreneurs and benefit from the value their inventions create to a much higher degree, as well as providing them with the self-employment opportunity. In addition, Shane (2004) points out that creating RBSOs is more profitable for the PRI itself than licensing, as equity in spin-off captures more of the value created from an invention, rather than only the value from receiving royalties for the use of IP. Hence universities increasingly encourage the formation of RBSOs, as PRIs seek alternative income sources for the future (Shane, 2004). Lastly, as previously accentuated, governments are a major driving force for the formation of spin-offs. RBSOs diversify and develop the local surrounding economy, creating more jobs compared to licensing and stimulating to more economic growth (Shane, 2004).

4.1.2 Characteristics

RBSOs are new ventures that emerges from PRIs and whose products or services are based on proprietary technology or skill (Heirman and Clarysse, 2004). Mainly, there are four types of ventures emerging from a research setting that occur in literature: Academic spin-offs (ASOs) (e.g Wright et al., 2007, Clarysse et al., 2007), University spin-offs (USOs) (e.g Clarysse et al., 2011, Baldini, 2010), new technology-based firms (NTBFs) (e.g Rasmussen and Sørheim, 2012b) and RBSOs (e.g Lockett et al., 2005). All types are based on research and a general requirement is that they are all dependent on transfer of proprietary rights from the parent organization. However, while ASOs and USOs spring out from a pure academic setting, NTBFs and RBSOs extend this definition to also include other research organizations (Heirman and Clarysse, 2004). RBSOs is a subset of NTBFs (Wright et al., 2007) and, according to Heirman and Clarysse (2004), RBSOs do not necessarily develop a physical technology, thus can include other form of ventures such as consultancy firms. Table 2 gives a systematic overview of the four different types.

Table 2 - Different types of new ventures

Factors	RBSO	ASO/USO	NTBF
Basis	Research	University or college research	Research
Founders	From PRIs	From academic institutions	No requirement
Product or service	Technology and/or skill	Technology and/or skill	Technology

As acknowledged, there are several types of start-ups that are based on research. The obvious enquiry the reader may make is the rationale for choosing precisely RBSOs as the type of firm to investigate. Essentially, the explanation lies in the characteristics of the Norwegian context. As was presented, much of the R&D in Norway is performed by PRIs, with approximately a quarter performed by universities and colleges (predominantly universities), and a quarter done by research institutes (Rasmussen et al., 2007). Further, as will be examined later, most of the governmental schemes, that form an important part of the funding sources for new ventures, do not distinguish between the different PRIs. Notably, the FORNY program, which constitutes the main support mechanism for the commercialization of research, targets research-based spin-offs from all PRIs, and support both the development of both technologies and services. Hence, the authors considered it purposeful to study the more inclusive RBSO type of firm

Information asymmetries and uncertainty

There are two essential challenges for RBSOs. Firstly, as new and small business, RBSOs are subject to a high degree of uncertainty, and have short track records that makes it challenging to value the company (Shane and Stuart, 2002). In others words, it is especially challenging for investors and founders to confidently predict what the future prospects of the company are going to be (Gompers and Lerner, 2000), and there is a wide number of potential outcomes for the venture. For more established firms, the evaluation of the company is often based on observable history, but for RBSOS, this is not possible until after the entrepreneur has obtained resources, established a functioning organization and started the development of products (Shane and Stuart, 2002). Another uncertainty aspect of young high-tech firms is that new technology is unpredictable and requires undefined large resource commitments in order to create prototypes and further develop the technologies. As a result, the revenues and profits often lie far in an unpredictable future (Shane and Stuart, 2002). Firms with more tangible assets find financing often both easier to obtain and on more favorable terms than firms with more intangible assets (Gompers and Lerner, 2001).

Another prominent challenge is the differences in information possessed between entrepreneur and others, making it difficult for outsiders to evaluate the RBSO with the same accuracy as entrepreneurs (Rasmussen and Sørheim, 2012a). The entrepreneur naturally possess deeper knowledge about the venture's prospects, the capabilities of the entrepreneurial team and their level of commitment to the venture (Shane and Stuart, 2002). The resource providers can't supervise actions made by the venture's management, which further leads to two main challenges from the investor's perspective: Either the founder may take decisions that prove to be harmful to the venture and that the investors cannot observe, or the entrepreneurs might deliberately exploit the information asymmetry to their self-motivated benefit (Gompers and Lerner, 2000).

4.1.3 The development process of RBSOs

When evaluating RBSOs as business units, it is fundamental to use a framework that accounts for the evolution of the venture. Generally, this type of new venture unit seems to grow in similar patterns and Wright et al. (2007) described the development through four phases: the *Research phase,* the *Opportunity-framing phase*, the *pre-organization phase* and the *reorientation phase.* Commonly, studies use a life-cycle approach that distinguishes between *pre-seed, seed*, *start-up, growth* and *exit* (Figure 1). The three first stages are often referred to as the early stages in literature. The four phases described by Wright et al. (2007) and in the life-cycle approach contains similar elements. For the purpose of this

thesis, a model incorporating elements from both will be presented in the following. Each phase specify activities to be performed as well as strategic planning the firms must perform moving forward (Vohora et al., 2004). Literature often places these stages through a projected revenue graph for the RBSO and the financial sources that are available. As the authors consider this revenue graph to vary significantly between the different types of RBSOs, as will be further elaborated in the next section, only the timeline itself will be used to describe the stage-model. Furthermore, it is important that this is a model, and the time-horizons for each stage considerably vary among the different types of RBSOs, The activities to be performed are however similar.

Figure 1 - Evolution of RBSOs

Pre-seed stage

In the pre-seed stage, the purpose is to generate and assess business ideas from initial research developed at the PRIs (Ndonzuau et al., 2002). As a result, this stage is often referred to as the *proof-of-concept* phase. It is an opportunity recognition phase where the founders alone or together with associated TTOs need to identify the commercial applicability of the intellectual property they have created (Wright et al., 2012). Through a screening process, the technology itself is evaluated, and its validity for further development and commercialization is assessed(Vohora et al., 2004). The overall costs associated with this stage are usually not high, and funding is therefore often procured from internal sources (Politis et al., 2012). Vohora et al. (2004) found that the ventures in this stage often suffered from a lack of understanding for commercial exploitation of the technology and inexperience in creating commercial value of research. Important challenges in this phase include imprecisely defined opportunities, ambiguously targets and impracticable solutions (Wright et al., 2007). The entrepreneurial team consequently needs to acquire additional competence in this stage, often through an associated TTO.

Seed stage

In the seed stage, the purpose is to further develop the business ideas. The venture becomes more tangible and Strategic plans are implemented. The founders are confronted with several critical decisions such as when and where to acquire future needs for resources and knowledge. Typical activities here are related to the protection of the technology or idea, the development of the product or services into prototypes, and further development of the business plan with deeper analyzes and quantification of market potential (Ndonzuau et al., 2002). This stage is characterized by high intensity of R&D and as a result, technical competencies are usually critical for this phase (Wright et al., 2007). Moreover, critical decisions for the further development of the firm have to be made. As a consequence of this increasing strategic importance, the managerial competencies within the entrepreneurial team become increasingly important in this stage (Politis et al., 2012).

Start-up stage

In the start-up stage, the initial product or service developed is introduced to the market (Politis et al., 2012). Entrepreneurs must continuously identify, acquire and integrate resources and re-configure them into the venture. This is especially important if the RBSO is founded with low start-up capital and inexperienced management (Vohora et al., 2004). As a result, this is the stage where a competent management and relevant network relations are crucial to succeed. Moreover, this is where the need for material and financial resources significantly increases in order to produce and introduce the product or service developed (Ndonzuau et al., 2002), often forcing RBSOs to seek support from private investors (Politis et al., 2012). This phase is characterized as a learning phase, and interaction with outside actors leads to acquisition of information and knowledge (Wright et al., 2007).

Growth stage

In the growth stage, the RBSO starts to generate economic value and sustainable returns. It is common to divide this stage into early growth phase and expansion phase, as RBSOs often have to adopt a two-step growth strategy due to lack of financial resources in the start-up stage. Many RBSOs will remain indefinitely in the early growth stage as initial prospects prove wrong, while the most promising RBSOs with high growth potential and international scope will move quickly to an expansion phase (Ndonzuau et al., 2002). At a certain point in time, the growth rate will decline and move into the eventual “mature” phase of the growth stage. Along with the growth of the venture, a need to scale up the production

emerges. Although the RBSO starts to generate profits, several subsequent rounds of raising financial resources are often required (Politis et al., 2012). The fundamental objective in this phase is to access and reconfigure resources in order to assemble the capabilities which enables the venture to reach such a phase (Vohora et al., 2004). While many RBSOs up to this point have had access to facilities through their institution of origin, expansion lead RBSOs in this stage to professionalize their operations and move closer to the industry (Wright et al., 2007).

At some point, the life-cycle of the RBSO will end. This can either occur through sale of the whole firm to a third party (e.g. trade-sale, typically a strategic acquirer) or through liquidation of the firm due to non-viability (Cumming and MacIntosh, 2003).

Critical Junctures

In addition to the fixed phases, the authors found it purposeful to include transition phases in the stage-model. Vohora et al. (2004) introduced the concept of critical junctures due to the complex challenges that need to be overcome in order to move from one stage to the next. They claimed that ventures often will stagnate in a stage unless it overcomes the juncture to move to the next stage. An improved version of the stage-model (Figure 1) is presented in Figure 2.

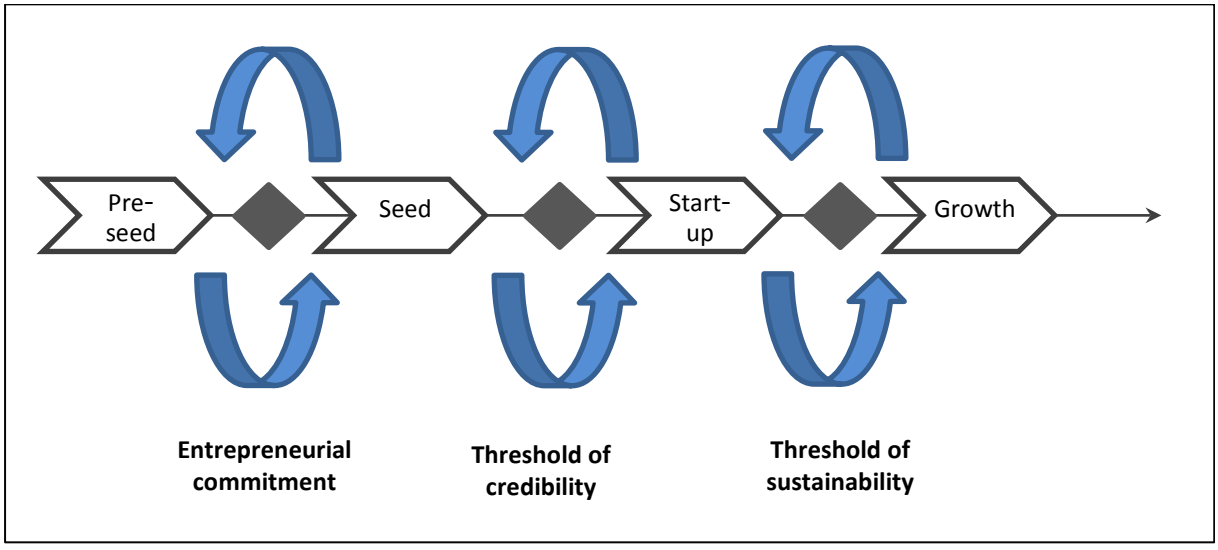

Figure 2 - Stage-model for RBSOs

As can be observed, the life-cycle process presented in Figure 1 has been refined with an additional three transition phases. The first critical juncture is defined as the *entrepreneurial commitment*. Commitment from the entrepreneurial team is essential for the venture to be taken from an idea into forming a business (Vohora et al., 2004). It is important to differentiate between entrepreneurial intentions and commitment, where the major difference is that in the latter, the entrepreneur commit to a certain course of events (Wright et al., 2007). For example, some entrepreneurs must make the decision whether or not he should leave his initial job at the PRI in order to focus full time on the RBSO. The commitment made by the entrepreneur creates stability and ensures a continuous flow of innovative inputs in the RBSO, hence leading to steady improvements of initial products and introduction of new products and services (Vohora et al., 2004).

The second juncture is the *threshold of credibility,* as this is a crucial challenge for all new ventures. Especially for RBSOs, the initial resources are intangible and compromise mainly of technical know-how (Vohora et al., 2004). Additionally, RBSOs seldom have long track-records, and acquiring external capital is particularly challenging for RBSOs that have not passed this threshold.

The last critical juncture is the *threshold of sustainability*. The essential element to overcome this juncture is the management's ability to continuously re-configure resources, capabilities and liabilities from weaknesses into strengths for the venture (Vohora et al., 2004). This threshold is highly dependent on the initial resources of the entrepreneurial team. By eliminating the weaknesses through the acquiring of new competence, the RBSOs achieve new competitive advantages that can be benefitted from through new markets and increased revenue generation.

4.1.4 Typology of RBSOs

As previously mentioned, RBSOS are a heterogeneous group of firms. It is therefore purposeful to create a relevant framework that can distinguish between the different types that exist. There are three different analytical perspectives on RBSO types that are common in the literature. These mainly differentiate between the determinants that define competitive advantage for the RBSOs. The first perspective, namely the *resource-based perspective,* attributes excess performance to resources and capabilities property of the venture, and has become increasingly influential in recent literature (Wright et al., 2007). The second perspective, the *business-model perspective,* focuses on the activities developed by the RBSO, the industrial sectors in which they belong to and other differentiating key indicators (Wright et al., 2007). Lastly, the papers that focus on the institutional link between the venture and the parent organization, and try to determine the context that shapes the development of

the RBSO, are categorized within the *institutional perspective*. Several studies have tried to address typology of RBSOs. Mustar et al. (2006) studied the different taxonomies of this type of venture, and found that existing studies are mostly based on only one of the analytical perspectives, focusing only on certain aspects and ignoring other important topics.

As all the RBSOs in the selection of case firms are considered high-tech ventures, the authors found it purposeful to differentiate between the **concept maturity** – the radicalness of the technology, and the varying **resource needs** for the venture. A high concept maturity usually involves products that are a further development of, or new use of an existing technology, while low concept maturity describes products or services that are based on a more radical technology. Resource needs is used as a collective term for all technical, financial and human resources needed in order to develop the RBSO into a company with sustainable returns. While both dimensions are highly related to the resource-based perspective, the dimensions also incorporate parts of the two other presented perspectives. It is important to note that no previous typological studies found by the authors differentiated RBSOs along these exact dimensions. The result of the development of a theoretical framework to differentiate RBSOs led to the formulation of a new typology that the authors considered suitable to evaluate the funding choices of RBSOs. It is important to note that while the following classification is highly anchored in existing literature, many of the distinctions that are made are based on the authors own perception. Figure 3 portrays the categorization of the different types of RBSOs. Figure 3 portrays the typology.

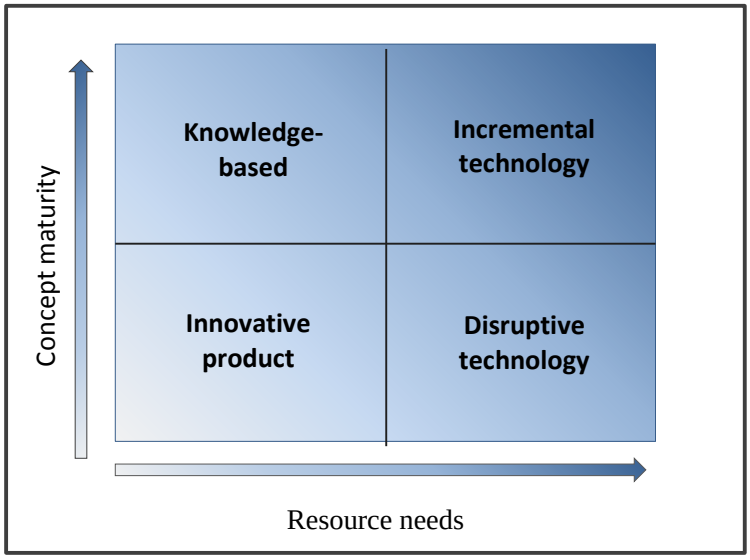

Figure 3 - RBSO Typology

Knowledge -based RBSOs

Ventures with high concept maturity and low resource needs are often founded in order to commercialize the entrepreneur's knowledge (Heirman and Clarysse, 2004) and is a way for the founder to employ themselves. They often take the form of technical consultancy firms and builds upon the central research the founders performed while at the PRI (Druilhe and Garnsey, 2004). In fact, Heirman and Clarysse (2004) found evidence that technical consultants comprised a major part of RBSOs. With high concept maturity, solutions are often an incremental step from existing products with relatively small degree of innovativeness. The service offering is unlikely to be based on patents, or demand significant further R&D (Druilhe and Garnsey, 2004).. As the market offering often is a service, the start-up costs are small compared to other types of ventures, which leaves little need for external investors in the earliest phases (Heirman and Clarysse, 2004). Additionally, this type of RBSO is close to the market at start up, and the service addresses clear unmet market needs (Wright et al., 2007). This gives the RBSO the opportunity to rely on revenues for further growth in earlier stages than other RBSOs. RBSOs in this category will typically have few employees (Heirman and Clarysse, 2004), and are often compared to the "lifestyle" firms found in the literature. (Wright et al., 2007).

Innovative product -based RBSOs

As the name indicates, this type of RBSO is based on innovative technology and is often the product of extensive research at the PRI. As a result, the technology is closer to market introduction when the firm is established, and resources needed for further R&D are thereby small compared to other types of RBSOs (Heirman and Clarysse, 2004). Costs related to the market introduction itself are however similar to the other types of RBSO. Additionally, the closeness to product launch leads the RBSO to expect revenues shortly after start-up, and is less dependent on external funding sources (Wright et al., 2007). A low concept maturity indicates a product solution that is very innovative compared to existing market solutions, and this type of RBSO often target niche markets (Wright et al., 2007). Typically, these RBSOs will have few employees at start-up, and have higher focus on market introduction and further business development than other RBSOs, with for instance most growth being based on after-sale services (Wright et al., 2007).

Incremental technology -based RBSOs

RBSOs with a high concept maturity and high resource needs will typically provide a new product based on an incremental step in existing technology (Wright et al., 2007), where existing technology is underdeveloped or can be put to new commercial use. These RBSOs are often formed with the aim to develop a technology for later licensing to outside firms, but frequently end up performing the downstream services and production themselves (Druilhe and Garnsey, 2004). At the time of venture establishment, the technology is far from market-ready (Heirman and Clarysse, 2004). Incremental technology -based RBSOs are therefore based on a technology that addresses a market need rather than adapting a technology to a market, which is rather the case for the previously presented innovative product -based RBSOs. The development from technology to products is both time-consuming and costly, but has a lower degree of uncertainty than the more disruptive technologies. As the technology often needs to be researched and further developed after venture start-up, the venture typically needs several years in order to start growing.

Disruptive technology -based RBSOs

RBSOs with a high need for resources to develop and grow will typically require a waste period of R&D to introduce a product or service to the market. A low concept maturity means that the applicability of the technology is unclear, and the technology is often disruptive and proprietary (Heirman and Clarysse, 2004). In fact, this RBSO represent the most radical technology-offering among the different RBSO types. In addition, contrary to the innovative product-based RBSOs, the technology is in its early-stage development and far from market-ready at start-up (Wright et al., 2007). The high resource needs are linked to the time-consuming and costly development process from uncertain technology to final, and this type of RBSO is highly dependent on additional funding. Secondly, this type of RBSO is also the one with the steepest growth curve, and typically the highest requirements of technical expertise and commercialization competence. Therefore, this type of venture is commonly described in the literature as VC-backed ventures, defined as spin-offs that are based on radical, early-stage and general-purpose technology that more easily attract external equity funding (Shane, 2004).

The importance of a typological framework

The authors would like the emphasize the important impact the heterogeneity of RBSOs (Mustar et al., 2006) have on the topics that will be treated later in the thesis. As the attentive reader may have noticed, the dimensions chosen to differentiate RBSOs, namely resource needs and concept maturity, were carefully chosen in order to give the authors a suitable framework to later analyze the different funding sources, and evaluate the initial and subsequently needed social and financial resources. Notably, the typology will be used to categorize the case firms, and later examine the empirical evidence using the different types of RBSOs as basis.

4.1.5 Social capital and network

Before examining the resource needs of RBSOs, it is essential to map what resources RBSOs initially possess. As the particular field of resource mapping is rather complex, it is important to note that only the main features will here be assessed. Furthermore, only the core entrepreneurial team and "privileged witnesses" will be considered, thus excluding individuals that solely have financial interests. The core entrepreneurial team will be defined as individuals that played an active role in the founding of the RBSO, have a financial interest and are involved in the strategic decision-making (Wright et al., 2007). "Privileged witnesses" was a term introduced by Vanaelst et al. (2006) and are defined as individuals that guide researchers in the pre-startup stage, often part of TTOs and incubators. Above all, the essential characteristic of an entrepreneurial team is that it is largely dynamic. Hence, the evolutionary aspect of social capital and network has to be taken into consideration (Wright et al., 2007). With this in mind, a generic overview of the initial social resources a RBSO typically possess will first be presented. Thereafter, changes in the RBSO's social capital and network over time will be briefly examined. Lastly, critical success factors established in the literature will shortly be discussed.

At the core of every RBSO lies research, thus the core entrepreneurial team will initially be comprised of scientists. Evidently, this implies strong technical capabilities, but also often a strong academic network that includes e.g. science parks, TTOs and other scientific entrepreneurs. Nosella and Grimaldi (2009) presented four main advantages of such a network: (1) it increases the entrepreneurs' opportunity identification capabilities, (2) it facilitates access to resources, (3) it favors economies of time and (4) is a source of status and referrals.

On the other hand, Wright et al. (2007) claim that researchers initially tend to be *support oriented* and *innovation oriented*, often lacking goal orientation and intentionally avoiding bureaucracy. *Support*

oriented implies more informal interaction and important features such as mutual trust, cooperation and individual growth. *Innovation oriented* indicates a flexible and unrestrained attitude towards performance indicators and accomplishment accountability.

Putting the two previous paragraphs in perspective, one could argue that the deficiencies put forward by Wright et al. (2007) are precisely what a strong academic network can potentially compensate for. Indeed, the earlier-mentioned "privileged witnesses" are often procured through this network, giving strategic advice to overcome the lack of goal orientation from the researchers, while providing support to overcome the challenges posed by bureaucratic formalities (Vanaelst et al., 2006). Table 3 summarizes the main capabilities and deficiencies of a typical RBSO founding team.

Table 3 - Overview of initial social resources

Capabilities	Deficiencies
Technical competence	**Goal orientation**
Access to academic network	**Processing bureaucratic formalities**

When the RBSO is established as a legal entity, passing the critical juncture called the *entrepreneurial commitment*, the RBSO founding team evolves into a management team and a board of directors. This marks a significant change in the social resources of the RBSO. In fact, Bjoernaali and Gulbrandsen (2010) showed that changes in social resources are closely related to overcoming critical junctures and reaching the next development stage. Early social capital is generally added through social networks and largest stakeholders such as e.g. a university, a research institution or investors. In addition, industry representatives are often added to help covering the gap between RBSO and industry (Nosella and Grimaldi, 2009). Indeed, it is generally these gaps (e.g. absence of relevant experience, know-how and networks) that ultimately provoke the need for additional social resources. Social capital added in later stages are usually value-adding investors, professional executives and individuals with market-specific knowledge aiding with acquisition of other resources such as sales and marketing for example (Bjoernaali and Gulbrandsen, 2010). Moreover, Wright et al. (2007) found that researchers usually prefer to recruit those people whose way of looking at a business is very close to theirs. Social network theory similarly indicate that scientific-entrepreneurs are likely to recruit individuals from their existing social network (Bjoernaali and Gulbrandsen, 2010).

Ultimately, the literature generally agrees that social capital and network significantly influence the performance of a RBSO (Wright et al., 2007). A study by Heirman and Clarysse (2006) determined that the single most important predictor of growth during the first five years after startup was the degree of commercial and sector-specific competence in the entrepreneurial team. The *upper echelon perspective* posits that there are two important success factors that positively affect the performance of a RBSO (Wright et al., 2007).

- **Cognitive diversity**, the existence of different individual characteristics, educational backgrounds and business experiences.
- **Behavioral integration**, the ability to work collectively and benefit from cognitive diversity, characterized by interaction, sharing and discussion that create a culture that integrates differences.

Vanaelst et al. (2006) examined these two factors in depth, and found that the acquiring of team members with commercial background expectedly had a positive effect, but had surprisingly little influence on the cognitive diversity. Often, new team members in the entrepreneurial teams only reinforced the current cognition of how to run the venture, a finding that has been shown in the literature to have mixed effects on the performance of ventures (Vanaelst et al., 2006). This is a rather interesting finding, and will be briefly explored in the analysis of the empirical results in the thesis.

4.1.6 Performance indicators

To conclude the section on RBSOs, an interesting theoretical discussion can be conducted around what indicators can measure their performance. Finding appropriate indicators to map the performance of RBSOs is a particularly challenging task. Indeed, most current studies generally use only limited and quantitative units of analysis such as turnover, market capitalization, sales growth, sales per employee etc. (Lawton Smith and Ho, 2006, Zhang, 2009, Walter et al., 2006). A review by Shepherd and Wiklund (2009) analyzed over 80 empirical studies published in leading management and entrepreneurship journals attempting to explain differences in growth performance of firms, and revealed that very few of these studies used qualitative measures in order to establish performance. Despite all these studies, researchers have not been able to isolate variables that have a consistent effect on growth performance, and individual studies have only explained a limited portion of the differences in performance (Macpherson and Holt, 2007). One could argue that the performance of RBSOs has to be defined through more long-term indicators, as the development of uncertain technology is time-consuming and often require long time spans before the RBSO can start to grow. In fact, several cross-country performance

studies have shown that economic performance alone is poor (Gulbrandsen and Rasmussen, 2012). Rasmussen et al. (2012) argue that the performance of RBSOs should be affiliated more to the societal benefits and the technology transfer itself, rather than the economic impact.

McKelvie and Wiklund (2010) made an extensive review of the growth performance literature, and sorted the literature in three different streams: *Growth as an Outcome*, *The Outcome of Growth* and *The Growth Process*. The first stream examines growth as an outcome and primarily intends to explain the variances in growth performance. The second stream focuses on outcomes of growth, thereby taking growth as given and looking at the consequences on the firm. The third stream looks at growth as a process and examines what goes on within the firm while it is growing. All three streams form the basis for many interesting and important discussions around the performance of RBSOs. However, due to the scope of this thesis, only the first stream of growth performance literature, *Growth as an Outcome*, will here be treated.

Performance is a multidimensional element, as it can be both objective and subjective, financial and non-financial (Walter et al., 2006). Assessing performance and disregarding one or several dimensions can easily be criticized as an oversimplification. However, as emphasized, the scope of most papers does not allow the possibility to assess all dimensions, and most may not even be capable of identifying all. It is therefore necessary to select the most relevant and accessible dimensions. Moreover, performance indicators will often ignore RBSOs that have been discontinued, thus not separating for example a high-performing RBSO that has been acquired by a large corporation from a poor-performing RBSO that went bankrupt. This is particularly an important limitation when assessing quantitative performance indicators.

Performance is essentially linked to the firm's growth, the differential outcome between at least two points in time (Penrose, 1959). Delmar and Wiklund (2008) argued that **growth in revenues** is the most effective growth performance variable as it translates easily across geographical regions and industries, and is also the measure of choice for entrepreneurs and investors. Furthermore, Shepherd and Wiklund (2009) found that **employment growth** seemed to be the unit of analysis with best concurrent validity across studies. Moreover, these two quantitative indicators are easily available from secondary databases in most countries. Financial statements over several years of development can provide a solid overview of the overall value creation of an RBSO, primarily by evaluating the development of operating profit and salary expenses. Employment size itself and its evolution can also provide a precise picture of the development run and current state of an RBSO.

For this thesis, it is important to recall the qualitative nature of the study. This gives a unique opportunity to assess more qualitative performance indicators. The **perceived present performance** of a RBSO can often prove a simple way of mapping performance (subjective and both financial/non-financial), encompassing many but varying dimensions. As such, it is a strong multidimensional indicator, but is potentially weak methodologically as firms have different perceptions and priorities when assessing present performance. For example, as McKelvie and Wiklund (2010) illustrate it, a major advertising campaign may increase sales growth but decrease growth in profitability, a perception of growth performance that may be perceived differently. It is thus a highly subjective indicator, but strong as it encompasses many variables.

Furthermore, many studies have used qualitative units of analysis where the firms were asked to account for their growth performance over a certain number of years, typically over a 5-year period (McKelvie and Wiklund, 2010). Several of these studies showed that many new firms start small and remain small throughout their existence (McKelvie and Wiklund, 2010). These firms are often disregarded in growth performance studies, an exclusion that is too restrictive as many RBSOs fall into the previously presented knowledge-based category. Delmar and Wiklund (2008) assessed these studies and found that the **initial willingness to grow** was able to largely predict **subsequent growth**. McKelvie and Wiklund (2010) however argued that this finding may be a setback for a consistent understanding of growth performance as it is a varying unit of analysis. Indeed, the intentions and goals of a firm may vary over time, and the acquiring of a new manager or the acquirement of a new external funding source such as a venture capitalist may entirely change the expectations of growth performance. It is thus important to be aware of these evolutionary changes when assessing this particular performance indicator. This is particularly relevant for RBSOs that hire surrogate entrepreneurs to develop the firm, often representing an important change in perception of future goals as was the actual case for some of the case firms presented later in this thesis.

Together, these units of analysis are highly relevant for RBSOs in particular and are easily available through secondary and primary data collection such as qualitative case studies. They will form the basis for further assessment of the performance of the case firms, and are summarized in the table below. As emphasized, it is essential to keep in mind that there are however important limitations to the presented indicators. Table 4 gives an overview of the performance indicators used in this thesis.

Table 4 - Performance indicators

Quantitative	Qualitative
Financial statements	**Perceived present performance**
Employment size	**Initial willingness to grow vs. subsequent growth**

4.2 Funding sources

A major constraint for the development of RBSOs is access to financial resources (Wright et al., 2007). Need for these resources change as the business grows (N. Berger and F. Udell, 1998) and depends on the nature of the RBSO. Entrepreneurs seek to lower the cost of obtaining financing through selecting sources of funding that are available at a low cost, thus *internal funding* – investments made by the entrepreneur, friends or family – is preferred over external sources (Rasmussen and Sørheim, 2012b). In most cases, the founders do not have sufficient personal capital to fund their own venture. Different *external sources* of funding are therefore necessary in order to ensure continuous development of the RBSO and its products. *Soft funding* is funding originating from government initiatives and support given by the associated PRI. *Private equity funding* includes informal investors such as business angels and professional investors such as venture capitalists – both private and corporate. A *strategic alliance* between a RBSO and an outside firm commonly involves shared funding of the product development. *Debt funding* is a rare source and mostly serve as leverage for the growth phases of RBSOs. Table 5 provides an overview of the funding sources available for RBSOs.

Table 5 - Funding sources available for RBSOs

Type	Stage of investment	Involvement	Financial contribution	Availability
PRI incubators	Pre-seed to Seed	Depends on incubation strategy	Depends on incubation strategy	High
Government programs	Pre-seed to start-up	None	Low	High
Business Angels	Pre-seed to start-up	Mostly high	Medium	Generally low, depending on access to investor network.
Strategic Alliances	Seed to start-up	Low in management, high in R&D	Medium to high	Generally low, depending on business sector
Venture Capitalists	Start-up to Exit	Very High	High	Low
Corporate Venture Capitalists	Start-up to Exit	Very high	High	Low

Throughout the next sections, each funding source will be reviewed individually. For each source, a presentation of the main theoretical findings will first be given, followed by a thorough theoretical analysis performed by the authors.

4.2.1 Internal funding

Internal funding is mainly obtained in two ways. First, the financial contribution by the "3Fs" (family, friends and fools) can provide a limited amount of capital in the earliest stages (De Clercq et al., 2006). It is procured through the founder's personal funds, interest-free loans or investments from family or friends as well as sweat equity in the form of time and effort put into the venture.. Secondly, the RBSO can cut their costs to reduce the overall capital need. Often, the PRI from which the RBSO emerge from offers use of their resources such as office location and access to testing labs, which for some RBSOs represent central early-stage costs. This way of cutting costs through acquisition and use of resources without raising equity or borrowing, or minimizing the need for funding by securing resources at little or no costs, is termed bootstrapping (Brush et al., 2006). It is important to note that only equipment and spatial resources offered by institutions will here be considered as bootstrapping (and thus internal funding). Access to for example competence within the institution or direct funding will be treated as incubation funding and treated in the next section.

Internal funding is highly dependent on the properties, abilities and attitudes of the entrepreneurial team (Vanacker and Manigart, 2010). Some founders strive to reach independence with their RBSO. This can be attributed to the reluctance of working for superiors, wanting to do their own thing or wanting to have control over their venture (Hessels et al., 2008). Furthermore, Hessels et al. (2008) found that entrepreneurs who were mainly motivated by this independence did not have a strong focus on growth and they were not likely to have high ambitions with their business. Conversely, those with low growth ambitions are less adverse towards external funding and rely more heavily on internal funding.

As established previously, RBSOs as a group include both technology-based businesses and technical consultancy firms. The development costs are higher for the product-driven companies than service-driven companies. Additionally, within the product-based group of RBSOs, ventures based on software have shorter time-to-market and lower development costs than other companies (Heirman and Clarysse, 2007). The companies that have lower development and production costs are less dependent on external funding and as a result use more internal sources when funding the growth of their venture. In some cases, the product or service offered by the RBSO has already been developed previous to the venture creation, and as a result, the RBSO can to a larger degree rely on revenues as part of the

investment structure from the beginning than those without a finished product at start-up (Politis et al., 2012).

The main advantage with this kind of funding is that the **ownership** of the RBSO is entirely kept by the founders. According to the *pecking order hypothesis* of Myers and Majluf (1984), firms tend to follow a pecking order when acquiring funding for their projects: internal equity, debt and then external equity. This theory reflects the mind-set that has been documented in other parts of the literature that founders wish to keep the ownership of their ventures within the founder group.

Founders have full disclosure of their own business and especially in the case of RBSOs where information asymmetries and uncertainties are highly relevant this is important for the founder. An additional advantage is that internal funding is much less costly than external funding, mostly due to the **little to none information asymmetry** associated with it.

The main disadvantage of internal funding is that the available funds almost always are **insufficient** to successfully develop a venture (Vanacker and Manigart, 2010), as most founders do not possess substantial financial resources to cover the start-up cost of the venture. While bootstrapping can be used in order to cut costs in some parts of the development, particularly companies that are established with a far from market-ready product have substantial product development costs that cannot be funded this way.

Another significant shortcoming is related to the related advantages of other funding sources, as these can offer other competencies the RBSO do not possess at start-up. As previously stated, managerial competencies in particular are lacking in high-tech start-ups. This poses the risk of **founder bias** when it comes to topics such as the commerciality of the technology or development of the company. While some founders prefer to keep the control within the group of founders, they might have predetermined opinions concerning central strategic patterns that potentially can lead the RBSO to wrong directions. For example, the most common shortcoming in relation to this is the commerciality of the final product. Several academics do not understand how to create a package of their research that is appealing to the market they want to attract, or they are targeting the wrong market (Vohora et al., 2004).

4.2.2 Soft funding

In general, initial funding obtained by RBSOs does not come from private sectors investors. Although it may vary across institutions depending on their level of prestige, RBSOs often need to obtain public sector capital before they can obtain private equity financing, referred to as the *finance gap* (Mustar et al., 2008). Shane (2004) presented evidence that even RBSOs from a prestigious academic institution such as MIT had trouble raising seed stage capital from private sector sources. He explained this mainly by the high uncertainty linked to the commercial exploitability of products or services deriving from new technologies. To answer this challenge, governments and institutions have engaged in numerous funding activities, as RBSOs represent a significant stimulus to local surrounding economy and job creation (Shane, 2004). In this thesis, soft funding will be divided into funding provided by government programs and funding provided by incubators, although these are closely linked to each other. Throughout the thesis, PRI is used to designate the institution of origin when it comes to initial research performed, thus encompassing universities, colleges and research institutes in one term. This generalization is considered appropriate for this part by the authors, as soft funding schemes seldom target a certain type of institution performing research (Rasmussen et al., 2012). Some minor distinctions between research institutes and universities/colleges will however be made throughout the rest of the thesis.

Government programs

Government funding is often the major source of funding during the initial period of technology development and allows RBSOs to develop their technology to the point where they can achieve private sector financing (Shane, 2004). Most researchers acknowledge that government funding is vital for the founding and development of RBSOs in the first place (Wright et al., 2007, Rasmussen and Rice, 2012, e.g. Queen, 2002). According to Shane (2004), there are several reasons for this. First, government funding allows technologies to be transformed to products and services, often referred to as the *proof-of-concept*. Second, it allows RBSOs to find commercial uses of their technology through market and customer need analysis. Third, government funding provides a way to decrease the risks associated with new technology. It thereby facilitates the obtaining of private sector financing, serving as a catalyst.

Every country has a different set of funding programs aimed at bridging the RBSO funding gap. Some target RBSOs exclusively while others target new technology-based firms in general (Rasmussen and Sørheim, 2012a). Several attempts to categorize the different initiatives have been conducted, among others by Wright et al. (2007) who divided them into six types of measures: (1) public funds focused on pre-seed, (2) public funds focused on seed stage, (3) public/private partnership funds focus on pre-seed

and seed phase, (4) schemes which leverage the deals made by adding public money to the private investment, (5) insurance schemes which guarantee part of the VC money in case of bankruptcy and (6) fiscal incentives and incubation schemes.

The recent study conducted by Rasmussen and Sørheim (2012a) identified three main types of public funding based on empirical data from Canada, Finland, Ireland, Norway, Scotland and Sweden. This model classifies the different initiatives by looking at the rationale behind, giving a more relevant categorization of the different types of programs. The three types of government programs are presented more in detail:

- **Proof-of-concept funding** aims at lowering the technological uncertainty of projects at an early stage by supporting technology verification. It is typically awarded as a 100% grant to projects. Some proof-of-concept schemes also provide competence-enhancing and networking activities. Usually, these grants are restricted to applicants approved by the TTOs to secure a proper anchoring of the project in the local infrastructure. The funding itself is most often administered by the projects themselves.
- **Pre-seed funding** aims at reducing organizational uncertainty by providing assistance in the development of business plans, strengthening the entrepreneurial team and networking with external partners. This type of funding is often administered by regional actors such as the TTOs. Much of this funding is done through initiatives such as counseling, training programs and indirect support such as leave-of-absence grants.
- **Seed funding** aims at reducing the overall investment risk by improving the availability of early-stage funding through direct funds to RBSOs. It is often designed as a "gearing" mechanism, by supplementing private investments with public loans or equity. Another approach is to set up public funds exclusively aimed at early-stage project or tax relief measures.

For RBSOs, the main advantage of government funding is the **low risks** associated with it. Government institutions require few guarantees, and an eventual failure in the formation of a RBSO does not have great consequences for the founders with regards to personal responsibilities (Lockett et al., 2005). This may however prove a disadvantage as the lack of financial responsibility could lead to entrepreneurs abusing the system with a "nothing to lose" attitude. Funding of projects with excessively high risks may lead to government funding being "wasted" in fruitless projects, hence negatively affecting the funding of other projects and increasing the selection criteria for later projects.

Another important positive aspect of government funding is its **stability** and relatively large independence of the market conditions. During the crises in 2001 (dot-com bubble) and 2008 (financial crisis), access to VC funding plummeted as markets experienced severe decline. Due to the difficulties of accessing capital, fewer projects were carried out and the chances for success decreased substantially (Darcy et al., 2009). The role of government funding becomes increasingly important in periods of recession. Furthermore, government funds are generally more important in regions where the industrial activity is not as high, in a way substituting the lack of industrial funding (Siegel et al., 2007). Stable access to government funding makes RBSOs less dependent of the economic cycles and influences.

From a holistic perspective, government funding programs were implemented as a result of the lost socio-economic value creation due to the risk adverse nature of the private sector in the early stages of RBSO development (Wright et al., 2007). This has positive implications for RBSOs, as the financing measures put in place have limited focus on returns and have a rather long-term focus (Rasmussen and Sørheim, 2012a). Governments also have limited involvement on the RBSOs operations, and do not generally require ownership or board positions in contrast to private equity investors. As a result, RBSOs have **high control** over their company after they receive government funds.

In several European countries, a perceived problem is that risk capital from private sector largely goes to specific geographic areas and to more mature technological fields (Borlaug et al., 2009). This is where government funding proves necessary as it **covers the funding gap** created by market failures between different regions and technological sectors, due to the private sector's investment preferences (Siegel et al., 2007, Ben-Ari and Vonortas, 2007). Thus, the more specialized the technology is or the more distant the institution is from industrial activity, the more valuable government funding becomes. Whether or not this is positive is however arguable, as it is, on a national basis, often better to focus on specific technological areas where you have a competitive advantage relative to the global market (Porter and Millar, 1985).

Governments are often focused on holistic and profit-inhibiting measures such as the environment or district activity enhancement that may be disadvantageous for RBSOs (Siegel et al., 2007). This could for example be requirements to what use the technology should have that could benefit the environment the most, or that production must be set in place in a defined area to promote regional growth. This overall focus often take shaped as **regulations** that conflict with not only the RBSOs interests, but also other additional investors such as VCs, as their goal is often more growth and profit-oriented (Sørheim et al., 2011). Hence, the implication for the RBSO is that there has to be a trade-off between the value of

governmental funding versus the economic value lost to the restrictions imposed by the government, both from the regulations and other potential investors.

Another negative aspect of government funding is that the investment process often has a large set of **reporting requirements** (Jones-Evans, 1998). This leads RBSOs to have to devote a lot of resources on time-consuming paperwork, resources that RBSOs with few employees often struggle to allocate. Additionally, there are usually several government institutions managing the different funding instruments, often leading to additional bureaucracy problems for RBSOs due to coordination problems between these institutions (Borlaug et al., 2009).

Lastly, government programs in general provide relatively **low financial contributions** to RBSOs (Wright et al., 2007). This is problematic as technology is not as basic anymore and the development process is costly, particularly within life sciences and biotech (Darcy et al., 2009). Markets have also become increasingly global, thus the introduction of new products or services often require a significant amount of resources (Knight, 2000). Researchers argue that the lack of large investments in the early stages has transformed the phenomenon of "funding gaps" into a situation of "thin markets" (Nightingale et al., 2009). Murray and Marriott (1998) presented evidence from all over Europe that suggested that the performance of early stage government funds is poor compared to later larger funds' performance.

Incubators

A PRI involved in technology transfer can engage in a variety of support activities to provide RBSOs with the resources and capabilities it needs to develop through its different phases (Wright et al., 2007). Today, most European PRIs organize these activities through own associated technology transfer offices (TTOs), which exclusively focus on the commercialization of research (Gulbrandsen, 2010). This leads to another interesting categorization where different so-called *incubation strategies* employed by institutions can be classified in terms of resources utilized, activities undertaken, and their goals and objectives. Wright et al. (2007) further examined these different strategies through a sample of 43 European PRIs. They identified three *reference models*:

- The **Low Selective model** has a mission towards maximizing the number of entrepreneurial ventures and relies on a natural selection process. Activities undertaken are mostly oriented towards raising entrepreneurial awareness among researchers and students. Funding is characterized by small amounts originating from public funds and ranging from 15 000 € to 100 000 €. Support is typically given at pre-founding stage.
- The **Supportive model** is oriented towards generating RBSOs as an alternative to licensing and tends to focus on profit-oriented RBSOs with growth potential. It takes its name from the extensive support it provides to the entrepreneurial team during the pre-startup phase. Key activities are incubation and business plan advice, and the funding is typically provided in the early stages through public-private partnership funds ranging from 350 000 € to 600 000 €.
- The **Incubator model** is oriented towards creating financially attractive RBSOs with focus on exit possibilities in the later stages. The PRIs are more proactively seeking opportunities, and resemble VC investors in their selection of projects and support activities provided. The funding scale is also similar to a VCs ranging from 1 to 4 million € in startup capital and followed by several investment rounds in the later stages. The staff is often more professional and the link with industry is tighter than the two previous models.

In addition, Wright et al. (2007) identified two *sub-optimal model types* related to two types of deficiencies.

- The **resource deficient model** type refers to the PRIs with high ambitions in terms of objectives but with the lack of resources to realize them. These are often trying to imitate other models without having the key success elements. These elements are for example sufficient financial resources and a strong regional network that support entrepreneurial activities.
- The **competence deficient model** type refers to PRIs with sufficient resources but which do not have the sufficient ability to perform the activities needed for success. Typically this deficiency is related to the institution employees' lack of experience and knowledge in the fields of entrepreneurship and networking.

Arguably the funding provided by incubators is by far the most **easily available** financing source for RBSOs, a fact that can be explained by the few barriers present between the different actors. As mentioned previously, the legislation changes that turned PRIs into IPR-owners lead institutions to take on a more active role in the commercialization activities. PRIs have become increasingly involved in the operation of TTOs and commit own resources for this purpose (Siegel et al., 2003). The advantages are mostly related to the close geographical proximity (face-to-face interaction), the low "psychic distance" between the founding entrepreneurs and the incubator employees and the evident fact that technology developed is a direct result from previously funded research at the institution (Darcy et al., 2009).

Not only is funding provided by incubators easy to come by, it is also **highly available**, as most institutions in Europe have established their own TTO (Darcy et al., 2009). High availability of funds is often a necessity to close the gap between academic research and commercial application. According to Rasmussen and Rice (2012) funding provided by incubators can be seen as part of the idea of extending research into technology development. In other words, risks associated with the high uncertainty of technology developed at institutions discourage industrial actors to take part in the technology development, making funding through incubators a necessity for many RBSOs. As stated previously, difficulty obtaining financing is considered by RBSOs as the main obstacle towards commercialization, an obstacle that incubator funding helps overcome.

Formation of RBSOs is however a costly mechanism for technology transfer due to the additional costs involved in the formation of a new firm, for example through acquiring market knowledge or time-consuming activities such as networking (Shane, 2004). Incubators in general have **tight budgets**, a

restriction that brings us back to the two sub-optimal incubation strategies that we presented previously (Wright et al., 2007). Consequences of the *resource deficient* type are the most obvious ones, as general lack of financial resources has been shown to lead to unsuccessful commercialization results. Budget constraints of incubators also directly leads to a competence deficient type of incubation strategy, as it often results in a lack of sufficient staff and necessary training programs at TTOs (Wright et al., 2007).

In addition to being funded through government programs, incubators receive funds directly from the institutions. Institutions' role as investors is disputed by several experts (Shane, 2004, Rory et al., 2004). The primary mission of institutions is creation and dissemination of knowledge through research and teaching, for which the institutions in large part receive taxpayer's money to achieve. This raises the **ethical dilemma** of using institution funds aimed at education and research to invest in high-risk formation of RBSOs. In addition, the underlying goal of achieving profit from RBSOs can reduce research on areas with limited commercial potential (Shane, 2004). Furthermore, involvement in potential unsuccessful firms can risk the institution´s prestige and reputation, making subsequent acquisition of financial resources from industrial actors more difficult (Rory et al., 2004).

Another negative aspect of incubator funding is the potential lower involvement of industry actors in the early stages. According to Shane (2004), high share of incubation funding can lead to less focus on commercial applicability, increased difficulties to work with private sector in later stages, and make introduction to market more difficult. In other words, it increases the "**academic naïveté**" of RBSOs (Shane, 2004). Too much affiliations with the institution could lead the RBSO into a confined "institution bubble", hence giving difficulties to adapting the technology to the business world.

4.2.3 Private equity investors

In this thesis, three types of private equity are considered: *Business angels (BAs), Venture Capitalists (VCs)* and *Corporate Venture Capitalists (CVCs)*. Start-up funds through private equity is vital for many start-up firms as informal, institutional and industrial investors can provide larger investments than most soft funding programs (Meuleman et al., 2009). Private equity investors accept more risk than e.g. commercial banks (Wright et al., 2006). This type of investor provide capital beyond the level that can be guaranteed by a venture's assets, thus seed-stage investors cannot shift risk to entrepreneurs completely and must bear some of it themselves (Shane and Cable, 2002).

Profit is an important measure for all private equity investors and return on their investments as motivation behind investment decisions is shared by all, but to different degrees. The ventures they invest in are therefore often regarded as means to a goal. Additionally, private equity investors share a selective behavior when choosing ventures to invest in (Berger and Udell, 1998). VCs for example have strict predetermined screening criteria potential ventures need to qualify for.

The size of the investment often qualifies private equity investors for partial control over the venture which is a reason for hesitance in seeking this kind of funding from the RBSOs point of view. In order to make sure they get the most out of their investments, private equity investors often take on an active role within the new venture and provide several value-adding activities. Mainly this additional value is provided through managerial and organizational competencies that RBSOs commonly lack. Often researchers and academics have a false impression on the commercial applicability of their product due to less market knowledge (Wright et al., 2004b), which these value-added activities can help substitute for. In the following sections, the different sources of private equity will be more thoroughly discussed from the perspective of RBSOs.

Business Angels (BAs)

BAs are individuals who invest their own capital directly into new ventures. They often have entrepreneurial backgrounds which gives them the needed knowledge of evaluating prospective investments. Although BAs share similar characteristics, they are heterogeneous in many ways (Erikson and Sørheim, 2005) and several attempts have been made in order to classify this kind of investors (e.g. Sørheim and Landström (2001), Avdeitchikova et al. (2008)). As individuals, they are hard to come across for the entrepreneur, and personal networks are important in order to attract this kind of investor. Most countries in Europe have established BA Networks (BANs) (Christensen, 2011). Typically, these networks are operated by a non-profit organization such as a university (Berger and Udell, 1998).

When it comes to BA funding, the trend seems to be that these investors enter RBSOs at an earlier stage than other private equity investors (Shane, 2004), often in pre-seed and seed stages. Their evaluation process is more subjective than the other two private equity sources, and often results in a preference for geographically close proximity and investments in ventures that, on a later stage, will attract funding from venture capital (De Clercq et al., 2006). Furthermore, the evaluation process is emphasized more by *agency risk* – the belief that the entrepreneur have the needed competence to bring the product to the market, than *market risk* – the assessment of the market potential of the venture (Wright et al., 2007).

BAs are **heterogeneous** (Erikson and Sørheim, 2005) when it comes to their technical focus, experience, targets, and motivation behind investments. A comprehensive categorization of BAs was made by Sørheim and Landström (2001) who split this kind of investor into four categories: The *Lotto Investor* who have a low investment activity and low competence in regards to founding and running entrepreneurial ventures, the *Traders* who have a high investment activity, but possesses low competence, the *Analytical investor* who have a low investment activity, but have a high competence and lastly the *business angel* who have both high investment activity and high competence. By consciously looking for suitable BAs, founders of RBSOs can look for a fitting investor rather than try to subjugate themselves to the demands of more institutional investors, a fit that can, in later stages, prove to be a competitive advantage. Deciding which type of BA to reach out for is an important decision for RBSOs who seek this kind of financing. In the following, the last category of business angels is the one discussed.

Like the other private equity providers, BAs aid the venture through **value-adding activities**. Politis (2008) found several ways the BA is involved in the development process such as providing consultancy services for the board of directors, and by promoting and protecting the venture's interests. This resulted in four different roles of BAs: (1) *sounding board/strategic role* – provide strategic advice to the entrepreneur, (2) *supervision and monitoring role* – shielding investments from potential managerial misbehavior through instating proper accounting information systems and by serving on the board of directors, (3) *resource acquisition role* – providing access to resources such as investor groups, business contacts and additional funding through their networks and (4) *mentoring role* – providing more informal support. (Politis, 2008).

More often than not, BAs have previous **valuable experience,** both as investors and as entrepreneurs. Firstly, most BAs have gained their funds through a successful start-up and subsequent buyouts (Politis, 2008). The entrepreneurial competencies BAs can contribute with are therefore highly relevant for new start-ups, and can be used as tools to reduce the market risk of the RBSO. Secondly, the networks BAs have built during previous involvement in start-ups or their own entrepreneurial venture provide connections that are useful for the RBSO. For example, the contribution of these networks can open up for additional funding (Politis, 2008).

Contrary to other private equity investors, BAs are **patient** investors; they have generally a longer time frame on their investments and do not require the same rate of return on their investments as for example VCs (Shane, 2004). In his work, Shane (2004) furthermore express the motivation behind BAs'

investments as not only return on investment, but also a genuine **interest** in the technology or business concept. This lets them become more involved in the creation process of the RBSO on a personal level and they will invest in ventures where they believe the entrepreneurs are the right persons to bring the technology to life (De Clercq et al., 2006). As a result, they do not require the same return on interest as VCs (Shane, 2004).

As other private equity investors, BAs want a degree of interaction and control over the progress of the RBSO, thus requiring some sort of influence on how the RBSO is managed in order to reduce the agency risk of the investment (Wright et al., 2004b). This control is however not as fixed as the demanded control from other private equity funders (Ehrlich et al., 1994). As already discussed, BAs depend more on this agency risk than market risk when choosing firms to invest in which imply that BAs are confident in the entrepreneurs abilities. For example, BAs are influenced from referrals when considering investment opportunities (Sørheim, 2003). With their confidence that the entrepreneur is the person to bring the RBSO to life, the need for personal control over the venture is reduced. Consequently, BAs demand **less control** over the ventures they invest in than other private equity sources.

The main disadvantage for this kind of investor is the **low availability.** While there is a trend of developing BA networks (Christensen, 2011), BAs are few and not easy to find (De Clercq et al., 2006). As a result, procuring this kind of funds is, in general, not easy. The number of RBSOs compared to BAs is big, and there are simply not enough BAs to fund the projects. In fact, the study by Sørheim (2003) found that informal investors come across more than enough investment opportunities, but lack the funds to follow through. Directly, this means that while BAs might want to invest in a venture, they do not have capacity to fund the development. As a result, the competition among RBSOs seeking this kind of funding increases.

BAs dispose **smaller funds** than other private equity actors do and consequently their contributions are relatively smaller. As a result, they risk being diluted if the business requires additional funding (Mason and Harrison, 2004), increasing the expected risk of entering the RBSO. Especially in technology-driven start-ups, there is a need for extensive capital investments in several phases, increasing the risk of dilution. Hence, BAs are often more hesitant to invest in ventures with uncertain technology.

Furthermore, due to the BA only being private individuals, the process is more **informal**. This can prove as both an advantage and a disadvantage. On the one hand, the informal approach can give the entrepreneurs more freedom to develop at their own pace. On the other hand, a relation-based

involvement of an investor can prove problematic when it comes to conflict management (Lee and Cavusgil, 2006). The potential conflicts that arise often depend on the actual level of trust between the BA and the entrepreneurs. As seen before, BAs give more freedom to entrepreneurs than other private equity actors. If this trust only shows at the surface, the parts might question each other's incentives which in turn lead to a less constructive working environment. Potential conflicts that are not dealt with accordingly can cause bigger troubles than necessary. For example, some BAs are more profit-oriented than others and have several similarities to VCs, and might take advantage of the less rigid relational collaboration between the RBSO and the BA (De Clercq et al., 2006).

Venture Capitalists (VCs)

VCs buy stakes in the entrepreneur's idea, nurture it for a short period of time and then exit the investment with expectations of high return on their investments (Zider, 1998). At any point of time, they have interests in several projects, thus they are portfolio-firms. These portfolios are evaluated continuously and every investment is made through a staged approach. VCs generally operate with a short time horizon on investments, often between five and seven years (Gorman and Sahlman, 1989). In order to control the progress they demand important decision making positions in the venture (Macmillan et al., 1987), and the level of control is much higher than for BAs (Berger and Udell, 1998).

VCs prefer to invest in later development stages, where the technology risk is lower (Berger and Udell, 1998) and investments are made in a staged process based on the performance of the RBSO (Dahiya and Ray, 2012). New ventures launched in large industries and those in industries that have stronger patent protection are more likely to receive venture capital funding (Shane and Stuart, 2002). Objective dimensions of venture development such as financial statements have significant impact on the probability that a venture will receive external financing (Eckhardt et al., 2006).

Tyebjee and Bruno (1984) distinguish between three phases of the VC investment cycle: *pre-investment*, *post-investment* and *exit*. In the different phases, respectively, the VC screen for the "right venture", monitor and provide values, and end the investment in the venture. The screening process of the VC in the pre-investment phase has been thoroughly researched. Emphasis is often put on the extensive and time-consuming nature of this process.

VCs seldom seek ventures in the latest stages of development, and at the same time no sooner than the seed-stage (Sahlman, 1990). In the earlier stages, the uncertainty concerning the technology and business concept is too high even for this type of investor. Information asymmetries and uncertainties

that often occur in connection with RBSOs are commonly attempted to be reduced with strict, pre-defined contracts on the investments (Sahlman, 1990) and staging of contributions (Kaplan and Strömberg, 2003).

The most common exit-strategy for RBSO founders is through a trade-sale (Wright et al., 2007). Other forms of exit are through an initial public offering (IPO), buyback of the VCs shares buy the founders or liquidation of the venture. IPO is often a preferred exit-method for both entrepreneur and investor as this type of exit often results in the highest valuation of the RBSO (De Clercq et al., 2006). Receiving venture funding is the single most important determinant of the likelihood of IPO, which in turn implies that much of the variance in new venture performance is attributable to the factors that affect the likelihood of VC funding (Shane and Stuart, 2002).

VCs are experienced investors and have competencies in several aspects concerning venture development, particularly when it comes to managerial issues such as business plans and financial administrative tools (Gorman and Sahlman, 1989, Sapienza, 1992). As a result, the VCs offer a varied selection of **value-adding activities** such as building the investor group, reviewing and helping to formulate business strategy and to fill in on the management team (Gorman and Sahlman, 1989). Time spent on value-adding activities is short but frequent, depending on the investor's position (lead/non-lead investor), and meetings are typically shorter ranging from monthly visits to quarterly visits (Gorman and Sahlman, 1989). As with the *resource acquisition* BAs, VCs offer social funding through providing access to professional networks and industries and thus give access to unique market information or increase the likelihood of additional funding by promotion (Berglund, 2011). As studies have shown, RBSOs typically lack in the managerial aspect of getting their concept ready for market, and deliberately seek founding through venture capital in order to gain these competencies (Colombo et al., 2010, Ortín-Ángel and Vendrell-Herrero, 2010). There have been several studies on these value-adding activities (Macmillan et al., 1989, Sapienza, 1992, Hellmann and Puri, 2002) which generally result in the acknowledgement that the activities varies along with the competence of the VC. VCs intensively monitor start-up managers, typically demand a large enough share to control the venture and demand representation on the board of directors, often in order to address information asymmetry related problems. Entrepreneurs receiving funds from VCs also appear to be more likely to gain access to additional rounds of equity at critical stages of their development (Ehrlich et al., 1994).

In the seed-stage and forward, need for financial support is high as the technology or idea start to develop. A main advantage with VCs as investors is the **high financial contribution** they offer in the

phases where capital is most needed. In fact, VCs can be considered the dominant form of equity funding of businesses that rely heavily on technology (Lerner, 2004, Berglund, 2011).

VCs are highly selective and only invest in the most promising ventures, thereby providing **increased credibility** for RBSOs (Colombo et al., 2010, Knockaert and Vanacker, 2011). In order to decrease the risk associated with information asymmetries and choosing the right venture, VCs' screening process often consist of extensive information collection and they seek to continuously develop their abilities in selecting ventures (Kaplan and Strömberg, 2003). Criteria for getting this kind of funding are consequently tough, and the start-up must not only show an appealing business idea, it must also prove that it has the entrepreneurial skills to bring the concept into life (Tyebjee and Bruno, 1984). Only the start-ups deemed the most promising will be considered for possible investments, thus funding through venture capital sends important signals about the start-up, even if the USO is only in the earliest screening process (Davila et al., 2003). As other market actors are aware of this screening practice, the RBSO can be associated with the same values of high potential and credibility that VCs portray.

The disadvantage of the capital provided by all types of private equity investors, and VCs in particular, is that the founders must give up parts of the ownership. VCs often invest enough to be qualified to a position on the board of directors where their opinions have significant influence. Of the three private equity funders, VCs are likely to place stricter control measures than any of the others and demand more reporting (Ehrlich et al., 1994). Additionally, according to Hellmann and Puri (2002), VC-backed firms are more likely to replace the founder with an outside CEO. Consequently, founders may feel **loss of control** of their own venture.

A supplementary disadvantage to the demanded ownership position of VCs is the potential for **conflicts of interests**. VCs often have the organizational or managerial understanding to drive the development of the RBSO, but may lack in technological knowledge. As a result, their emphasis when making decisions for the RBSO is influenced by this (Wright et al., 2007). While the entrepreneurs tend to have a personal attachment to the RBSO or the technology, the VC regards it as a means to create returns.

Combining the two above-mentioned disadvantages, there are several potential areas of conflicts where the loss of control is particularly apparent. For example, determining time spent on developing the technology, the relevance of the technology for the market, understanding the market potential or using market knowledge to further develop the technology may be sources of conflict. VCs will push towards

commercialization while RBSOs often will push towards more technology development, and the loss of control may be enhanced as the entrepreneurs and the VC representatives have conflicting opinions.

VCs frequently evaluate their portfolio of investments; they weigh further investments in current portfolio companies against new potential ventures which are a constant trade-off between costs of development and uncertainty against the potential for revenues in the future (Gorman and Sahlman, 1989). As a result, if the VC owner group decides the investment is no longer beneficial for the VC, they will liquidate the project. Alternatively, the VCs do not have the funds for further investments even though they want to continue investing. As VCs often hold the majority of shares, there is not much entrepreneurs can do in order to keep the RBSO running with the exception of buying back the venture. As a consequence, investments by VCs bring along a threat of **premature liquidation** the RBSO. For example for a technology-based RBSO where the time needed to develop the technology in order to make it ready for the market might exceed the preferred time horizon of the VC thus leading to a liquidation in order to reduce costs.

Corporate Venture Capitalists (CVCs)

The investments in external start-ups by corporate funds can be defined by two features: the objective of the investment and the relationship between investor and venture (Chesbrough, 2002). Where the VCs main objective with an investment is financial, CVCs usually have more diverse and complex strategic objectives as well (Park and Steensma, 2012), seeking synergies between the parent company and the venture (Chesbrough, 2002). The strategic objectives of the CVC may however conflict with the interests of the RBSO, where the investor may be more interested in the technology than the venture itself (De Clercq et al., 2006). The second characteristic of this kind of investments is the linkages between the RBSO and the CVC's current operational capabilities. In investments where the venture is closely linked with the CVC, additional value-adding properties such as access to manufacturing plants or distribution channels become available for the start-up (Chesbrough, 2002).

RBSOs are chosen based on their potential strategic contribution to the parent company and the chance for an acquisition or a trade-sale at a later stage is high (De Clercq et al., 2006). The study by Park and Steensma (2012) revealed that when specialized complementary assets were needed, CVC-backed firms were more likely to reach an IPO. Additionally, they deemed CVCs as more beneficial when the operational environment of the RBSO was characterized by high uncertainty. RBSOs operating in stable markets are able to predict their resource needs and equity ownership is less important as it is less

opportunity for opportunistic behavior. In uncertain environments, the performance of CVC-backed ventures is enhanced compared to non-CVC funded ventures (Park and Steensma, 2012).

Corporate venture capitalists represent most of the same advantages as the VC. They are able to provide a relatively **high financial contribution** at a critical time in the venture development, and participate in the development process through **value-adding activities**. Furthermore, their access to networks are highly relevant for the RBSO (Chesbrough, 2002). As with the VCs, RBSOs backed by CVCs will receive an **increased credibility** in the market as the technology is deemed interesting by a highly selective investor. If the CVC holds a respected brand, this could be extended to the RBSO (Chesbrough, 2002).

In addition to benefits shared with the VC, CVC investments also include the option of **industry experience**. The competence of the CVC management often includes technical capabilities, especially within the operation field of the parent company. As a result, the investors can appreciate that development of technology might take more time. An additional advantage of the industrial experience is that the networks provided through the company are related to the business area of the RBSO to a greater extent.

Involvement of a corporate investor may also have some disadvantages. For one, the parent company's strategic interest could be different to the RBSO's, and as with VCs, this might cause an additional **conflict of interests**. The potential conflict concerning profit versus technology that VCs represent is still valid for CVCs, but the strategic interest provide the investor with another important factor to account for when making decisions. Investments in RBSOs as a way of outsourcing R&D leaves the CVC susceptible to exploit the properties of the RBSO (De Clercq et al., 2006). Motivation behind the investment decision is to create value for the parent company, and consequently, if the RBSO cannot contribute to increasing this value, the CVC may pull out of the investment. Furthermore, there might be underlying motivations behind strategic decisions which will subordinate the RBSO to the parent company (De Clercq et al., 2006, Chesbrough, 2002).

Funding from a corporate actor will establish a lasting link between the RBSO and the parent company. Involvement from one market actor can cause other companies in the same sector to be **hesitant in investing** in the RBSO as an extension of their competitor (De Clercq et al., 2006). One could argue that co-investment with a direct competitor is not a preferred situation for most companies, as investment in other companies that are subordinated to another company's practice will conflict with own interests.

Alternatively, the potential customers might be hesitant in acquiring the products as they consider this an extension of the parent company (Park and Steensma, 2012).

4.2.4 Strategic alliance (SA) between a RBSO and an industry partner

CVC is the option for firms to indirectly invest in new ventures. A direct approach to corporate investments is through SAs. For the purpose of this thesis, a SA will be defined as a relationship between a RBSO and an industry partner to pursue a set of agreed upon goals or to meet a critical business need while remaining independent organizations, hence excluding the alternative where the outside firm owns equity in the RBSO. SAs will in this thesis include both technological agreements (e.g. research joint ventures and technology sharing agreements) and commercial agreements (e.g. joint distribution agreements and customer-supplier relations) (Colombo et al., 2006).

Whilst many researchers and academic entrepreneurs have collaborated with industry partners on research projects, the literature on this subject is limited (Wright et al., 2004a). A study conducted by Lubik et al. (2013) shows however that the formation of alliances for RBSOs in particular is surprisingly common. Indeed, more technically innovative firms and firms in emergent markets exhibit greater likelihood of alliance formation (Colombo et al., 2006). The main rationale behind such collaboration lies in the potential gains for both partners. From a RBSO's perspective, the industry partner can contribute with crucial resources such as capital, development know-how, technological capabilities and scale-up facilities. Additionally, industry partners can often contribute with important complementary assets such as market information and market access (Lubik et al., 2013). From the industry partner's perspective, the RBSO provide the technology and solutions the firm needs to achieve competitive advantage in the form of innovation. In other words, the RBSO can be seen as a form of outsourcing partner of the R&D operations of the firm (Eisenhardt and Schoonhoven, 1996). Hence, a SA represents a great opportunity to create value from "getting the best of both worlds".

Moreover, Eisenhardt and Schoonhoven (1996) argued that firms capitalizing on founders strong social positions is another important basis for alliance formations. These social positions include personal relationships, status and reputation of key individuals and capitalizing on these has been shown to create higher awareness of opportunities of alliancing. In addition, strong social positions give increased knowledge and trust among potential partners, especially beneficial for the high information asymmetries associated between RBSOs and industrial partners (Eisenhardt and Schoonhoven, 1996). The predominant factor found in the literature that allegedly hinders alliance formation is related to the small size of RBSOs. Indeed, SAs potentially lead to high transaction costs, often unbearable for the

limited resources of RBSOs (Colombo et al., 2006). The time and attention of the few employees in an RBSO are valuable resources, and the costs of searching, assessing, negotiating and later managing a SA will take away these resources from critical core activities.

In essence, a SA gives a **competitive position** that otherwise would not have been possible (Teece, 1986). The outside firm does not always possess the technology or idea it needs to develop an innovative product, while the RBSO lacks the financial strength and market expertise to be able to enter a product development phase with acceptable associated risks. Given the outside firm´s prior knowledge of its industry and an overall superior "**market intelligence**", it possesses a great advantage in developing opportunities from an industry-relevant technological discovery (Wright et al., 2006). A key word here is the firm´s knowledge of the customer's unmet needs, which leads to an accelerated product development process and reduced development costs (Tsang, 1998). Furthermore, the industry actor often has managerial expertise that facilitates the commercialization process, as well as access to superior facilities and equipment that the RBSO does not have initially (Miles et al., 1999).

Another positive aspect is the **increased credibility** the new venture can acquire from this cooperation (Wright et al., 2004b, 2006). The prestige of the university or research institution where the RBSO originates from in addition to the outside firm's reputation gives the SA both the recognition of accomplished research and market competence. A key word here is **legitimacy**, a feature crucial for the often pioneering technologies that RBSOs try to implement (Eisenhardt and Schoonhoven, 1996). Tying the technology to established firms and making them spend resources on developing it can often outperform other rival technologies.

An important difference between a SA- and VC/CVC-backed RBSOs is that the SA relation is more **constructive** (Wright et al., 2004b). Usually, the only common goal that exists between a VC and a RBSO is the goal of growth and profit. A SA on the other hand will have other equally important common goals, such as for example knowledge transfer through trade of technology and market competence, or the reduction of development and production costs. Furthermore, the possibility of retaining independence as an autonomous entity while receiving the competencies and capabilities needed for successful commercialization makes SA a preferred alternative to equity investors (Miles et al., 1999).

There are however always goals not common to both parties, constituting possible **sources of conflict**. The question of who should own the intellectual property rights of the technology developed will often be problematic. In the same way, industry partners will often claim some form of exclusiveness, limiting

the market potential for the venture (Forrest and Martin, 1992). There will also be a discussion during the product development, as the firm often will require product properties to be specific for their corresponding product portfolio, while the RBSO would want the product properties to be compatible with the rest of the market. Another source of conflict could be that firms often have a shorter time horizon and are less ambitious than the ventures (Forrest and Martin, 1992). The interest of the outside firm will often only lie in covering one specific technological need for their product line giving them the competitive edge on the rest of their competitors. A RBSO on the other hand is looking to establish itself as a solid firm, and will often aim at developing the products and solutions further with a more long-term focus.

The **power distribution** between the two partners is also potentially problematic, as outside firms are significantly stronger financially and have little dependence on the RBSO. The RBSO on the other hand possesses few assets and will be tied up to the firm when collaboration has been initiated (Miles et al., 1999). This high dependence gives the industrial actor a higher bargaining power, and is a possible source of exploitation of the RBSO. Furthermore, Lubik et al. (2013) suggested that RBSOs that had several alliances had increased and more sustained commercial success, thus pointing out the potentially vulnerable position of only relying on a single alliance partner.

Cultural difference between academic environments and the business world may also prove a disadvantage (Shane, 2004). Researchers and academics are often not used to being pressured by time aspects and managers, as well as the high focus on income potential from the outside firm. Another factor for academics is that collaboration with outside firms leads to more confidentiality measures, hence no academic recognition or publication reward (Siegel et al., 2007). Lastly, an important disadvantage of collaborating and receiving funds from the private sector is that several soft funding alternatives will no longer be available (Wright et al., 2004b).

4.2.5 Private Debt Funding

A simplified version of the debt funding process is that a loan is issued from a lending institution, which is to be paid back within a given time period against an interest rate which rises along with the uncertainty (Berger and Udell, 1998). It is important to note that only the debt funding provided by private lending institutions is here considered, hence excluding soft and internal loans.

When seeking funding by credit, the uncertainties the RBSOs represent are particularly critical. Banks are highly risk-adverse, and lending money to a high-risk project such as a RBSO is rare (Colombo and Grilli,

2007). As already thoroughly discussed, the technological uncertainties and high information asymmetry that RBSOs embody severely increase the risks associated with them. This is intensified by the often absence of audited financial statements in the early stages, and a way to decrease this is through collateral and guarantees (Hogan and Hutson, 2005). Berger and Udell (1998) found that most small businesses that actually have loans are in fact backed by collateral of either the firm's or the entrepreneur's assets or through guarantees. This is however a rare luxury for RBSOs in particular, as human capital and IPR are often the only assets they possess. Hence, the limited tangible assets highly constrain the size of the loan that lending institutions can justifiably provide (Mason and Harrison, 2004).

Audretsch (2004) argues that debt funding for RBSOs is essentially an **inappropriate mechanism**, as the administrative costs for lending institutions to assess the creditworthiness of RBSOs are too high. Indeed, lending institutions are almost unanimously generalists, thus have difficulties in evaluating technology projects due to too high information asymmetry. In addition, the fact that banks cannot benefit from the higher expected returns to the same degree as other funding actors further emphasizes the unsuitableness of debt funding for RBSOs (Colombo and Grilli, 2007). The underlying goal of a lending institution is solely to secure the loan back with interest, with minimal risks associated with it. Compared to the previously presented funding sources, there are no value-adding activities or network access associated with bank loans.

Despite the inappropriateness of debt funding, there are some advantages. The most obvious is that it does not require entrepreneurs to give up ownership. **Independence** can often be considered as the main motive for starting a firm, and is the main rationale for seeking private debt funding (Hogan and Hutson, 2005). Moreover, the interest payments are **tax-deductible,** thus potentially reducing some of the operating expenses (Hogan and Hutson, 2005).

However, there are also some significant disadvantages with debt funding. Firstly, lending institutions generally require a fixed schedule of repayment, thus ignoring the varying performance of the RBSO (Ben-Ari and Vonortas, 2007). If the firm experiences a period of low income and is not able to reimburse the periodic payment, it can potentially **default**. This is particularly negative for RBSOs, as many require a lengthy and uncertain product development process. Secondly, debt has a negative impact on the firm's cash flow, as revenue that should be reinvested into the company is forced into repayment of debt (Ben-Ari and Vonortas, 2007). Thus, private debt funding may in some cases prove somewhat short-term, as it potentially **inhibits future growth**. Lastly, debt funding reduces the incentives for private equity actors to invest in a RBSO, as debt holders are more strongly protected by law (Audretsch, 2004). If the RBSO is

financed both by banks and private equity, it is the lending institutions that get the money back from selling assets or collateral owned by the firm. Hence, debt funding practically implies **disregarding private equity** as complementary source.

To conclude, the literature suggests that private debt only play a minor role in early stage financing of highly innovative firms (Audretsch, 2004, Colombo and Grilli, 2007, Van Osnabrugge and Robinson, 2000, Wright et al., 2006). It is only in the late growth stage, where much of the initial uncertainty has disappeared and the firm experiences positive cash flows, that debt financing becomes more suitable. The need for leverage however only arises for firms with high resource needs, typically high-growth firms with high concept maturity (Bottazzi and Da Rin, 2003).

4.3 Summary of funding sources

As funding sources is a leading topic for this thesis, the authors decided to perform a thorough theoretical analysis based on an extensive literature study. This provided insightful knowledge and permitted the authors to perceive the prominent strengths, weaknesses, opportunities and threats for each source. The result is summarized in the next table. Throughout the thesis, these perceived characteristics formed a solid framework for gathering empirical evidence and further analyzing the results. Table 6 provides a summary of the funding sources discussed in the previous sections.

Table 6 - Summary of funding sources

Source	Strengths	Weaknesses	Opportunities	Threats
Internal funding	- Independence - Little-to-none information asymmetries	- Lack of complementary competencies - Small contribution	- Founder makes decisions	- Lose perspective over commercial potential - Critical decisions
Soft funding	- Stability - High control - Availability	- Regulations - Reporting requirements - Low financial contributions	- Covers funding gap - Low risks	- Nearly inexistent
Business Angels	- Experience - Networks - Value-added	- Low availability - Smaller funds - Informal process	- Investor heterogeneity - Patience	- Success might not work other places
Venture Capital	- High contribution - Competencies	- Information asymmetries	- Value-adding activities - Increased credibility	- Conflict of interests
Corporate Venture Capital	- Industry experience - High contribution	- Information asymmetry - Strategic motives	- Increased Credibility - Value-adding activities	- Conflict of interests - Other hesitant in investments
Strategic Alliances	- “Market intelligence” - Constructive relations	- Power distribution - Cultural difference	- Competitive position - Increased credibility	- Conflicts
Private debt	-No external influence	- Inappropriate mechanism	- Tax-deductible	- Default the company

4.4 Note for further reading

The literature study has hopefully provided the reader with a deeper theoretical understanding of the central topics surrounding RBSOs and the funding sources available to them. Throughout this chapter, several frameworks were developed such as to reduce some of the complexity characterizing RBSOs, and further give the authors suitable tools to present the gathered empirical data in a meaningful and transparent way. Hopefully, the reader will find this approach relatively simple to follow.

In the following part, the empirical results will be presented in a narrative way following copiously the structure employed in the theoretical part. Hence, the first part will present the main characteristics of the case firms. The stage-model will provide a sound basis for evaluating where the RBSOs are in the development process. Further the RBSOs will be categorized using the developed typology. Last, the performance indicators will serve as basis for assessing the performance of each of the case firms in the sample. The second part will present the main empirical findings concerning each funding sources, and each will systematically be summarized in a table to facilitate the interpretation for the reader.

5 Empirical results

5.1 RBSOs

5.1.1 RBSO development process

During the theoretical examination, a stage-model of RBSO development was appointed. As a reminder, an important expansion was made that incorporated critical junctures to pinpoint the transitions between the different stages. The stages and critical junctures include several activities that must be performed in order to proceed to the next stage. In the following, each individual stage will be discussed chronologically. Figure 4 provides an overview of the present situation for the case firms. The blue dot evidently represent their present situation, while the "**X**" represents either failure to perform the set of activities in that particular stage or failure to overcome a critical juncture.

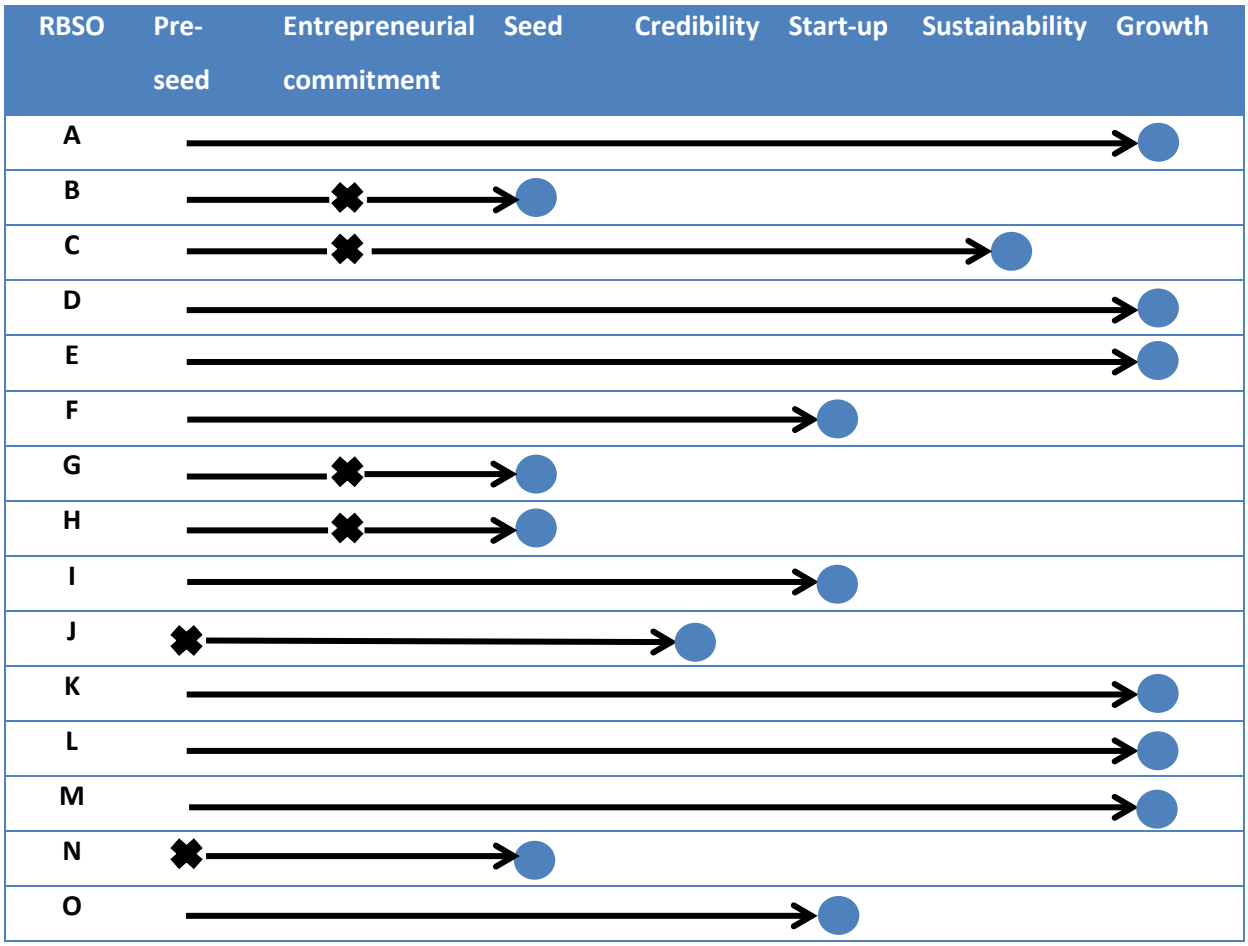

Figure 4 - RBSO development through the stages

As a recapitulation, it is in the *pre-seed* stage that the business idea is recognized. There are two aspects of the idea recognition; the technical and the commercial. All the case firms in the sample had evaluated the technical opportunity of their technology, or had started the venture with the aim to further research the opportunities of the technology. The commercial potential was however significantly less evaluated or at least was given less importance from the entrepreneurs. Evidently, most of the companies started up with an idea for the commercial use of their technology, but the actual work of screening it was however not a central part of the process in this stage. Particularly, lack of understanding of how to create a commercial package of the technology seemed to be critical for the companies. For example, firms C and O only identified these commercial opportunities at a later time. Companies G and H, under direction of their incubator, stated a current consideration to together form a collaborative commercial package. The founder of company J started the company in order to develop the technology further and initially knew which markets they wanted to target. There was however no actions taken in order to reach the targeted market. In addition, company N had an idea for which market to target, but had not researched how to introduce their product to the market. There were however some exceptions, such as for example firm A that was a product of an entrepreneurship school at a university and therefore the commercial potential of the technology was assessed as part of an educational project, and company O that changed their target market when a new investor entered the company.

Already in the first critical juncture of *entrepreneurial commitment,* several of the companies revealed shortcomings (company C, G and H). These were companies that had founders who were still employed by their PRI, and thus needed to juggle responsibilities in both their research job and in the RBSO. In addition, the fact that they had a stable income arguably decreased the incentive to develop the company further. A particular case was Company B, where the researcher was asked if he had any research that could be exploited in a RBSO, but had other commitments, and as a result was not as eager to follow up the technology development within the company. As he said: "*I did this with my left foot. The student who wrote a thesis on the project was not interested in the business part of it. No one really had the passion and the resources to continue this".* This company was later dissolved. Company C was a unique and interesting case in the sample, as they hired an external CEO in order to push the firm forward. The lack of commitment from the initial founders led to stagnation of the company in the start-up stage as will be discussed later on.

In the *seed stage*, the technology is further developed and strategic plans are implemented. As a result, managerial competencies among the founders become increasingly important. RBSOs like company D, F, I and O, where the founders had previous experience with start-ups, proved to put a greater emphasis on the strategic part than others in this particular stage. Five of the companies

seemed to have stagnated in this stage. Interestingly enough, neither of these five had focused on strategic aspects in the previous development. Company B was dissolved before it could evolve further mostly due to lack of entrepreneurial commitment, and company J suffered in this stage as they had no apparent strategic plan for reaching out to the market. Subsequently, they did not receive sufficient funding in order to develop further. Other companies such as G and H only recently seemed to find a strategic direction for their technology, as given by the common board leader in both companies:

> *"These companies are underfunded, single solutions with a bit of a 'shaky' foundation. We are considering the possibility of merging these two and a third company […].There is a larger commercial value if we merge the companies and services into one."*

The threshold of credibility is the second critical juncture. The focus here includes creating credibility among industrial actors and potential customers towards the RBSO. Ten of the companies had moved past this threshold. Company J on the other hand seemed to have stagnated in this stage before it was sold. The technology development reached a point where new capital was needed in order to develop further. It proved hard to gain the necessary funding and lack of funding ultimately led the entrepreneur to sell the company. The technology was however not brought further in the buying company.

In the *start-up* stage, all the RBSO had become legal entities. In most cases, the entities were started in earlier phases, while companies such as C and I established themselves only in the start-up stage. The essential aim in this stage is to have a market-ready product. Six of the companies had introduced their product or service to the market. Further, this was the stage where the shortcomings from the previous stages and transition phases become distinctly evident. A common response to the perceived development during interviews was that it was lengthier than expected. Company F ran into collaboration problems with their industry partner concerning their patent, and was to a certain degree successfully sold. Moreover, Company I was sold in this phase, as they considered it beneficial to continue the development of the RBSO through an industrial acquirer that could provide a large distribution network rather than grow independently.

The third critical juncture, the *threshold of sustainability*, is where the management needs to re-configure their resources and turn weaknesses into strengths. Company A employed a CEO with managerial background in order to overcome this threshold that proved successful. Company C also hired a surrogate entrepreneur, and went from stagnation in the start-up stage, mainly due to underperforming in all prior stages, to finally beginning to move further. However, even though this company started to generate revenues that kept the company *"barely floating"* as put by the CEO,

the company was still dependent on support from the incubator. Companies K, L and M were all service-oriented companies which had a shorter development period, and were able to receive revenues from early on. As a result, they all had sustainable operations today.

Lastly, the *growth stage* is where the companies generate sustainable returns and aim at further growth. Companies A, D and E had all reached this expansion stage and were all seeking international markets. Companies L and M had no particular growth strategy, and claimed that they had grown as much as they wanted. Lastly, Company K had stable growth and was not interested in increasing the growth rate, as explained by the CEO: "*We have had an annual growth of 20% until now. That is a suitable growth in order to keep the quality in what you do."* As a result, these last three companies seemed to have matured and on their way out of the growth stage.

5.1.2 RBSO typology

The empirical case study investigated 15 RBSOs. As can be ascertained by reading about the wide variety of development runs and ultimate faiths of each of these cases (for further reading, see appendix 2), the RBSOs were formed on diverse concept maturities and experienced significant differences in resource needs along the way. On the basis of the developed typology, the authors distributed the case firms to the corresponding type of RBSOs. The categorization ended up as illustrated in Figure 5. In the following, empirical evidence to support the categorization will be revealed

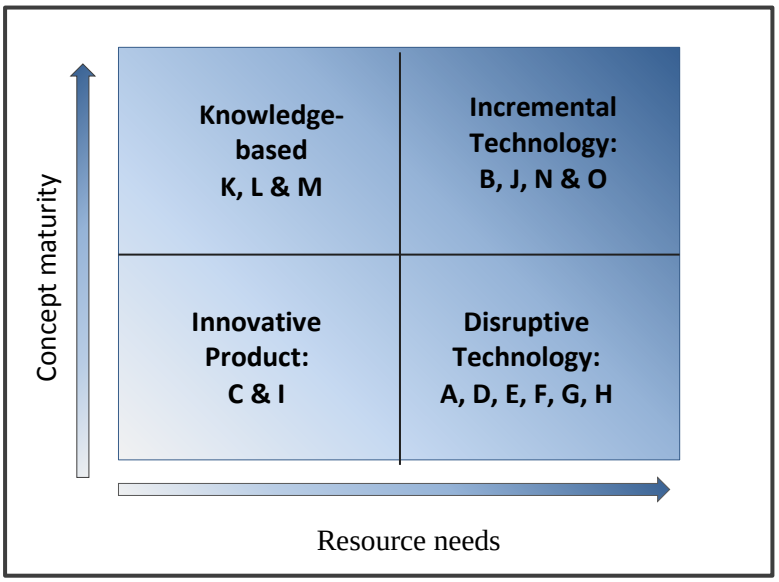

Figure 5 - Typology of the cases

Knowledge -based RBSOs

Knowledge-based RBSOs are, as the name implies, based on the knowledge of the founder, and are often formed as technical consultancy firms. Among the cases, this description particularly fitted Company K, L and M. It was important to not mix this type with RBSOs where the entrepreneurs resorted to consulting in order to keep revenues coming as part of the financial mix. For instance, company C had a technology product as their main product offering, while knowledge-based RBSOs often base their operations on consultancy services.

In addition to the service-oriented offering, all companies within this group also shared the fact that the founders were able to employ themselves full-time contrary to founders of other types of RBSOs. This was mainly due to an already existing client-base at start-up, and as a result, generated revenues from day one. This evidently led these firms to be much less dependent on external funders. Company K was partially owned by the research institution in which it originated from, and as a result, they gained the necessary funding from the incubator. Moreover, company L had an agreement on partial funding of their projects, which made them less dependent on client claims. Company M was lucky enough that they had a contract partner ready at establishment of the company, a contract that had provided them with a stable customer-base since start-up.

The growth ambitions of each of the companies were rather small. Company L had slowly built their stock of employees correspondingly to the growth of their work, but their growth was exclusively organic. Company K had recently opened up a subsidiary in Sweden, and was among the companies that employed the most people in the sample of case firms. Company M deliberately chose to be small, as the founders exquisitely desired a small team. The co-founder of this company expressed it the following way:

> *"We do not have a growth ambition now. We are content with keeping the current level […] We were six employees previously, but then he quit and then we will not employ anyone new now. Any more [employees] than that is not anything we want […] because then you need administrative employees etc. and then you reach a completely new financial level"*

Innovative product –based RBSOs

Innovative product –based RBSOs are founded when the product offering is close to market-ready. These RBSOs are often founded on the basis of previous extensive research at a PRI, and the technology development of the initial product is close to completion. Company C and I were assessed to correspond with this description, as both companies originated from considerable research and had strong links to their PRI of origin. For company I, the research institution from where it

originated from had a commercialization model that actually required own RBSOs to be based on near to complete R&D performed at the institution. This was thoughtfully expressed by the interviewee from this particular research institute:

> *"In our system we have a tradition for not starting ventures unless we have a clear idea and we work consciously with business plans and … so that there is a good basis for the venture. […] So we have not started many ventures. Common for all we have started is however that there is a substantial R&D behind them."*

Company C had a slightly different business model. They were able to market their product shortly after the start-up. However, the founders still were employed at the research institution after start-up. Contrary to Company I, this company had less growth ambition after start-up and as a result, the company did not have the funding necessary to employ the researchers full-time. The growth ambitions later changed with the recruitment of a hired executive to develop the venture, an interesting case that will be further analyzed in the next chapter.

Incremental technology –based RBSOs

Incremental technology –based RBSOs, contrary to Innovative product –based RBSOs, establish the ventures with still much R&D to perform before their product offering is ready for introduction to the market. Among the cases, company B**,** J, N and O fell into this category. An important distinction for these firms was that the technology developed was not as innovative and disruptive as some of the other RBSOs, but rather represented the mentioned "incremental" step. Among the companies in the sample that were found here, company N had patented a technological tweak to an established tidal energy solution. Another example was company O, where the business idea was based on technology that was originally developed for another business area.

None of the RBSOs in this category managed to finalize a commercial product as of 2012. A main reason for this was claimed to be the lack of funding for the further development of the initial business ideas. Company B was dissolved at an early stage, while the technological solution of company J was forced sold due to lack of funding.. Company N had procured interested industrial partners, but was not able to gain the necessary funding in order to create a prototype.

Disruptive technology –based RBSOs

This type of RBSOs is based on a disruptive technology and typically has high growth ambitions. In the empirical sample, Company A, D, E, F, G and H were considered to be part of this category. A common fact for all these firms were the close relationship they had with the industry In order to acquire enough funds to develop the technologies, as well as industry acceptance. For instance, company F had several strategic alliances with central industry actors in order to test their product. Others, such as Company A and E, were dependent on facilities and market knowledge provided by their industrial partner to develop their initial technology.

A common feature for these firms was that many had international operations. Company A, D and E all cooperated with globally present industry actors, and were planning to grow through these partnerships. For instance, during the work of this thesis, company E acquired a world-leading industrial partner that contributed with significant funds to expand the RBSOs operations. While the technology of company F was somewhat successfully sold, company A, D and E all had sustainable operations.

Further, companies G and H were still in the earliest stages of development, and growth-wise seemed to have stagnated. Their technology was among the more disruptive and high-tech technologies in the sample, but several factors had impeded their development. The analysis of the empirical results will offer further enlightenment around these factors.

5.1.3 Performance

The aim of this thesis was to reveal the impact of funding sources on the performance of RBSOs. In order to achieve this, it was therefore essential to measure and establish the performance of the case firms. As ascertained through the theoretical discussion around performance indicators, this was a rather challenging task as there is no set formula to perform this. Fortunately, a set of indicators were developed and were later applied to the empirical analysis of the case firms, which resulted in the distribution shown in Table 7.

Table 7 - Performance of RBSOs

Case firms	Growth in revenues	Employment growth	Perceived present performance	Initial willingness to grow vs. subsequent growth	Overall assessed performance
A	Very high	Very high	Very high	Medium	**Very high**
B[1]	-	-	Bad	Bad	**Bad**
C	High	Moderate	Good	Bad	**Medium**
D	Very High	Very high	Very high	Very good	**Very high**
E	Moderate	Moderate	Very high	Medium	**Good**
F[2]	-	-	High	Bad	**Good**
G[3]	Very low	-	Bad	Bad	**Bad**
H	Negative	Negative	Bad	Bad	**Bad**
I[4]	-	-	Very high	Very good	**Very high**
J[5]	-	-	High	Medium	**Bad**
K	High	High	High	Good	**Good**
L	Very high	Stagnated	High	Medium	**Medium**
M	Stagnated	Stagnated	High	Good	**Medium**
N[6]	Negative	-	Bad	Bad	**Bad**
O	Negative	Stagnated	High	Bad	**Medium**

[1] Company closed down.
[2] Company sold.
[3] No permanent employees.
[4] Company sold.
[5] Company forced sold
[6] No permanent employees.

Growth in revenues and *employment growth* were assessed through the preliminary secondary data collection performed, and are based on the previous 5-year existence of the RBSO. For the attentive reader, the data collection method was presented in chapter two. The companies that were sold or had no employees registered could however not be assessed by means of these indicators, as can be observed by the gaps in the table.

Further on, the primary data from the case study was analyzed and incorporated in single terms (e.g. "Good", "Medium" and "Bad"), a data compression performed by the authors themselves as a result of an overall assessment of each case firm interview. As can be observed, the *perceived present performance* often differed from the perception of *initial willingness to grow vs. subsequent growth*. This is largely due to the latter variable explicitly incorporating the initial intentions and goals of the case firm, an aspect that change over time. Several of the firms did for example hire new managers or encountered large hinders (e.g. technological challenges resulting in extended R&D process or lack of funding), thus changing the expectations to the performance of the firms, and thereby the *perceived present performance*.

Ultimately, the overall evaluated performance was not based on a weighted mathematical formula, but on a subjective assessment from the authors. This was essentially due to the nature of the study, as qualitative data is rather difficult to conceptualize into tangible measures.

5.2 Funding sources

Choice of funding source varied considerably among the RBSOs in the study. Almost every RBSO had internal funding as part of their funding mix, while few used private equity sources. Additionally, only one company had procured private debt. On the other hand, different soft funding sources along with SAs were frequently used. In the following sections, the collected perceptions and preferences of the entrepreneurs will be presented individually for each source. A summary of the main empirical findings will be given at the end of each section (Tables 9-15). An overview over the distribution of financial sources among the RBSOs is listed in the below table.

Table 8 - Overview over the funding sources used by the case RBSOs

	Internal	Debt	Soft funding				Private equity			
			RCN	IN	Incubation	Other	BA	VC	CVC	SA
A	X	-	X	X	-	-	-	X	X	X
B	X	-	-	-	-	-	-	-	-	-
C	X	-	X	X	X	X	-	-	-	X
D	X	-	X	X	-	-	X	X	X	-
E	-	-	-	X	-	-	-	X	X	X
F	X	-	-	X	-	X	X	-	-	X
G	-	-	-	-	X	-	-	-	-	-
H	-	-	-	-	X	-	-	-	-	X
I	X	-	-	X	-	-	X	-	X	-
J	X	-	-	X	-	-	-	-	-	X
K	X	-	X	-	-	X	-	-	-	-
L	X	X	-	-	-	-	-	-	X	X
M	X	-	-	-	-	X	-	-	-	X
N	X	-	-	(X)	-	X	-	-	-	-
O	X	-	X	-	-	-	X	-	-	X
TOT	**13**	**1**	**5**	**8**	**3**	**5**	**3**	**3**	**5**	**9**

5.2.1 Internal funding

As is to be expected for most start-ups, nearly all case firms used internal funding. Evidently, sweat equity put into the venture was common for all these firms. Further, the most common way of internally funding the venture was through personal funds, with most entrepreneurial teams contributing personally to the initial share capital required. Additionally, several of the case firms used bootstrapping as a mean to reduce costs by using the associated institute's equipment or partly sponsored office locations. CEO and founder of company O illustrated this the following way:

> *"The only reason we are situated on campus is access to 100 m^2 of extensive equipment and machinery that we rent and use, thus avoiding the large costs of having our own workshop."*

The three RBSOs (companies E, G and H) that did not use internal funding were entirely associated with research institutes, and can nearly be considered as founded by the research institutes themselves. Initial funding was entirely provided by the institutes and salaries were paid to the initial entrepreneurs from day one. As previously mentioned, this funding is throughout the thesis considered as incubator funding and not internal funding.

A common finding was that internal funding proved too scarce for further development of the RBSOs and most reported requiring additional funding sources. Two of the case firms relying on internal funding discontinued as they were not able to acquire this additional funding. The founder of company J, sold mainly for this reason, put it the following way:

> *"We got it started, sold some, but came to a situation where we didn't have a lot of resources, were not able to move any further, were not so eager to go through the efforts of obtaining external funding. […] We ended up selling all the activity to a larger firm."*

Somewhat surprisingly, as many as three firms (companies K, L and M) considered internal funding sufficient as virtually the only source of capital. These firms had based their development mainly on organic growth, thus using revenues as the primary way of funding the venture. A decisive factor for these firms was the exquisite wish for independence and retaining of ownership shares. Evidently, as most entrepreneurs, these founders had strong entrepreneurial mindsets, thus desired to avoid having to answer to superiors or interfering with other actors such as external investors. Co-founder of company M expressed it the following way:

> *"We enjoy working for ourselves, be our own bosses. We dislike others controlling us. […]. We kept our independence in order to keep the freedom of choosing the course of action. […] We initiate the projects we find interesting."*

These firms were found to have less focus on strategic aspects of their businesses, both during start-up and later during growth. Indeed, some didn't even have a business plan in the basis when started

or any further competence on how to establish and develop a firm. A "learning by doing" attitude was a common position for these case firms. The CEO and co-founder of company K illustrated this adequately:

> *"We have never sat down and written a business plan. […] As long as you have a product, a marked and a few customers, you don't need to write a business plan. And that was how it was for us. So then we just started."*

The firm's ability to sustain development through using primarily internal funding was found to depend heavily on the ability and attitude of the entrepreneurial team. Some had favorable contacts through family or friends, and procured direct funds and loans through these (companies F and M), while others had previous successful ventures that gave them enough personal funds to develop the RBSO (company N). On the other hand, some founders (companies O and L) did not wish to risk personal assets as they considered the sweat equity put into the venture as constituting enough risk-taking. The founder and CEO of company O put it the following way:

> *"The only safety I've had is to live in a farmhouse, a security that can be passed on to family. I have never leveraged own assets, I can only recommend it if you can afford it. […] I believe that a start-up involve so much risk and coincidences that betting house and all you have has no place. The fact that you spend so many working hours, you are available 24/7, travel a lot etc. is enough sacrifice already."*

Moreover, the empirical evidence suggests a link between high share of internal funding and type of case firm considered. Indeed, the three mentioned firms that relied mostly on internal funding belong to the knowledge-based type of RBSOs. This rather makes sense, as these firms had substantially lower need for resources and were based on more mature concepts that the researchers opportunely discovered through knowledge of a narrow field.

Another empirical finding was that entrepreneurs who were more heavily academically involved such as professors and acknowledged researchers generally put less sweat equity into the venture, as more focus was put on their academic careers. This type of founder was ascertained to later in the RBSOs development rather assume a consultant type of involvement, thus getting paid by the hour rather than involving themselves directly in the venture. Hence, they represent a different type of entrepreneur as they partly exit the venture before the critical *entrepreneurial commitment* juncture. Empirical evidence showed that his aspect led to two different outcomes: (1) acquiring of surrogate entrepreneurs, hired executives or sales persons brought the venture to the next stage (companies A and C) or (2) the RBSO never managed to overcome the juncture (company B, G and H). Hired CEO of company C described their situation the following way:

"We have formal consultant agreements with the three professors who founded the company. […] They still work many hours, it's working very well. […] The main shareholder used a headhunting firm that contacted me about the position. […] I perceived that they required a manager with background in sales and marketing."

Lastly, RBSOs originating from research institutes proved to use less internal funding than those who originated from other types of PRIs. RBSOs from research institutes often had less to none internal funding because the institute paid salaries and had own commercialization units that invested in the RBSO, along with offering access to their facilities. This type of funding demonstrates a gray area between internal and soft funding, but as previously clarified, it will be treated as incubator funding. Research institute leader and founder of company I illustrated this:

"All research institutes in Norway have their own investment firms. […] This is where we gather all the spin-off firms, and provide funding for them. And then we practice schemes for researchers to obtain leave of absence from the institute to enter management roles in this type of firm."

Table 9 - Internal funding

Internal funding
Mostly considered insufficient as funding source.
Knowledge-based RBSOs with high focus on independence and low growth ambitions nearly entirely relied on internal funding.
RBSOs with internal funding as primary source of funding showed less strategic focus.
RBSOs with more academically involved founders used less internal funding, due to less commitment into the venture.
RBSOs originating from research institutes used less to none internal funding, as incubator funding often substituted this initial need.

5.2.2 Soft funding

Evidently, as all the case firms were supported by RCN through the FORNY program, every firm had soft funding. However, the extent and magnitude of soft funding procured varied a great deal.

Nearly all the case firms reported use of SkatteFUNN to fund R&D projects, bringing forward easy acquiring and appropriate gearing mechanisms as the most important features. The perception of SkatteFUNN as government scheme was overwhelmingly positive, as the following two citations brilliantly depict, first from the CTO from company A and second from business controller from company E:

"Very easy reporting, easy structure, everything gets accepted, seems like they have a pretty low threshold."

"We had SkatteFUNN, you never manage to finance everything during all phases through industrial funding only, and thus it's fantastic when you can pull away 20 % of your cost expenses."

IN proved to be an important contributor to soft funding of the case firms. However, the opinions concerning IN support mechanisms were mixed. Some emphasized the invaluable nature of IN funding, as a demanding and valuable interlocutor, as expressed by the CTO from company A:

"With IN, it's very different. We talked directly to the people, pitched our ideas, they have been involved all the way from writing to decision-making. They tell you what is bad and what is good, and they are very flexible. We are very impressed with the way they work."

Additionally, the most successful firms in the sample of case firms emphasized the important role IN play for RBSOs with global ambitions, as illustrated first by the business controller from company E and second from the CFO of company D:

"Close cooperation with IN have been positive to us. We are perfect for them as we are developing a new technology for a global market, the development is both national and international, it is highly exportable to other countries, and the firm intends to build an organization there. This is where IN has been most valuable, as globalization and business development support. […]They end up supporting as much as 30 % of these costs in given intervals, which has given us the opportunity to take larger steps and given us a lot of security as the costs are covered no matter what. We have had several projects with them, both in developing the product and the organization, the latter one being probably the most uncertain part of the costs."

"They offer a lot of services beside financial support, with network and foreign offices. […] They are helping us in Brazil, facilitating with offices and other stuff."

Other firms had negative experiences with IN, often pointing out the lack of competence in the IN apparatus, as illustrated by the co-founder of company L:

"I find there level of knowledge about start-ups in general as superficial, or insufficient at least, there are certainly not many of the caseworkers that have started anything"

Further, some drew attention on the limited and unequal contributions IN was providing. CEO and founder of company O gave a rather detailed argumentation explaining this:

"Everyone is getting some, but they get too little, insignificant sums really. It doesn't cost 400 000 NOK to start a company, it does not cost 1 million NOK to develop a finished product, it cost 10 million NOK! […] The initial programs from IN give around 200 000 NOK on average, but then you need much more to even survive the first year. And then there is a maximum limit of

800 000 NOK over the first 2 years, that no one achieves due to the large number of applicants. And further, IN has this governmental role, with district politics and gender balance, thus the farther away from Oslo you get, the more money you get, and if you are a girl, you are lucky."

Similarly, the opinions around the support schemes provided by RCN were also mixed. The competence of RCN was also similarly to IN put to question by some, as founder of company J put it:

"We went through many consultant people that without realism see an interesting market for us, multiply it and claim that this has gigantic potential. We encountered a lot of weird stuff from RCN, and we have become very critical to them after that experience."

Additionally, several case firms pointed out the little involvement of RCN in the application process as a very negative aspect. CTO from company A expressed:

"With RCN, it's a "fireball" process, you write the application, send it in, there is no communication during the process, and you get either a "yes" or a "no" for an answer."

Others considered RCN more professional than IN, but defined the RCN apparatus as rather bureaucratic. CEO and founder of company O illustrated it the following way:

"RCN is more professional. There they have industry represented in the program committees, they know how hard it is to start a firm and how much money you actually need. But you have to push them in order to get things done, and they are supposed to help you connect to industry and help you internationalize, but they never have time for it. […] Typical bureaucracy, it's the definition of it. Your project just lays there till they have time for it."

Moreover, several case firms had some general remarks on soft funding in general. For example, some pointed out the easier acquiring of soft funds due to the previous academic careers of the founders. CTO from company A stated:

"We had 2 professors on the team. They were used to report on research projects. I believe they saw it as routine, it was not so bad in terms of work put into the reporting."

One other finding was that some firms used external specialist in order to deal with the application process for soft funding, as the CTO from company A expressed:

"Rather than use time ourselves, we hired a firm that specializes in application writing. We have done it before, and we say that there is a 10-20 % chance of getting the application through if we write it, 30-40 % chance if the specialists write it. So we found that it was worth it."

For some of the smaller firms, the fact that funding comes a certain time after the application process itself proved a problem, as illustrated by hired executive and current CEO of company C:

"It takes time to write applications, but that is ok. The worst part is that money comes after. For a small company, this is a major burden on the cash flow as you first pay many work hours to write the applications and after some time receive the actual money."

For the few larger firms in the sample, a whole other issue was pointed out, as that they had encountered becoming too large to acquire soft funding, as illustrated by the CFO of company D:

"We have had a lot of IFU projects. […] We are actually in one now, but IN have stated that this was our last supported IFU project. We have become too established now, too big."

For RBSOs originating from research institutes, some particular issues appeared. Especially, the problems posed by EU regulations were shown to be challenging, as competitive regulations significantly reduce the amount of funding support they can receive from governmental sources. Both the research institute leaders interviewed had some interesting perspectives on the matter, first the research institute leader responsible for commercialization of companies G and H, and second the current research institute leader and founder of company I:

"A problem that has occurred now is that EU has introduced competitive regulations. This is actually a major issue when making spin-off from our research, and for all research institutes today, if you own more than 50 %, you get much reduced funding support from government agencies. This slows down many projects, reduces the attractiveness. Even if we own much, we do not possess a lot of money. […] We are not a capital-intensive organization. But we still wish to own a lot in the start, so we can decide a lot in the start."

"We don't use soft much for the initial part itself. […] It is for the R&D stage where the different parts of RCN come in, this is where the significant soft funding is, where they match you with industry. IN comes in for the commercialization of the product itself, but it is not as attractive as it was, because they demand a lot. We have to go in with 1/3, a demanding industry partner 1/3, and then IN come in with 1/3, but from this they subtract the funding from SkatteFUNN, which lead to lot of work for little reward. They are however okay to deal with, they have 2 months processing time, no deadlines, as opposed to RCN that only has deadlines every year."

Table 10 - Soft Funding

Soft funding
SkatteFUNN was considered a valuable scheme.
Some considered IN a demanding and valuable interlocutor, as well as an important partner for RBSOs with global ambitions.
Some claimed that IN provided too small contributions and had a lack of competence.
RCN had too little involvement in the application processes and was considered bureaucratic by some.
Some considered RCN more professional than IN.
More academically involved founders made it easier to acquire soft funding, while some case firms found it valuable to use external competence for the application process.
Small firms pointed out the delay between application work and actual received funding as a severe burden to the cash flow, while some of the larger firms had become too established to receive soft funding.
RBSOs from research institutes encountered significant limitations in the amount of soft funding.

5.2.3 Private Equity Funding

As the attentive reader may have observed from the overview of funding sources used by the case firms, few RBSOs in the sample used VCs, CVCs or BAs as funding sources. In fact, the following empirical results for each source of private equity will reveal some distinct perceptions and preferences several of the entrepreneurs had towards the different private equity sources.

Business Angels

Four of the case firms had used BA funding during some part of their development process. Some of the firms that had not acquired BA funding often argued that they had not even considered this as a funding source. Other firms argued that they had received sufficient funding from other more institutional funding sources, thus did not need further private equity funding. Particularly company A and E promoted this reason, as CTO of company A illustrated:

> *"We are looking at around 100 million dollar sizes in investment… There are private individuals that invest these amounts, but then they practically operate as professional investors."*

The different BAs were found to be quite different, thus confirming the heterogeneous nature of BAs that was determined from the literature study. BA (D) and BA (I) were individuals that were experienced in starting up new ventures, but had low investment activity. This is comparable with the *analytical investor* type of BA described by Sørheim and Landström (2001). The two other BAs were matched with the *Traders* or *Lotto* type of BA. BA (O) had invested in several ventures with

varying degrees of success, but had no technical competence concerning the relevant business field of company O. BA (F) was already affiliated to the founder, and wanted to contribute financially to the patent-seeking process as long as he was appointed co-investor on the application, even though he had no experience within the relevant field of study. This last investor did not have any further connection than this initial contribution and as a result, will not be discussed further. BA (D) and BA (O) were however more interesting cases and will be depicted more in detail.

BA (D) had largely contributed with managerial competence in several ventures, and was previously employed by a VC. Company D considered the BA's experience as vital for the company, and stated that he was often used as a consultant in the earliest stages of the development process. Particularly in the seed-stage and start-up stage of company D, his contributions were considered essential. Additionally, BA (D) helped appointing a network of additional investors for the firm, as CTO of company D illustrated:

> *"Because of previous experience in starting new ventures they were particularly important in the beginning. BA (D) knew which steps to go through".*

BA (O) had varying degrees of success with his previous investments. In addition, his education was not relevant for the business field where company O operated. However, the founder and CEO of company O had several previous experiences with start-ups, and as he himself said, did not need further competence on how to start up a firm but rather valued the financial contribution of the BA itself.

Some of the firms in the case sample expressed skepticism towards BAs as investors, as they considered BAs to have too fixed mindsets on how to develop a venture. CEO in company C depicted this perspective:

> *"I have always been kind of skeptical towards this kind of investor. This is because: Yes, they bring cash, but they also bring some home crafted opinions on how things should be. And while they have succeeded in a way […] they believe that what they succeeded with previously can be applied other places. I don't really believe in that."*

The BAs in the sample often had long time-frames on their investments. However, their degree of ownership varied largely. While BA (D) presently only owned a small share of the company, BA (O) acquired a majority share of 90.1 % to achieve complete control of company O, illustrated by CEO and founder of company O:

> *"BA (O) is a 100% investor, he wants things to be done as he desires, something you can't achieve ownership-share context until you have acquired 90,1 %, because then you can throw*

out the minority shareholders with nothing more than a case coordinator, though he has to then pay the market price for the rest of the share."

The founder of company O considered the very large share of ownership of BA (O) as a threat, as the firm was highly dependent on financial contributions from this single source. He therefore intentionally chose to seek soft funding as an additional source of funding, in order to decrease this dependence. In fact, the case of BA (O) was rather interesting. Company O targeted a renewable energy source that is rather undeveloped, and the BA's (O) main motive was in fact considered to be idealistic, as expressed by the CEO of company O:

"He wants to be renewable/ecological/sustainable. That is his sincere opinion. I have tested him several times. The money arrives. He used to be more idealistic, bus has become more cynical in later times. […] I believe investments according to BA (O) are primarily an ethical and moral responsibility and contribution to the next generation. Return on investments is a secondary priority I think. "

The informal nature of the connection between the case firms and the BAs in this sample was brought forward as a positive feature. For instance, BA (O) had full control over the company, but the daily operations were entirely left to the CEO and contact kept through informal meetings. Some had more involvement in the companies' operations, as for example BA (D) that frequently took part in managerial decisions, but the involvement was more directed towards strategic guiding than direct influence on the firm's operations.

Table 11 - Business Angels

Business Angel funding
BAs were largely heterogeneous, with differing investment motives and size of contributions.
The BAs were considered to have vital roles in the early stages of development.
Some firms disregarded BA funding as they required much larger contributions than what BAs usually can offer, while others had not even considered BAs as a possible source of funding.
The relation with BAS was considered informal, a fact that was positively perceived.

Venture Capital

Out of the case firms, three (A, D and E) used institutional VC investors as funding source. Common for these companies was that they all had high initial growth ambitions and had subsequently high growth. In fact, these firms represented some of the most successful firms in the sample, as was established by the previously performed performance assessment. Furthermore, all the firms were coincidently characterized as disruptive technology -based RBSOs, an implication that will be further treated in the next chapter.

Among the companies that did not acquire VC funding, some considered their venture not mature enough to acquire VC funding, thus did not even attempt to acquire it. Others made definite statements that VC funding was not desired at all. Most case firms were in fact hesitant to VC funding, as illustrated by CEO of company M:

> *"You know that typically, if you get an external investor involved, if they only enter with capital, they also want a fast exit – they want their money back on their investments. For most companies this is negative as the focus shifts to revenues and profit as opposed to the quality of the work"*

One of the main negative perceptions around VC involvement was loss of control of the venture. This perception often originated on the basis of stories told by other entrepreneurs or the general negative image given to VCs. However, some case firms also had first-hand negative experiences with VCs. For instance, the founder of company O had a previous start-up experience where he ended up being completely overruled by a VC. Ultimately, he was forced to sell his stocks for a small amount compared to the actual worth of the stocks. He evidently expressed a reluctance to trust VCs as a potential source of funding of this company.

> *"In [a previous start-up] we used VC. […] There is no long-term perspective, which creates conflicts among the investors. I experienced that the involved VC called a meeting with me the day before an emission. I was told that unless I signed off my shares to them, they would pull out and take other investors with them. I had no choice. My shares were sold for 1 NOK."*

A few firms that had no VC funding did however have a rather positive perception of VCs. For these firms, the main reason for not acquiring this type of funding was a self-evaluation of being an uninteresting investment case for VCs. As CEO of company C put it:

> *"I think we actually are too small to be relevant for VCs. […] I believe that VCs are competent people, demanding but also very experienced. They create a whole new dynamism in the firms they enter, they are thorough, and seek to develop the firm, contrary to an industrial owner that with time only aim at integrating the firm in their own organization."*

For the three firms that had VCs as funding source, a highly positive attitude towards external investors, or "competent capital" as many termed these, was brought forward. Predominately, they demonstrated high awareness of the value added that the VCs provided, as expressed by business controller in company E:

> *"They have competent people who have been through different technological developments and commercializations. […] they have been part of this technology development from the start through the establishment of the operating company. […] They are a professional actor; they know both technological and the commercial sides of the business. […] They are very important people!"*

The case firms with VC funding all reported that they had active VC members on the board. First of all, emphasis was put on the professionalism that was added to the venture through the VC. Secondly, the VCs largely helped the companies to provide additional funding through their investor network. The financial contributions made by the VCs were found to be quite substantial. It was the mix of private equity funding that was attributed importance to, as all these three firms had both VCs and CVCs as equity holders. The mix of funding sources was not report to pose any conflict-related problems, as the different sources were part of a seemingly collaborating investor network.

Lastly, the case firms with VC funding highlighted the fact the VCs often had very experienced people in many relevant business fields, with a large network containing the most important industrial actors. The business controller from company E summarized some of the main positive perceptions around VCs:

> *"The persons behind the VC who are now owners of this company […] have highly valuable contributions, they are important strategic partners and are valuable through their provided networks, their role as knowledgeable discussion partners and through help managing the firm".*

Table 12 - Venture Capital funding

Venture Capital funding
The companies with VC funding were high-performers and disruptive technology –based.
The main reason for not acquiring VC funding was not attempting.
The main negative perception of VC funding was loss of control.
The firms with VC funding had a highly positive attitude towards external investors, emphasizing value-added such as previous start-up experience, providing access to investor networks and access to important industrial actors.

Corporate Venture Capitalists (CVCs)

Six of the case firms had CVC funding. All the CVCs were associated to large multinational corporations with close links the Norwegian oil and gas industry. None of the firms that reported having no CVC distinctively expressed seeking CVC funding in particular. In fact, these interviewees in general had few perceptions around CVCs, neither negative nor positive. For the case firms that received CVC funding, the acquiring seemed to either have originated from a previous SA or acquired through the academic network available to the initial entrepreneurs. The following empirical findings mostly originated from the case firms actually receiving CVC funding.

The main perception of CVC funding was the privileged access to market knowledge. The competence provided from the industrial partner to help developing the technology was highly valued, especially related to needed product specifications. Further, several of the firms brought forward the role the CVCs performed as strategic guides through active participation in boards, as important. When asked for possible strategic disagreements between the entrepreneurs and the large industry actor, all the firms surprisingly declared that very little overruling from CVC was made. For instance, when company A desired to increase their product offering to expand to new markets, the firm received unexpected support from the CVC:

> *"It is actually quite incredible. We asked for funding in order to enter financial and medical markets, and were granted this by CVC (A)!"*

Moreover, the CVCs were shown to have very little actual involvement in the case firms besides the active involvement in the boards. The CVCs were found to require little control of the operations of the RBSOs, and none of the case firms reported any form of exploitation. CTO of company A expressed it the following way:

> *"We are regarded as a small and innovative company. Most do not even consider trying to control us".*

As was pointed out for the VC-backed firms, a mix of CVC and VC as funding sources was shown to be common. The contributions from this investor network were shown to be high, and some of the interviewees explained the mix of CVC and VC as a way for the private equity investors to share the high investment risk, as well as increasing the extent of value added to the firms.

Table 13 - Corporate venture capital funding

Corporate Venture Capital funding
The acquiring of CVCs originated from previous SAs or through the initial entrepreneur's academic network.
CVC funding was found to give a privileged access to market knowledge and valuable strategic guidance.
CVCs were found to have little actual involvement in the operations of the case firms.
CVCs and VCs often constituted a mixed source of private equity funding.

5.2.4 SA funding

The number of firms found to use strategic alliances as a source of funding was surprisingly high, with a total of eight firms. Among these, a total of seven were firms situated in the oil and gas industry. Indeed, empirical sources pointed out that large firms in the oil and gas industry in Norway had important incentives to invest money in new technologies through RBSOs. Moreover, the RBSOs themselves considered cooperation with large firms in the oil and gas industry as a critical success factor, as the industry was regarded as as rather "conservative". Business controller in company E put it the following way:

> *"We put the project in place through industrial funding, funds that can be considered virtually depreciable for the oil and gas industry. In addition, they have a goal to become technology leaders, thus they have to support the development of products that can give them a competitive edge. […] When the product starts to get a bit more ready, the firms start to make some requirements, and require something in return. […] Industrial funding is a must for the business area we are operating in, new technology in a very conservative sector."*

Many of the SAs were further shown to often originate from initial soft funding that triggered projects such as JIPs and IFUs. Nearly all the case firms that had engaged in SAs mentioned soft funding schemes as precipitating factor for collaboration with industrial partners, exemplified by the CEO and founder of company O:

> *"RCN were the triggering institution for our collaborative development. […] For the moment, we have two large oil companies that have entered, and are awaiting a third industry partner."*

The positive aspects of associating with industry partners were widely put forward, where legitimacy and market intelligence were the main positive features. Hired executive and CEO of company C expressed it the following way:

> *"Our industry partners have contributed a lot with market expertise and identification of market needs. A number of them have been our main customers during the R&D processes, and a few of*

them have worked tightly with us and contributed enormously to how we have defined new products. And then we have one industry partner who has not contributed so tightly but has brought a clear oil and gas perspective on a product development."

During the case interviews, the authors tried to reveal potential negative aspects related to the cooperation with larger and more established firms. Despite the case interviews being anonymous, the views on SAs were nearly unanimously positive. The cultural differences for example were shown to pose very little problems for the interviewed case firms. Several pointed out that the industry partners often were people of similar backgrounds, as illustrated by co-founder and former CEO of company J:

"We had a good relation with our industry partner, lots of familiar people, same backgrounds and network. […] It's a major challenge in principle to work with different partners with varying firm size. One expects big cultural differences and different understanding of things. We had to look at what was needed in order to work well jointly. Indeed, one quickly achieves positive effects from affiliating with larger partners. "

Others pointed out that the RBSO often only cooperated on a more strategic level, and not so much on a technological level, thus there were fewer sources of conflict. For instance, company A stated it the following way:

"It is often the more operative parts of the industrial partner that were involved with us. I don't think the relevant technological departments even knew about us. […] The only thing we get strung over our head is standards most often, […] and technological challenges that are only relevant for a specific strategic partner. […] There are very large differences in cultures, but we have not experienced anything significantly negative about it. […] They try from time to time to thread upon us some bureaucratic processes, but they often end up understanding that these do not work for us in particular."

Another empirical finding was that the main perceived problem with cooperating with large firms was the threat of reorganization within the industry partner. This was experienced by the CTO in company A for example:

"In autumn 2008, our large industry partner made a significant reorganization due to a merger. […] It was a bit of a crisis for us, because it happened near the end of our joint R&D development, and those industry people that were involved with us where now to be found completely different places in that organization, […] thus for example reducing the ownership feeling to our collaboration."

The singular case where the RBSO had an overwhelming negative experience with cooperating with an SA was experienced by founder and former CEO of company F. He brings forward the negative aspect of having to deal with a large and powerful industrial actor, as the unequal power distribution

in this case lead to a forced sale of the RBSO. It could seem however that this case was rather unique in the sample. After telling a successful JIP story, he expressed the following:

> *"Then something occurred. The leader of the steering committee from our partner applied for an alternative patent, being of the opinion that the technology we developed wasn't good enough. Evidently, no one wanted to sponsor us when there was a pending patent conflict with a large industry partner. […] There were later additional problems as the industry partner wanted to rather license the technology than building up the organization, we did not agree. […] It ended up with us being forced to sell our shares, the whole affair was in the juridical borderland, and our large industry partner ultimately never admitted doing anything wrong."*

Lastly, empirical evidence indicated that the industry in general was more closely linked to RBSOs originating from research institutes than universities. Often, the research institutes had well-established links to important industrial actors through previous projects, thus facilitating access to SA funding. For one research institute in our case sample, the industry even had direct ownership in the research institute, as stated by research institute leader and founder of company I:

> *"The university controls 85% of the shares in the research institute. And then we have three industrial owners, which own 5 % each. And they all have representatives on the board."*

Table 14 - SA funding

SA funding
High share of case firms used this type of funding.
Oil and gas industry had special incentives to fund RBSOs, and RBSOs considered SAs a critical success factor to overcome the conservativeness of the oil and gas industry.
SAs were often triggered by soft funding schemes.
SA funding was principally motivated by legitimacy and market intelligence.
Insignificant problems caused by cultural difference and unequal power distribution.
RBSOs from research institutes had easier access to SA funding than RBSOs originating from universities.

5.2.5 Private debt funding

Not surprisingly, only one of the case firms reported use of private debt as source of funding. The procurement of the loan was however in this case both challenging and somewhat temporary, as expressed by the founder and current CTO in company L:

> *"We lent money for an R&D project […]. We had no assets, applied for a loan, got rejected at first, but a local bank provided us with a loan in our second attempt. The first bank later argued that they had to tighten up on corporate loans at that time, and without security it was not justifiable to provide loans."*

The remaining firms stated nearly identical reasons for not using private debt. The most evident was the lack of collaterals for most of the firms, as they, when asked, immediately excluded private loans as even attainable due to the lack of tangible assets. Further, some firms elaborated the fact that they intentionally avoided loans due to rigorous requirements of banks, as uncertain cash flows and unavoidable periodic payments were declared as a bad match. Founder and CEO of company K put it the following way:

> *"Banks secure themselves well, so what they can't collect from me, they take from other co-owners. […] You never know what is going to happen the next day. Always negative to have a loan."*

It is not unexpected that private debt funding is virtually inexistent as funding source, as few of the case firms are actually experiencing positive cash flow. The firms that experienced positive cash flows were in fact the firms that relied solely on organic growth. Empirical evidence thus indirectly state the inappropriateness of debt funding for RBSOs in particular, as lack of collaterals and/or positive cash flow practically make it impossible to acquire loans from banks.

Table 15 - Private debt funding

Private debt funding
Virtually inexistent.
Unattainable due to lack of tangible assets and/or positive cash flow.
Unwanted due to rigorous requirements from banks.

6 Analysis

At first, a theoretical framework was developed based on an extensive literature review and the addition of some refined theoretical models. Thereafter, this framework was used as a basis for presenting the empirical findings. This proved a systematic and organized approach to present the different topics examined during the case studies, hopefully making it easier for the reader to follow the intended thread. In this part, the authors wish to promote an analytical method in order to examine some of the main issues that were discovered through the literature review, and bring forward some new elements identified through the case studies. As emphasized previously in this paper, RBSOs are heterogeneous and dynamic in nearly every aspect. The authors therefore found it purposeful to develop a set of scenarios to encompass these dimensions. Hopefully, this approach will help shed some light over the divergent processes of developing a RBSO, and contribute to the discussion around funding sources and their impact on subsequent performance of RBSOs

In order to develop the different scenarios, the typology of RBSOs proposed in chapter three formed a suitable starting point as it encompassed much of the heterogeneous nature of this type of firm. Moreover, the established stage-model together with the identified critical junctures appeared evident to include in order to incorporate the evolutionary aspect of a RBSO. Further, the thorough discussion around the different funding sources together with the empirical findings will construct the foundation for the conceptualization of the different scenarios. As the starting point was chosen to be the typology of RBSOs, the scenarios were named:

- **Scenario #1 – Knowledge -based RBSOs**
- **Scenario #2 – Innovative product –based RBSOs**
- **Scenario #3 – Incremental technology –based RBSOs**
- **Scenario #4 – Disruptive technology –based RBSOs**

For each scenario, the initial capabilities that characterize each type of RBSOs will firstly be analyzed. Thereafter, a discussion relating the empirical findings t the stage-model will be given. Further, common funding sources used for each type of RBSOs will be determined. Ultimately, the performance of the case firms in the different categories will be assessed, and patterns will be identified. The product of each analytical discussion will be conceptualized as a “best practice” scenario. To illustrate the different scenarios, a comprehensive graphical model was conceived. At the basis of each design, the evolution of resource needs, both social and financial, was initially outlined based on the prior theoretical work. As illustrated in Figure 6, the X-axis gives the different stages and junctures that are found along the development process of a RBSO, while the Y-axis

represents the total resource needs. For the RBSO to successfully develop through the different stages, the area below the graph has to be covered by one or several funding sources. The following analytical discussions will comprehensively attempt to identify a "best practice" approach to cover these areas.

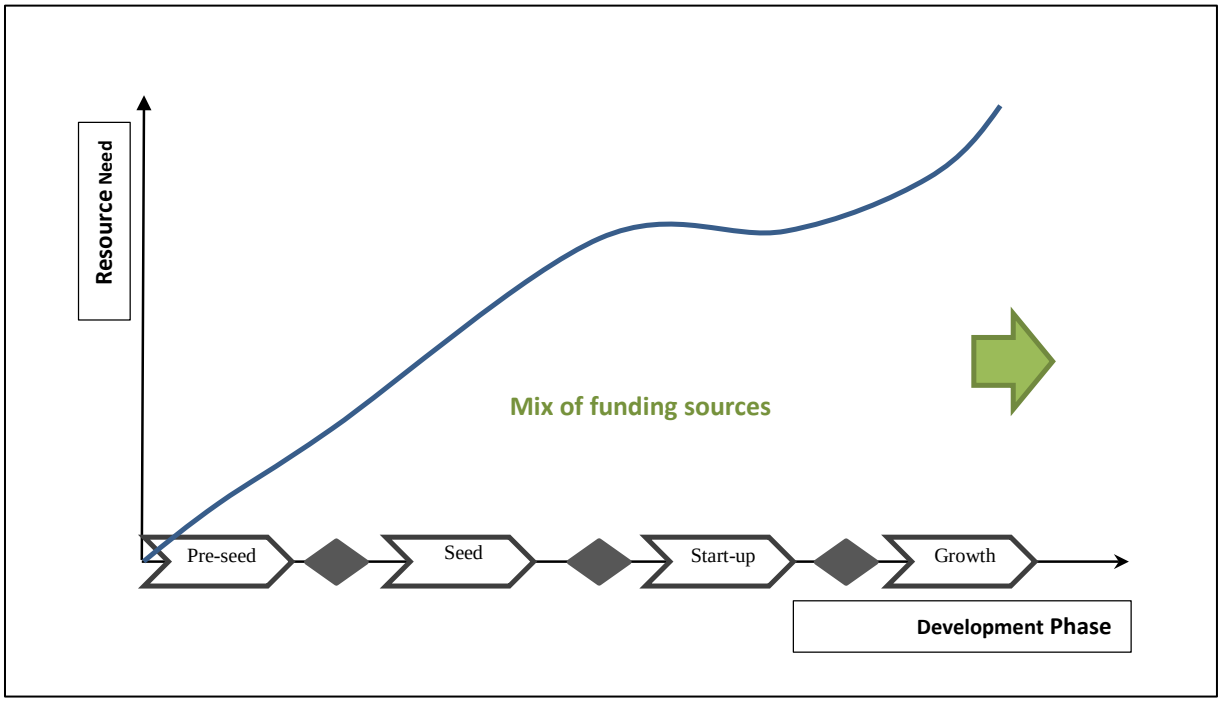

Figure 6 - General Scenario Model

6.1 Preliminary scenario draft

Companies K, L and M

Knowledge-based RBSOs are characterized by high concept maturity and low resource needs. A common rationale behind starting up the venture is to employ the knowledge and competence of the founders and the staff (Heirman and Clarysse, 2004). As a result, these companies are often designed as technical consultancy agents (Druilhe and Garnsey, 2004). Among the RBSOs in the sample, companies K, L and M are included in this group. Company K and M are purely service-oriented, while company L is more product-oriented.

The core entrepreneurial team of these companies consisted of 1-3 persons. The founders came from both research institutes (K and L) and university (M). None of the founders had notable previous entrepreneurial experience before the start-up. They all used the trial-and-error method in the earliest stages of RBSO development instead of strategically plan their development process. The linkage between the parent institution and the RBSO varied. Company K had the strongest academic network, with the parent institution being the majority owner for a long time, followed by company

M, who found the connection to academic research crucial in order to keep updated with current technologies. Company L, on the other hand, had a weaker institutional linkage as there was no evident relation to their PRI after start-up. Particularly for the knowledge-based companies, the network resource is central both concerning academic and commercial networks. At start-up, RBSOs are small and have weak market recognition, thus lack necessary legitimacy recognition in their markets. They are therefore dependent on good working relationships and access to customers is particularly important (Walter et al., 2006). Among the case companies, company K and M were able to bring their personal, commercial networks from the PRI into the RBSO. In fact, company M was able to base their start-up with a contract already secured. Indeed, the initial resource mix of the company is influential on the success of the company in later stages (Rasmussen and Rice, 2012). The relation between the RBSO and the SA in the abovementioned case has led company M to have comfortable access to customer projects since start-up

Through assessment of the stage-development of the ventures in this group of case firms, it seems that all RBSOs have reached the growth phase. This appears to be attributed to the properties of knowledge-based RBSOs that allow them to quickly move through the stages and in shorter time than other types. For one, the small size enables the RBSO to adapt to the dynamic environment in which it operates in. Most important reason for the fast move through the stages is furthermore the lack of a costly product development process. Heirman and Clarysse (2007) found that time-to-market was significantly higher for high-tech companies. For knowledge-based RBSOs, this leaves activities related to the commercialization of the venture to be performed rather than product development, and implies that the activities undertaken in the seed stage will be less time-consuming. By starting out with a client base, the marketing efforts can be omitted as the access to the market is provided through the network base. This is particularly applicable in the start-up stage, where marketing efforts are continuously important. Passing the threshold of credibility is arguably connected more to the knowledge and academic reliability of the entrepreneurs than the product-oriented types of RBSOs who depend on a product to a greater extent. It was also shown that the entrepreneurial commitment juncture was overcome for all the companies in this category. Founders of both company K and M had prominent careers in their respective PRI and as such, this reliability was accounted for. Notably, the future growth ambitions for these companies were quite small. It is therefore arguable that the knowledge-based companies in this sample have reached the end of the growth stage.

Knowledge-based RBSOs are the most independent of all the types of RBSOs. For one, as already discussed, the nature of their business idea leads to a less costly development process, and as a result, they have lesser need for expanding their financial mix to include more than internal and basic

soft funding. Indeed, internal funding was the main funding sources for all companies. Company K had additionally used soft funding schemes in several projects. Company L had by far the largest variance of funding sources in this group with both SA/CVC and debt funding, in addition to the early internal and soft funding. It is noteworthy to recognize that this also was the only company who started out without already having a commercial network. As all companies had entered markets and had constant business, they also generated revenues that funded operations, and as such, the need for additional capital was not noticeable.

As expressed above, the need for external funding in connection to knowledge-based RBSOs is rather small or even non-existent. During the interviews it also became evident that the founders of these RBSOs were cautious towards private equity funding, and VC in particular. Apart from company L, none of the interviewees had personal experience with this kind of funding and thus, when asked about their perception of this kind of funding, they focused on the aspects traditionally considered as disadvantages, such as loss of control or cultural differences, while not paying attention to the potential benefits of external funding. These value-adding activities include the commercial expertise RBSOs commonly lack as well as network connections to mention a few (Sapienza, 1992). Furthermore, there are several ways to gain the commercial competence and other critical competences for the RBSOs. Rasmussen et al. (2011) argue that this can be created through interaction with several actors and thus a base of demanding customers and partners might be just as useful to the RBSO as external funding sources. In fact, based on the low growth ambitions and low capital needs, these companies are not of particular interest to VCs (Wright et al., 2007). It is therefore plausible that both the knowledge-based RBSOs and private equity funders are mutually not interested in each other. A last point concerning knowledge-based RBSOs and external funding is that this type is able to grow organically to a greater extent than other companies and they gain network access through their operations. Deciding on the funding mix is therefore often to bootstrap costs rather than gaining external funding.

Evaluating the performance of this kind of RBSO is challenging because they typically score lower on quantitative measures, while generally low growth ambitions leads to higher scores on qualitative measures. According to Delmar and Wiklund (2008), growth performance studies often disregard these companies. Company K had an overall good performance and comparing quantitative measures with other successful RBSOs, and was actually considered one of the better performers. Company M, who was rather pleased with the state of their business, had an overall low performance, but scored high on the qualitative measures. Company L had higher growth ambitions and as such, did not score as well on the qualitative performance. This illustrates the complexity this group of ventures provides for this thesis and arguably, if the performance evaluation would have

been based on purely qualitative measures, this group of ventures would consequently be considered better performers.

The best-performing RBSO, company K, had the strongest connection to their parent organization as the PRI owned the majority of the company until 2007. Furthermore, this company had expanded their staff continuously, which led to an increased competence base within the company. While, objectively, this is the best-performing company in the sample, company M performed best according to their own growth ambitions. Development of network capabilities and the RBSO network is a mean to improve performance of the company, and successful RBSOs have been shown to be continually networking (Walter et al., 2006).

As the only RBSO type, all companies had reached the growth stage. This implies that time spent in each of the previous stages and phases are significantly shorter than other types. Activities in pre-seed, seed and start-up are quick and less costly due to small associated development costs. Mainly the start-up process itself and fixed costs make up the resource needs. As with other RBSOs, the development presumes entrepreneurial commitment and passing of the threshold of credibility, but these companies do not aim for high or fast-paced growth. Combining this with the presence of sustainable revenues early on, the resource needs in the growth phase is declining. Investments aimed at increasing the value of the company are done as to increase the competence and knowledge of the staff. With exception to initial soft funding provided by the incubator, internal funding was used by all: Company K through their PRI, L and M through personal funds and funds provided by family. Funding sources were almost exclusively based on internal funding till the revenues increased. This leads to the following “best-practice” scenario, as illustrated in Figure 7.

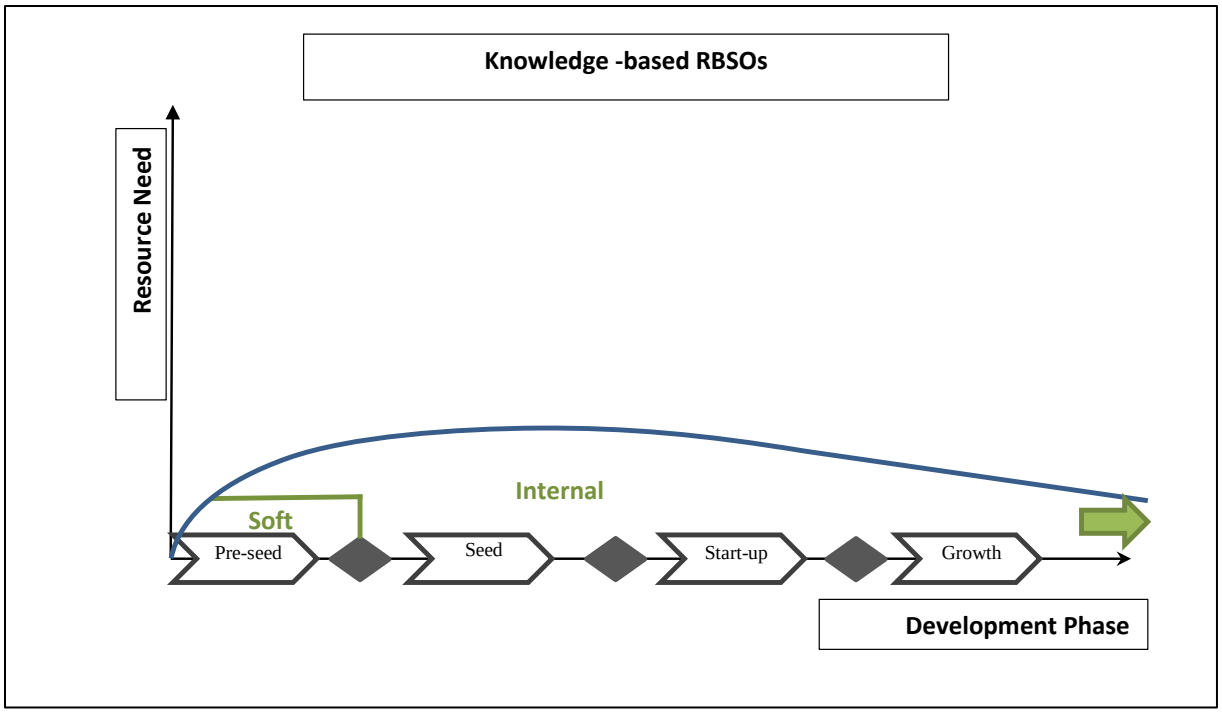

Figure 7 - Scenario 1: Knowledge -based RBSOs

6.2 Scenario 2: Innovative product RBSOs

Companies C and I

Innovative product –based RBSOs are characterized by low concept maturity and low resource needs. The technology is innovative compared to existing technology and is based on extensive research in the PRI (Druilhe and Garnsey, 2004). When the venture is established, the product is close to market-ready and subsequently, they move through the resulting phases faster than the other product-oriented RBSOs (Heirman and Clarysse, 2004). Among the case companies, Company C and I belong to this group. Both emerged from a PRI and had close relations to their mother institution. As only two companies belong to this group, distinct patterns were hard to identify, but some generalizations could be made from the analytical discussion.

The size of the core entrepreneurial team varied significantly from one founder (I) to five founders (C). All founders were however experienced researchers or professors, and thus had prominent academic reputation and competence within their field. Central to innovative product-based RBSOs is that the technology is developed at a PRI prior to establishment and consequently, the founders had spent years on development of their respective technologies. Entrepreneurial experience was predominately more present in company I, as this particular founder had participated in starting up several RBSOs. Through a close relationship with his PRI, the founder of company I had access to an

important incubation apparatus. Company C on the other hand eventually suffered from lack of entrepreneurial experience. After starting the company, the founders of both companies were still employed at the PRI, and thus strengthening the link to the PRI.

Assessing the two innovative product-based RBSOs through the stage-mode, company I reached the start-up stage before being sold, while company C had finally moved into the threshold of sustainability but not achieved growth yet. While company C apparently has reached farther than company I, this last company was sold in 2002, and as such surpassed the previous stages much quicker than the other. Following the findings of Heirman and Clarysse (2007) companies that have a more or less market-ready product at start-up will enter this into the market at earlier stages than other, it became apparent that both companies spent short time from start-up product launch.

While it may seemed that the two companies had a similar development pattern, there is a clear difference between. Due to lacking commercial experience in company C, activities that should have been undertaken in the earliest stages were not fulfilled before the first product was introduced into the market. The prime example for this is the lack of entrepreneurial commitment by the initial founders, who still held their part-time positions at the PRI. According to Vohora et al. (2004), if the important issues to overcome each individual juncture are not dealt with, the company will stagnate in its development process. This evidently appeared in the case of company C. While the company spent few years on reaching the start-up stage, it spent almost three times this time on achieving sustainability. Company I on the other hand was meticulous in performing the required tasks in each stage, and therefore had an overall better performance. It was not until company C hired a surrogate entrepreneur that the firm started to move out of the stagnation phase.

Innovative product-based RBSOs depend on the industry in order to reach the last development stage of their product development, as the technology developed on the PRI needs to be adapted to the market needs. In addition, in order to perform a full-scale testing of their product, they need proper specifications (Heirman and Clarysse, 2004). Both companies had extensive collaborations with industrial partners, both companies through a number of SAs. These were easily achieved as their product offering complimented operations in the industry. Using the CVC/SA as a distribution channel is an advantage with this kind of funding (De Clercq et al., 2006). For this kind of company, there has often been some interaction with industry while the technology was developed at the PRI, a connection often taken advantage of from the resulting RBSO.

Even though company C is the one existing today, company I was assessed as the better performer of the two. As this company is discontinued, the quantitative measures are not available. In addition the perceived performance of company C was assessed as bad, a result of the lengthy development

process. The difference in how the activities in the different stages were performed is essential to ultimately understand how to create a successful venture. Company I ultimately performed better due to higher strategic focus in the earliest stages than company C. Further, the close relation with the PRI turned out to be a pitfall for company C as the initial entrepreneurs returned to their research positions.

Both had substantial cooperation with the industry, as both companies had several SAs. Both products had managed to reach the markets. Both RBSOs used soft funding to a large degree, a fact that can be related to the founders' origin and credibility acquired from associated PRIs. In fact, both companies had used soft funding to a degree in which they could not receive more as governmental schemes generally do not fully finance R&D projects.

The difference in the performance between the two companies gives an indication for the formulation of a "best practice" for innovative product-based RBSOs. Due to the fact that much of the R&D has been performed at the PRIs for this type of firm, the costs of technology development are mostly covered going into the venture. The costs in the earliest phases are therefore highly related to commercial activities such as marketing. Costs in the seed stage are in addition related to the adaption of the technology to a particular customer, and creating "beta-versions" of the technology. Academic entrepreneurs too affiliated to the PRI of origin can further turn out to be a pitfall in the first critical juncture of entrepreneurial commitment. On the other hand, a strong linkage to the PRI proves useful in passing the threshold of credibility. As the company is rooted in a highly academic setting, close relations to the industry through SAs or CVCs provide the RBSO with the required "market intelligence". The initial soft funding is mostly procured from the associated incubator to initiate the firm development process, while the relations to the industry become increasingly important in later stages. As a result, a choice between SA and CVC or both is optimal when much of the market activities need to be performed.

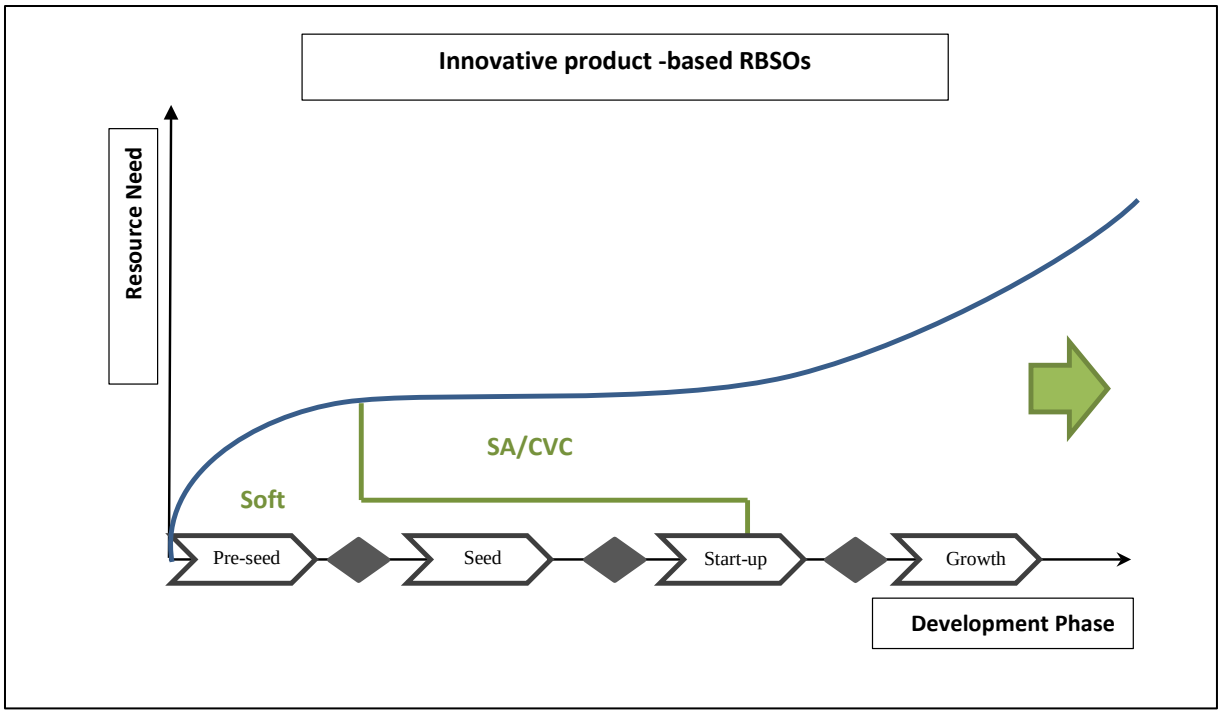

Figure 8 - Scenario 2: Innovative product -based RBSOs

6.3 Scenario 3: Incremental Technology RBSOs

Companies B, J, N, O

As a reminder, this type of RBSO has a high concept maturity, but requires considerable resources to develop the concept into commercial products or services. The concept is typically a non-disruptive technology that addresses a known market, but is far from market ready (Druilhe and Garnsey, 2004). For the sample of case firms, this corresponded to four firms: B, J, N and O.

The core entrepreneurial team of these firms consisted initially of 1-2 scientific researchers, with varying degrees of bond to a PRI. For example, the researcher from company B had worked for a university for many years, while the researcher from company N was more of a self-proclaimed inventor. A common feature was that the entrepreneurs had relatively weak networks when the firms were established. Nosella and Grimaldi (2009) found that this led to poor opportunity identification opportunities, harder access to resources, and lack of status and referrals. Moreover, the initial entrepreneurs did to a very limited degree recruit additional individuals. Solely firm O had permanent employees besides the entrepreneurs themselves. As Wright et al. (2007) presented through the *upper echelon perspective*, the lack of cognitive diversity was shown to negatively affect the performance of RBSOs.

A common feature for these firms was that they had identified a market opportunity, but needed to develop their research in order to exploit it. The founder of company B, a researcher at a university for many years, attempted for several years to recruit a person that had the technical competence and entrepreneurial curiosity to develop his idea. Unfortunately, he did not achieve this, leading to a close down of the firm as he prioritized his academic career rather than further committing to the firm. A part from company B, the entrepreneurs possessed the entrepreneurial commitment to their initial idea, but needed to receive both financial and social capital in order for the RBSO to surpass the *credibility threshold.* This juncture is critical in order to acquire external funding and industry support (Vohora et al., 2004). However, only one of the case firms, company O, managed to overcome this juncture, and that only recently. The research and business idea of company J was sold for very little to a research foundation, and the development was partly continued in this entity. Company N still exists, but is struggling to achieve credibility among both commercialization units and the relevant industry. It may seem from a stage-model perspective that R&D-based technology-development companies struggle to achieve support from both soft funding actors and industry actors.

Through assessment of the different funding sources acquired for these firms, it appears that internal funding stands out as the most common source. Company B and N practically solely used internal funding, despite the costly development processes ahead of them. For company B, this was partly due to the limited resources needed as the entrepreneur did never initiate the development phase itself. He explained this by the lack of interest from the industry and the previous inability to recruit an individual committed to developing the firm. For company N, the owner invested a significant amount of his personal funds gained from a previous successful venture, but is as previously stated struggling to overcome the credibility threshold. In addition to small amounts of personal and soft funds, company J did acquire SA funding, but was promptly cut off due to declining oil prices and changes in priorities by the industry partner, according to the founder.

Company O is interestingly enough one of the three firms in the sample that acquired BA funding. This did however only happen after several years of struggling with small amounts of soft funds and a short period with SA funding. As presented in the empirical evidence, this BA had no relevant background for providing value-adding activity to the firm in question, and entered the investment rather on more idealistic motives towards renewable energy. Moreover, the BA required a large majority share in the venture, but did not involve himself in the business other than for more important strategic decisions. Hence, a relevant theoretical category for the BA in question is problematic to find due to the rather unusual characteristics, hence only emphasizing the heterogeneous nature of BAs (Erikson and Sørheim, 2005). Two features that describe this BA is the

low level of control over the operations of the firm, and the informal relation between the entrepreneur and the BA. Mostly, the authors would like to argue that the increased credibility that the strong financially situated BA gave company O through his involvement, in addition to the financial resources themselves, were the two factors that ultimately allowed company O to surpass the credibility threshold. The founder of company O admitted this as he emphasized the importance of having strong financial backing when seeking industrial partners. The acquiring of BA funding later led to SA funding and new ambitious growth goals for company O.

Not surprisingly, companies B, J and N were assessed to have performed badly. Company B was shut down, company J was sold for very little and company N is still struggling after several years of stagnation in the seed stage. Company O was assessed to have moderately performed despite the high presently perceived performance. This was due to the poor employment growth and poor subsequent growth with relation the initial willingness to grow.

Ultimately, this sample of case firms revealed that the key to higher performance for the incremental technology RBSOs is surpassing the credibility threshold. This type of RBSO requires considerable resources to develop their initial ideas, and convincing investors and industry partners that their business concept is valid remains a crucial factor. Therefore, it is essential for these firms to acquire support in the early stages, especially in the seed face where much of the business planning is done and the venture becomes more tangible (Ndonzuau et al., 2002). The R&D-based technology-development firms in this sample were however shown to use surprisingly little soft funding. Several of these firms stated that they applied for additional soft funding to the initial FORNY support, but their applications were rejected or the contributions given were too small. A possible reason for this may be the low level of anchoring in the local infrastructure for some of these firms, especially relevant for company J and N. Additionally, the case firms in this category were shown to have rather weak networks, making it harder to access resources and leading to lack of status and referrals (Nosella and Grimaldi, 2009).

The authors would like to argue that a larger degree of soft funding in the stages preceding the credibility threshold may have helped the incremental technology RBSOs in this sample of case firms to perform better. Soft funding contain several schemes that aim at lowering technological uncertainty through proof-of-concept funds, as well as pre-seed and seed funding schemes that aim at assisting the entrepreneurs with making business plans more tangible as well as networking (Rasmussen and Sørheim, 2012a). These are essential support activities to help firms overcome the credibility threshold.

Further, it is evident that the backing from a financially strong BA made it possible for company O to surpass this same challenge. The authors would like generalize this to argue that the acquiring of a sound financial partner in general to provide for the initial development of the RBSO is essential for the subsequent performance. An industry-relevant SA would therefore also prove an optimal funding source for the stages preceding the credibility threshold.

Empirical results show little evidence as to what sources may be most suitable for this type of RBSO after the credibility threshold, as only one of the firms just recently overcame it. One could however expect that the often non-disruptive nature of the products and services developed, together with the known market needs they cover, may prove valuable investment undertakings for equity investors and particularly industrial investors.

To conclude, a "best practice" scenario for incremental technology RBSOs contains two phases. As argued, to overcome the credibility threshold, the firms basically depend on soft funding schemes. Further, the additional acquiring of a strong financial investor to help fund the resource-intensive technology development itself is essential. After the credibility threshold, the RBSO becomes a valid investment object for more resourceful and value-adding investors such as VCs and CVCs. The scenario can be illustrated the following way:

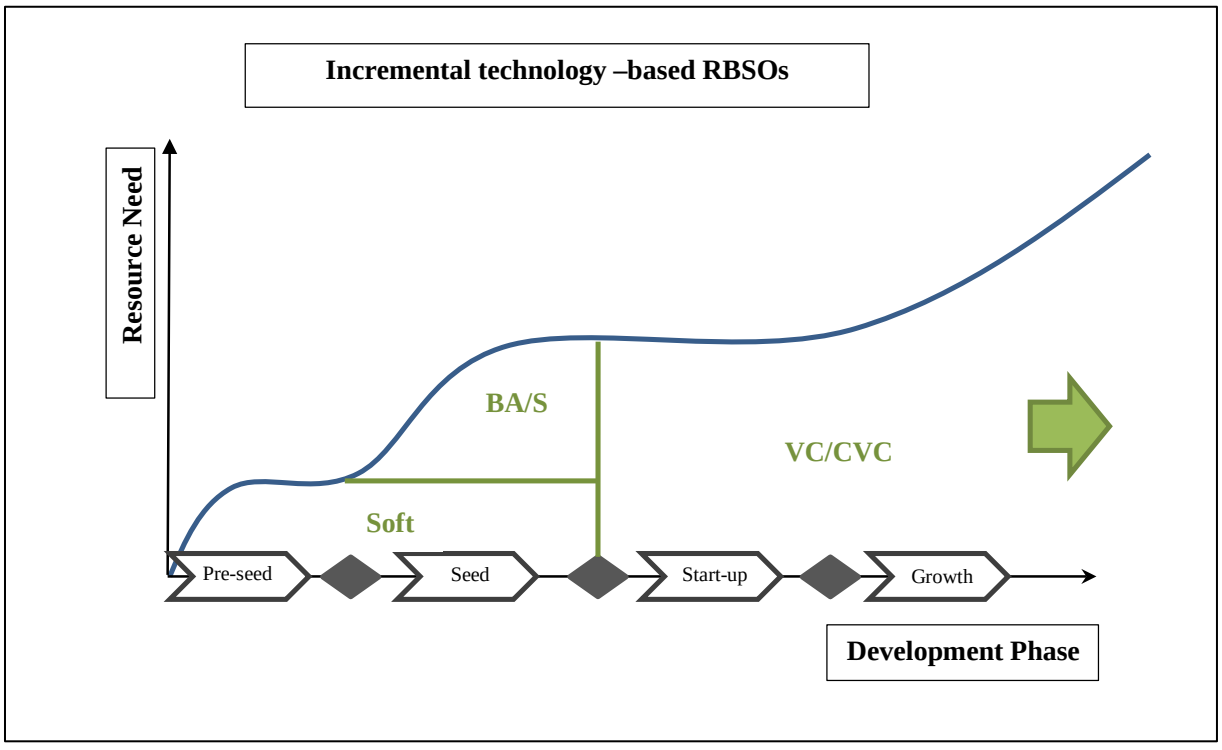

Figure 9 - Scenario 3: Incremental technology -based RBSOs

6.4 Scenario 4: Disruptive technology RBSOs

Companies A, D, E, F, G, H

To recapitulate, this type of RBSO, similarly to the previous type, requires considerable resources to develop the concept into commercial products or services, but has a lower concept maturity. The RBSO will typically develop a disruptive technology that often addresses more unclear market needs (Heirman and Clarysse, 2004). It is considered as the type of RBSO with largest uncertainty but highest growth potential (Shane, 2004). For the sample of case firms, this description suited five of the firms: A, D, E F, G and H.

The initial core entrepreneurial team of three of these firms consisted of a research team or a group of professors containing 3-4 persons (A, D and E). The other three firms in the sample (F, G and H) consisted of a single researcher closely linked to the research institute where he initially worked. A common feature here was that the entrepreneurs had a very robust academic network and had strong support from their mother institutions when commercializing their research. This often leads to increased opportunity identification capability, strong both financial and organizational support from associated incubator and can significantly increase the credibility of the RBSO (Nosella and Grimaldi, 2009). Moreover, the strong anchoring in the local infrastructure made it easier to recruit additional technical competence, as well as acquiring guidance and organizational support using "privileged witnesses" (Vanaelst et al., 2006). As a result, this type of case firm often benefitted from strong cognitive diversity through larger entrepreneurial teams in the earliest stages and access to "privileged witnesses" to compensate for deficiencies related to market knowledge, and sales and marketing for example (Bjoernaali and Gulbrandsen, 2010).

Assessing the case firms' position in the stage-model, it appears that there are two sub-types of RBSOs in this category: firms overcoming the entrepreneurial commitment juncture and firms that did not. Included in the first type, companies A, D and E have all developed through the different stages and are presently situated in the growth stage. It was however not the initial entrepreneurial that took the firms pass the entrepreneurial commitment threshold. Indeed, the initial group of professors in companies A and D gradually stepped out of the venture itself, only participating part-time on the technological development. Similarly, the research team behind company E was not the main drivers for developing the venture, but the PRI itself. For all three firms, external entrepreneurs and hired competence were acquired in order to overcome this critical juncture, while the initial entrepreneurs gradually returned to their academic careers and research activities. The three firms passed the credibility juncture very early due to the previously presented strong support from their PRI. The sustainability threshold took however a varying time to overcome for these three firms, as

for example company D has been situated in the growth stage over several years, while company E just managed to overcome this critical juncture. Company F correspondingly overcame both the entrepreneurial commitment juncture and the credibility threshold, but was then more or less successfully sold during the start-up stage.

Included in the second type, companies G and H never managed to overcome the entrepreneurial commitment juncture. Both researchers were closely linked to their PRI, and continued to work there part-time along the venture. The researchers were only committed to developing the technology itself and did not seek to recruit the needed competence and entrepreneurial will to develop the firm itself. Both these ventures have still not surpassed this juncture, and the firms can today more or less be considered as "living-dead", as the researchers have entirely returned to their research careers, while the legal entities and associated intellectual property still exist.

Assessing the different funding sources, a pattern emerges. In fact, all 4 firms that managed to overcome the credibility juncture used a combination of soft and SA as main funding source in the pre-seed and seed stage, while a mix of VC and CVC constituted the main funding sources pass these stages. The high use of soft and SA as funding sources in the early stages is not surprising. The use of soft funding is clearly linked to the strong anchoring in the mother PRI, which make it easier to acquire funds from governmental schemes together with the strong incubator support. Additionally, empirical evidence showed that RBSOs with global growth ambitions were the ones having the best impressions from IN and RCN. Furthermore, the early use of SA funding covers an especially important feature when introducing a disruptive technology, namely legitimacy (Eisenhardt and Schoonhoven, 1996). Tying the technology to established firms and making them spend resources on it gives increased credibility. Further, SA funding provides many value-adding activities that are essential for this type of RBSO to succeed, such as "market intelligence" and access to facilities.

Further, the mix of VC and CVC in the later stages is sensible. Indeed, developing a disruptive technology requires a considerable amount of resources, amounts that practically only VC and CVC can provide (Lerner, 2004). Moreover, to successfully introduce a disruptive technology in the market, substantial activities besides the development of the technology itself are needed. This is certainly why this type of RBSO is commonly described as the VC-backed venture, together with the often high growth potential (Shane, 2004). The value-adding activities VCs and CVCs can provide is essential for the disruptive technology-development RBSOs. Especially the efforts they bring into building an investor group, whom often lead to this mix of VC and CVC together, and the fill in on the management teams, are particularly valuable (Gorman and Sahlman, 1989).

Moreover, company D and F had small contributions from a BA in the pre-seed stage. For both companies, these contributions were considered essential for the early development of the firm. For company D, the importance of the contributions was more linked to the value-adding competence the BA provided. For company F, the contributions were solely financial, and the BA was more of a *Lotto investor* (Sørheim and Landström, 2001).

Between the two firms that did not overcome the entrepreneurial commitment juncture, solely soft funding was used, mostly through incubator funding from the PRI itself. It is evident that without entrepreneurial commitment, other funding sources are hard to acquire.

Not surprisingly, companies A, D, E and F were assessed to have highly performed. Besides company F that was successfully sold, the 3 other companies constitute the case firms in the sample with highest overall growth and most jobs created. Companies G and H are today merely "living dead" firms, and were assessed to have performed badly.

Ultimately, the key to high performance for these firms was shown to be overcoming the entrepreneurial commitment juncture. All of these firms were strongly anchored in the PRIs, thus received substantial support in the earliest stages from the mother institution, which led to the attainment of sufficient soft and SA funding to surpass the credibility threshold. The successful firms were then later shown to attract a mix of VCs and CVCs, as they potentially constituted very valuable investment objects.

With such a definite pattern between funding sources and performance, the "best practice" scenario for the disruptive technology-development firms is rather given. As argued, soft funding and SA gave the legitimacy and resources needed to overcome the credibility threshold. CVCs and VCs were later considered indispensable to fund the considerable resources, financial and organizational, needed to introduce the disruptive technology to the market.

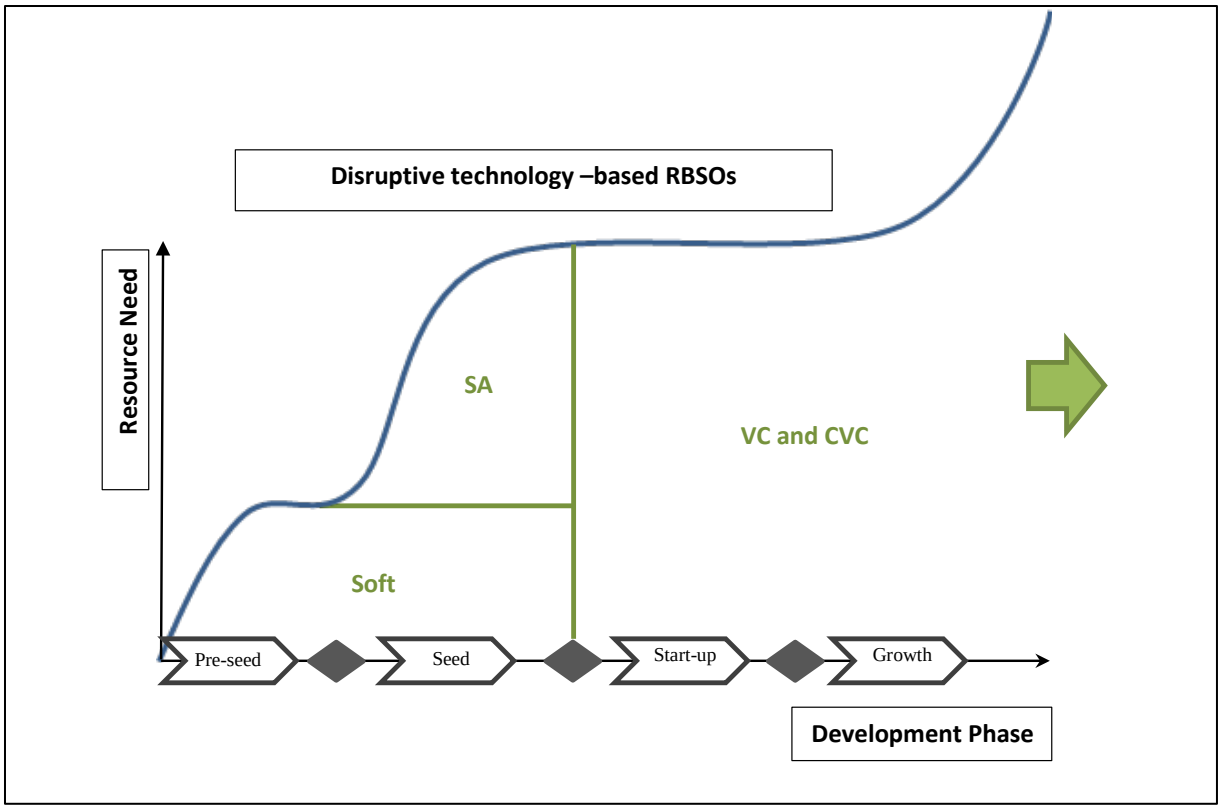

Figure 10 - Scenario 4: Disruptive technology -based RBSOs

7 Conclusion

This thesis has combined deep theoretical understanding on RBSOs with extensive empirical evidence from a set of case studies, and attempted to clarify the connection between choice of funding and subsequent performance. The value-adding resources provided by each type of funding source have additionally been linked with the initial resources possessed by the entrepreneurial team. Moreover, collected perceptions and preferences of academic entrepreneurs have been presented and analyzed. Due to the largely heterogeneous nature of RBSOs, the environment surrounding this type of start-up is complex, and many factors have been taken into account when trying to understand their development processes. The authors have attempted to introduce several theoretical frameworks in order to reduce this complexity, and further provide suitable tools for presenting and analyzing the empirical evidence. Hopefully, this made the understanding of RBSOs and the topics brought forward in this thesis easier to grasp for the reader.

In the end, a conceptual scenario model of "best practice" has been created in order to analyze the empirical evidence in a comprehensive and enlightening way. Four scenarios named after the different types of RBSOs have been illustrated by graphical models after a thorough analytical discussion, and constitute one of the main contributions of this thesis.

Suggestions for further research

As emphasized throughout the thesis, there are a large number of factors influencing the development processes of RBSOs, and the study field is waste. The topics that were promoted in this paper are complex, and require further theoretical work in order to reduce the intricacy. Therefore, the authors would like to call for the development of more comprehensive theoretical frameworks that can ease future studies on RBSO performance.

Moreover, the empirical case studies performed were limited to a rather specific context. Evidently, the Norwegian context possesses many particularities that are hard to generalize, and the chosen industry context only increased the specificity of the study. To achieve consistence and deeper understanding of the topics in this thesis, studies that include RBSOs present in all are required. Further, comparative studies with other countries are needed to provide more generalizable results.

Lastly, policymakers have an increasingly important role in supporting the initial commercialization process of research. This study distinguished soft funding schemes to some degree. However, to construct a set of support activities that optimally helps the commercialization of research, an in-depth study of the impact of individual funding schemes on the subsequent performance of RBSOs is necessary.

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9 Appendixes

9.1 The FORNY Program

FORNY (Forskningsbasert Nyskapning) is a joint program between the Research Council of Norway (RCN) and Innovation Norway (IN), and is considered the main support mechanism for commercialization of public-funded research in Norway. It was established as a project within the RCN in 1995 and became an independent program in 2000. The FORNY program was officially terminated in 2010 and replaced by a new program, the FORNY2020 program. As all cases in the selection were founded before the new program was put into action, the old FORNY program will be presented, followed by a brief summary of the main improvements in the new program.

The overall objective of the FORNY program is to increase wealth creation in Norway through commercialization of research-based business ideas with high value creation potential (RCN, 2009). In order to achieve this, the program has two strategic target areas (Borlaug et al., 2009):

- To establish an infrastructure to lower barriers towards commercialization at the research institutions.
- To professionalize the commercialization process aiming at increasing both the number and the quality of commercialization projects.

The theoretical rationale of the FORNY program is the perceived "gap" between academic research and industry, and the need for facilitating processes that may lead to increased commercialization of academic research. In this context, the main objective of FORNY is to contribute to the development of the system by supporting organizations that may serve as intermediaries, to contribute to bridge the gap between academic research and industry, and to provide economic resources adequate for stimulating processes of commercialization (Borlaug et al., 2009).

Rather than targeting researchers and entrepreneurs directly, the FORNY program works through the technology transfer offices (TTOs) of research institutions as well as other commercialization units such as innovation companies and science parks. The resources for running the program are provided by several Norwegian ministries and Innovation Norway. The Ministry of Trade and Industry is by far the most significant provider of funding with more than fifty percent of the total budget (Borlaug et al., 2009). From an initial budget of 27 million NOK in 1995, the budget in 2011 amounted to 107 million NOK (RCN, 2011b). In total, during the period 1995- 2011 the program received about 1,3 billion NOK (Rasmussen and Gulbrandsen, 2009, RCN, 2011a) An illustration of the FORNY program organization is given below.

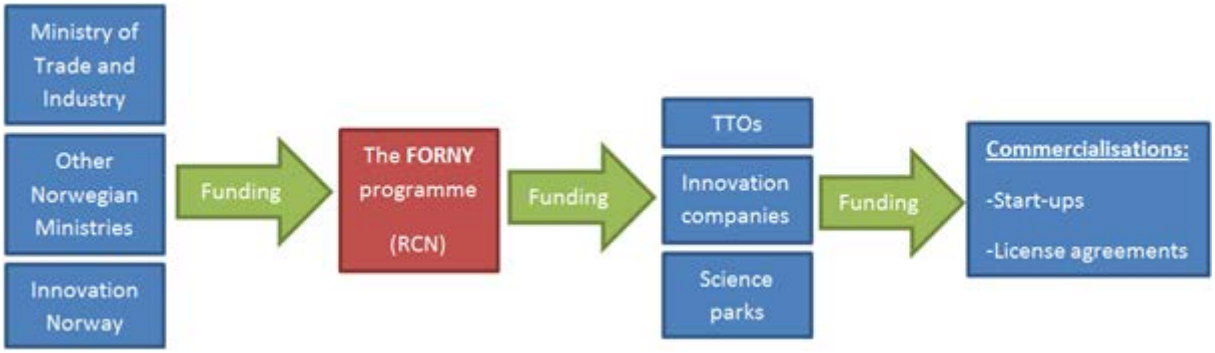

Figure 11 – Appendix 1 - Organization of the FORNY Program

The staff of the FORNY program is organized as a small secretariat within the RCN. The main task of the secretariat is to allocate resources to organizations that are approved for participating in the program, and to serve as a coordinating body for information exchange and strategic development of the program (Borlaug et al., 2009).

Most of FORNY´s budget is channeled through the TTOs, and is distributed among four different funding schemes and one incentive scheme. A brief overview of the different schemes is presented below (Gulbrandsen and Rasmussen, 2012):

- The **infrastructure funds** allow the research institutions to apply for funds to include commercialization as part of their strategies, to increase awareness and knowledge about patenting and commercialization, and to stimulate the search for commercialization possibilities. FORNY covers up to fifty percent of total costs.
- The **commercialization funds** award the TTOs with a lump-sum grant based on annual application. FORNY covers up to fifty percent of the costs of specific commercialization projects up to licensing or firm establishment, excluding product development costs.
- The **proof of concept funds** are awarded only to TTOs already receiving commercialization funds, and are granted to prioritized projects to support product development. The funding decision is based on a panel evaluation of submitted applications.
- The **leave of absence grant** is designed to support researchers to commercialize an idea through covering from twenty to hundred percent of the employment cost of the researcher.
- The **incentive funds** award the TTOs with an annual bonus depending on the performance of start-ups and licenses regarding several qualitative criteria.

A major challenge for the assessment of the results and performance of government programs such as FORNY is to find relevant indicators. These indicators could for example be the number of commercializations and corresponding exits, the number of jobs created, the total turnover created or more qualitative indicators such as number of organized commercialization seminars and

corresponding number of participants (Gulbrandsen and Rasmussen, 2012). To provide a picture of FORNY´s performance since its inception, some indicators are given below based on numbers provided by the FORNY secretariat.

- From 1995 to 2011, FORNY facilitated the creation of 436 start-ups.
- Over the years 1995 to 2011, the accumulated value created is estimated to 2,2 billion NOK, where Opera Software accounted for 827 million NOK.
- In 2011, the value created by all the FORNY start-ups amounted to 573 million NOK, where Opera Software accounted for 454 million NOK.
- The total number of employees in 2011 amounted to 1245 distributed among 158 firms that reported these figures to the Brønnøysund Register Center, where Opera Software accounted for 310 employees (these figures are not mandatory to submit, hence figures are only indicative).

The FORNY program has been evaluated several times during its existence, last time in 2009 by NIFU. This report concluded that the FORNY program has succeeded in its goals, but measurable results such as number of patents and start-ups have been modest compared to international results. The report also pointed out that most of the start-ups had low growth potential (RCN, 2011b). As stated previously, the FORNY program was replaced in 2010 by a new program, the FORNY2020 program. The new program is essentially similar to the old, but emphasizes on the proof of concept activities with increased pre-seed funding and closer monitoring of commercialization projects in the early stages. This resulted in a change of focus for the program, from building up the commercialization units to promoting the commercialization projects with highest value creation potential. Furthermore, the infrastructure and commercialization funds are now awarded only to the commercialization units and on a multiannual basis, giving more financial power and predictability to the TTOs (RCN, 2011b).

9.2 Cases in the Selection

In the following, a better description is given of all cases in the thesis. As the contents of the interviews are confidential, the authors have chosen to give a more thorough background in this appendix so that the reader can get more information on the companies.

Table 16 – Appendix 2 - Overwiew over the tables in the appendix

Company A

Table 2-1 – Main facts: Company A

Company A	
Employees	60
Area	Trondheim
Age	9
Start-up Year	2004
Institution of origin	University
Business Area	Petroleum
Type	Disruptive Technology –based RBSO
Stage	Growth
Funding Sources	Internal, Soft, VC, CVC, SA

Company A is a product from the school of entrepreneurship. As part of the school's program, students are required to start up their own company. The founding team behind company A was therefore a combination of four students of the university and two professors who had worked on the technology in their research.

The company was founded in 2004, but it did not develop much until 2006 when they were granted support from the PETROMAX program from the Norwegian Research Council. Through this program, the founders were given funding for a two-year project grated that they could find an industrial partner. After several rounds of discussion, CVC (A) agreed to participate in the project provided they would be allowed to invest in the company and also brought along VC (A).

The development during the first year and a half of the project was slow. However during the autumn of 2008 and shortly into 2009 the company started to form and the entrepreneurs got a better idea of where they wanted to take the company. However, CVC (A) went through substantial internal changes at the same time due to a fusion with another large company. This resulted in reorganization internal in CVC (A) and company A suddenly found that the ownership disappeared. In addition, the funding through the PETROMAX-program ended in 2008 and they realized that they needed to generate revenues. As a result, they hired a CEO who had substantial commercial experience. Shortly after hiring a new CEO, the target market was redefined from national to international. A subsidiary was established in Houston.

In 2011, the company was split into three separate subsidiaries, targeting the energy-, financial and medical sector. This was because an industrial actor within the oil-business was interested in a

sponsorship of the technology. The founders of company A wanted to keep open the option of developing their technology into other markets without any involvement from this SA.

In 2012, the company reached sustainable sales in their operations. Mainly, they target the onshore oil business, and get access to offshore markets through their SA.

Company B

Table 2-2 – Main facts: Company B

Company B	
Employees	N/A
Area	Trondheim
Age	N/A
Start-up Year	2005
Institution of origin	University
Business Area	Petroleum
Type	Incremental technology –based RBSOs
Stage	Start-up (but never crossed the Critical juncture of entrepreneurial commitment)
Funding Sources	Internal

Company B started up in 2005. A professor at a university was to participate in another project by a network contact. He declined the offer on the other project, but upon request he offered them the technology behind company B. The professor himself did not have the time to participate, but a student of his had started to develop the technology. She had however no interest in the business-aspect of the company. This start-up was after the change in regulations, which led the TTO at the university to claim some ideas. In addition, researchers from another institute at the university were engaged in the project. Unfortunately, the project never developed from the idea-stage, and after a few years the TTO wanted out. The professor bought the TTO out and dissolved the company shortly after.

Company C

Table 2-3 – Main facts: Company C

Company C	
Employees	2
Area	Trondheim
Age	12
Start-up Year	2001
Institution of origin	Research Institution
Business Area	Petroleum
Type	Innovative Product –based RBSO
Stage	Stagnated at Start-up (but never crossed the Critical juncture of entrepreneurial commitment and threshold of credibility)
Funding Sources	Internal, Soft, SA

Company C was started in 2001 in order to commercialize technology and knowledge created at the research institution. All the founders were either employed at the research institution or at the nearby university. From start-up there has been several development projects funded by the Norwegian Research Council as well as Joint industry projects. In addition they have exploited the opportunity of having a university nearby to write their doctoral thesis for them. Today, the company has two market-ready products and one product in development.

The level of ambition among the founders was rather low in the earliest years. As a result, the company stagnated in the start-up stage. In 2011 however, a new CEO with substantial commercial experience was hired and has started the process of developing the company into growth and the ambition level changed drastically. In addition to increased growth ambitions, the company is also seeking external funding in order to finance the growth.

Company D

Table 2-4 – Main facts: Company D

Company D	
Employees	16-24
Area	Trondheim
Age	11
Start-up Year	2002
Institution of origin	University
Business Area	Petroleum
Type	Incremental technology –based RBSOs
Stage	Growth
Funding Sources	Internal, Soft, BA, VC, CVC

Company D was founded by four professors along with a BA and a lawyer. Their product targets the petroleum and shipping markets. During the years the company has cooperated close with several industrial actors. Their ambitions are to become a global actor and a large company.

The company was founded in 2002 in order to avoid the coming legal regulations on intellectual properties developed at a university, but had to take several rounds with their TTO in the earliest stages. In 2005, the company wanted to grow further and found that in order to test their technology they needed specifications and a collaborative partner. Therefore they did an emission which led to the entrance of CVC (D). Additionally, the company moved out of their locales at the university and into their own. From 2006 and further on, the company continued to grow in their international market, a lot due to close cooperation with their CVC. The CVC provided regulation in which their operators had to comply with which led to an incentive for the operators to use the technology of Company D.

Company E

Table 2-5 – Main facts: Company E

Company E	
Employees	21
Area	Stavanger
Age	1 (9, 9)
Start-up Year	2011 (2004, 2004)
Institution of origin	Research Institution
Business Area	Petroleum
Type	Disruptive Technology -based Company
Stage	Growth
Funding Sources	Soft, VC, CVC, SA

Company E is a particular company in that it was established in 2011 in order to operate the technologies of two companies (E1 and E2). For the representation in this thesis, it was decided to only use the operating company, but the historical development follows the companies E1 and E2 as this is where the properties is stored today. The process is quite similar for both companies. Both companies sprung out of a research institution in Stavanger where they wanted to develop the technology further than the research institution was able to.

Company F

Table 2-6 – Main facts: Company F

Company F	
Employees	N/A
Area	Stavanger
Age	N/A
Start-up Year	1997
Institution of origin	Research Institution
Business Area	Petroleum
Type	Disruptive technology –based RBSO
Stage	Dissolved (Start-up)
Funding Sources	Internal, Soft, BA, SA

The idea behind the technology of Company F was developed in 1995 by the founder while he was between jobs. It was patented in 1996 right before the founder was hired by the research institution in Stavanger. The costs of filing the patent were covered by an American investor who wanted to be named as co-investor on the filings in return.

The technology behind company F is an alternative to more used procedures of re-injection and hydro cyclones. Development happened through several projects and several industrial actors were included in this process. The first JIP, finished in 1998, was a success and was followed by an emission in order to acquire further funding. The technology was licensed out to an industrial actor. The next test did not turn out remotely close in results. It was however discovered that they had received wrongful specifications and another JIP was done. In addition a company which specialized in injections and mixing equipment was incorporated. Meassures was made in order to commercialize the product.

However, a competing patent was filed in 2004. In the end, the company was sold to the company that had filed for the competing patent. Later on the company was incorporated into another company which furthermore was sold to a Canadian company.

Company G

Table 2-7 – Main facts: Company G

Company G	
Employees	N/A
Area	Stavanger
Age	9
Start-up Year	2004
Institution of origin	Research Institution
Business Area	Petroleum
Type	Disruptive technology –based RBSO
Stage	Stuck-on-seed
Funding Sources	Soft

Company G was started in 2004 by a single researcher that took a patent on a so-called "Smart water" solution, treatment of water in oil reservoirs. The special about his solution was its applicability to limestone reservoirs in particular, a type of reservoir that there only exists one of in Norway. The majority of the reservoirs in the Middle East are however of this type. Some research was done previously to the start-up, but much R&D remained. Today, the company is underfinanced and has not managed to develop the technology much further.

Company H

Table 2-8 – Main facts: Company H

Company H	
Employees	N/A
Area	Stavanger
Age	10
Start-up Year	2003
Institution of origin	Research Institution
Business Area	Petroleum
Type	Disruptive technology –based RBSO
Stage	Stuck-on-seed
Funding Sources	Soft, SA

Company H was started in 2003 by a single researcher that had a lot of experiencing with in-reservoir chemical treatment of water. He had no patent, but lots of expertise in modeling and implementing new disruptive technologies involving use of bacteria to solidify water around reservoirs. The researcher had performed a large amount of research on the subject before the company was created. The company had a test for a large field in Norway, but never managed to develop the firm beyond the initial test. Today, the company is underfinanced and has not managed to develop the technology much further.

Company I

Table 2-9 – Main facts: Company I

Company I	
Employees	N/A
Area	Bergen
Age	N/A
Start-up Year	2000
Institution of origin	PRI
Business Area	Petroleum
Type	Innovative Product –based RBSOs
Stage	Start-up
Funding Sources	Internal, Soft, BA, CVC

Company I started with an idea the founder came across during a visit to an American science park in the middle of the 90's. After a time of collaboration, adding seismic data to the model in USA and several trips back, he gained a non-exclusive license on this technology to target the oil and gas market in 1997. As the business model at the PRI in this case involves developing the idea at the PRI closer to market-readiness and much of the research was done before the RBSO was established. The research department of a large industrial company provided the seismic data. Further on this department became the main collaborative partner in the development process. Tests of the first prototype occurred in 1998/1999.

The technology is a virtual technology program and subsequently was dependent on internet resources in order to work. However, at the time, the equipment necessary to run the technology was large and heavy. In addition, in order to promote the product the management had to travel to location to demonstrate. With the heavy equipment, this was a difficult process. It is important to note that this development happened in late 90s/early 2000s. Industrial interest for this technology was however relatively large on an international scale.

The company was established in 2000 and sold again in 2002 as the founders had to make the choice between attracting funding for further development or selling the product in which the development could happen. This mainly concerned the commercial development of the company, in particular distribution channel and proper sales.

Company J

Table 2-10 – Main facts: Company J

Company J	
Employees	N/A
Area	Bergen
Age	N/A
Start-up Year	1997
Institution of origin	Univeristy
Business Area	Petroleum
Type	Incremental Technology –based RBSO
Stage	Growth
Funding Sources	Internal, Soft, SA

The technology behind company J is a modelling of geological structures and petro-physical parameters that is translated into seismic models. It was started as a research project at a university with a larger development project as a combined effort between the NRC, industrial oil and gas companies and the university. As the projects ended, some of the researchers wanted to take the development farther and established the company in 1998. Through the incubator, the two founders was aided with strategic help towards starting the company, but the consulting help received was found to be more abstract than what was productive for the company.

During the development process, also this company had a close cooperative relationship with a industrial partner. The process went well the first years, but as the drop in the oil prices occurred, and the income the founders had generated through consulting dried up. As a result, the company had financial troubles and as there had been no big effort in attracting funding for their project, the company struggled. They then made a royalty agreement with a research center who gained rights to the technology. All IP was transferred during the acquisition.

Later on, the company name was transferred to a new start-up within a new field but with a different unit number and no connection to the first company.

Company K

Table 2-11 – Main facts: Company K

Company K	
Employees	22
Area	Oslo
Age	15
Start-up Year	1998
Institution of origin	PRI
Business Area	Renewable Energy
Type	Knowledge -Based RBSO
Stage	Growth
Funding Sources	Internal, Soft

Company K was founded in 1998 as a consulting company spinning out from the local PRI. In the beginning, the parent organization was the main owner but had gradually pulled out of the company. The founders were all researchers at the institute.

As this is a consulting company, there is a focus on competence and the employees have education within fields ranging from physical/fluid mechanics to meteorological and environmental. The company has several times won awards both on local and national level. Also this company was named a “gazelle” for 4 years. In 2010 a subsidiary was started in Sweden.

Company L

Table 2-12 – Main facts: Company L

Company L	
Employees	14
Area	Oslo
Age	1996
Start-up Year	17
Institution of origin	PRI
Business Area	Renewable Energy
Type	Knowledge-Based RBSO
Stage	Growth
Funding Sources	Internal, Debt, SA/CVC

Company L offers a combined energy solution that combines several heating alternatives. The idea for the company came to the founder during a stay in the north of Norway. After moving back south, the founder further developed the idea. He was granted a position as Doc.ing. and through the PRI he had access to an incubator who helped with the establishment of the company. Through the FORNY program he was bought out of his position and never returned to this.

As the development of the company continued, the founder sought external funding and as part of the technology relied on oil as a heating source, the natural partner was an actor within this field. This partner entered first as a SA, but the trade provided the SA with the option of later gaining owner shares, which they took later on. After a process and combined with the oil prices, it was decided that oil might not be the best energy source for the concept after all, and the then CVC pulled out. When the time came to develop hardware for their product, the process was funded through debt in a local bank.

Company M

Table 2-13 – Main facts: Company M

Company M	
Employees	5
Area	Oslo
Age	14
Start-up Year	1999
Institution of origin	University
Business Area	Petroleum
Type	Knowledge -based RBSOs
Stage	Growth
Funding Sources	Internal, Soft, SA

One recently graduated student and one researcher from a university founded company M. The researcher had been involved in several collaborative projects between the industry and the university and subsequently had contacts through these. When the company was started, the founders therefore had a contract going in to the collaboration. Still the company keeps their close relation with the university in order to keep updated on the project.

Apart from access to locales, the founders did most of the work themselves. One had family who has had great success with another start-up and has become an internationally leading company within this field, and another had lawyers within close family. The resulting activities in order to start up a company were mainly done by one of the founders who used resources available on internet to learn. The cooperation with the initial company has provided company M with further contracts, which is where their main income comes from.

Company N

Table 2-14 – Main facts: Company N

Company N	
Employees	0
Area	Oslo
Age	13
Start-up Year	2000
Institution of origin	N/A
Business Area	Renewable Energy
Type	Incremental Technology –based RBSO
Stage	Seed
Funding Sources	Internal, soft

The founder of company N had little experience with this kind of technology and considers himself self-made. The idea is inspired by larger scale projects in mainly France and Russia and the founder has visited several sites in both countries and has collaborated with a Russian PRI on his idea. It was however no real interest from Norwegian PRIs in the projects. While some has been interested nothing has come from this. The technology is patented. In addition to the original founders, a previous incubator consultant is part of the board of this venture.

Funding for this venture has proved difficult, as it has not been granted funding through the NRC. The idea was acknowledged by IN, but in order to get the funding from them, company N needs industrial partners. Several international actors has been interested, but these are not accepted by IN. Shortly before the interview, an application was sent to a European fund.

The family who owns this company also has a property in the north of Norway and through the holding company of this property; they have mainly funded company N. The university college located close to the property has shown interest in research following this idea.

Company O

Table 2-15 – Main facts: Company O

Company O	
Employees	N/A
Area	Oslo
Age	9
Start-up Year	2004
Institution of origin	Other
Business Area	Renewable/Petroleum
Type	Incremental technology –based RBSO
Stage	Start-up
Funding Sources	Internal, Soft, BA, SA

Company O was initially started in Trondheim in 2004 by a serial entrepreneur that had been involved in several relevant start-ups and established firms. Lack of funding led the firm to be sold in 2009 to a BA situated in the Oslo area. The company was initially focusing solely on geothermic power generation, but later developed their solution for purposes useful to the oil and gas industry. He then made a SA with two large oil and gas industry partners, and managed to perform a feasibility study. The entrepreneur received salary from NCR to develop the technology. Today, they are situated at a university location in the Oslo area, where they rent facilities from the university itself. They are only a few employees now, but are planning to employ 6-9 persons during the following year. They have managed to achieve a new SA now and are aiming at achieving VC support next year.