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Collaborate to Commercialize?

*An Explorative Study of Young Innovative
Swedish Cleantech Firms*

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Abstract

- Title:** Collaborate to Commercialize? - An Explorative Study of Young Innovative Swedish Cleantech Firms
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- Course:** Master thesis in Business Administration, 15 University Credit Points (15 ECTS).
- Authors:** Daniel Buza-Vidas and Jacob Littorin
- Advisors:** Sofia Avdeitchikova and Lars Coenen
- Key Words:** Collaboration, Cleantech Commercialization, Open Innovation, Value Chain Networks, Customer Segments
- Purpose:** The purpose of the thesis is to explore how early stage Cleantech firms *establish* and *utilize* collaborative means to overcome resource, ability and legitimacy constraints in the process of commercialization.
- Methodology:** Using an abductive research approach, we conducted a descriptive multiple case study through semi-structured interviews.
- Theoretical Perspective:** The thesis develops a theoretical framework based on Jolly's sequential process model for new technology commercialization and integrates perspectives from the literature on the Liability of Newness, Network Relationships, Open Innovation and Customer Adoption.
- Empirical Foundation:** The thesis is based empirically on interviews with the CEO's and founders of twelve Cleantech firms in the southern regions of Sweden. These firms were all members of the 'Cleantech Inn Sweden' initiative at the time of the interviews.
- Conclusions:** The journey towards Cleantech innovation commercialization is initially constrained by a lack of resources and legitimacy. It is suggested that collaborative means can help the firm gain legitimacy among customers and investors. The activities supporting the creation of legitimacy are especially those associated with proving the technology – such as prototyping and technology demonstration. It is also suggested that close technology development collaboration with a customer or a partner can help a Cleantech firm gain legitimacy in the eyes of an investor. To identify appropriate partners to collaborate with it is, among other things, important to consider dependency risks, the referencing power of a certain segment and the politics in organizations.

Sammanfattning

Titel:	Collaborate to Commercialize? - An Explorative Study of Young Innovative Swedish Cleantech Firms
Seminariedatum:	Fredagen den 21 Januari 2011
Ämne/Kurs:	FEKP01, Examensarbete magisternivå, 15 HP
Författare:	Daniel Buza-Vidas och Jacob Littorin
Handledare:	Sofia Avdeitchikova och Lars Coenen
Fem nyckelord:	Samverkan, kommersialisering av miljöteknik, öppen innovation, värdekedjor och nätverk, samt kundsegment.
Syfte:	Syftet med denna uppsats är att utforska hur unga miljöteknikföretag <i>etablerar</i> och <i>använder</i> olika samarbetsformer för att övervinna brist på resurser, förmåga och legitimitet i processen att kommersialisera sina innovationer.
Metod:	Med en abduktiv forskningsansats har vi genomfört en deskriptiv multipel fallstudie med hjälp av semi-strukturerade intervjuer.
Teoretiska perspektiv:	Studien utvecklar en teoretisk referensram med hjälp av Jollys processmodell för teknisk kommersialisering och integrerar perspektiv från litteratur kring öppna innovationer, hinder som ungt företag, nätverksrelationer och olika kundsegment.
Empiri:	Uppsatsen är baserad på intervjuer med VD:ar och grundare för tolv miljöteknikföretag i södra Sverige. Dessa företag var vid tidpunkten för studien medlemmar i organisationen 'Cleantech Inn Sweden'.
Slutsatser:	Vägen till att kommersialisera innovationer inom miljöteknik hämmas initialt av företagets brist på framför allt kapital och legitimitet. Det föreslås att olika samarbeten kan hjälpa ett företag att uppnå legitimitet hos kunder och investerare. De aktiviteter som anses generera detta är framförallt förknippade med att bekräfta teknologins funktion – såsom utvecklandet av prototyper och demoversioner. Det föreslås också att ett nära utvecklings-samarbete med kunder och partners kan skänka legitimitet åt företaget ur en investerares synvinkel. För att kunna identifiera rätt typ av partners anses det bland annat viktigt att ta hänsyn till olika beroenderisker, referenskraften i en viss typ av partner eller segment, samt organisationspolitiken.

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1. Introduction

1.1 Background

“Contrary to popular belief, we do not face a choice between economy and ecology. It is often said that protecting the environment would constrain or even undermine economic growth. In fact, the opposite is true: unless we protect resources and the earth’s natural capital, we shall not be able to sustain economic growth.” (Kofi Annan, 2001)

In the first decade of the 21st Century the world has seen a substantial rise in the awareness of environmental issues. Especially the global debate concerning global warming and climate change has come to receive a greater and more widely spread attention. Parallel to this development there have been rising concerns about the world’s energy dependency. Despite this remarkable progress in global understanding, the global community still suffers from severe difficulties in reaching wide spread consensus regarding common goals and principles for how to collectively work towards a sustainable future.

Adopting a society to become truly sustainable contains a great amount of challenges. Existing means of production and consumption in areas like transportation, energy, housing and agriculture will have to be adjusted, converted or replaced by sustainable alternatives. It becomes evident that we need something more than just incremental changes to our patterns of living. This implies something that could be regarded as a ‘system innovation’, a transition from one sociotechnical system to another. The diffusion and application of new technologies with the ability to achieve better environmental performance, is one of the most important factors identified in order to achieve sustainable development. New technology plays a large part in making this transition, but so does the new technology’s relationship with behaviour, norms, politics and institutions. Research has for long emphasized the role of the entrepreneur as an important agent for fundamental change through a process of so called ‘creative destruction’ (Schumpeter, 1934). The entrepreneur is believed to discover and utilize new combinations of innovations, products, markets, processes and organizational forms to create change. Entrepreneurs could therefore play a central role in the development towards a sustainable society.

The increased awareness of the magnitude of the current sustainability challenges has in recent years led to the emergence of research on the creation and adoption of sustainable innovations. In this emerging field of sustainable entrepreneurship the role of ‘Davids’ as opposed to ‘Goliaths’ is often emphasized. It is described as rare that the larger Goliaths succeed with these radical innovations. It is the Davids, the entrepreneurial SMEs, who are believed to be the agents for ‘creative destruction’ (Wüstenhagen, 2008). Thus they can function as important catalysts to larger-scale socioeconomic transformations towards sustainability (Foxon and Parish, 2009).

The possibilities of innovation and entrepreneurship are fortunately not only receiving scholarly attention. For instance the Swedish presidency in the EU in 2009 made a sincere effort to stress the European need for a shift towards an eco-efficient economy, and the focus on research, innovation and development was considered to be one of the cornerstones (Swedish Presidency of the European Union, 2009).

However, with this increasing popularity it is important that society and its institutions do not rush into decisions or overlook the many dimensions of innovation. Barriers to commercialize sustainable innovations may be found on a number of levels. They may lie on a systemic level, meaning that for instance policy or regulations could be more adequately designed to promote a more fair competition for sustainable alternatives. The barriers may however also lie embedded in the industry structure (Coenen and López, 2010). The last barrier can be related to the nature of the sustainable business sector as such. Cleantech can be understood as any knowledge-based product or service that improves operational performance, productivity or efficiency, while at the same time reducing costs, energy consumption, waste or pollution. Thus, as an emerging sector, Cleantech spans over a great variety of industries, where each industry has reached a different level of development (Wüstenhagen, 2008). In addition, the barriers to commercialize Cleantech innovations may lie on the individual firm level. Young firms in general are believed to share a lack of resources, ability and legitimacy, to create change on their own (Stinchcombe, 1965; Van de Ven, 2005).

1.2 Problem Discussion

On the level of the firm, some of the previous research concerning the commercialization of Cleantech innovations concentrates on venture capital funding (Dealflower, 2003), as well as the various barriers for obtaining such (Steen & Frankel, 2003). Receiving venture capital is

described as anything but an easy game. Cleantech as a sector, although hard to generalize upon due to its heterogeneity, has traditionally received less venture capital financing than other technology innovation sectors (Dealflower, 2003). Even though the sector has seen an extraordinary boom in investment capital flows in recent years (Pernick & Wilder, 2007), it is still relatively hard to receive early stage funding. The main motives for not investing in early stage firms are the non-fulfilment of commercial verification and time to market. Early stage investments are also often not considered profitable due to the amount of work required for the business development and the long investment time (Marino, 2008), and there often exists a substantial capital need for initial investments during the early years to test and verify the technology (Investera i Cleantech 2009, Energimyndigheten). In this sense, the big question that troubles many innovators is how to make it through the ‘valley of death’, the economic gap that arises after the birth of a groundbreaking idea until the development of a marketable product (Hargadon, 2010). If you sink too deep into the valley, there is a risk that you will not make it up again.

The question of how to receive funding is a large problem to Cleantech firms, but so is the question of how to find, develop and approach a market for the Cleantech innovation. Van de Ven (2005) states that it is often more successful to ‘run in packs’ than ‘going it alone’ to develop and commercialize knowledge-intensive technologies. He describes a reality where no single actor controls the technology development process alone.

The motives for ‘running in packs’ could be further understood in the context of today’s knowledge-based service economy where the basis for competitive advantage is increasingly often not found in the product itself, but in the knowledge design that is used to create these products. This knowledge often develops at several places and not only in the single commercializing firm. This makes the knowledge embedded in the supply chain, especially as more and more firms have come to focus on what they do best, outsource the rest and become nodes in competing value chain networks (Bartlett and Ghoshal, 1995; Kogut and Zander, 1993). Underlying factors supporting this development have also been the advancements in information technology that have drastically reduced the costs of coordinating collaborative strategies (Adner, 2006).

There are numerous institutions and organizations in Sweden that support a prosperous entrepreneurial development. One such initiative active in the sustainable sector is ‘Cleantech Inn Sweden’ (CINNS).¹ It is an organisation, which can be regarded as being both a virtual incubator and a business network. Significant to CINNS is that it in various ways actively supports its growing network of member firms to commercialize their Cleantech innovations. For these reasons, it is highly interesting to study how entrepreneurs, who are members of such an initiative, strive to take new sustainable innovations to the market and see how they collaborate with others in their networks and supply chains to get there, and how they at the same time overcome the constraints associated with being a young and small firm.

By looking closer at the Cleantech firms’ external relationships with suppliers, partners and also customers – both concerning how the actual relationships are established and how they are used – we hope to contribute to the overall understanding of the Cleantech sector. The thesis therefore addresses the possible constraints of the young and small Cleantech firm, and takes a holistic approach on potential collaborative means for overcoming these constraints.

1.3 Problem Formulation

How do early stage Cleantech firms *establish* and *utilize* collaborative means to overcome resource, ability and legitimacy constraints in the process of commercialization?

1.4 Purpose

The purpose of this thesis is to contribute to the understanding of why and how young and small Cleantech firms *establish* and *utilize* collaborative means to commercialize their innovations. Thus the aim is to study how vital relationships with for instance partners, suppliers and customers are established and how these relationships can help a firm in the process of commercialization.

1.5 Delimitations

An innovation commercialization process can be researched from many different perspectives. With the collaboration perspective employed in this thesis we will mainly look

¹ CINNS is an independent nationwide initiative with governmental credentials that supports its growing network of Cleantech firms in Sweden. To become members these firms have undergone a thorough screening process where their means for sustainability, as well as their business potential and acumen have been examined. As members these firms get access to advisory, business angel networks, network meetings and various support throughout the entire commercialization process. For more information please visit www.cinns.se.

at the firm level, meaning the Cleantech firm's closest external network relationships. It is however important to keep in mind the interconnected nature of sustainable entrepreneurship. The subject spans over different levels, from micro to macro. In addition, the empirical findings could be relevant for different kinds of actors engaged in the sector. For these reasons we attempt to discuss the implications of these firm level findings, both for the individual Cleantech firm, but to some extents also for the greater surrounding context.

2. Research Methodologies

This chapter presents the methodology of the study. A thorough description is given of the different procedures to find, structure and analyze the gathered information, thereby giving the reader a chance to reflect upon the various considerations that have been made.

2.1 Methodological Considerations

One of the first pathway decisions in business research is the question of which research strategy to employ. According to Bryman and Bell (2007) a researcher has two main strategies to choose from – a quantitative or a qualitative research strategy. Qualitative research usually emphasizes words rather than quantification in the collection and analysis of data. In this context the qualitative approach supports interpretivism. This means that the research is more engaged in trying to grasp the subjective meaning of a particular social activity, rather than collect measurable observations. In this sense much qualitative research often does not support the notion that science in all aspects should or even could be generalized (Ibid).

We have chosen to do a qualitative study in order to meet the purpose of this thesis, believing that this more explorative approach will give us a deeper understanding of the commercialization process of the young Cleantech firm.

Moreover, we have chosen a mix of deduction and induction, called abduction (Patel & Davidson, 1994). In a deductive approach the researcher draws conclusions based on existing theories, meaning that a theoretical hypothesis is first developed and then tested empirically. In an inductive work the order is reversed and relevant theories are chosen first after the empirical material has been gathered. The advantage of abduction is that the researcher has a theoretical base to originate from, but there is still a possibility to gradually complement the theoretical framework as well. This explorative research outline suited the aim of both identifying the constraints of the studied firms, and to find possible solutions to them.

2.2 Theoretical Studies

During the literature review we noticed a difficulty in finding literature describing the specific commercialization processes for Cleantech firms. Most likely this has something to do with

the concept of Cleantech itself. Cleantech is not believed to be a specific industry. Neither does it have one standard definition, but rather many interpretations. It can represent a diverse range of products, services and processes in a variety of industries. Simply put, Cleantech firms seek to increase performance, productivity and efficiency by also minimizing negative effects on the environment.

For the reasons described above we entered the study with a broad view looking at general characteristics and challenges ascribed to young and small firms. For this purpose a review of literature engaged with the liability of newness was conducted. After having established this general understanding for the constraints of the young and small firm, a selection of theories were incorporated, which discuss the level of innovation radicalness with regards to both technology itself, but also the market and its development stage. In connection with this, a model was added to give enhanced understanding for different phases of the commercialization process and the key concerns in each phase. The majority of these theories were also of general character and not specific to the Cleantech sector as such.

As a third step, after having done a large part of the interviews, we realized the importance of the interplay with a firm's future market. For that reason the framework was extended to include a model and theory regarding the differences between customer segments and what implications these differences have for a high-tech firm trying to reach its market. We also found that the logic of customer segments could be applied to the identification process of various partner and supplier relationships too.

Finally, the thesis incorporated theories concerning collaborative settings and the managerial implications associated with close collaboration through different external relationships.

At large our theoretical study gradually moved from acquiring a general understanding for young and small high-tech firms and their commercialization processes, to more hands-on suggestions regarding how to act in a collaborative environment with regards to those premises. This theoretic outline is reflected both in the way the empirical findings were sampled, but also how they later came to be analyzed and presented.

2.3 Procedure of the Empirical Study

The empirical study is based on primary data from interviews conducted with the CEOs of 12 Cleantech firms in the southern parts of Sweden who are members of the CINNS initiative. This means that going into this study we were sure of two things; that these firms were members of CINNS, and that they were developing or had developed a product, which could be regarded as Cleantech. However, we believed that there also could be found common denominators among their individual challenges and constraints, and perhaps also in how they had chosen to approach these challenges and constraints.

This final selection of firms was influenced by how far in the process of commercialization the firms had come. To deepen our understanding the intention was to gather and integrate perspectives from a variety of firms at different stages of development, active in a variety of industries. By gathering information from this broad selection of firms, the goal was to identify not only a firm's challenges in the beginning of a commercialization process, but also the factors and behaviours that can make a firm overcome these challenges. This selection was successful and the empirical data spans from interviews with firms who are just about to leave a conceptual phase behind to focus more on prototyping, to others who are doing extensive testing together with prospective customers, or about to enter a specific market. Yet others were already established and focused more on reaching an even greater market adoption. The innovations of these firms range from a diverse selection of sectors, from industrial applications within energy efficiency, to household sewage water applications. The sizes of these firms range from 0 to 1 million SEK in turnover and from 1 to 7 employees. The age of the firms ranged from 2 to 6 years (majority ranging from 3 to 4 years). There was one firm that stood out from the crowd with 17 million SEK in turnover and an age of 10 years. However, this firm and also others that could be regarded as rather established firms were still asked about the earlier phases, the challenges they had met and how they had overcome them.

The empirical material was also complemented with secondary sources of information such as the Ramböll report (2009), which was the final report and evaluation on the CINNS initiative in its prior regional form, when its activities and members belonged only to the southern region.

2.4 Interviews

To large extents the interviews were carried out as personal meetings with the respondents at their respective workplaces. This we believe made the interviewees feel secure and relaxed when discussing the topics with us, a matter which can be important to get reliable answers (Jacobsen, 2002). Three out of twelve interviews were conducted over the phone due to weather constraints and geographical location. These interviews were not much different than those taking place face to face, however these interviews tended to be somewhat shorter and contain more concentrated answers.

In the interview invitation the respondents were given a brief summary regarding the topic of the thesis and the character of the questions.

The personal as well as the telephone interviews were conducted with the semi-structured model (Bryman and Bell, 2007). To some degree the questions were tailored to the specific firm but the covered areas and the majority of questions originated from the interview guide (Appendix I). This structure allowed a flexible setting where the respondent's answer came to influence a great deal of the direction of the conversation. This was a deliberate intention from our side, as we wanted to give our respondents enough room to be able to speak freely and thereby provide us with information that we would not have obtained if the interviews had been fully structured and guided (Ibid).

To simplify both the actual interview situation and the succeeding work, the interviews were all recorded with a digital recorder. Before starting each interview we asked for permission from the interviewees to do so. Some of the respondents requested delicate information to be left out of the thesis and some also requested to stay anonymous. To simplify the whole process we therefore kept all firms anonymous in the writing of the thesis. Having made these considerations we felt that the respondents were not bothered by the recordings in any negative way, which can be a risk as a recording could potentially affect the answers (Jacobsen, 2002). Important to note is that the interviews were conducted in Swedish, as this was the mother tongue for both respondents and authors. The translation needed for the writing of the thesis was handled in careful manner and thereby we were trying not to influence the message of the respondents' answers.

2.5 Structuring and Analysis of the Empirical Material

The process of managing the interview data started with transcribing them to make the material more graspable and easier to work with. In this process we also acquired a feeling for which parts to focus on. We highlighted those parts of the interviews we felt were important and relevant for our purpose of study. This helped us to structure and divide the respondents' answers into different categories.

Jolly's (1997) model describing the process of technology commercialization has been the tool for structuring the empirical material associated with the first part of the research question – that of how the firms *establish* collaborative means to commercialize innovations. This model consists of a number of interconnected phases. Between every phase is a so-called bridge. These bridges highlight the challenge of mobilizing resources and interest from various stakeholders, which are essential in order to reach a new phase. For that reason we used these bridges as headlines in the first half of the empirical chapter, and thus it was a tool for structuring about half of the empirical material. By doing so the aim was to try and categorize the firms' activities chronologically. However, all firms are unique and possess different characteristics. Moreover, the firms had a tendency to be active in different phases at the same time, or even skip phases and jump directly to later phases. This made it somewhat difficult to make an exact categorization of each firm's activities. On the other hand this also shows how iterative, irregular and chaotic the journey towards innovation commercialization really can be.

For the second part of the research question – concerning how the firms actually *utilize* collaborative means – we categorized the empirical material after whom a firm was collaborating with, if it was with a partner, a supplier or a customer. Each collaboration type got its own headline in the empirical chapter. It was however sometimes hard to make absolute accurate distinctions; sometimes a customer could be viewed as also being a partner or a supplier at once, or vice versa. We believe that this has to do with the majority of firms being in the business-to-business sector.

For the analysis of the empirical material the findings have then been discussed in comparison with the selected theory to examine what the implications of these findings might be.

2.6 Validity and Reliability

According to Bryman and Bell (2007), the quality of a study is determined by the validity and the reliability, which means that it is important to do a critical evaluation of a research at all times.

2.6.1 Validity

The definition of validity is the capability to determine if the study can be measured as it was intended (Bryman and Bell, 2007). There are two kinds of validities in a research, one of them being internal and the other being external. The internal validity is concentrated on how well the empirical data can be connected with the theoretical framework, which is something that we have been focusing on in our study when doing alterations on the theories we use. The interview guide was as described earlier first formed after having selected key theories of the study, and thereafter customized as we proceeded with further interviews.

To what extent a study can be generalized is the external validity of a research (Ibid). Although all firms are regarded as Cleantech, and have been approved as such by the CINNS initiative, all firms represent different industries and therefore have their own specific characteristics. This makes it somewhat difficult to generalize. What we have tried however, as described earlier, is to see what common constraints and challenges that could be found among this variety of firms, and also to see what common solutions their experiences would suggest.

2.6.2 Reliability

The meaning of reliability according to Eriksson and Wiedersheim (1995) is whether other researches would come to the same conclusion using the same methodology. In our case it is very difficult to draw these types of assumptions as it all depends on the actual settings and circumstances of the gathering of empirical data, namely our interviews. However, given that these firms and persons would be the same, one would probably end up with fairly the same empirical material using our interview guide. Where it could come to differ is rather in what way the theories would come to be interpreted in relation to the empirical material.

3. Theoretical Framework

The intention of this chapter is to provide a framework that describes some of the key areas of challenge that an entrepreneur is facing when trying to commercialize his Cleantech innovation, but also to make suggestions on how these could be overcome. In conclusion the chapter aims to connect related theory on innovation commercialization, with inter-firm and customer collaboration as a means to overcome the constraints of being a young, small and innovative Cleantech firm. First however, a brief discussion regarding the value of an inclusive approach to this area of research.

3.1 Towards a Sustainable Technology Transition

Entrepreneurs could function as important agents of change and as catalysts towards a sustainability transition. Important to have in mind however is that there is an interactive dynamic between technologies, institutions and business strategies. This linkage spans from factors on the micro-scale business level, to macro-scale socioeconomic mechanisms. This is not important only to policymakers and the various institutions and initiatives that are out to support sustainable entrepreneurship. It represents the reality for the individual Cleantech entrepreneur, who has a challenge of meeting the immediate needs of the consumer, while at the same time trying to challenge the lock-in of the existing dominant technologies, incumbents, institutions and strategies (Foxon and Parrish, 2009).

3.2 Commercializing Innovations

This section gives an introduction to the logics of innovation and its possible implications for the process of technology commercialization. By also illustrating this with the help of a model, the aim is to present different challenges in relation to how far a firm has come in its development. First however, we discuss different types of innovations.

A disruptive innovation is something that introduces a different set of features, performances, and price attributes relative to an existing market, its products, services and technologies. One of the most significant characteristics of a disruptive innovation is its potential to fundamentally change a price-performance relationship, meaning that the innovation is both more affordable and better than the existing alternative (Christensen, 1997). When a disruptive technology is first introduced to a market however it is most often not fully developed yet, and this new price-performance relationship is not reached straightaway. It is

suggested that the commercializing firm therefore often will have to introduce the technology in a smaller more peripheral market. As performance improves, the product then comes closer to meeting the performance demands of the larger mainstream market (Adner, 2002).

Furthermore, there are several other forms and definitions of innovation. Sustaining innovations for instance, in contrast to disruptive innovations, do not have an effect on existing markets. The innovation can in that case be either discontinuous, if it creates a whole new market, or evolutionary, if the products in a given market are improved in ways that the customers are expecting (Christensen, 1997).

Other scholars make their distinctions based on the degree of radicalness (Govindarajan and Kopalle, 2004). An innovative technology can range from incremental to radical where the radicalness is the degree to which each innovation relates to existing knowledge (Henderson and Clark, 1990).

Where does this place Cleantech innovations? In what ways are Cleantech innovations different from these general descriptions of innovation? These are questions without definite answers. There are many different Cleantech definitions. One common description of Cleantech is that it has to provide superior performance at lower cost, while at the same time greatly reduce or eliminate negative ecological impact (Wüsthagen, 2008). This suggests that the innovation cannot only provide sustainable advantages. It must also be competitive with, if not superior to, existing alternatives also from an economic perspective to be successful as a Cleantech innovation. At large however it looks as if a Cleantech innovation very well can be described in terms of disruptiveness or radicalness just like any other technological innovation. Perhaps it is in the Cleantech innovation's relationship with its context where the differences appear? In this sense it is appealing to look closer at the Cleantech firm's relation with a potential market at different stages of development, such as interactions with presumptive customers, but also with other key stakeholders such as potential suppliers, partners, or investors.

In order to grasp the process of commercialization, and relate a firm's situation to this context, and for instance understand what stakeholders the firm tends to approach at a certain point of development, an illustrative model would be in favour. There is however no model that is specific to Cleantech firms. Therefore we have integrated a general technology

commercialization model. These models are sometimes argued to have their limitations. Often they are illustrated as being linear, a model type that risks to ignore the many feedback loops that occur between the different stages of such a process (Godin, 2006).

One such illustrative and helpful, but partly linear, model is provided by Vijai K. Jolly (1997). The author himself discusses the possible limitations with such a model, but concludes that his more sequential model in comparison to a single integrated process better recognizes the different mindsets needed in different situations. One could say that his model is a mix of the linear and singular model, as it takes into account some of the possible feedback loops, but perhaps not all.

Jolly describes technology commercialization as being about performing successfully in a number of different sub processes, where each step adds value to the technology as it progresses. As pictured in *Figure 1* (see next page), Jolly has identified five key activities involved in bringing technology to market. These are: *imagining* a techno-market insight, *incubating* a technology to define its commercializability, *demonstrating* it contextually in products and/or processes, *promoting* adoption and *sustaining* commercialization. In between these are four equally important so-called bridges. While the large circles constitute activities related more to building value from the technology itself, the intersections in between them are associated with mobilizing resources and interest from a variety of stakeholders, which often change along the way (Jolly, 1997).

“Many technologies fail not because of the technical skills of their proponents, nor because of the market to which they are targeted. They fail simply because no one got sufficiently interested in them at the right time.” (Jolly, 1997)

It is in the *incubating* stage where the meaning of those words becomes evident for the first time. The entrepreneur has to convince others about the potential that a new technology offers in order to secure grants, receive venture capital or mobilize other types of support.

This stage also involves seeking market information, developing prototypes and doing feasibility studies among many other activities. Jolly mentions a number of reasons why firms fail at this stage. One is that they often do not succeed to present their technologies in an attractive enough way to be appreciated by potential stakeholders. A reason for that is the

difficulty for an outside viewer to understand the principles underlying the technology. Another concern looking from the outside is the uncertainty about the future course of development and the speed by which the technologies' performance will develop. Another challenge to define commercializability in the incubating stage has to do with the difficulty to estimate the market opportunities and the timeframe for when they will begin to be profitable (Ibid).

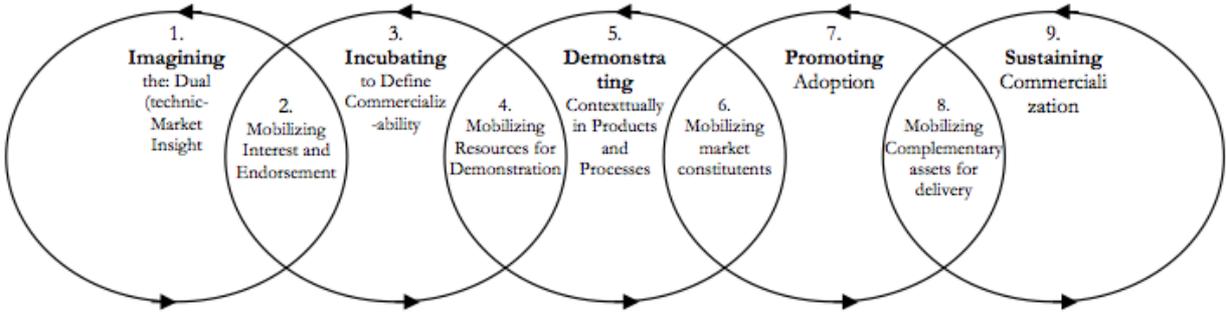


Figure 1: Commercializing New Technologies, 'Getting from Mind to Market' (Jolly, 1997)

The next phase of *demonstrating* is mainly associated with product development. Jolly describes it as a tightrope walk between conceiving what the customer could be willing to buy and what on the other hand is possible to implement with the firm's existing technology. The transition challenge of getting a marriage between the functionality of a new technology with market worthy end products, are told to lie behind many of the delays and cost increases in commercialization. Sometimes the firm needs to do more research than was initially expected and at other times the firm has to compromise at the product level, simply because technical ability and resources does not allow more (Ibid).

The process of *promoting* consists of a number of challenges too. Jolly states that no matter how much market research is done, market acceptance is never assured. Often technology based innovations encounter the need to create a market where none has existed before. For that reason market acceptance often involves a complex socioeconomic process over which the firm seldom has total control of (Ibid).

We have chosen to exclude the last phase of *sustaining*, as it is not as much linked to the young firms' initial more critical situation as the other phases.

When looking closer at the bridges one can see that the first two are more technology related and the later two more market oriented. The first bridge is about acquiring resources for research and development, to conceptualize, test and prove the technology. The second bridge, which enables technology demonstration, is often more expensive than the research leading up to this point. Money is therefore the key constraint – but it is not the only constraint. To succeed with the demonstration of new technology two other concerns are also important to have in mind according to Jolly. These are context and capabilities. Context refers to seeing the opportunity of a specific product and having the knowledge of what and how to demonstrate it. Capabilities relate to research skills and the infrastructure necessary for bringing together the technology and succeeding with product development. This includes more than just R&D. Project management skills become particularly important to integrate market and manufacturing considerations, but these skills are clearly also important be able to manage supplier and research partner relationships (Jolly, 1997).

The third bridge is related to getting the technology accepted from a first set of customers, but also from other market constituents, such as suppliers of complementary products, lead users and other third parties who are important to involve. Sometimes even competitors can be of help, for instance when trying to establish a new standard. The last bridge is about the broader large-scale diffusion and the resources and stakeholders needed for that transition (Ibid).

As described it is about mobilizing both interest and resources to bridge a technology from one phase to another. In addition the stakeholders tend to change along the way (see figure Appendix II). This stakeholder management challenge is important, in particular the more radical or disruptive a certain technology is perceived.

“Everything – even technology – is politics”. (Jolly, 1997)

The technology might even sometimes be relatively easy to develop in comparison to the task of engaging the different institutions and actors that are needed to commercialize it (Ibid). Van de Van (2005) states that gaining legitimacy is a key problem in the emergence of a new technology, and the growth of a critical mass of actors is often a prerequisite for legitimacy.

3.3 The Liability of Newness

In this section a general description is given to the challenges and constraints that can be related to the age and size of a firm. These characteristics are suggested to be more associated to the first half of the process described above – especially mobilizing interest and endorsement, and mobilizing resources for demonstration.

Death rates at the early ages of a firm are much higher than those at later years (Stinchcombe, 1965; Freeman et al, 1983). This is often related to the young firms' lack of experience, resources and legitimacy (Stinchcombe, 1965). It is described as a combination of both internal and external factors. The small size associated with being a young firm often derives from limited financial resources, and a young firm often only has access to funds from the founder himself, his family, friends or other strong ties (Freeman et al, 1983). Lack of experience often relates to the lack of knowledge and routines, but as the firm overcomes challenges and pursues opportunities, it develops experience that becomes part of the firm's processes and values (Dougherty and Heller, 1994). In addition survival is also challenged by a firm's limited contacts with external stakeholders. It has not existed long enough to build up a network that can connect the firm to other valuable organisations or networks (Hite and Hesterly, 1990). As the firm ages, it becomes easier to view the firm's suitability as a network member, which increases the firm's chances of successful interaction and cooperation with other firms (Gulati, 1998). Limited outside connections and contacts can also be seen as a result of a young firm's limited market exposure. High competition and/or limited resources may force the firm to market their products in small niches (Covin et al, 1990). Market niche presence can however also be related to the nature of the technology as stated in the previous chapter.

As one can see the constraints of being a young firm tend to be interrelated and the order of factors that lie behind a certain constraint is not always obvious. It is however often likely to be a combination of factors. Legitimacy for instance, the perception that an organisation is meaningful, predictable and trustworthy has to do with a number of things, many which have already been mentioned. A young firm has not had the time to get a track record for itself or its product when it is in the process of commercializing a novel technology. This gives little information upon which to assess the firm. Furthermore, young firms have had little time to develop organizational routines, rules and skills, which face them with inexperience in various operational areas. Factors like these make stakeholders feel uncertain about the young

firm's reliability, and as a consequence this can lead to a perception of a lack of legitimacy (Suchman, 1995). The short track record and the little information available on the young firm also result in bad visibility from the larger firms' perspective. A consequence of low visibility and the lack of information is the difficulty to do inter-firm comparisons (Chen and Hambrick, 1995). Another characteristic that gives external stakeholders perceptions of legitimacy is the organizational size, which is closely tied to the firm's financial resources. Size gives legitimacy because it is an indicator of past success (Hannan and Freeman, 1984). Others suggest that size affects legitimacy because the larger the firms the more visible its actions and therefore there is more information available to assess it (Suchman, 1995). Small firms are however also often associated with numerous positive characteristics that support innovativeness, such as lack of hierarchy, open boundaries, mobility and high-developed adaptability. In addition, smaller firms are argued to have less bureaucracy, more efficient internal communications and an ability to develop partnerships (Van Dijk et al, 1997).

Lack of visibility and legitimacy appear to be two of the most significant liabilities of newness as they are closely related with how external stakeholders view the firm. Stakeholders in their turn could contribute to reduce other liabilities of newness, such as lack of experience, ability, visibility, network access and resources.

3.4 Collaborative Relationships with Key Actors

Until now emphasis has mainly been given to the exploration of the challenges ascribed to a young and small firm striving to commercialize a novel technology. This section will present a few concepts regarding the management of relationships that can be vital for the commercialization process. From this point we will therefore proceed into the collaborative aspects of technology commercialization.

Technological innovation is fundamentally a collective process of building a structure that reduces the time, cost and risks for each participating member. Knowledge-intensive technologies very seldom provide sufficient proprietary benefits for sustainable competitive advantage to individual firms. Instead they provide collective benefits for cooperative advantage. Developing and commercializing these innovations require resources and competences not available to the single firm, therefore the expression 'running in packs' as opposed to 'going it alone' (Van de Ven, 2005).

The context for firms running in packs could be further understood using different analogies from the literature on strategic networks. One such concept is that of knowledge webs, which is understood as when individual actors or organizations join forces to work towards a common goal (Eneroth and Malm, 2001). In their idea about the creation of knowledge webs between firms, as a means for competitive advantage, they argue that inter-firm relations are only valuable to a firm when they are generative, meaning that they help you to develop knowledge. In order to create generative relations these following three factors are said to become important:

- (1) A balance between novelty and confirmation in the knowledge exchanges (completely new knowledge could be difficult to comprehend and absorb)
- (2) A complementarity of competencies
- (3) Shared visions across organizational borders

Another related concept is that of ‘innovation ecosystems’ and how firms are suggested to act in them. Ecosystems in a business sense is a metaphor to describe the increasing complexity of the relationships between firms and should not be confused with biology.

“When they work, ecosystems allow firms to create value that no single firm could create alone.” (Adner, 2006)

Adner states that depending on others for your own success has important strategic implications. It involves having to consider three fundamental types of risks:

- (1) Assessing interdependence risks of coordinating with complementary innovators
- (2) Assessing integration risks of having the innovation adopted across the value chain
- (3) Assessing which risks are to be taken internally and which are better shouldered by a partner

Dealing with interdependence risks is about understanding whose projects must succeed before yours can. Adner (2006) suggests that the joint probability, that different partners will be able to satisfy their commitments within a specific timeframe, decreases with the number of partners engaged.

Integration risks are about understanding who will have to adopt the solution before your customers can. Each intermediary will assess the costs and benefits of the innovation. If benefits do not exceed cost at every adoption step the intermediaries will not move the offering further down the line. It is important to remember that these costs include both direct costs (the charged price) and indirect costs (switching costs, required complementary investments, the risk of failure, and so forth). Assessing all of these risks makes strategy making in innovation ecosystems very much an iterative process (Ibid).

By returning to the thoughts of Van de Ven an appealing proposition can be found that constitutes an important capability for dealing with both the risks described above, as well as the constraints and challenges presented in previous parts of the chapter.

“Actors with political savvy – an ability to recognize the interests of key actors and enrol them to one’s viewpoint – will be more successful in effecting institutional change and realizing their goals than actors without political savvy.”

(Van de Ven, 2005)

Who are these key actors that one is suggested to recognize and enrol?

We have chosen not to go into every possible collaborative relationship form in detail. Instead we have let the relationship with mainly customers, but to some degree also suppliers, in a high-tech market be the ‘bearer’ of this idea. There could be many similarities between establishing customer relationships for collaborative reasons, and between establishing supplier and partner relationships for the same reasons. Both in how a small young firm with limited resources, power and legitimacy can find ways to attract an external organization or person, but also the reasons behind going into such a relationship.

The idea of collaboration is not a new one. The discussion of inter-firm R&D for instance, dates back to the 60s, but the one concept that perhaps catches collaboration in its essence is rather new.

“Open innovation is a paradigm that assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as the firms look to advance their technology.” (Chesbrough, 2003)

Knowledge is not anymore proprietary to the company. It resides in employees, suppliers, competitors, universities and customers (Chesbrough, 2003). By collaborating with external sources like these, companies are suggested to be able to find faster and more profitable ways of bringing new products to market than companies with closed innovation processes.

The concept of open innovation can be applied in many different contexts, thus it has been subject to a wide interest from the research society. One of the main research areas is how to manage open innovation. This is exemplified for instance by the process perspective of open innovation, which describes how firms do in order to open up their innovation processes and how they choose external collaboration partners. Gassmann and Enkel (2010) acknowledge that companies use three different strategies in order to engage in open innovation. The first strategy is the *outside-in process* where companies get new knowledge from external sources. For instance they might decide to communicate with suppliers, customers or competitors in order to get hold of new information or technology.

The second strategy is called the *inside-out process* and refers to how companies choose to license innovation to other companies that are able to reach a market, which the licensed company is somehow unable to reach alone. It can also represent activities such as technology spin-offs or the selling of IP (Intellectual Property). In addition, there is a third choice of strategy, which is called the *coupled process*, which means that companies can use a mix of the two previously mentioned strategies in order to open up their innovation processes. In this thesis we are mainly focusing on the *outside-in process* and the *coupled process* as these clearly relate to the needs for young small firms with a possible need for resources, abilities and legitimacy. A collaborative relationship could be believed to help a firm overcome these constraints (Ibid).

The most important features of the *outside-in process* are investments in external knowledge and contacts with customers and suppliers. It can mean the integration of gained external knowledge through interaction, but also for instance the buying of IP. The gains from supplier involvement range from earlier identification of technical problems and availability of prototypes, to better utilization of internal resources. It can also give access to supplementary products and services and reduce technical and financial risk. The gains from early customer integration are also described and the authors point to the fact that customers in general, have

moved from being passive recipients to being more active and demanding in the product development. By involving the customers in the innovation process, it can be possible to obtain the customers' needs even before they themselves are aware of them. This can be accomplished for example by establishing focus groups, partnership with key customers or interaction with lead users (Ibid). A requisite is however to have the necessary competence and supplier management capabilities, which we have touched upon previously, with for instance risk assessment (Adner, 2006) and political savvy (Van de Ven, 2005). Gassmann and Enkel (2010) name the overall capability that is needed to succeed with this process as the *absorptive capability* – being able to absorb the outside knowledge coming in.

The *coupled process* describes a more complementary collaboration process where both parties are on the same level and thus both want to mutually gain from the collaboration. It is often a relationship, which is based on a give and take premise. Thus this relationship process integrates external knowledge and internal competencies for *both* parties to higher extents than the *outside-in process*. This can be important for instance when there are critical interfaces, a standard or a so-called dominant design that needs to be developed, which all actors in a certain industry could gain from (Ibid). At large the *coupled process* shows many similarities to the generative relations described earlier by Eneroth and Malm (2001), where the importance of complementarity, but also common visions, were stressed. Gassmann and Enkel (2010) describes the skills that are needed to succeed with this process as the *relational capacity* – which stresses the need to maintain and build new relationships within a network of suppliers, partners and customers.

3.5 Crossing the Chasm

Many argue that customers do not buy products but rather benefits or solutions to problems. Or put differently, a technology has no value unless it can be utilized and applied to allow a customer to realize these benefits. In this sense, one of the most important factors in successful technology transfer is the identification of applications for the technology. This is however not a sequential process. It can instead be a rather chaotic process, with continuous interaction between the customer and the entrepreneur. Important to remember about this dynamic interaction is that the perceptions of a technology tend to be different for each actor in the process (Gibson and Smilor, 1991).

This section therefore aims to give a deepened description of the challenge to identify and connect with one’s market, from finding the first critical customers to reaching the larger masses. The presented parts of the theory addresses the differences between customer segments and the various implications these can have for the commercializing firm. We also believe that the logic of connecting with a particular customer segment can be applied to the process of finding and connecting with different partners and suppliers too, especially in a business-to-business environment where the differences and boundaries between suppliers and customer is sometimes inseparable.

A widely used model illustrating the market development for new innovations is the adoption and diffusion cycle (Rogers, 1995). This cycle has different categories of adopters, each with a unique set of characteristics and needs. Being successful is described as a smooth process of gradually moving from one category of adopters to the next. The graph below is a modified version of this process created by Moore (1999). He describes a cycle where he has identified a chasm between what he names *visionaries* (innovators and early adopters) and the *pragmatists* (early-majority).

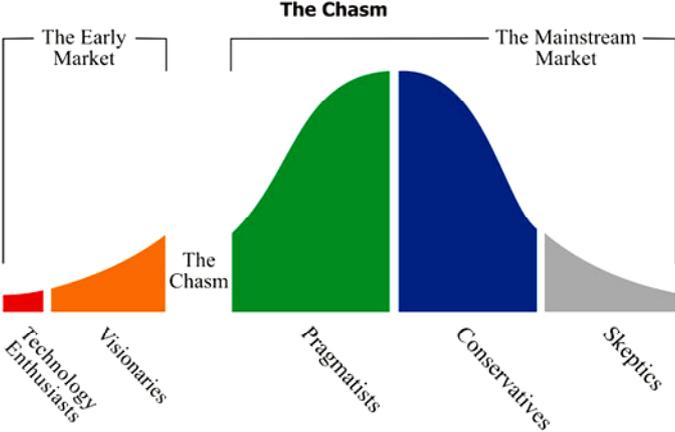


Figure 2: The Technology Adoption Life Cycle, ‘Crossing the Chasm’ (Moore, 1991)

To begin with however, the first people to adopt a new technology are the technology enthusiasts. They appreciate the technology for its own sake. Most often, these people are not powerful enough to dictate the buying decisions of others, nor are they a significant market in themselves. Instead, Moore says, they represent a source of initial references. In addition they can offer great feedback early on in the design cycle. The key is to find ways of letting them in on the secrets, letting them play with the products and letting them know that an

appropriate feedback is being implemented. It is of advantage if the technology enthusiasts are near or have access to the next group – the visionaries. This second group are the few people that have the ability to match an emerging technology to a strategic opportunity. They can develop this insight into a high-visibility project even though risks are high. Visionaries tend to have the charisma to get the rest of their organizations to buy into the project (Ibid).

Additionally, if these persons are responsible for large budgets, they can represent a hidden source of venture capital. The key point here is that visionaries do not derive value from the technology itself, but from the strategic leap forward that the technology can imply. Therefore, because they look more to potential than risk, they are also more willing to work with small firms, with limited funding and who are far from delivering a finished product. This also makes them the least price-sensitive segment. One has to keep in mind however that it can be a highly demanding customer who will try to influence the firms' priorities, and the projects are often very riskful, which could leave all participants disappointed in the end. But without the boost that this segment constitutes many high-tech products cannot make it to the market. They will not gain the needed visibility in their window of opportunity. Or the firm will not have the financial strength to wait for the larger 'mainstream' market to develop (Moore, 1999).

In contrast to visionaries the pragmatists' goal is to make incremental, measurable and predictable progress. When they buy they look at the company, the quality of the products, the infrastructure of supporting products and system interfaces, and the reliability of the service.

“Pragmatists won't buy from you until you are established, yet you can't get established until they buy from you.” (Moore, 1999)

This catch 22 is the essence of the chasm. Moore (1999) argues that the chasm arises because of the fundamental difference between visionaries and pragmatists. References and relationships are important to the pragmatist, but because they are more vertical in their communication they tend to talk only with people like themselves in their own industry and not over boundaries like the previously described segments do. Obviously it is tricky for the young, small firm without reputation, experience, resources and the right connections. It takes patience. One has to be acquainted with the issues of their industry, show up at the same trade shows they attend, being mentioned in articles they will read, having installed base in other

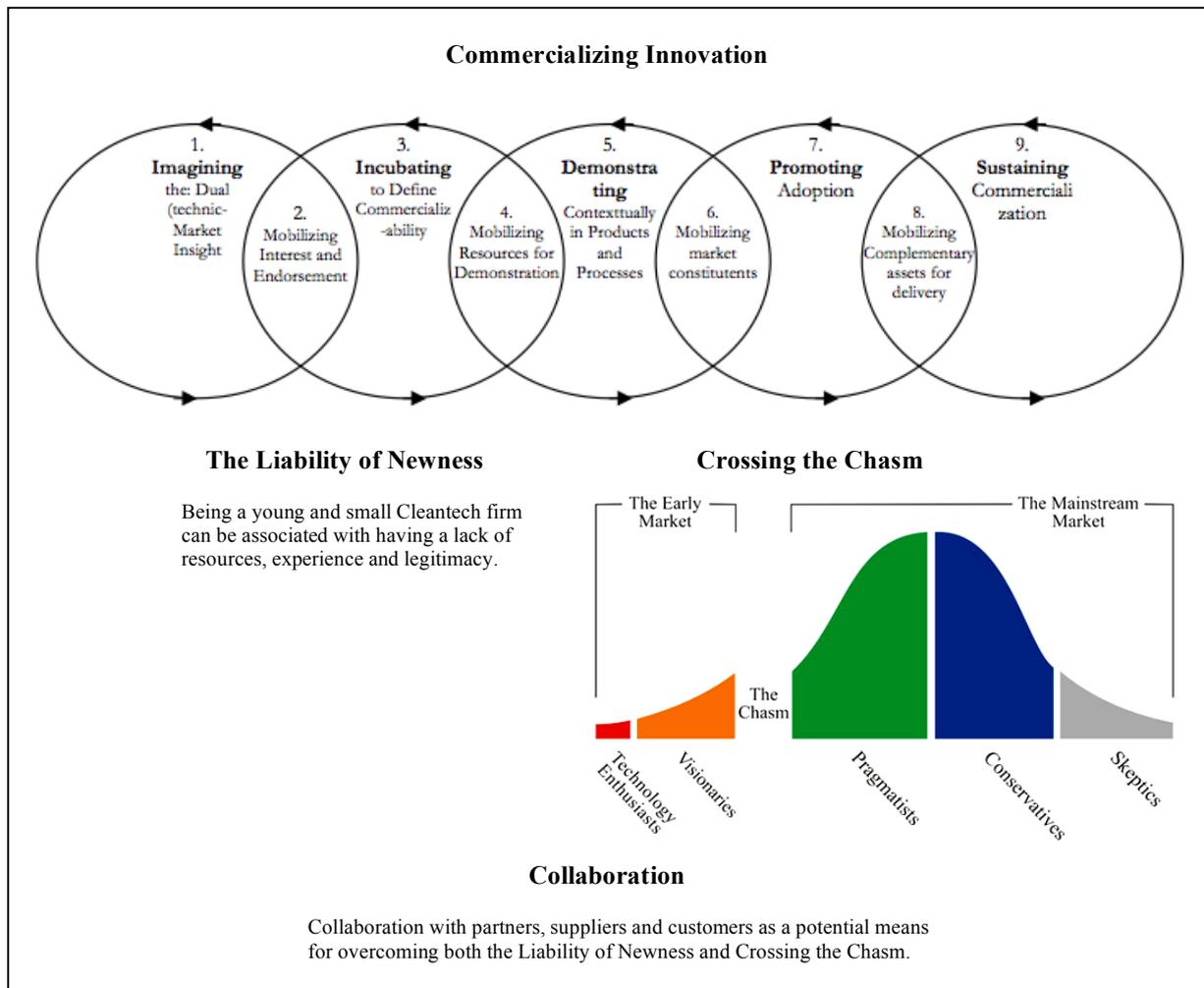
companies in the industry, and having products with applications specific to the industry. One way into the pragmatist community is also to establish partnerships and alliances with already established and accepted vendors. Once a relationship of trust is established with the pragmatists, the rewards are worth the effort. Pragmatists are loyal – they are in it for the long haul and they constitute a large group of buyers. Another advantage once the pragmatists are convinced is that the conservatives look at what they purchase (Ibid).

3.6 Theoretical Summary

In order to successfully develop and commercialize innovations, not only does the firm need to conceptualize and develop the innovation in the first place; it must also be successful in reaching more than just a niche market of technology enthusiasts and visionaries. In other words, it must cross the chasm and in the process overcome the liability of newness, by mobilizing the adequate resources and stakeholders along the way in each sub process. On this journey it is proposed that the firm will face a number of challenges, especially those associated with the constraints of lack of resources, experience, ability and legitimacy. We have also taken a closer look at how collaborative means can help a firm make this journey. This suggests that it is beneficial for the firm to ‘run in packs’ rather than ‘going it alone’ to develop knowledge intensive technologies. It is suggested that relations are especially valuable and long lasting when they are generative – meaning that knowledge is generated on both sides. Especially the collaboration with a future customer is described as having a potential to be valuable, and it is proposed that the logic of connecting with customer segments could be applied to the quest of establishing relationships with partners and suppliers too. It is however emphasized that, because of the collective and pluralistic characteristics of the arena where technological change takes place, the entrepreneur has to be politically savvy to understand and mobilize the interests of those with potential stakes in the emerging technology. Related to the ability of ‘political savvy’ is the need of being able to assess the different risks associated with external relationships, such as interdependence and integration risks and the question of which risks to take on internally.

The last section finally suggest that the most important difference between stakeholders to have in mind is that of how they reference each other; pragmatists for instance tend not to take references from others than their own group, therefore the existence of the so-called chasm. In summary this tells us the importance of modifying the firm strategy to recognize the various stakeholders at each phase, whether they are potential suppliers, partners or customers.

3.5.1 Summarizing Model of the Theoretical Framework



- *The Liability of Newness* explains and describes some of the critical challenges and constraints of the young firm.
- *Political Savvy* ‘the ability to recognize the interests of key actors and enrol them to one’s viewpoint’ summarizes the overall capability in each of the bridges in the process model, *Mobilizing Interest and Endorsement*, *Mobilizing Resources for Demonstration* etc. Establishing these relationships is essential to ‘bridge’ the firm to the next phase.
- A relationship is described to be especially valuable if it is *Generative*. A requisite is that the firms (1) *Complement* each other, (2) *Share Visions*, and that the knowledge being transferred has (3) a balance between *Novelty* and *Confirmation*.
- To be successful it is also suggested that the firm (1) *can assess interdependence risks* of coordinating with complementary innovators, (2) *can assess integration risks* of having the innovation adopted across the value chain and (3) *has an ability to assess which risks are to be taken internally* and which are better shouldered by a partner.
- *Open Innovation* gives an idea of the vast possibilities with collaboration, and suggests how especially suppliers and customers can be utilized in the business in various ways, to reduce time to market, boost product development etc. The *Outside-in Process* describes customer co-development and supplier knowledge integration and the *Coupled Process* describes a partner collaboration that is on a more mutual level, where both partners tend to have the same goals, for instance through strategic alliances. The *Outside-in Process* stresses the need for *Absorptive Capabilities* and the *Coupled Process* stresses the need for *Relational Capacity*.
- *Crossing the Chasm* describes different customer segments and how they can be utilized, but also the challenge of establishing these relationships due to the segments’ tendency to only reference each other.

4. Empirical Findings

In this chapter we present our empirical findings. The gathered material has been structured with the help of our theoretical framework and mainly been divided into two types of subchapters, that of mobilizing, or utilizing collaborative means. First however, we present the firms' thoughts of the CINNS initiative. Thereafter we proceed to general constraints and challenges.

4.1 The Importance of CINNS

The interviews confirmed many of the results that were made in the Ramböll report (2009).

The overall impression is that the firms are very pleased about their CINNS memberships and the organization at large. Depending on how far the firms had come in their respective commercialization processes they were utilizing the business advisory possibilities to various extents. Also the amount of prior industry or business experience seemed to influence the degree to which the firms utilized these possibilities. The quality and sustainability accreditation that the membership represented was an important aspect. Many firms stressed the importance of not to compromise with the screening process but to continue and keep a high standard now that the network is expanding from regional to national level and will acquire many new members in the process. In connection with the network growing, a few were also raising concerns that the individual support might decrease now that more firms needed advisory. The majority however were pleased about the development of going from regional to national. Some firms did not see a problem with the network growing as long as each sub-region could develop and keep a local touch, with their own meetings for instance. A few firms mentioned the idea of cluster development and its positive effects, as a possible long-term result of the network growing, but also as something that could contribute to preserve a regional and more personal feeling.

Concerning the question of what activities that could be developed, many of the entrepreneurs mentioned getting more support with finding capital. Many were pleased with the financial contacts that they had acquired through CINNS, but some mentioned that more could be done in the areas of finding soft finance and grants from Vinnova and the EU for instance. Especially the writing of applications for these grants could be an area where to some degree competence, but perhaps more so time, was said to be missing.

Collaboration among member firms was not as high among the firms that we interviewed as described in the Ramböll report (2009). This can however be a coincidence and have to do with the selection of firms. There was some cooperation being described but it could not be further discussed as the two firms were in the stage of negotiating with each other. Moreover, many entrepreneurs stated that they have a limited amount of time and resources and would therefore only engage in projects that have the biggest commercial chances and shortest pay-off time. Often the projects that believed to generate this were together with customers or partners, not other Cleantech firms. A few entrepreneurs however mentioned that they thought this very well could change in the future as more firms joined the network and the markets would begin to mature.

Meeting other peer Cleantech entrepreneurs at conferences and meetings such as those facilitated by the CINNS initiative was told to be both valuable and invigorating. Especially talking with others who had experienced a similar business journey earlier and to discuss what lessons that could be learnt from those experiences was told to be valuable.

4.2 General Summary of Constraints and Challenges

The firms who were not yet established on a given market described the biggest challenge as how to prove and demonstrate the technology. In particular the funding of larger reference and pilot projects was described as high priority. About as much of a challenge was the quest of finding and establishing the right channels and links into the marketplace, both in terms of end customers but also in terms of different intermediaries such as distributors, partners or co-developers. For the firms who were more established, the challenge was still described in terms of how to reach greater market adoption, but also how to cope with the implications of growth, despite still being a young and small firm. However, the ways of framing and approaching these challenges proved to differ somewhat between the CINNS firms.

Initially it is described as a question of how to make a trustworthy and credible impression to various potential stakeholders, especially those needed to finance the product development. Gradually more is then being presented about the actual stakeholder relationships themselves once they have been established, their different characteristics and how the firms manage and make use of these relationships. Thus we go from *mobilizing* (chapters 4.3-4.5) to *utilizing* (chapters 4.6-4.8) collaborative means for Cleantech commercialization.

4.3 Mobilizing Interest and Endorsement

One firm, that was developing a technology to generate electricity from wave power, talked about the difficulties of finding investors:

“They find the technology and the company really interesting, but they also realize that it is a long time until there is a commercial product. It’s a difficult industry with relatively many actors. But also high-risk. There are many that won’t go the whole distance. Many have already started dropping off, so at the moment many of the investors wait with doing these kinds of investments, because of high risk and long time to market.”

All of the firms mentioned that one of the initial and biggest challenges was getting their innovations accepted.

“It’s a phase of recognition. To get it accepted. One wants to see that it works in reality. Therefore it is important with external indications like research results.”

Once a firm has received some initial acceptance it is described as much easier to proceed. Certain events seem to trigger each other.

“Then it is a ketchup effect. You get one person with respect that says that this is good, which creates trust, then the ones after don’t need to do as much due diligence and it starts accumulating from there. But of course it is much easier to sell something if you have a reference. /.../ Case studies that are defined for each segment is the best.”

Being a member of the CINNS initiative was by all interviewed firms also recognized as a way of acquiring accreditation, especially in the sense of sustainability and being considered a Cleantech firm.

“Helena (the project manager of CINNS) told me the first time I met her that they wanted to work with companies that were not only ‘putting filters on chimneys’ /.../ but rather to work with those that had more radical solutions on how to make things right from the beginning /.../ Those kinds of firms who work with so-called ‘root causes’, and that I think is exciting, that we get a kind of accreditation that we in fact work with ‘root causes’.”

This recognition approval of being a Cleantech firm was however seen as more important in the context of catching the attention by potential investors than by customers. This was related to the fact that most interviewed firms were active in the business-to-business sector, where the industrial buyers that the firms approach were still believed to look more to what the specific application could do to improve their costs and what the pay-back time was. The innovation being Cleantech was more believed to being seen as a bonus for the buying firm.

“Many think this is really fun (regarding Cleantech) and many do want to be seen as environmentally correct in what they are doing. But in the end when you are the company manager (in the buying company) or a board making the decision for an internal investment it is the pay-back time that rules the decision.”

“Of course you take advantage of the fact that you are a Cleantech firm – to hunt investors. But in the end B2B is about making money – making money. You have to have a product that somebody is willing to pay for. And you have to deliver the product, ensure that the customer is happy and build up the business around it. If you are a company in ICT, Biotech or Cleantech, it doesn't matter. It's the same.”

The two business-to-consumer firms that we interviewed had somewhat different, but still related experiences and views. One of these firms was approaching eco-farmers, to whom the innovations means for sustainability obviously was important, but so was value for money. If the product promised what it could do it would also mean a decrease in cost, which was also important alongside with sustainability. The other business-to-consumer firm experienced that the end customer did not see the environmental problem that his firm's innovation could solve. The environmental problems were on an aggregated societal level and not obvious to the individual consumer. Therefore his innovation looked very expensive compared to existing alternatives from the eyes of the general consumer.

To help catch the attention of investors many of the interviewed firms stressed the importance both of the Cleantech accreditation in itself, but perhaps more so the actual membership in CINNS, and the various business advisors and investor relations that were obtained through the networks of the organization. This was emphasized more so by the younger and smaller firms, who were not yet established and who did not possess previous industry experience.

“Without them (CINNS) I wouldn’t have made it this far, that I have to say. It has only been myself in the firm and I don’t have the experience of running a large business. You have to have some type of support.”

Having a close connection to the university and having personnel with backgrounds in applied research was also acknowledged as an important asset. For instance having a high degree of PhD personnel with in-depth knowledge of the particular field, but also previous industry experience and acumen, was seen in the same limelight.

In addition to these internal capabilities with strong signaling effects, all firms had their own tricks and strategies regarding how to get seen and how to gain legitimacy. One firm claimed that the reason for putting up an advisory board was more important for the credibility than for the actual advice it generated.

Business competitions and their use for marketing reasons were also an interesting matter. Some firms argued that taking part in these competitions was more important than the actual price money they could generate.

“These prices generate a certain amount of credibility, of course. Somebody has evaluated the firm and believes in the idea. So before having started to sell, it’s always good to win prices. Then afterwards, when you have started to sell, it’s good for the reason that you win a third-party evaluation, that it is a good product, that’s a confirmation.”

“It’s marketing effect. If you look at our company in 2008 you would have thought that we were a larger company than we actually were. Before we had enough substance, the products and references, we put a lot of effort into marketing. Although we didn’t have anything back then, we were still out on the market for one year. And then you have had time to establish a relationship with somebody. So those who wait with marketing, I think it’s a mistake. Of course if you are to protect something, then it is relevant. But to get out on the market and start to communicate, then you start to build up a relationship with the customers.”

Yet others were more skeptical, and therefore highly selective, but still taking part in these competitions for marketing reasons.

“There is a huge amount of different arrangements for Cleantech firms and all sorts of things going on. We are never attending them, apart from very few occasions. WWF has an arrangement named Climate Solver where they pick out companies with huge potential to reduce CO2 until 2020. /.../ China, everybody knows what the cute Panda stands for. We won it and today it is even part of our logotype.”

Another topic, which received a few different viewpoints, was the question of whether to take part at tradeshows or not. From a cost/benefit point of view some entrepreneurs only considered participating at tradeshows, as an alternative once the product was more or less finished. They did not believe in participating with only an idea or an undeveloped product. Another firm was more positive about promoting early on.

“One shouldn’t be afraid. I was very afraid in the beginning. Shall we really attend this tradeshow, and this one too? But we realized that you have to invest money to earn money, that’s how it is. You have to go for it otherwise you won’t get anywhere.”

“It is also good to have a balance to what tradeshows you attend. /.../ We have tried to have a balance between academic communities and commercial customers. Because there is a dynamic between the two, people go back and forth. And it is important to find the gurus and get them to approve the product, then it can trickle down to the others, and everybody wants it after a while. That’s what we hope.”

4.4 Mobilizing Resources for Demonstration

According to the interviews, it cannot be emphasized enough how important it is to prove and also show the technology to various stakeholders. It was often told to be the key for reaching the next step of development.

“Proof of concept is completely essential. We know that this works, but to show it is another thing. This is the first construction. We’ve done a lot in lab and seen that it works. But to also make it work sufficiently well is absolutely critical. /.../ If it wouldn’t work it’s a loss of prestige. Now there are many different groups that know we are on

our way, and many who want to come and take a look to see how it works. So a lot is on stake. It's absolutely crucial."

Another firm gave a related answer.

"We have to get a verification of the system as a whole, to prove that our simulation models are right. There is always some deviation between simulation and reality. And before you put down too much time on optimizing the system and improving the transmission /.../ you have to have some kind of reference to reality to work with. That's why we want to do this trial, this prototype, to move on and later build an even bigger one."

Another entrepreneur related the need to demonstrate his firm's products to the pragmatic characteristics of the firm's customers. He said that these particular customers would not consider the product if they had not seen it tested in reality or if somebody who had seen it, that they trusted, could recommend it.

For these reasons the question of how to finance demonstration and pilot projects was one of the most crucial ones.

"The difficulty is to finance the development and also to get money in order to build a reference plant. There lies the key. Nobody wants to buy a plant if they don't see that it works, but it is difficult to find willing investors. It easily becomes a catch 22 since they want to see that things work before they invest. Then when you have showed that it works then you don't need any money because then you have customers instead that pay in advance."

Another firm responding to the same topic described the difficulties of getting a signature.

"A signature on a paper is the most difficult. We are basically done at the lab, as far as you can come. We now need money for scaling this up and to demonstrate this technique in a bigger setting. The pilot at hand can even be profitable."

This problem was related to getting in contact with a large company that had a potential interest in the firm's products and could help with the investments for scaling up the production. This can however be tough for a small player in a complex industry.

“What we do now is that we work a lot with market development and try to find entries in different ways. The problem is that if you take one of our products as an example, then there's a world market of 400 000 ton/year and only four manufacturers which are the largest in the world. These companies have 45-100 000 employees. Which one of these employees are we going to speak with, and how shall we reach out to him or her?”

“It's a little more difficult to find the right way in a giant corporation and especially to get a deal. We get sent a lot between different people and even when we arrive at relatively high levels, it still becomes difficult. Somebody who is responsible for these kinds of products has to think that it's really good, but in the end it still isn't he who makes the final decision. It can be certain people at a really high managerial level who are really interested in our thing, but then it only needs to go up one notch to get approved and then it gets completely killed.”

In the meantime the firm worked to develop their processes and tried to be active in different contexts to get seen.

“Part of our marketing strategy is to be very present at conferences and not only do we try to be present at the conferences but we also try to be active at the conferences, so we give presentations about the technology and are visible. Networking. Being visible in order to find the right people, so that the right people can find us rather than for us to find the right people, which is almost impossible.”

During this search for a large industrial partner with financial muscles to help build a first reference plant, the timeframe is also emphasized as an important factor to have in mind. The window of opportunity can be limited.

“If we don't succeed with finding this partner next year it will be difficult to see how we're going to continue on, but of course, we will continue to fight. Somewhere you lose

an element and it's no fun anymore after three years. And you also risk losing credibility. It's not so interesting anymore to those who you negotiate with. The news is over. The challenge is to strike while it's hot."

After having a pilot and demonstration project in place, a closely related subject is the importance of having reference customers. If a partner or customer is co-financing these projects, which could be one of the scenarios for the firm described above, you get both things at once.

"There are actually Swedish companies that would be very interesting to have as a first reference customer. It is really that particular part which is missing. If we would have had one successful reference customer then we could have been able to sell to everyone. Because then we would at the same time prove the scalability and have a finished product."

4.5 Mobilizing Market Constituents

One of the entrepreneurs who had not yet started promoting the company towards the market again talked about the importance of having a verified product before engaging in too much activity with the market.

"We did some verifying measurements, which showed that the product was not really finished, so we had to pull on the engine break. /.../ It's important that before preparing your marketing message, make sure you fix your product. On the other hand you can engage in market probing as much as you want. In fact, that was the case with the guy who sat in this position before me, but he wanted to sell something that wasn't ready yet. And nobody understood why he didn't manage to sell anything. /.../ If you are going to build a high house you first need a stable foundation."

To get the product's function verified the firm co-operated with an institute called JTI², an organization also used by one of the other interviewed firms in the same sense of proving the technology, but also to acquire the recognition and accreditation that such an organization can give.

² Institutet för Jordbruks- och Miljöteknik, Swedish Institute of Agricultural and Environmental Engineering

One aspect that was frequently described by many firms, in order to successfully work one's way into the marketplace, was the importance of adapting the original innovation to fit the needs of the potential buyer. The possibilities and ways for actually doing this varied a lot between what type of innovation and industry the firms were dealing with, and also what possible conflicts of interest that could potentially hinder a buy.

"It's not seen as good if it is completely new, that you have to build a completely new plant in order to do this. It's better if you can integrate it into theirs. One has to understand that they have put several billions into their plants and want to continue and use them. /.../ It's about finding modular parts that fit into existing production. /.../ But it is hard to know what they want."

For some firms adjusting the product to fit the market could mean making it a lot simpler and more tangible. The more complex systemic type solutions were described as more favorable to promote later on when you had established a relationship by selling simpler products.

"We would've succeeded sooner as a company if we would have focused on a simple product that we could have sold to more people. It is much easier to sell a hardware product that is packaged and defined, than a product that has attached services where the business model is more complex."

This is not only viewed as important for making the first steps on a market and gaining credibility, but also for financial reason – a simpler product could easier and faster bring in money to the firm.

"Go for the products that have very short sales cycles so that you can start making money for the company straightaway. We went for something that was more complex, took longer to sell in and as a company the hardest thing is to get credibility in an industry. Cleantech is not an industry in itself, it covers many different industries. And depending on which one you are working in it can be rather conservative or really progressive. /.../ This means that it can take a really long time to develop a reputation and gain credibility in the market. /.../ Later on you can invest in products that are more extensive and take longer to develop. /.../ Simple business models are very important. Define the product as much as possible. Sell a part of the product that is a

bit cheaper, and then later sell the more expensive components. Try not to eat a big piece of the pie at once.”

The complexity and cost of the initial product, and its effect on establishing a relationship – step by step – is something this entrepreneur returns to several times. It is said to be about minimizing the perceived risks; with less complex products the customer is more likely to choose them, and when he uses the product the relationship starts to take form.

“If you have the opportunity to take a step back and then take a part of a much larger product, which is much cheaper for a customer to invest in. This means that when somebody has bought it, they have spent time reading, understanding and using it. Then it is more natural to later budget for something that is connected to that, because you have built up trust. And this relationship is the most important thing. How you establish a relationship? – You should not expect that the customer is going to put a lot of money on something. Most people want to avoid risks. Therefore start with something cheaper and less complex.”

The same firm also saw this as important in the sense of finding investors during the critical first five years.

“How you survive the ‘valley of death’? You have to prove to investors that you have something that can sell. This means you have to have a product with these short sales cycles, something that you can sell to a local market, and then go for the more complex products that take longer to develop later on.”

Another firm gave a similar type of description. They had been able to finance the innovation development by developing custom-made products to a few large firms. However, these firms were contacts that were already established. The firm had been able to bring these customers into the business from a previous firm.

“It took us 5-6 years before we had a developed product and during that time the firm financed its development by running another type of heat-exchange business. /.../ That operation had quite low margins, but it wasn’t very hard work, so it made out the basis for being able to afford this product development.”

This same firm, when asked about ways of getting into the market and how to approach the right potential customers, said the following.

“I think the only way to market yourself is to think critically where the product comes to best use and where it at the same time costs the least. /.../ We’re interested in selling applications where our heat-exchangers cost as little as possible in comparison to the system of the customer, but where it at the same time can be the most important factor for how effective the whole system can be.”

“I think that many more companies should ask themselves this question much earlier; ‘So, who has a use for this?’ But they don’t, they do it far too late.”

Furthermore, he states that if one has done the homework of analyzing the market properly before engaging in it, then one would have the highest chances of finding the right firm to approach. He emphasized that the only reason for the prospective customer to listen to them is that the firm can provide a unique opportunity for them to lower their costs and get better performance. It was said to be important to approach those customers where this could be accomplished with the shortest pay of time.

However, many of these prospective customers, as have been mentioned earlier, can be very large industrial enterprises. For that reason he emphasizes the importance of experience and previous market contacts, and the understanding for what it is that decides the companies’ internal decision processes. These individuals do not always have the same priorities as the company itself.

4.6 Close Collaboration with Partners

Some firms looked at ways to build partner or agent networks. Others had already begun doing this. The motives for doing it were the same. It was often considered too costly or for different reasons unwise to build an own sales organization.

“What we look at is to establish agents in a few different markets. But the climate is totally different in other countries. You only need to go to Denmark and it’s different. /.../ We have chosen to work with agents who know their local market, they have

knowledge that we don't have and that we'll never get, even if we use all kinds of statistics, market research, trade councils etc. It won't give the complete picture compared to using a local agent. Moreover, it would take us incredibly long time and money to do this on our own. Instead we give the agent a recommended end price and one price from us, plus the estimated time for delivery. It should be as simple as possible. But we would really like to find somebody who is a little larger, with muscles that can bring us out in the world, with distribution networks already in place, sales personnel and so on."

Having an ability of doing as much as you can, with what you have at hand, is something that is discussed in several interviews. With this comes for instance being able to establish sales networks that fit the firms' financial situation.

"There will be partners. At the moment, we sell ourselves, but in the short and the mid-long strategy, since we are a small firm and we don't have a big financier behind us, our plan is to build a network of external sales agents that sell in our name and then they get a provision based on how much they've sold, i.e. we don't get a capital tie-up in the actual sales process. We won't pay a fixed salary but only pay when they actually have sold."

The challenge is also described as to finding the right persons, representatives, agents etc. to work with, and there are also certain risks mentioned associated with relying on others for your business.

"This is of course a strategy that has certain disadvantages. You want to have this solid and stable ground that I talked about, at the same time there's somebody out there that has to make a living from his business selling our products. The risk then is that he talks too much, that he promises more than what we can promise so to speak. So it is important to find serious people. /.../ But then you have to, and this industry is a new world for me, you have to find new clever roads all the time and try to proceed with the means that you have."

An agent's ability to guarantee and fulfill service agreements was to several firms a critical factor when considering working with an agent or not.

"I have studied a bit on how to try to develop an agency network. The disadvantage with agents is that you stand there by yourself with the service responsibility and all that. /.../ I was actually on my way to start selling to another country through an agent, but they couldn't guarantee any service, so it didn't follow through. And it immediately becomes very uninteresting."

Another firm mentions that in order to get a partner or agent network to work in the firm's interest it is important that the incentives are adequately designed. This same firm also had a lot of thoughts on how to build an effective agent-partner network and how a firm with limited resources could do it without taking too much risk. It was said to be all about how you approach the idea and what type of agent agreements you design. Done in a smart way, where the agent had a lot of room to grow and could profit from the relationship over a long period of time, was said to be the key. This is how this particular firm did it:

"We came up with an idea to have a partner structure based on levels. The first level is normal agent, the second we call solution partner. When an agent succeeds and is selling well, we tell them, and they know about this possibility beforehand, that we want them to establish an enterprise where they only sell our products. But at the same time we sign a contract with them that gives us the option to buy back the company for the investment sum plus 10% per year. So the price of the enterprise is basically set beforehand. So the partner can make money on this mark-up when it comes to selling it back. That is the difference of the price for lending money for the initial investment and the money to sell it. And then we also offer them a minority post in the company we buy from them."

"So basically we use local capital to build an operation and then we buy back the enterprise for an undervalued price. This strategy allows us to simultaneously build this structure around the whole world, on 25 different markets, and then depending on maturity we buy these enterprises and consolidate them into the parent company. So instead of having to invest perhaps 2 Million SEK in a market and take a large risk, we tell somebody; 'Hey, take in local money, you have to invest yourself, and if it goes well we'll buy it from you'."

“The alternative of saying; ‘From now on we are starting a subsidiary company, and you won’t get anything from this’, which we want to avoid. It is about incentives, and also engaging the agents in the business. If they realize that they can make money, not only now but also in the future, they will devote more time to it. So without much cost you can make it out in the world.”

Another beneficial aspect of this close relationship was the sharing of marketing cost. The agents were also partly financing for instance the participation in tradeshows, which made the products come out to display around the world for less of a cost than doing it alone. And when talking about tradeshows this entrepreneur stressed the importance of going out in the world and trying to establish partner relationships early on.

“The only way of going out in the world – is going out in the world! Not sitting behind a desk. /.../ In many cases we have met customers saying that; ‘I have read about the product, and you have told me about it, but now when I actually see it, it is a totally different thing’. There you can explain how it works. But you have to get out there, meet people, and build relationships. It’s a lot of work in the beginning, but if you have built a good partner network, and you have several good products or one really good one, and you start introducing new products, there is a multiplier effect.”

The rational behaviors of analyzing the market to find your ways into the market was a reappearing subject in many interviews, but so was the matter of luck and meeting the right person at the right time. Having a prior relationship with a certain industry had a positive effect on these random events. One firm told us about a contact that had led them right into the centre of the Japanese market, which was told to be one of the most important in that particular industry.

4.7 Close Collaboration with Suppliers

The way the firms collaborated with suppliers was perhaps the collaboration form, which showed the greatest variation between firms. Some firms appeared as if they only needed to buy standard products ‘off the shelf’ and did the more complex development processes themselves. Others had previous short-term engagements to construct a specific custom-made part. Yet others had more mutual and extensive collaborative relationships with their

suppliers. It seemed as if the generativeness of a particular supplier relation increased with the complexity of the innovation. The availability of standard parts for a particular application played a large role as well, which in turn could have to do with the novelty of the innovation itself.

Some firms however had customer relationships that provided them with the special components or competences needed for their applications. These relationships are described in the next section (chapter 4.8).

But there was especially one entrepreneur who applied an extensive use of suppliers in his firm. His development was described briefly in the first section; the firm that developed a device to utilize wave power to generate electricity.

“We work with an open innovation strategy. That means we can utilize the development resources and design departments of large suppliers who are contributing to our construction. What we do ‘in-house’ is really just to act as system-engineers to bring everything together and to develop the requirement specifications and such things.”

When asked upon the challenges with such an organization he mentioned the logistics of keeping everything in place and to get everyone to stay to the time schedule, but the advantages were told to outweigh the drawbacks. Particularly for cost reasons as he only needed to pay for the time of the suppliers’ input. He had about ten engineers at different suppliers that from time to time worked with his project. If he had to employ these engineers himself this would have been a lot more expensive. It would also have been hard to find that specific knowledge that these supplier engineers possessed in the labour market. Another advantage was that these design engineers in their respective workplaces sat right next-door to the manufacturing departments and could get direct feedback on a particular design. In summary he believed this open innovation strategy to be at least double as effective as opposed to developing the technology completely by themselves.

When asked what kind of risks it could generate he did not think that there were any. Rather this work style was believed to reduce risk, especially that associated with technology development. Important however was to be careful with the contracts, i.e. how to manage legal rights and technology ownership for instance. In order for the supplier to put in this

amount of dedication it is described as important that they benefit from the development as well. This means that the supplier needs to be assured that the entrepreneur's firm does not simply go to a cheaper supplier once a certain construction is developed. At the same time he stressed the importance of not ending up with exclusivity contracts.

4.8 Close Collaboration with Customers

Using customers to get insights on how to develop an initial product is something that was used by almost all of the interviewed firms, although the extents to how this was done varied a lot.

One entrepreneur who had developed a weed-cutting machine for eco-friendly farmers (who cannot use herbicides) had used his initial customers both for marketing reasons and product development.

“What we’ve done is that the first customers have gotten a discount in exchange for them showing our product at a few tradeshows. We have also tried to spread this geographically so that these customers become representatives in their respective areas. In this way these customers were also able to make money from using these machines at their neighbours’ farms and thereby showing them even more. /.../ We have also embraced a lot of their practical experiences with the first edition. What worked, and what didn’t. In total we made 17 changes from the first to the second edition. /.../ It’s an evolving product and we find more and more application areas all the time.”

Another firm described their strategy to engage in extensive development projects together with customers in the following way:

“It’s the interplay with the customer that drives the development.”

Characteristic to their innovation however was that it could be integrated into a prospective customer firm's system, a system which these customers then in turn sold to someone else.

“We are a bit unique in that sense that before we have a finished product, we develop it together with the customer. We take a product idea to a prospective customer that we

have chosen because we think it can be a good future partner, and it's almost always large international firms that we work with. And you can do this despite being a little 'shit-firm' like us. It is possible if you have a unique product, meaning that they can't get hold of this competence somewhere else and that the product provides them with really good advantages. That makes them willing to go down to our level and cooperate with us. And this is something that I believe that many high-tech firms in general do wrong; they develop their products alone in their basements. We don't. We have a customer in mind – whom we also contact – from day one.”

When asked about the challenges with this close long-term cooperation with a large customer several things are revealed. First, you need to be able to deliver what you have promised. This is said to be demanding especially because of the big differences between the large and the small firm. An example was the difference in the number of personnel, but also differences in competence and experience could have an influence. The larger partner could know a lot more than the smaller one about a certain process. Other firms in similar situations also described this particular problem; especially having qualified personnel that spoke the ‘language of the customer’ was stressed.

The second problem was related to the time of the project. He believed that the projects for his firm could take 2-4 years. However, during this time the customer would contribute a lot to the funding of the project, but it could still be viewed as financially tough for the smaller firm. The third problem was related to interdependence issues; there could always be some risk that the larger customer suddenly dropped out. To prevent this from happening, it was regarded as essential to identify those he called ‘internal ambassadors’ in the large firms.

“You have to have somebody inside with a high position who is willing to fight for your cause. And who believes in it. We always have that. In every project we have one guy that we are willing to risk our lives for so that he stays happy basically. But then this guy could potentially change jobs and then you stand there with nothing. So you are very dependent on a few persons. /.../ Often it is the R&D manager who are these ‘internal ambassadors’ who have the power to push through these kinds of projects.”

Furthermore, there was one other important aspect regarding whom in the large company that one should decide to approach. It related to the question of getting a good deal in the end.

“Normally, it is the purchasing department who makes the decisions on these kinds of projects. But we never talk with purchasers. We only talk to the R&D people – those we have the project with. /.../ In the end after two years, if you have succeeded with the developments and the testing, then the R&D manager will go down to the purchaser and tell him that; ‘This is the product you should buy’. Then the purchaser has no alternative. So we basically want to delay the bargaining and price discussion as much as possible, because these large companies are extremely good at bargaining. And the later you can have this discussion, the more dependent they are on you, and you are in a totally different position to negotiate.”

This particular entrepreneur had a lot of opinions on how other small high-tech firms were working and what activities they devoted their time to. As it has been emphasized in earlier sections, by other entrepreneurs, this particular entrepreneur was also describing a situation where the largest problem is how to acquire financing. However, he stressed the importance of approaching customers and not only financiers early on, and if done wisely, these customers could then help to influence the financiers.

“The majority of firms devote $\frac{3}{4}$ of their time to chase money, and only $\frac{1}{4}$ is left to work with the development. There we have a big advantage with the way we work. /.../ These Venture Capital firms have no idea whatsoever what it is we really do, or what any other Cleantech firm does for that matter. They can’t judge it, and they don’t like to take the risk. Then it is perfect with a company like us where they don’t need to judge it, because a customer has already judged it. If our customer has been willing to put in x amount of millions then that is a guarantee for the venture capitalists to do it too.”

4.9 General Comments on Entrepreneurship

The business journey of commercializing a new technology is surrounded by many challenges as indicated by the many activities and the nature of the relationships described earlier.

This short selection of comments captures the essence of some of those challenges.

“It means a great deal of hard work, and most firms won’t succeed, that’s what the reality looks like. But it’s also about having luck, finding the right people with trust and patience, because it takes time. One has to have a gut feeling and follow it, and always try to find new possibilities and views on how to do things. It’s not a straight road.”

“Timing is everything, you have a hard time knowing if something is going to be hot in either five or ten years, so you really need to take a shot, strive for something.”

“The hardest about this is the time. It doesn’t generate anything in the beginning, it just costs money, and to get money, you need to have money. And you have to remember that it always takes longer and costs more than you initially think.”

5. Analysis

In this section we discuss our empirical findings with the help of the theoretical framework. The structure is divided into two sections – establishing and utilizing – collaborative means to commercialize Cleantech innovations.

5.1 Establishing Collaborative Relationships

The interviewed firm managers all used words like *trust*, *reputation*, *credibility*, and *acceptance* to describe their initial challenges. To succeed with activities that would give them this was described as essential to their businesses. This can be related to the *lack of legitimacy* described by Van de Ven (2005) among others. If the firms succeeded with acquiring this legitimacy in the eyes of an external viewer, then the possibility for other *liabilities of newness* to decrease, such as the lack of resources, power and visibility, could increase substantially. From a simplified view it could be understood as a process where one good event or contact can lead to an even better event or contact. The first you were told to need as a firm is legitimacy in order to acquire either investors or customers, and this legitimacy could be obtained in a number of ways. Proving the technology in different ways turned out to be the most frequent activity to obtain legitimacy. Related words being used by the firms to describe this were the importance of *verification* and *proof of concept*. These words described the activities of showing and demonstrating the technology, either to prospective investors or customers. At large it was told to be more effective to demonstrate to prospective customers as they had a much greater potential of understanding the advantages of the innovation than investors. If a customer had accepted and acquired the product then this would in turn increase the likelihood for an investor to open up his pockets too.

It is however not as linear and simple as this. It would be naïve to believe that a firm *per se* acquires all the necessary contacts at once after having showed the first signs of legitimacy. It is described as a constant going back and forth, where each new level of legitimacy, represented by for instance a more developed prototype, or a more market-worthy product, represents a higher level of funding or a new larger set of customers. The higher the stakes the more pressure was put on the firm to prove its capabilities. In the beginning when the stakes are low it is even said to be enough to have a credible advisory board and being good at networking and marketing. Later on it is absolutely critical that the firm can prove the actual

technology. This suggests that each level of development has its own set of legitimacy requirements.

In order to mobilize and establish these different relationships that can give the technology the relevant legitimacy to acquire relationships and resources needed to bridge the firm to the next level of development, the importance of various signaling effects cannot be emphasized enough. These did not have to exist of relationships themselves, although relationships proved to be the strongest legitimacy symbols. Being accredited as a Cleantech firm by CINNS was a strong legitimacy symbol. This was believed to be important especially in the eyes of investors and not as much to the customers or partners. This could have to do a lot with a majority of the firms being in the business-to-business sector, a sector which still proved to look a lot more to the pay-back time of an investment and the internal cost savings generated by the innovataion, than to the sustainable aspects of the Cleantech innovation.

Among all of the various legitimacy signaling effects perhaps referencing is the strongest one. It is a concept, which also relates to the importance of being able to prove the technology. Referencing is most often understood as obtaining a customer, which other customers can refer to (Moore, 1999). This reference could, as our interviews show, however also be a partner. It is desirable that this initial customer or partner is well known and higly regarded by other prospective customers. Therefore it is absolutely crucial that a firm, before trying to mobilize a certain group into a relationship, identifies the right actors to approach. When trying to identify the right actors there are a number of things to have in mind. We were able to prove many of the capabilities and aspects that the selected theory suggests. With a radical innovation at hand that is not yet fully developed, the theory suggested that one should start in a peripheral end of a given market (Adner, 2002). This could be related to Moore's idea of the technology enthusiasts who are the ones often found in this part of the market. They are told to see more to the technology itself than its application (Moore, 1999). Some firms were successful at mobilizing this group and could utilize them to improve their technology, but also to improve their marketing. The technology enthusiast is more likely to appreciate the radicalness. He will also accept a technology that is not yet fully developed. Finding this group was however viewed as easier for some firms than for others and related to the type of industry. Some industries only consisted of large incumbents where it was hard to get through and find the right people. One solution to this, suggested by a few firms, but especially one, was to focus on to clearly define the technology and trying to make it as simple and cheap as

possible. This would improve the chances of getting an initial acceptance. Later on, when the relationship, the trust and the receiving partners' knowledge of the technology had been established one could then increase the focus on systemic and more complex applications where the returns would be greater. This shows many similarities with Moore's (1999) description on the challenge of attracting the pragmatists, who are told to look very much to functionality. The technology must work and contain little risk for them to buy it.

Another way of getting around this problem, according to another firm, was to focus more on identifying those people within a large firm with whom one could develop the product together with. They had an outspoken strategy to try and identify R&D managers in certain large companies with whom they could develop the product with, a partner, which in the end would become a customer if the project succeeded, because the partner could integrate the Cleantech firm's innovation in its own product. These 'internal ambassadors' that the entrepreneur talked about showed many similarities with the *visionaries* that Moore (1999) describes as influential people in their respective contexts. If one has established a contact with them then the technology does not have to be fully defined yet. In order to attract this group, the interviews emphasized the importance of explaining the possibilities of what the technology could do to the partner firm, in terms of for instance cost savings and efficiency. There was however a lot of risk associated with these projects. This motivates the importance of having something comparable with Adner's (2006) three risk assessment principles in mind when doing these kinds of considerations.

At large the question of which relationship to go into seems to be highly individual, but by trying to categorize them into different segments, realizing their differences and to critically think in which context the innovation makes biggest sense, one seems to increase one's chances of finding the right collaboration partner. This would most likely improve the chances for an established relationship. Which industry the firm is active in also plays a large role for the availability of actors to get involved with. Certain industries are more conservative than others and some entail more incumbents than others, which can make it harder for some Cleantech firms.

Jolly's (1999) sequential model for new technology commercialization, proved to be valuable as a framing tool for integrating different key areas, especially the question of how to bridge a technology from one phase to another. The capability that could be argued to best meet this

need is the assessment of integration risks (Adner, 2006). Being able to understand who it is that will have to adapt the Cleantech innovation before the customers can do it must be one of the keys to successful Cleantech commercialization. Being able to assess integration risks is also very closely associated with the political savvy that Van de Ven (2005) talks about. He however does not only mention the identification as important, but also emphasizes the actual ability to enrol different actors to the individual firm's viewpoint. This can be related to the previous discussion concerning legitimacy. Starting with initial very important small steps of confirmation and recognition that later, after many accumulated positive relationships and events, can lead to for instance the delivery of complex systems to large incumbents.

However, when looking at all firms and comparing their journeys, the reality seems way more chaotic than any sequential model can illustrate. The journey towards commercializing a Cleantech innovation is filled with different types of challenges; it is not a straight road. Sometimes even luck and coincidence can play a large part when finding the right partner or customer.

5.2 Utilizing Collaborative Relationships

The *technology enthusiasts* described by Moore (1999) had a lot of similarities to the first set of customers of our interviewed firms. As stated above they were utilized for marketing reasons as references to attract new customers or partners. However, they also proved to be particularly helpful to get feedback on the products.

Larger customers were believed to be able to fund a large part of the development costs for certain projects. By engaging with prospective customers on an early stage the Cleantech firm could take on development projects that they would otherwise perhaps not have been able to engage in, from a financial perspective. In the process they would acquire not only a partner but in the end also a customer, if the development project succeeded. Managing these projects was however described as sometimes being riskful.

The same was to some extents true for close collaboration with suppliers, even though this collaboration form was not as frequently used among the interviewed firms. There was especially one firm who engaged heavily with suppliers and he described it not only in terms of less costs and shorter development time, but also in terms of getting access to knowledge that would otherwise have been very limited if he had chosen to 'go it alone', to use Van de

Ven's (2005) expression, or if he would have had a closed innovation process (Chesbrough, 2003).

The openness of the innovation processes proved to differ substantially between firms. This had to do with the needs of the individual firms. Not all of them had business models or innovations that demanded an extensive use of external knowledge contribution. However, there were some firms where this perhaps could become increasingly important as they come further in their respective development processes.

Among many things, the writing of contracts was an important aspect, and with that the question of IP. However, it was said to be highly important that the counterpart benefits from the relationship as well. This confirms the concept of 'generative relations', where Eneroth and Malm (2001) suggest that only generative knowledge relations are valuable.

In addition, the interviews suggest that it is preferred to sell a less complex, cheaper and well-defined product initially. This also connects to the idea of generative relations. One of the prerequisites for generative relations was that the knowledge being transferred needs to have a balance between *novelty* and *confirmation*, meaning that it is not viewed as valuable to a customer if the innovation for instance does not fit the existing systems and processes. On the other hand it still has to have elements of uniqueness to be attractive. This balance act is confirmed through the experiences of the interviewed firms. The best way to approach this was to start with simple and affordable products and gradually increase complexity and price, as the relationship becomes more established and there is trust both between firms and in the actual technology.

The concept that perhaps best describes both the ability of identifying the right relationships and succeeding with managing them is the concept of 'political savvy' (Van de Ven, 2005). This is closely related to being able to assess for instance the integration and interdependence risks with a certain project, simply meaning that one has to be able to see the greater picture of how all the nodes are related. For firm managers with prior industry experience this ability seemed to be one of their strengths. These persons to a higher degree also had a larger prior network and contacts, which had proven to be of great value.

5.3 Collaboration among Cleantech Firms

As stated in the empirical section we did not encounter as much collaboration between Cleantech firms as we had expected. This could however very well be a coincidence as we only interviewed 12 out of the current 34 firms in the CINNS initiative. The interviews however gave some indications that there could exist a latent potential for many close and collaborative relationships, particularly in the long-term as more Cleantech firms are being established, and the existence of certain more specific industry clusters become more frequent. With a growing population of firms one could intuitively believe that the similarities and opportunities for synergies would increase. This question is also related to the maturity levels of different industries.

6. Conclusion

6.1 Conclusions for Practice

The journey towards Cleantech innovation commercialization is initially constrained by a lack of especially resources and legitimacy. It is suggested that collaborative means can help the firm gain legitimacy among customers and investors. The activities supporting the creation of legitimacy are especially those associated with proving the technology – such as being able to show prototypes or demonstrate a technology in a larger scale. It is also suggested that close technology development collaboration with a customer or a partner can help the Cleantech firm gain legitimacy in the eyes of an investor. When working to identify an appropriate partner to collaborate with, it is particularly important to consider interdependency risks, the power of referencing between groups and the politics in organizations.

Moreover, our study indicates that one of the most important success factors is to identify and enrolle collaboration partners that share the same vision and therefore are able to see the same potential in the innovation as the company that has come up with the Cleantech innovation. Engaging in open innovation can also lead to an important extension of the firm's network. Further collaboration opportunities can arise through previous ones and the range of possible applications for the innovation could increase on this journey.

Relationships did not have to be entirely generative to be valuable, the signaling effect or marketing effect of a certain relationship could in itself in some cases be more important than the actual knowledge transfer. This tendency was however more prevailing among firms at an early development stage.

At later stages, when close collaborative relationships where knowledge is being transferred or explored, it is important that the relationship is of generative character, meaning that both partners profit from the relationship. The innovation itself and the knowledge transfer associated with it must be in balance with regards to new and existing knowledge. The empirical evidence for this was the constant adaption of many firms' original Cleantech innovations to fit into the customer firms' processes, products and systems. The openness of the innovation processes however proved to differ substantially between firms. Some engaged heavily in these types of projects and others did not.

Furthermore, the interviews showed that the Cleantech innovation has to make sense from an economic perspective, not only from a sustainable perspective. This observation thus confirms the explanations of Cleantech innovations presented earlier in the thesis.

These conclusions are to be seen as conceptual, meaning that it would require more research to test the generalizability of these findings. At large however it seems as if Cleantech is no different from other new technology sectors when it comes to having challenges when trying to break in to a new market. It is however, as discussed above, hard to make these kinds of distinctions due to the fact that different Cleantech firms operate in different industries, with their own particular rules and characteristics. Some consist of highly progressive actors and others consist of highly conservative ones. Therefore it is important that the commercializing firm is aware of these differences.

The commercialization model by Jolly (1997) has some limitations (see next section 6.2) but for the intentions of this thesis to work as a structure to highlight some of the most important aspects of technology commercialization it proved to work satisfactory, especially if one takes the perspective of the entrepreneur into consideration. Many of the entrepreneurs emphasized the importance of doing things as simple as possible for oneself. The entrepreneur has a goal of bringing his innovation to the market and he will try to take the fastest and most efficient way in order to get there. For those reasons one could argue that the entrepreneur by all rights thinks in a linear way. From these both perspectives the model proved to meet its purpose.

As the interviews have showed, initiatives like CINNS clearly plays a very important role in the Swedish innovation system to strengthen the development and commercialization of Swedish Cleantech firm innovations. CINNS is important not only for their various advisory support functions but also as a facilitator for the creation of spontaneous relationships between Cleantech entrepreneurs. Our research indicates that the future could see more extensive collaboration between firms as more firms join the network and more industries start to mature. Therefore, the facilitating aspects of supporting Cleantech firms to ‘run in packs’ could get more important as the network evolves.

6.2 Conclusions for Research

We were able to confirm many of the theories used, especially the liability of newness associated with a lack of legitimacy and resources. Also in the way the firms used

collaborative means to develop their innovations and work to commercialize them we were able to confirm many theories. Especially the concept of *open innovation* proved to be important. How the firms integrated their internal capabilities with external knowledge in different ways showed many similarities with both the *outside-in process* and the *coupled process* of open innovation. The complexity of a specific innovation and the availability of standard components seemed to affect the need to engage in joint development projects. This was done both with customers, partners and suppliers.

The use of Jolly's (1997) commercialization model was motivated for its illustrative reasons. In addition, it can be regarded as an appropriate model from the entrepreneur's point of view, as mentioned in the previous section. However, looking back on the different firms and their individual journeys it becomes clear that the model has some limitations. No firm experienced a journey that entailed all elements of the model. Neither did any firm follow the exact order of the different phases. Some firms even skipped certain phases entirely and committed themselves to market development together with a customer early on. Commercializing Cleantech innovations is clearly not only a so-called act of technology-push, it is just as much a question of technology-pull. Our research shows that there is a lot of interaction from both ends of the supply chain. In this interaction the pull and push forces work together as far as we can see. For further research in the area we therefore suggest the use of a more modern and realistic dynamic model that in a better way takes the surrounding network into consideration, as well as the many parallel developments that can take place.

6.3 Suggestions for Further Research

The explorative character of this thesis was appropriate for building an initial understanding of the constraints and challenges of the young and small Cleantech firm, and also to understand the different collaboration alternatives that exist. To further increase this knowledge we suggest studies with a narrower focus. For instance, one idea could be to do research on different categories of Cleantech firms and compare these sectors.

We had many indications showing that the firms that were able to integrate their innovations into the customers' systems had a better chance of succeeding with early commercialization. This could suggest further research to be done in the area of common standards development and modularity among Cleantech firm innovations.

One important area that has to be taken into greater consideration is also the difference between business-to-business and business-to-consumer Cleantech firms. Our impression is that the product being Cleantech is a stronger marketing asset when approaching certain end consumers than it is when approaching professional buyers. Hopefully the buying behaviors of both consumer groups will continue to progress in the same way that the Cleantech sector does.

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Appendix I: Interview Guide

Presentation av studien

Tack för att vi får möjligheten att komma hit och prata med er. Vår fokus för den här studien är hur mindre miljöteknikföretag kommersialiserar sina innovationer. Mer specifikt vill vi undersöka hur medlemsföretagen i CINNS samverkar dels med varandra, men även hur ni involverar och använder er av era respektive nätverk och värdekedjor för att snabbare komma ut på marknaden. Vi har förhoppningar om att få en fördjupad bild av vilka utmaningar entreprenörer kan stå inför och hur ni jobbar för att överkomma dessa genom att involvera era partners, leverantörer, kunder etc.

Övergripande frågeområden

- Generella utmaningar som litet Cleantech-företag
- Hur olika samarbeten etableras
- Hur olika samarbeten kan se ut
- Utmaningarna med olika samarbeten

A. Öppningsfrågor av mer generell karaktär

- Kan ni kortfattat berätta om företaget?
 - Vad har ni för bakgrund?
 - Vad har ni för målsättning på kort och lång sikt?
 - Vilka är era viktigaste konkurrensfördelar?
- Vem riktar sig er produkt till?
 - Vilka behov uppfyller er produkt/tjänst för kunden?
 - Ersätter den ett existerande alternativ? På vilket sätt?
 - Hur har ni tänkt nå era kunder?
 - Skalbarhet? Tillväxtmöjligheter? Nya marknader?
- Vad upplever ni har varit era största hinder i arbetet med att kommersialisera er affärsidé? Varför då?

- Kategorisera i olika områden
 - Hitta och övertyga marknaden om er produkt
 - Hitta kritiska partners, leverantörer etc.
 - Finansiering
- Hur har ni överkommit dessa hinder?
- Vilka stora hinder återstår?

B. Samarbetsorienterade frågor

- Kan ni kortfattat beskriva era viktigaste samarbeten och varför de är viktiga?
 - Produktutveckling
 - Marknadsaktiviteter, hitta försäljningskanaler
 - Samverkan med storföretag
 - Övriga partners, leverantörer etc.
- Kan dessa samarbeten på något sätt hjälpa er att övervinna de hinder ni berättade om tidigare? (bl.a. hur man tillsammans med andra CINNS-företag eller andra aktörer kan övervinna samma typer av problem kring t.ex. att övertyga marknaden)
- Vad har medlemskapet i Cleantech Inn Sweden inneburit för er?
 - I vilken utsträckning har medlemskapet gjort det lättare för er att kommersialisera er produkt? (t.ex. hitta finansiärer, kunder eller leverantörer)
- Samverkar ni med några andra företag i CINNS?
 - Vilken typ av samverkan handlar det om?
 - På vilket sätt har dessa samarbeten hjälpt er i kommersialiseringen?
 - På vilket sätt kan man utveckla dessa samarbeten?
 - Hur kan man stimulera kontaktskapande mellan företagen i CINNS?
- Tror ni att något av de övriga medlemsföretagen besitter kompetens, leverantörer eller andra kontakter som skulle kunna vara till nytta för er?
- Besitter ni kompetens, leverantörer eller andra kontakter som ni tror skulle kunna vara till nytta för andra i nätverket?

- Upplever ni att det finns regelverk eller andra politiska hinder som missgynnar er?
 - På vilket sätt skulle CINNS kunna användas för att övervinna dessa hinder?
 - Ser ni några andra aktörer som ni skulle vilja samverka med för att överkomma dessa hinder?

- Hur ser ni på möjligheterna att samarbeta med andra CINNS-företag kring kommersialisering av systemlösningar?
 - koordinerade produkt erbjudanden till gemensamt upparbetade kunder
 - kluster

- Hur ser ni på att samverka kring internationaliseringsfrågor?
 - Hitta kunder, partners eller leverantörer i andra länder
 - Samverkan med storföretagen
 - Etablera samarbeten med exportinriktade organisationer och myndigheter
 - Samverka med utländska inkubatorer och nätverk

C. Övrigt

- På vilket sätt skulle CINNS kunna utvecklas?
- Finns det några funktioner som ni saknar?
- Är ni medlem i några andra liknande nätverk?
- Hur skiljer sig de olika organisationerna?
- Nu när CINNS går från regionalt till nationellt fokus, hur ser ni på möjligheterna för samarbete mellan företag trots den ökade geografiska utspridningen?

Appendix II: Extra Model

THE LINEAR VIEW CONTRASTED WITH THE SEGMENTED VIEW OF THE COMMERCIALIZATION PROCESS

