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Entrepreneurial Signaling: A Norwegian Cleantech Case Study

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Preface & Acknowledgments

This Master Thesis is written by Philip S. Wright and Gjermund T. Nordskar from NTNU's School of Entrepreneurship (NSE) at the Norwegian University of Science and Technology (NTNU), in Trondheim, Norway, June 2016.

The importance of contributing to the global climate challenges together with the authors' cleantech background and start-up experiences from NSE, has given the interest to research the field within cleantech start-ups.

We wish to thank all the companies and interview subjects participating in this qualitative study for taking their time and contribute with unique information through the in-depth interviews. We also wish to thank our supervisor and Post. Doc. Ekaterina S. Bjørnåli from the Norwegian University of Science and Technology (NTNU), who has given valuable guidance on the way and contribution to this study.

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Executive summary

Mitigating climate change is one of the most pressing issues of today, and critical for the future of our planet. As an effort to find solutions to mitigate the climate change, new cleantech ventures develop new innovative and environmentally friendly technology. Reaching important entrepreneurial milestones, such as first investment or getting the first pilot customer may be decisive whether a cleantech start-up survives and grows or not. In order to reach such milestones and overcoming the liability of newness, the start-ups must signal own qualities and intentions to convince potential investors, customers and important strategic partners. These signals may be information about legitimacy, patents, market share, board members or growth potential. Signaling as a strategy to achieve important milestones in new cleantech ventures is an overlooked research area, even though the general public as well as investors are drawn to their attention.

The purpose of this master thesis is to investigate the signaling process of cleantech start-ups both in the early and in the later growth stage to see if there are any significant differences or similarities. Therefore, the research question was developed as following: “*How do cleantech start-ups signal to achieve important milestones in different growth stages?*”. To answer the research question, the research investigated what were the underlying motives for signaling, what kind of signals were sent to which receivers, and how was the signals sent in both stages.

The study starts with a brief review of the most important literature from the entrepreneurship research stream regarding legitimacy, signaling and stage-based theory. Based on the reviewed literature, a conceptual framework is proposed describing and explaining what is expected to be found later in the findings.

Analyzing the findings revealed several interesting aspects of how cleantech start-ups signal towards potential partners. The most significant finding suggests that environmental signals has a greater effect when signaled in the growth stage rather than the early stage. Another finding also suggests that the cleantech start-ups benefit from using their board to signal towards investors, customers and other potential partners, as well as there is a difference in the use of external agents when signaling in the early and the growth stage.

Sammendrag

Å bekjempe klimaendringene er en av største utfordringene dagens samfunn kjemper i mot, og har enorm betydning for fremtiden av vår planet. På veien mot nye løsninger, utvikler cleantech oppstartsbedrifter ny og miljøvennlig teknologi. Å nå viktige entreprenørielle milepæler, slik som å få investeringer eller en pilotkunde er ofte avgjørende for om en cleantech oppstartsbedrift overlever og kan fortsette å vokse eller ikke. For å nå disse milepælene og komme ut av oppstartsgropa må cleantech oppstartsbedriftene signalisere egne kvaliteter og intensjoner til investorer, kunder og strategiske partnere for å tiltrekke dem. Disse signalene kan være informasjon om egen legitimitet, patenter, markedsandeler, styremedlemmer eller vekstpotensial. Signalisering som en strategi for å oppnå viktige milepæler hos cleantech oppstartsbedrifter er et til nå oversett område innenfor forskning, selv om det har fått en del oppmerksomhet hos investorer og i media.

Hensikten med denne masteroppgaven er å undersøke signaliseringsprosessen hos cleantech oppstartsbedrifter som befinner seg i tidlig og sen fase for å se om det er noen viktige forskjeller eller ulikheter. Derfor ble følgende forskningsspørsmål utviklet: *”Hvordan signaliserer cleantech oppstartsbedrifter for å oppnå viktige milepæler i ulike vekstfaser?”*. For å svare på forskningsspørsmålet, dreier denne forskningen seg om å finne de underliggende motivene for signaliseringen, hva slags signaler som ble sent til hvem, og hvordan signalene ble sendt, både i tidlig og i senere fase.

Denne oppgaven starter med en kort gjennomgang av entreprenørskapslitteraturen som tar for seg legitimitet, signalisering og fasebasert teori. Basert på den gjennomgåtte teorien vil så et konseptuelt rammeverk bli foreslått, som beskriver og forklarer hva som kan dukke opp senere i funnene.

I analysen av funnene dukket det opp flere interessante aspekter ved hvordan cleantech oppstartsbedrifter signaliserer mot potensielle partnere. Et av de mest signifikante funnene foreslår at å sende miljø-signaler har større effekt i senere fase, enn i tidlig fase. Et annet funn foreslår at cleantech oppstartsbedriftene drar nytte av styret når de signaliserer, i tillegg til at det er en forskjell mellom tidlig og senere fase når det kommer til signalisering gjennom eksterne agenter.

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1 Introduction

The changing climate has in recent decades caused an impact on natural and human systems on all continents and across the oceans (Pachauri, et al. 2014). The debate regarding climate change and challenges, specifically human-induced changes has had a growing interest and importance the recent years. Governments all around the world seek a variety of policy approaches to achieve greenhouse emission targets. These approaches are often related to increasing the share of renewable energy and mitigation strategies to reduce greenhouse gas emissions (Bürer and Wüstenhagen, 2009). As a result of these policies and the public's growing concern over the climate change, cleantech as an industry has surfaced since the beginning of the 2000s (Caprotti, 2012). To reduce the negative impact of climate change, investment in cleantech companies and green technology will play a central role now and into the future (Eyraud, Clements & Wayne, 2013; Fitzpatrick & Gedaka, 2003). Cleantech is a wide concept, therefore the definition from Pernick and Wilder (2007, p. 2) will be used for clarification:

“A clean-tech firm develop any product, service, or process that delivers value using limited or zero nonrenewable resources and/or creates significantly less waste than conventional offerings.”

Reversing the climate changes requires substantial emission reductions over the next decades and achieving close-to-zero emissions of long-lived greenhouse gases by the end of the century. There are multiple mitigation options that are likely to keep the warming below two degrees and new innovations and investments in climate friendly technologies and infrastructure is one contribution (IPCC, 2014, s. 26). The cleantech industry has received a 20-fold increase of green investments globally, from \$7 billion to \$154 billion over the years 2000-2010 (Eyraud, et al., 2013). This creates an environment where entrepreneurs may translate the climate risk into opportunities by developing and providing innovative solutions (York & Venkataraman, 2010). Hence, cleantech start-ups that develop and commercialize technology, can be one of the important contributions in the work towards achieving of the globally greenhouse emission targets.

Recent cleantech studies have focused on important entrepreneurial milestones such as venture capital investment, establishment of strategic alliance with a partner and achieving first sale (Bjørnåli & Ellingsen, 2014). Strategic partners may come in the form of a research agreement, an important supplier or a sales agreement (Hoenig & Henkel, 2015). In order to reach these milestones, start-ups need to communicate own qualities to potential investors, partners and customers. These qualities may be team experience, alliances or patents (Alsos & Ljunggren; Hoenig & Henkel, 2015; Hsu, 2007). Start-ups are new firms, that often are short on resources and networks, and has not yet grown a big reputation (Lee, Lee & Pennings, 2001). Under these circumstances the potential partners might not yet be aware of important qualities of the start-up, which can be critical to communicate for further development. This discrepancy in information is defined as an information asymmetry (Spence, 1973). In order to overcome the information asymmetry between start-ups and potential partners, the start-up has to consider which qualities are more important, and how they are signaled (Leland and Lyle, 1977).

Despite the rapid growth of the cleantech industry and the increase in cleantech start-ups, limited research has been done on how they signal to achieve important milestones. Based on this research gap, the purpose of this thesis is to examine *how* cleantech start-ups pursue the process of signaling to partners to reach important entrepreneurial milestones and how this process can be carried out in an efficient manner. The entrepreneurial milestones are important steps towards achieving growth in cleantech start-ups (Nunes, Gonçalves & Serrasqueiro, 2013), and the information asymmetry caused by inefficient signaling is one of the main challenges towards reaching these milestones (Connelly, Certo, Ireland & Reutzel, 2011). To fulfill this purpose, the authors seek to answer the following main research question: *How do cleantech start-ups signal to achieve important entrepreneurial milestones in different growth stages?*

The signaling process is defined as the communication processes between the cleantech start-up and external receivers like investors, customers or other potential partners. To answer the research question, the authors will study the underlying reasons for why the start-ups signal and give insight on the internal goals and motivations, how the signals may be characterized, and finally how the signals are signaled to the receivers. To provide appropriate information about the signaling process, data from five separate cases has been gathered. The data was collected through interviews with five cleantech entrepreneurs, two investors and one important customer. The authors will combine insights from both sides, discuss and present the

main findings relative to how signaling can be performed in a more efficient manner by the cleantech firms.

This thesis is divided into five chapters. The following chapter will present relevant theory as basis for this study and construct a conceptual. Further, an overview of the conducted research method and data analysis techniques is provided, followed by an analysis of the findings. The thesis is concluded by discussing the main findings and theory, presenting the limitations of our study and finally outlining the implications for further research and practice.

2 Theoretical Foundations

This chapter presents the relevant theories about legitimacy, signals and entrepreneurial milestones. The different theories will be contextualized and a combined into a conceptual framework which describes what we may expect to find applying the chosen theories

2.1 Building legitimacy in clean-tech ventures

Overcoming the liability of newness is one of the problems which all new ventures experiences, and has been the subject of a broad spectrum of studies. New ventures have often low levels of legitimacy, depend on the cooperation with other organizations, and struggle with the competition from other established companies. This induces a greater risk of failure which is labeled as the *liability of newness* (Stinchcombe, 1965). Following the entrepreneurship stream of research, how to overcome the liability of newness mostly relates to the entrepreneurs' ability to discover and seize opportunities (Venkataraman, 1997). Discovering opportunities relates to how the entrepreneur is capable of finding or creating a market opportunity, while seizing opportunities translates to the transformation of resources into organizational capabilities which further enables the entrepreneur to pursue opportunities (Shane, 2000; Shane & Venkataraman, 2000; Eckhard & Shane, 2003).

Legitimacy is a resource that enables the entrepreneur to both gain other resources, as well as reducing the effects of liability of newness (Zimmermann & Zeitz, 2002). Treating legitimacy as an instrument enables the entrepreneur as newcomers, to survive the struggle in industries gain recognition and approval from other actors. Aldrich (1994), emphasizes on how entrepreneurs, by building *cognitive-* and *sociopolitical* legitimation, are able to gain the trust of skeptical investors, customers and suppliers. While cognitive legitimation refers to how knowledge about a new venture spreads, sociopolitical legitimation refers to how the new venture is accepted or deemed appropriate by the general public, key opinion holders or governmental officials (Aldrich, 1994). Later research has focused more on how the founders of new ventures may leverage social capital to enhance their perceived legitimacy in their networks (Kim & Aldrich, 2005).

Networks are particularly important for startups due to being one of the key catalysts for obtaining important resources such as legitimacy and social capital for the individual entrepreneurs (Burt, 1992; Bourdieu, 1985), as well as being the locus of innovation (Powell, Koput & Smith-Doerr, 1996). The two most common types of networks within the entrepreneurship literature are mostly referred to as formal and informal networks (Slotte-Kock & Coviello, 2009). The main difference between the two network types is that formal networks are inter-organizational and contain professional relationships with for example banks, lawyers or national agencies, while informal networks are individual or personal networks, consisting of family, friends, previous colleagues, previous employers and more (Birley, 1985, p. 109; O'Donnell, et al., 2006).

Operating in a relatively new industry, cleantech ventures often lack the access to external resources and the legitimacy of other ventures in well-established (legitimized) industries. Therefore, new cleantech ventures are to a larger degree affected by the liability of newness than high-tech start-ups operating in more established industries (e.g. oil and gas). For instance, Zhang and White (2013) identified a significant difference between new- and late entrants of private Chinese solar PV ventures. While the early entrants had to build both their own legitimacy, as well as the legitimacy for private Chinese solar PV ventures as a whole, the later entrants were able to leverage the already established legitimacy and gained faster and easier access to external resources. Since cleantech covers a wider range of industries, there will be a difference between the level of which entrants are able to leverage established legitimacy. For example, it may be harder for a wave energy venture to build legitimacy than one utilizing of solar power because wave energy is an immature technology on the market.

2.2 Signaling as a strategy to build legitimacy

The premise of signal theory is that there in certain situations will be information asymmetries. Information asymmetry describes the situation where there is a discrepancy of information between two individual parts. Spence (1973), who introduced the term signal theory, illustrated this with the relationship between the employer and the applicant looking for a job. In this case the applicant, holds information about own qualities that the employer does not know of before the applicant is contracted. Similarly, entrepreneurs may hold information about own venture, its economic potential and other qualities, which is not available to investors (Leland and Lyle, 1977). This information asymmetry creates an uncertainty for the investors which affect their

decision to invest in the entrepreneur's venture. Thus, if entrepreneurs' goal is to receive an investor funding, they have to be able to transmit appropriate information about their venture to assure their legitimacy and economic potential. The information asymmetry is not only true for the entrepreneur's relationship with investors, but is also present in the contact with potential customers (Basuroy, Desai, & Talukdar, 2006; Rao, Qu, & Ruekert, 1999) and strategic partners (Dyer & Chu, 2000). In the interaction between the entrepreneur and other potential partners, there is always the risk of one of the parties being opportunistic, and exploits the other part in an agreement. This risk comes from an information asymmetry often referred to as a moral hazard, where one part profits from exploiting the trust of the other part (Venkataraman. 1997). One way to reduce the information asymmetry such as moral hazards is to signal own qualities and intentions to the potential partners (Elitzur & Gavious, 2003).

Connelly, et al. (2011), introduced a model describing four primary elements of signal theory; *signaler*, *signal*, *receiver* and *feedback*. This model is illustrated as a timeline where the signaling process functions as a timed sequence (Figure 1). A signaler sends a signal, which is received and interpreted by a receiver. When the signal is interpreted, the receiver may send feedback back to the signaler. The whole process takes place in a signal environment where also other signalers and receivers exist. To simplify the process, only the relationship between one sender and one receiver will be analyzed. Each element will in the following part be explained through an entrepreneurship literature perspective and there will be given examples for each element.

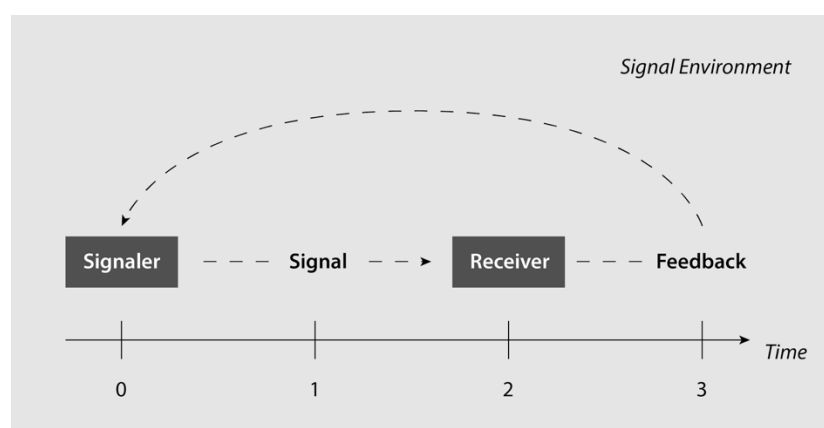


Figure 1: Signaling timeline. Inspired by Connelly et al. (2011).

Signalers, are insiders who possess certain information, about themselves or their organization which is inaccessible to outsiders. There are two types of information possessed by the signalers, one is the unobservable quality of the signaler, and the other is the intentions of the signaler (Stiglitz, 2000). In the entrepreneurship literature, the signalers are mostly treated as entrepreneurs (Elitzur & Gavious, 2003), start-up leaders or IPO firm management (Bruton, Chahine, & Filatotchev, 2009; Lester, et al, 2006; Zimmermann, 2008) in search of capital.

The information that the signalers hold might be positive or negative, and it is up to the signaler to choose what information to convey. However, signal theory has up to now mostly focused on intentionally sharing of positive information about qualities in order to achieve positive outcomes (Connelly, et al., 2011). Some examples of the quality or characteristic signals sent from start-ups, are by the entrepreneurship literature described to be technology patents, strategic partners and alliances, top management team (TMT), experience, social, human and intellectual capital (Alsos & Ljunggren, 2013; Baum & Silverman, 2004; Hoenig & Henkel, 2015; Hsu, 2007).

There are several examples in the literature of categorizations of the different signals sent from entrepreneurs to the receivers. Alsos and Ljunggren (2013, p13) divided the signals sent from entrepreneurs to investors into five groups; Entrepreneur, team, investor, venture and alliances and partners. The list includes most of the signals found in the modern entrepreneur literature, however many of the signals in the different categories overlap, thus making it difficult to separate the different groups. Connelly et al. (2011) made a similar list, only dividing the different signals into from which research stream they were found. Giones and Miralles (2015) made a simpler categorization consisting of only three signal groups, technology, market and social capital. The definitions of the different signal groups may be found in table 1 below.

| Signal Category | Definition | Example |
|------------------------|---|---------------------------------------|
| Technology | <i>“Technology signals are built on the unique technological resources of a new venture.”</i> | Patent, product, research, etc. |
| Market | <i>“Market signals include actions that raise awareness of the new venture and its reputation.”</i> | Market position, sales, etc. |
| Social Capital | <i>“Social capital signals include endorsements by public and private institutions and development and research partners, as well as well-known investors.”</i> | VC Investors, experienced board, etc. |

Table 1: Description of signal categories and characteristics (Giones & Miralles, 2015, p.47).

Due to its simplicity and for the purpose of this thesis, the categorization by Giones and Miralles (2015) will be used further in this thesis.

Effective signals have two main characteristics; signal cost and observability (Connelly, et al., 2011). Signal cost refers to the assumption that honest signaling of qualities comes with a higher cost than low quality signals, or dishonest signals. High quality signalers are more prone to pay a lower signal cost for high quality signals than low quality signalers (Smith & Bird, 2005). This means that for example that a nascent start-up has to pay a higher signal cost to signal high-tech products than a more mature high-tech venture because the nascent start-up is usually required to spend a lot of time and resources developing the technology, while the mature venture may already have all the infrastructure and resources required to develop such technology. Observability explains to which extent the signal is noticed and understood by the receivers (Connelly, et al., 2011).

In the entrepreneurship literature, the *receivers* are almost exclusively treated as investors (Connelly, et al, 2011), and are mostly distinguished between private (Busenitz et al., 2005; Daily, Certo, & Dalton, 2005) and public investors (Cohen & Dean, 2005; Jain, Jayaraman, & Kini, 2008). The receiver is the part of the signaling dynamics that is lacking information until the signal has arrived. In order to receive the signal, the receiver has to be observant and to be looking for specific signals (Gulati & Higgins, 2003; Janney & Folta, 2006). Some signalers may benefit from sending out falsely positive signals fooling the receiver to give positive feedback in return, for example advertising a product so that it seems better than it is (Arthus, Busenitz, Hoskisson & Johnson, 2008; Ndofor & Levitas, 2004). An important point from signaling theory is that the receiver seeks to gain from the information obtained from the signal.

Investors, for example, want to invest in companies that signal a profitable future (Certo, Daily, & Dalton, 2001).

Feedback, or counter signals is the response a receiver may choose to give back to the signaler. Assumed that the information asymmetry works in two ways, the feedback is usually given to facilitate the efficiency of signals or to give otherwise unknown information back to the signaler making it an iterative process (Srivastava, 2001). Typical feedback from an investor would be showing a will to invest or to give guidance to another direction, while a customer might buy the product offered and leave a good review (Gulati & Higgins, 2003).

Stated that the signaling process is an iterative process, the authors build on the signaling timeline proposed by Connelly, et al. (2011), demonstrating how the signaling process may be presented as a loop (Figure 2).

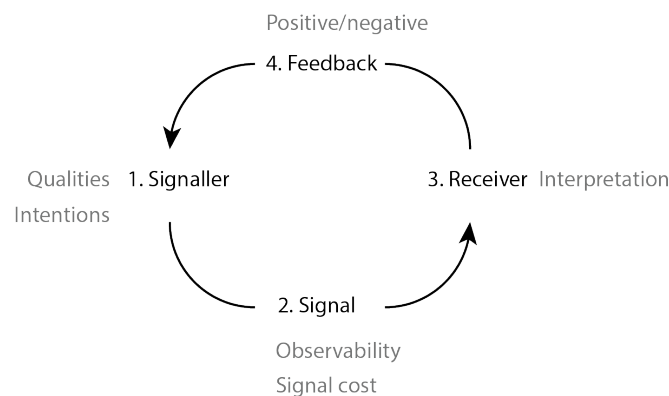


Figure 2: Signaling process loop. (Source: Authors).

2.3 Signaling in the cleantech context

Few studies have been done on how cleantech ventures signal, however Hoenig & Henkel (2015) did a study on patents, alliances and team experience as signals towards VC financing. Their findings suggested that team experience is one of the determinants signaling technological quality in cleantech start-ups. Looock (2012) investigated what kind of business models investors prefer when investing in cleantech. The findings indicated that investors seem to prefer business models proposing best services over best technology or best price. The same indications were found by Masini and Menichetti (2012), who investigated the renewable

energy investment decision making processes with venture capitalists. This may indicate that some investors are more likely to invest in ventures that signalizes fast and secure returns rather than long term technology development.

Based on the reviewed literature, a framework is proposed in Figure 3 to aid in the analysis of the collected data. The chosen environment for the signaling is the communication and interaction between a cleantech start-up and a receiver. The elements of analysis are: signal sent, signal received, qualities signaled, feedback from the receiver and whether the feedback reflects the achievement of milestones or reduction in information asymmetry.

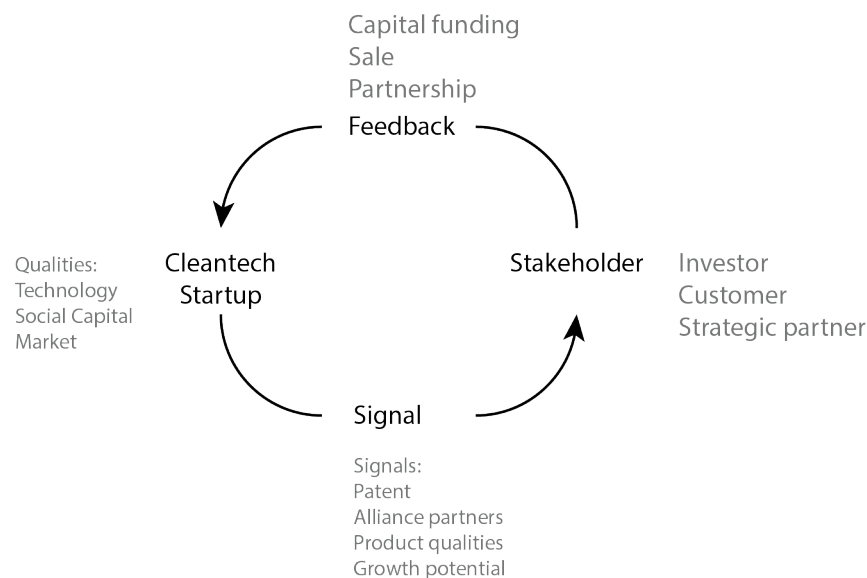


Figure 3: Signaling loop in the cleantech context. (Source: Authors)

2.4 Signaling and entrepreneurial milestones

To understand how the signaling by clean-tech start-ups change over time, we introduce literature on stages and states of new firm development. As a venture goes from start-up phase towards growth and maturity, the dominating tasks and resource configurations will undergo change (Nolan, 1973; Gaibraith, 1982; Kazanjian 1988). For high-tech ventures, Kazanjian (1988) introduced a stage model consisting of these four stages: 1) Conception and development, 2) commercialization, 3) growth and 4) stability. The article suggests that a firm's transition from one stage to the next is dependent upon the firm's ability to learn from problems

that occur. This way, firm growth may happen when a firm is able to replicate solutions they have learned and avoid recurring problems of the same type. Although the article only found foundations for the first and the third stage, Kazanjian (1988) proposed the existence of dominant problems within each stage. His research shows that the dominant tasks in the earlier stages (1 and 2) are primarily securing finance, technology development, and strategic positions in a new market segment (Kazanjian, 1988). The dominant tasks in the later stages are acquisition of additional resources, organization, sales, marketing, and administration. Late stage ventures (3 and 4) are also engaged in the same activities as the first stage, however for the sake of simplicity this study will only use the dominant tasks as mentioned earlier to demonstrate the difference between the early and the late stage. Later studies have criticized the stages of growth models for their inaccuracy and inconsistency and for being overly simplified (Phelps, Adams, & Bessant, 2007; Stubbart & Smalley, 1999). As a response to this, Vohora et al. (2004) proposed an updated model after having studied the critical junctures in the development of university spin-offs. They found that the ventures undergo different phases and that there is an iterative and non-linear transition between each phase. The phases are similar to the stages proposed by Kazanjian (1988) in the same fashion that there are dominant problems, or junctures which has to be overcome in order to transition to the next phase.

2.5 Legitimacy and entrepreneurial milestones

Inspired by the stage-based models, Zimmermann and Zeitz (2002) introduced the concept of the legitimacy threshold. The threshold describes the point where a firm goes from struggling with gaining the attention and acceptance of external parties, to being more occupied with growth-related issues such as decentralization, sales and marketing (Kelley & Marram, 2004). Studying the perceived legitimacy of entrepreneurs, Rutherford and Buller (2007) developed a model describing the transition of having overcome the liability of newness as the legitimacy threshold. The results from their findings implied that the legitimacy threshold would be the point where the entrepreneurs change from relying on personal selling skills and persistence due to lack of resources, to working on expanding the firm through additional hiring, sales, marketing and focusing on the growth of the market share. As seen in Figure 4, there is a clear distinction between the pre-threshold configuration characterized as highly centralized and lacking of resources, and the post-threshold where the firm is starting to decentralize and is starting to grow at a higher pace.

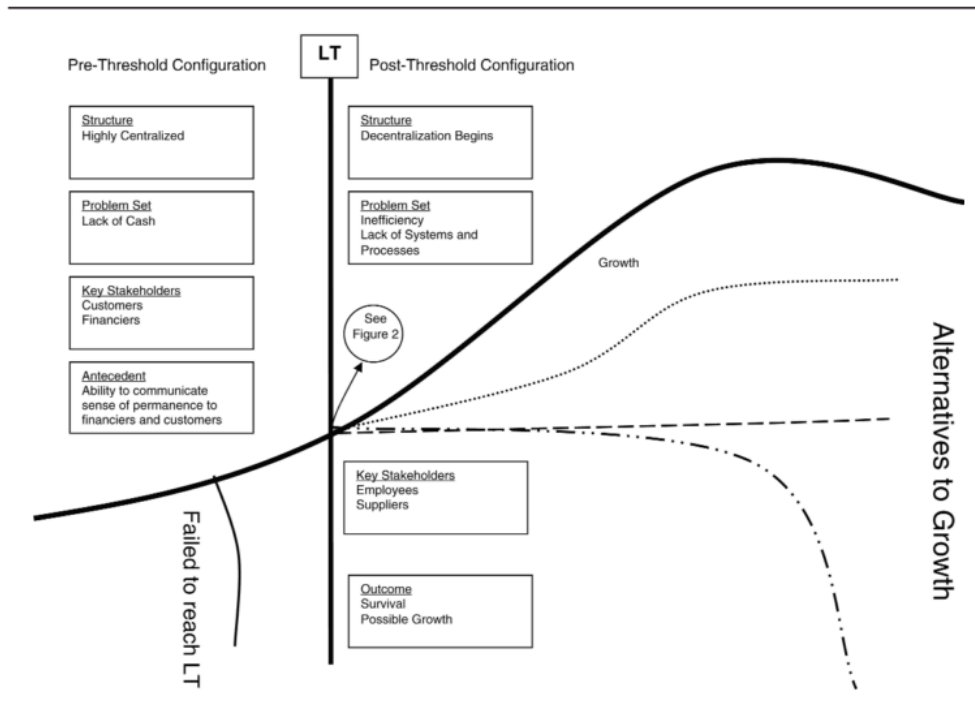


Figure 1: Pictorial Representation of the LT
 Note: LT = legitimacy threshold.

Figure 4: The Legitimacy threshold (Rutherford & Buller, 2007, p. 80).

2.6 Conceptual framework

The purpose of the framework is to create a theoretical foundation for the case study by applying the selected theories together. Building on the notion that it is difficult to identify the exact stages a venture undergoes, the authors propose a framework (Figure 5) combining the early stages and growth stages from Kazanjian (1988) with the legitimacy threshold model by Rutherford and Buller (2007). By adding the legitimacy threshold, a clear limit between the early and the growth stage is set. Whereas in the early stage the dominant problems or tasks, are technology development and resource acquisition, the dominant problems or tasks in the late stage are sales, marketing, production, organizational and acquisition of additional resources. The framework also includes the signals that are expected to be observed according to the dominant problems of each stage.

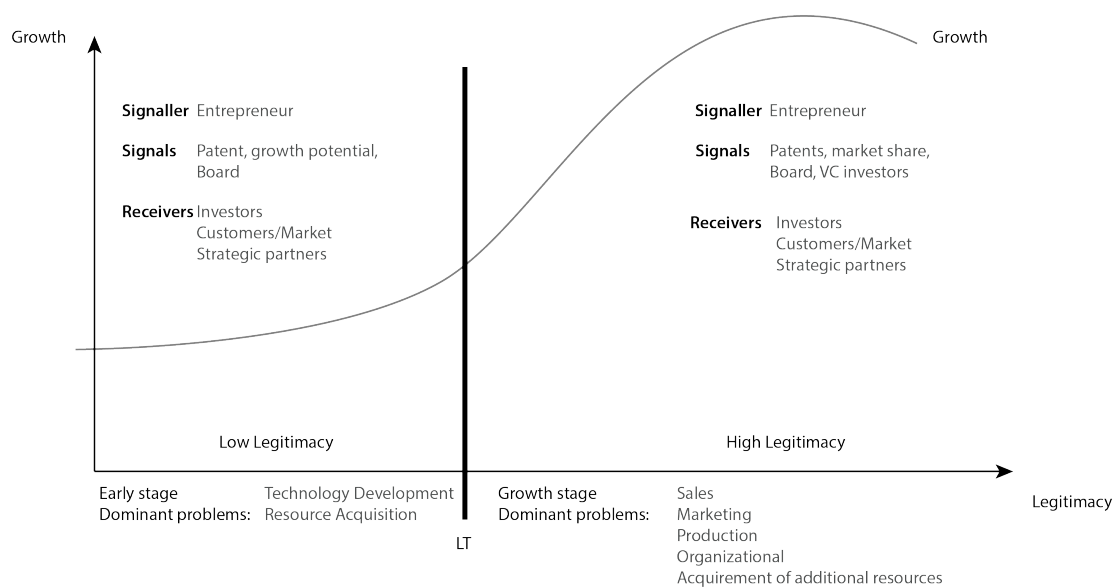


Figure 5: Combined framework. (Source: Authors).

Given the liability of smallness and lack of both sociopolitical- and cognitive legitimacy, firms in the early stage signal to initiate a dialogue with the market and important actors, such as investors, suppliers, research organizations etc. The early stage start-ups have often low, or are in lack of a reputation and recognition in the market where they wish to operate. Therefore, the framework proposes that the entrepreneurs of the early stage start-ups may use their personal network both to gain attention and recognition in the market and with other important actors like investors and suppliers.

In the growth stage, the framework proposes that the firms have reached, or surpassed the legitimacy threshold and have the sufficient legitimacy to be self-sufficient. However, in order to continue their growth, signals such as, market share and position, growth potential and existing customer relationships are expected to be observed sent to other customers, later stage investors, manufacturers and suppliers. In the same fashion that Vohora et al. (2004) proposed non-linear and iterative transitions between the phases, the framework includes that the point between before and after the legitimacy threshold often is unclear and that a venture may have to iterate several times before surpassing the legitimacy threshold.

3 Method

This section presents the research methodology used to address the research question and five cases. To give a deeper insight in the environment around the cases the empirical context will also be introduced.

3.1 Research Method

Given the limited prior research on signaling within cleantech, an exploratory case study approach has been followed to gain insight in the field (Shields and Rangarajan, 2013). The exploratory case study examines phenomena that lack primary research and is often the first step of an overall causal or explanatory research design (Streb, 2010). To include the robustness of comparative analysis (Eisenhardt, 1989; Yin, 2009) the research has been done by applying a multiple-case design. To be able to discern patterns and the emergent themes for the observed differences, we compared evidence across several cases. The research method has been selected in accordance with Yin (2009), explaining that the research method should be selected by evaluating three factors: Type of research question, extent of control of behavioral events and degree of focus on contemporary events. This is presented in the table below. All the three factors are met for the case study method, which indicate that the case study method has been an appropriate technique for this research. A second reason for choosing the case study method, is that the number of potential participants is small (Flick, 2015).

3.2 Case Study Design

According to (Yin, 2009), case studies contain single case or multiple cases. Single case studies give insight into one example, while multiple case studies allow us to get empirical richness and accurate and generalizable theoretical insight (Eisenhardt, 1989). Due to this and the limited research on cleantech start-ups, the chosen research method is multiple case study design. Multiple case study makes it possible to generate various perspectives around the research questions and perform cross-case comparison, which is relevant to our research. The cross-case comparison allows us to compare different signal processes between multiple cleantech start-ups that participate in the study. Evidence confirmed by multiple cases will also increase the validity of the study (Yin, 2009).

As Yin (2009) mentions, a multiple case study can be seen as a series of experiments, where each case provides reasoning for or against the conclusions drawn from the previous cases. The aim of a multiple case study is to generate empirical richness, and hopefully acquire generalizable and accurate theoretical insights (Eisenhardt and Graebner, 2014). This thesis has created an overview of the signaling process in cleantech start-ups, and serve as an exploratory step towards more specific and causal research in the field. A case study can be designed in a holistic or an embedded way. The embedded case study design will allow examining the process from two perspectives by having two units of analysis within each case and is therefore selected for this study. The units of analysis will be signal sent by the cleantech start-up and signal interpreted by the relevant receiver, as seen in Figure 6:

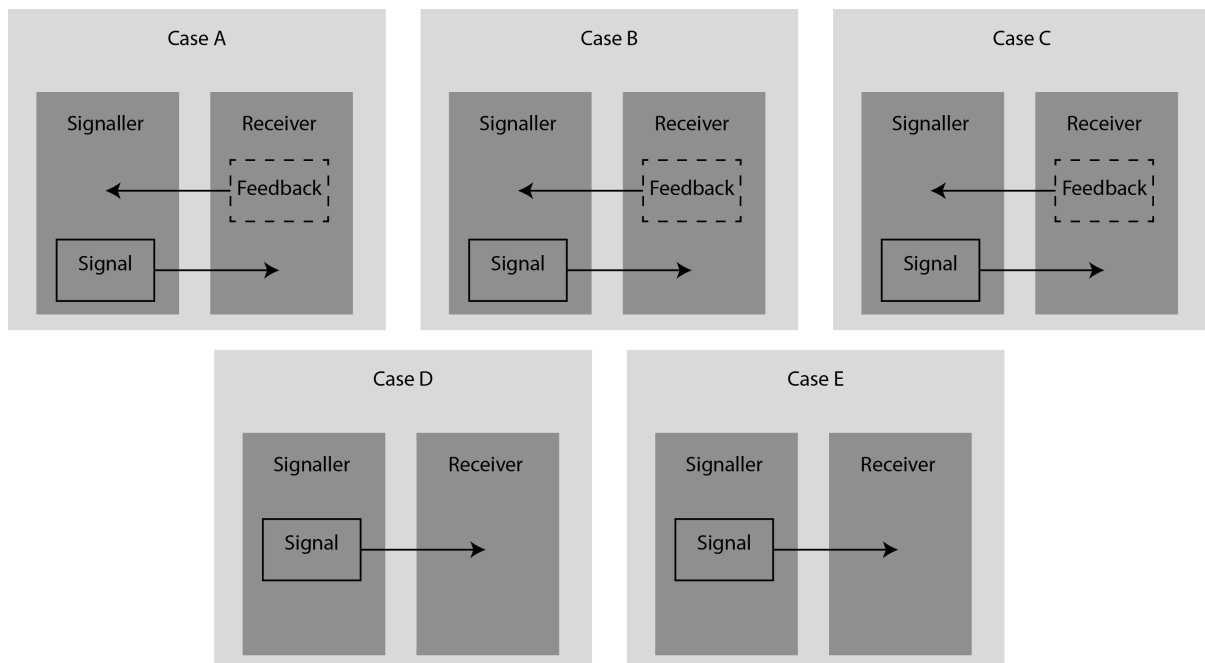


Figure 6: Case Study setup. (Source: Authors).

Figure 6 shows the setup for the exploratory case study. The context boxes represent the different cases that will be studied, while the firm boxes represent the firms that will be interviewed in each case. The boxes within the firms represent the unit of analysis, which is the signal sent and the feedback sent back. This case setup is chosen to be able to perform cross-case comparison.

3.3 Sample / Case selection

The start-ups were selected after the criteria for purposeful sampling techniques made by Patton (1990), combining the criterion and maximum variation sampling method to get as varied cases as possible within the scope of the research.

3.3.1 Signal-Side Cases

For the selection of cases, the authors have used a database of 27 cleantech start-ups in Norway. These are start-ups that earlier have participated in research at the Norwegian University of Science and Technology (NTNU) and matches the definition of cleantech. The signal-side cases were selected based on relevance in relation to the research question, set by these criteria:

1. *Has achieved milestones such as attracting the first investor or the first customer.*
2. *Fit the definition of cleantech by Pernick and Wilder (2007), described introductory in this thesis.*
3. *Variance in development stage (early stage and growth stage).*
4. *Variance in technology focus.*

The sample of both cleantech start-ups and their representative partners (investors and customer) was selected to get a substantial degree of variance relative to the signaling activities in both the start-ups and partner companies. This selection of both cleantech start-ups samples and partner samples, was important in order to see the variance between the different in signaling activities from both the signaler (cleantech start-ups) and receivers. All the start-ups in the database were checked whether they fit the definition of the cleantech start-up, to secure appropriate samples before the selection. For every company, we examined their background and historical information to better understand their stage of development and signaling activities. Documents on financial data and their investments was used in the screening process to determine which start-ups that were most relevant for our study. Several of the 27 start-ups in the database were found to having filed for bankruptcy, which made the selection of startups more narrow than anticipated. From the selection, five relevant and still operating companies from the database were chosen to participate and were therefore selected for in-depth interviews.

The initial contact with the start-ups was performed through established relationships between NTNU and cleantech companies that have participated in earlier research.

3.3.2 Receiver-Side Cases

All the five signal-side companies, were asked about contact information to relevant strategic partners. Only three of the contacted receiver-side companies, were willing to be interviewed. The receiver-side case companies were selected based on these criteria:

1. Has an established partnership with one of the selected start-ups.
2. Is either a customer, investor or supplier to one of the start-ups.

The interview questions were first approved by the respective start-ups, to avoid risk of negative impact on the partnership. The interviewed companies, were informed about the purpose of the study, and that all information in the thesis would be held confidential and anonymized. The initial contact with the receiver-side case companies were performed through relevant contact from the signal-side companies, that met the criteria mentioned above.

3.3 Description of cases

Five different cases have been analyzed in this study. From this point and further, the the term *Partner* will be used to describe a company that has established a partnership with the respective start-up, and the term *Receiver* will be used to describe a company who has yet to become a partner with the start-up at the given time.

3.3.1 Empirical context: Cleantech start-ups in Norway

Norway plays an important role in the production of renewable energy in Europe by contributing with more than 15 percent of Europe's renewable energy production (Menon, 2011). Norway has both unique natural resources and competence advantages when it comes to development of clean technology (Spilling, 2010). In 2007, the Energy21- strategy was introduced by the Norwegian Oil and Energy Ministry. The strategy is to increase the focus on clean energy development and production, with the ambitious vision that Norway will be "*Europa's leading energy- and environmental nation*". To reach this goal, will Energy21 focus on technology development aimed for value creation and commercialization. One of the challenges towards the vision, is that owners in the industry's largest companies are not concerned with technology development. This challenge addressed by (Spilling, 2010), proves

that Norwegian cleantech start-ups working with technology development and commercialization, will play an important role in the efforts towards achieving Norway's ambitious vision.

3.3.2 Signal-side start-ups

There is a great variety in the selected start-ups on the signal-side. The start-ups span from low-tech bioenergy to high tech wave energy and from being still developing technology to having sales internationally and going public (IPO).

1: WavePower

WavePower develops a unique wave energy technology. The company is still small, with only one employee. WavePower has a broad and relevant board, consisting of experienced people with solid technological backgrounds and connections into Innovation Norway, VC companies, and the wave energy industry. WavePower has so far raised 8M NOK in funding from Innovation Norway, 3,5M NOK in VC investment and 5-6M NOK in work for equity. The company was established in 1998 and has from the start in large degree focused on technology development, with filing of their first patent in 2007, and further in the period between 2011 and 2015. The CEO of the company is both the inventor and the founder, and is driven by passion and a strong desire for commercializing the technology. WavePower's technology is today nearly ready for sale, but there is still work left on the product development. The start-up has gained some legitimacy due to their strong board and verified technology, but has yet to cross the legitimacy threshold. Therefore, the start-up is classified to be in the early stage.

2: HydroEnergy

HydroEnergy commercialize technology for small HydroEnergy plants, based on licensed technology and has only two employees. HydroEnergy was established in 2000, and their first product was ready in 2009. They got recently acquired by a VC investor (VC investor B), thus have had financial backing the last couple of years. The board consists of four board members, two from the VC company and two external with investment connections and start-ups experience. HydroEnergy has outsourced their production and have today a nearly ready product for sale. Their main focus is to start sales and finish the product development, therefore they are classified to be in late early stage.

3: EnergyRecycle

EnergyRecycle has developed an energy recycling technology. The company is still small, but growing fast. Today (2016) they have six employees and around 5M NOK in revenue, with expectations of 17-18 M NOK in 2017. The company was established in 2006, finished their first full scale prototype in 2011, and has gotten investment from two large venture fund (VC investor A). After receiving investment, EnergyRecycle had to change their business model to be profitable and meet the investment requirements. Their board consists today of four board member, two from the venture funds and two external independent members, all with industry and investment connections. EnergyRecycle has started their sales and has just started to grow, and is therefore classified to be in the early growth stage.

4: MarineWaste

MarineWaste develops and deliver waste management products for customers in the marine. MarineWaste started with technology development of waste management systems already in 1993, and had their first sale in 2000. They have a subsidiary in the United States, who work closely with their customers (shipping companies). MarineWaste works with technology development and commercialization, while other partners take care of the production and installation of technology. They have a board, consisting 4 members, with background mainly from economic, law and the broker business. MarineWaste went public (IPO) in 2014 to raise 80 million, for refinancing old debt and continue further development, and has 38 employees today (2016). Based on this, MarineWaste is classified to be in the growth stage.

5: SunBio

SunBio is a spin-off company from a large bio-energy corporation with 170 employees. SunBio produce process steam and biofuels. The cooperation has around 50 district heating plants in different towns, and delivers district heating to 6500 customers, consisting of public buildings, building societies, municipal property, plants, etc., including Customer A. The company has a board, consisting of four board members, mainly with background from business administration. SunBio as a spin-off company was established in 2003 and have had an increase from 100M NOK in turnover to 1B NOK during the last three years, therefore they are classified to be in the late growth stage.

| | WavePower | HydroEnergy | EnergyRecycle | MarineWaste | SunBio |
|--------------------------------|--|---|--|--|---|
| Stage | Early | Early | Growth | Growth | Growth |
| start-up year | 2009 | 2000 | 2002 | 1993 | 2003 |
| Employees | 1 | 2 | 11 | 38 | 170 |
| Board members | 4, all with industry background | 4, two with VC background and two with industry background | 4, two with VC background and two with industry background | 4, with backgrounds in economics, law and ship brokering | Several members with background in law and business and administration |
| Key activities | Technology development, searching for funding. | Product development, nearly ready for sale. | Sales and continuation of growth. | Sales and continuation of growth. | Sales and expansion to neighboring countries. |
| Key milestones achieved | First patent application in 2007. Soft funding in 2007. First full scale prototype test in 2014. | First patent application in 2004. Proof of concept in 2009. Acquired by Investor B in 2014. | First patent application in 2004. First full scale prototype in 2011. First sale abroad in 2015. | First customer in 2000. IPO in 2014. | Product in sale. Grown from 100 million to 1 billion in sales during the three last years. |
| Partnering firm* | | Investor B | Investor A | | Customer A |

Table 2: Presentation of start-up companies in the case study.

*Partnering firms that agreed to participate in the study.

3.3.3 Receiver-side partners

Three of the startups agreed to share their contacts with their strategic partners, two investors and one customer. These partners on the receiving end of the signaling process share insight on how the signals are interpreted, both individually and how the start-ups are conceived as a whole.

VC investor A is EnergyRecycle's investor. The company is a fund owned by two large Norwegian energy corporations and was established in 2012. The investor company invest in renewable energy, clean technology and telecom companies that are in their growth stage. Their main focus is to create value and contribute with expertise through active ownership. Before making an new investment, is the product, market plan and the team among other considered. The people behind the company and in the team is always crucial for the investor.

VC investor B is HydroEnergy’s investor. The investor company is a venture company of a large Norwegian energy corporation. The venture company was established in 2007 and has 13 companies in its portfolio today. They invest in energy-related cleantech businesses from early to mature phase. When the company consider a new investment, they first check if the company fits their investment mandate. Secondly, is it important that the company has a business concept (market position, unique technology, relationship, business model etc.) and a significant lasting competitive advantage. Different qualities and especially the team can be crucial, but it is the entire company which is essential for an investment.

Customer A is SunBio’s customer. The company is a large provider of waste services and recycling services for Norwegian businesses. The company collects waste from industry and private actors through municipal contracts. SunBio is one of their main partners for handling a special kind of waste. The company sets high standards establishing new partnerships with customers and suppliers. All their customers and suppliers are assessed through a program and are tested before the partnership is established.

| | VC investor A | VC investor B | Customer A |
|--------------------------------|----------------------|----------------------|-----------------------|
| Start-up Partner | EnergyRecycle | HydroEnergy | SunBio |
| Year established | 2008 | 2005 | 2011 |
| Communication frequency | Almost every day | Twice a week | Once or twice a month |

Table 3: Presentation of partner companies (VC investors and customer).

3.3.4 Signal-Side and Receiver-Side

Although the cleantech start-ups as signalers are the focus in this study, the authors have chosen to include information from the receiver-side. By doing this, one can analyze if the start-ups expectations of the signal matches with the receiver's perception of the signal. As described by Yin (2009), will the information gathered from the receiver-side, be used to triangulate and increase the accuracy of the study. The case study may be divided in the 5 following steps.

1. Use the literature base as starting point.
2. Interview cleantech start-ups on the signal-side.
3. Interview strategic partner companies on the receiver-side.
4. Analyze the case study to answer the purpose and research questions.
5. Discuss the findings from the case analyzes and include additional literature.

Although the authors have chosen to study both the signal-side and receiver-side, the level of analysis is the same. Representative persons on firm level has been interviewed on both sides.

3.4 Data collection

The data were collected through in-depth face-to-face interviews as well as archival information collected from the internet. All the eight interviews lasted from 30 to 60 minutes and were recorded and transcribed. In addition to the interviews, several sources for account data and information was used. This triangulation of data, improved reliability to the inaccuracy of information responses (Yin, 2009; Jick, 1979). Triangulation was especially helpful when it was difficult to recall specific important information. In combination, this improved the richness and detailing of the data collection. By using three different data sources, the construct validity has been increased by using the triangulation strategy (Gibbert and Ruigrok, 2010). This has facilitated the authors to validate the data by cross-referencing. The use of a multiple-case embedded design, allowed the authors to examine both the process and content associated with signaling and conduct our analysis across several units (signals) (Yin, 1994). The collection of data came from interviews and archives. Semi-structured interviews with CEOs or key persons in the company was used as primary method of data collection in addition to archived information from the internet (proff.no, company webpage and Google).

3.4.1 Semi-structured interviews

Yin (2009) presents six sources for data collection that can be used in the case study protocol. These are: documents, archival records, interviews, direct observation, participant observation, and physical artifacts. Interviews is often the most relevant source for qualitative case studies (Mullen, Budeva and Doney, 2009). Based on the research questions, interviews are chosen as the sources for data collection in this thesis. Semi-structured in depth interviews were conducted on 5 CEOs and 3 key persons in partner companies (investors/customers). The interview objects were selected with the intention of securing the most representative and knowledgeable signaling activities between the start-up companies and their partners. All the interviews followed the same structure and were conducted by both researchers to secure quality and consistency.

A specially designed interview guide was developed for the interviews. The interview guide for the signaler side and for the receiver side may be found in Appendices I and II respectively. The guide was revised several times in cooperation with our supervisor to make sure the questions were appropriate and combined open-ended and focused questions. The focused questions addressed specific parts of the research questions and the conceptual framework, such as perceived start-up qualities by the partner and perceived feedback from the partner by the start-up. This was done to ensure that the important topics for the research questions was covered. The focused questions introduced the interviewees to issues that they would not have mentioned by themselves (Flick, 2015). A separate interview guide was developed for the receiver-side interviews following the same logic, as well as incorporating questions directly related to signaling events which were uncovered during the interviews with the start-ups. open-ended questions were chosen to make it possible to collect unexpected data from the interviews (Flick, 2015). During the interviews, the authors took the liberty to improvise in order to let the interview objects elaborate on emergent themes. All of the eight interviews were audio recorded, transcribed and ranged from 25 to 60 minutes. The interviews were recorded and later transcribed, to allow the interviewer to be fully present during the interviews. There was one person present at the interview taking field notes to capture factors that can get lost during transcribing (Locke, 2001). The use of multiple data sources has been important in order to enhance the data credibility (Patton, 1990). This has been done by interviewing the case companies, analyzing documents and, if possible, using direct observations.

3.5 Data Analysis

Thematic analysis was used in the initial phase of each case under our study. According to (Boyatzis, 1998), is this method very appropriate to use when encoding qualitative data. The transcribed interviews were analyzed and coded based on thematic classes, listed in Appendix III. The coding library, was developed according to Saldaña (2015), and the coding process was conducted by using the software Nvivo. The authors used an iterative process, to identify emergent code words from new discoveries.

Four major types of findings, were identified by separating the coded information into different signal categories. 1) Technological signals, 2) Social Capital signals, 3) Market signals and 4) Sustainable signals. In order to cross-validate each other's observations of the interviews, the authors had post-interview discussions, as suggested by (Gioia & Thomas, 1996). Within-case and cross-case analysis were conducted to analyze the findings, as described by Miles and Huberman (1994).

3.6 Validity and reliability

In accordance with (Yin, 2009), there are four tests that can be used to establish the quality of empirical research. These are: Construct validity, internal validity, external validity and reliability. These factors will now be addressed in the following part.

3.6.1 Construct validity

There is a risk that the chosen measures for data collection are not sufficiently operational. This means that the data collected may not address and/or answer the research question. To ensure that the test of construct validity is met in this study, cleantech start-up performance has been defined by the means of achieving specific milestones that are related to the research questions. Then, it is important to identify and use operational measures that match those concepts. The conceptual framework defines the concepts and measures that will be used to answer the research questions. Additionally, the authors will strive to use multiple sources of evidence, and have informants review drafts of the case study report (Yin, 2009).

3.6.2 Internal Validity

This test will evaluate the evidence for established causal relationships, and is relevant for exploratory studies, where investigators explain how and why event x led to event y. If an

investigator tries to explain that signal x has led to outcome y, the investigator might incorrectly assume a causal relationship between x and y without knowing about the factor z that might have caused y (Yin, 2009). To secure the internal validity, the case study has been designed to research the signaling strategies from both the sender's and the receiver's perspective.

3.6.3 External Validity

The test for external validity tests whether the the research findings are generalizable beyond the immediate case study. By having a multiple case and multiple milestone design, the findings of this research will be applicable in multiple areas. By using cross-referencing and looking for the same results and insights in the different cases, the authors intend the findings to be applicable for cleantech start-ups outside of the study.

3.6.4 Reliability

The test for reliability test whether the research procedures and findings can be replicated by other parties. The authors will address this by following a case study protocol (CSP) (Eisenhardt, 1989). This thesis will be used as a CSP by the authors during the thesis, and was adapted before and during the research.

4. Findings and Development of Propositions

This exploratory study has examined how cleantech start-ups signal to achieve important milestones. As described introductory in this thesis, the findings will be presented as answers to the following research question: *How do cleantech start-ups signal to achieve important entrepreneurial milestones in different growth stages?* In order to give a more structured answer, the research question is divided into the following sub-questions:

1. Why do cleantech start-ups signal?
2. What signals do cleantech start-ups send to which receivers?
3. How do clean-tech startups transmit their signals?

Propositions will be developed to highlight important findings and interesting directions for future research. In accordance with Kazanjian (1988), two of the interviewed firms are categorized to be in the start-up stage while three are categorized to be in the growth stage. Early stage signaling will be exemplified by the growth stage where possible, as they have given information about their signaling in the early stage. To strengthen the analysis and make the findings more interesting, the authors will present findings from three additional cases (partners) from the Receiver-Side.

4.1 Underlying motives for signaling

To uncover why cleantech start-ups signal, the authors have studied the underlying motives of each start-up. All the case start-ups, both in early and growth stage, are found to signalize to reach important milestones such as sales, investments and strategic partnerships according to their current dominant problems. While signaling theory at its core states that signals are sent to reduce information asymmetry (Spence, 1973), most of the interviewed start-ups have additional underlying goals of what they want to achieve. Intuitively signaling to an investor might imply that the start-up is in need of capital, however in the study it was uncovered additional reasons to signal to the specific receivers. In addition to securing capital, increasing own evaluation before investment, as well as accessing the right investors with the appropriate networks were among the most important factors affecting the signaling to investors. Findings by Kazanjian (1988) show that young high-tech firms focus on few dominant task at each development stage. In a similar vein, our findings indicate that successful companies focus on

one (or few) signals, that dominate the firm's current development stage and that, as such, may become a source of their competitive advantage. Findings from the case analysis, shows that all of the five cleantech start-ups have been found to use signals to achieve certain milestones.

4.1.1 Need for financial capital

One of the dominant problems in the early stage is to gain resources such as capital for further development of technology (Kazanjian, 1988). Start-ups that are in lack of capital, are found to typically signal their qualities towards investors. The CEO of WavePower could tell the following regarding why they needed additional capital; *"We have two strategies to acquire additional capital, the first one is to do smaller emissions to keep us floating and alive, the other one is to get a larger investor who spit in a larger amount in order to win larger market shares and hire more people."* Based on this quote and other findings in our case analysis, it seems like start-ups signalize to keep the business alive and grow the company from one phase to another phase.

In addition to securing capital for entering a new phase, increasing own evaluation before investment, accessing the right investors with the appropriate connections were among the most important reasons affecting the signaling to investors. This was exemplified by the CEO of HydroEnergy who stated the following regarding their approach towards investors: *"I was very keen on getting something more than money, we needed an investor who could contribute with something else, that's why we chose the investor B. They had the industry experience, and an internal market specifically suited for us which made it a perfect match."* Having an investor who may grant access to a first market, as well as providing industry experience seems to give the right conditions for further growth and may give them the potential to reach the legitimacy threshold faster when they start their sales.

For the growth stage start-ups, capital was found to be needed in order to continue their growth as well as finance debt. The CEO of MarineWaste gave the following description of their motives when they went public in 2014; *"We needed 80M NOK for a development project, as well as more working capital and to refinance old debt, that was our motive to go public."*

Another finding shows how the growth stage start-ups approached the problem of getting financial capital. The CEO of the company EnergyRecycle demonstrated the main focus when recruiting new board members: *"It is two things, one is the contacts and network the person*

has into the industry, and the other is how he/she can help to obtain financing". The example shows that board members are wanted both for their contacts in the general industry, but also within the financial world. Signaling towards customers also revealed that the firm's intent not only was to achieve a sale, but also enter longer term relationships. This holds especially true for the later phase firms, also when it comes to signals towards potential strategic partners, like suppliers and financial institutions.

4.1.2 Need for legitimacy

Stinchcombe (1965) states that the liability of newness induces a greater risk of failure and therefore, legitimacy is important for start-ups. Our case analysis revealed that start-ups use partnerships and customer references to build legitimacy. CEO in HydroEnergy states that; *"we have on several occasions utilized existing customers as reference"*. It seems to be a relationship between why start-ups are signaling and the perceiving of legitimacy. It is found that it was very important for HydroEnergy to offer high service to their first customer, in order to be recommended further on to new customers and get good references. The need of good references indicates that start-ups signalize in order to perceive legitimacy, which again can contribute to reach important milestones.

4.1.3 Need for customers

Gaining customers and market shares are parts of the dominating problems that the start-ups experience in both the early and the growth stage (Kazanjian, 1988). The early stage start-ups were found to need customers for several reasons, both to have someone to test their technology in a real environment, as well as establishing market relationships and gaining references for further market expansion. For example, the CEO of EnergyRecycle stated the following explanation to how they ended up with their pilot customer: *"They chose to be our pilot customer in spite of the risks they knew. For our part it was not at commercially viable project, however that was never the case in the first place. The purpose was to get out there and demonstrate that our technology actually works."* They chose to engage in a partnership which at first was not very profitable, but gave them a foothold in the market and gave the opportunity to test their technology.

Not all approaches towards the customers gave the expected results. When HydroPower approached an international customer, they experienced that the information asymmetry disfavored them in the terms of their agreement. A moral hazard occurred when HydroPower

trusted the legitimacy of what they thought would be a paying customer. When the customer company in the end did not pay after receiving the product, HydroPower understood that they had been fooled. As an interesting note, HydroPower had received a signal from the company that the department of energy of the respective country had vouched for them, however in the end it was clear that the department of energy had failed to do a due diligence.

Proposition 1a: *Cleantech start-ups pursue several parallel signaling strategies to reach multiple aims to fulfill various needs.*

Proposition 1b: *The need for legitimacy lies at the core at all stages, whereas the focus on other needs shifts from acquiring financial resources and finding customers to acquiring additional external resources depending on which need dominates.*

Proposition 1c: *The focus on a given signaling strategy will most likely follow the the dominant problem or task.*

4.2 Signal sent from cleantech start-ups

Investigating the signals sent, uncovered several of the signals mentioned earlier in the theory chapter. However, one type of signal in particular appeared as a new type of signal not mentioned in earlier signaling literature. As *Sustainability* is found to be an important signal for our cases, we add it as a own signal category. The sustainability signal category is added to the signal categories made by Giones and Miralles (2015) and can be found in table 4.

| Signal Categories | Signal characteristics |
|-------------------|--|
| Technology | Technology, patents, product |
| Social Capital | Team, Board, Investors, Strategic partners, Networks |
| Market | Growth potential, market position, business potential, price, service, long-term cooperation, customer references, history, achievements |
| Sustainability | Renewability, Environmental Sustainability |

Table 4: Description of signal categories and characteristics.

4.2.1 Early stage signals

The signals sent from the early stage start-ups are mostly characterized as technology signals and social capital signals and are therefore in line with what was expected from what is demonstrated in the proposed framework in the theory chapter.

Technology signals

Findings indicate that technology signals towards investors are used to a greater extent in the start-up stage. Also, it seems like there is a correlation between the amount of signal activity towards investors, and the stage of development the start-up is situated in. Patent as technology signal was for example triggering for the start-up WavePower: *“When we got the patent we were like “king of the hill”, and the investor company got interested”* (CEO, WavePower). Signaling the patent demonstrated that their technology was protectable, which resulted in WavePower’s first investment from a VC investor. The case analysis did not reveal what specific signals they signalized, but an interesting finding is that a unique technology was one of the most important decision criteria for HydroEnergy’s investor. Since the investor finally decided to invest in HydroEnergy, this implies that signals about a unique technology was signalized and decisive for the investment. The case of EnergyRecycle turned out to show a unique interaction between the technology signal and the investor on the receiving side. When EnergyRecycle first contacted their current investor, the signals they sent actually made the investor to decide not to invest due to the team and business model not being attractive enough. However, when they at last ended up investing in them it was only because of their unique technology. The investor later decided to change both the team and the business model. Another finding shows that advanced technology as a quality signal, not always has good response. The company HydroEnergy developed a very complex technology which appeared to be too complicated for their customers. This caused HydroEnergy to simplify the technology for a better market fit. It is clear that HydroEnergy misunderstood their customers need, which indicates the importance of having a good market and customer communication parallel to the technology development. All these three case examples, proves that technology signals are important for early stage cleantech start-ups, and can be crucial for an investment.

Social capital signals

Kim and Aldrich (2005) suggested that new ventures benefit from their social capital to demonstrate legitimacy. The early stage start-ups were found to have a lower level of legitimacy than the later stage start-ups, and therefore relied more on the social capital of their

investors and partners when signaling towards new customers or potential strategic partners. Leveraging the networks and relations of the investors tended to be an effective way to signal social capital. As the CEO of WavePower explained: “After we got our first investor, we got a completely different legitimacy and started to work together with an important strategic partner”. This imply that the investor were used as social capital signal and were decisive to the establishment in addition to building legitimacy in the company. The early stage start-ups were still developing their technology or had it just delivered to their first customers. To signal that the technology worked as intended, the early stage start-ups used third party actors, such as strategic partners to send verification signals.

Market signals

One market signal that seems to be important for achieving investment, is the business potential. WavePower was considered to be on a too early stage for investment, but due to the company's “billion dollars” business potential, the investor decided to invest nevertheless. This example indicates that a huge business potential, can be an critical market signal towards VC investors.

The company HydroEnergy deliberately signaled the intentions of a long term cooperation commitment towards suppliers and explained it in this way; “*When we were gathering a new supplier, it was important for us to establish a solid and long term cooperation. We signaled therefore clearly that we wanted a long term cooperation to the supplier*”. (CEO, HydroEnergy). Another signal of long-term cooperation intentions could also be interpreted from the offering of good service. For example, EnergyRecycle offered extensive service on their products and annual upgrades of the technology, long beyond what the normal warranty limits stated.

Environmental signals

The company EnergyRecycle signaled the sustainability of their technology with the intention to get government financial support without having any luck. The CEO explained the reason with the following: “*The only projects that get support is either if they are very deep beneath the water or if they can ten double the number of users within six to twelve months. If the projects not are within this two categories, they don't get financial support*”. However, the company had a different experience when their future pilot customer approached them in the following manner: “*Our first pilot customer, they had another approach, they were a little*

visionary and said that we see it as part of their social responsibility to contribute to the development of other types of technologies and the environment was important for them". The example demonstrates that their technology acted as an environmental signal, however it was not sent as an intentional signal.

Based on the findings in the signals sent from the early stage cleantech start-ups, the following proposition is presented:

Proposition 2a: *The signaling at start-up-stage will most likely consist of technology, social capital and market signals. Investors and customers will be the most likely receivers of this signals.*

4.2.2 Growth stage signals

Signals in the later growth stage are mostly characterized by being market, social capital and environmental signals sent to customers and strategic partners.

Technology signals

In the subsequent growths stage, findings indicate that technology signals are normally signalized towards potential strategic partners. It seems like this is due to the dominant problems defined in the growth stage, where the need for strategic partners, such as manufacturers and bigger customers are needed to expand their business rather than there is a need for additional investors. The growth stage start-up MarineWaste, has for example used their products as signals to attract suppliers: *"We haven't search actively for strategic partners, but we have gotten strategic partners because of their interest in our product and the concept we deliver."* (CEO, MarineWaste). Findings indicate that unintended signals are most common for growth stage start-ups.

Another finding shows that the product itself has been used as signals toward potential strategic partners. When the company SunBio entered a strategic partnership with their bank, they used the product to signal that they wanted a partnership: *"Our history and beneficial product was communicated to establish a cooperation with our bank which can be considered as a strategic partner."* (CEO, SunBio). Intention signals like this, seem to be more prominent for growth stage companies. These companies have normally experience with earlier partnerships, and

thus know what they need, which might influence their basis for sending out intentional signal when establishing strategic partnerships.

Social Capital signals

For the start-ups who were already established actors in the market, social capital was used to signal knowledge of sales processes as well as the board experience and network. This was particularly important when making long term contracts with customers. The CEO of MarineWaste explains how they used their board, as follow: *“In the board we got a lawyer who is responsible for our contract structure and liability, which is important for the type of technology we sell, so the legal has been an important part of our board competence”*. The findings show that social capital signals are used by the growth stage start-ups to signalize liability and attract customers, suppliers and investors. Another growth stage company, SunBio, states their use of social capital signals as follow: *“Personal networks are used deliberately to attract both customers, suppliers and investors”*. (CEO, SunBio). Social capital signals are found to be signalized towards potential investors, customers in both start-up and growth stage, hence it seems like these receivers are important for start-ups in both stages.

Market signals

Findings indicates that positive references from customers, contribute to establish new customers. The growth stage company MarineWaste explains in the following how the use of references has helped them to grow their business: *“One is never better than the last project delivered. So if you do a bad project you may get excluded from future contracts over a long period of time... ...That we have been successful with certain customers has led to us gaining the trust of other customers, which has been very important for us”*. As indicated by MarineWaste, if the customer not is handled well, a bad customer reference may swing back against their favor. This types of market signals, are found most applicable for start-ups in the growths stage, or for start-ups workings with their first customer and entering the growth stage.

Environmental sustainability signals

The signal sustainability was found to be mainly sent towards investors in the growth stage. The company SunBio explain how Sustainability has been signaled as follow: *“The sustainability and renewability of our concept has been our main selling point. The focus on sustainability and renewability has meant that we now have an American pension fund that owns one third of our company”* (CEO, SunBio). It appears that their sustainability signal was essential for the investor. The American pension fund, were concerned about thinking long

term regarding their investments with focus on sustainability and renewability. It is found that due to the nature of SunBio's core competence and business model, they don't signalize the technological attributes of their products, but rather the sustainability it offers over competing products and services. SunBio also states that signaling sustainability is a very important factor that the customers look for; *"If the price is wrong, then you're out, these are huge corporations (customers) who has public tender processes, then it is important to document the renewability and carbon footprint in all of the production (CEO, SunBio)*. Findings from the interview with SunBio's customer, reveals that the most important criteria for their partnership establishment with SunBio was; Delivering reliability, availability, compliance with required industry regulations and desire for a stable and long-term relationship. An interesting finding here, is that the customer did not mention the sustainability signal as important, despite SunBio's statement above. This suggests that the value of sustainability as signal can be perceived different by different receivers.

MarineWaste was found to use sustainable signals towards customers, as explained by their CEO: *"In the beginning, we demonstrated for the customers that had faith in us that we were able to deliver new environmental technology with high cleanliness requirements"*. The quote imply MarineWaste's use of Sustainability as a quality signal. There are strong regulations on products in the marine market they are operating in, therefore signaling their quality and Sustainability might come from the imposed regulations. The impact of regulations was also explained by the CEO from "SunBio", who stated that new state regulations for waste was essential for all their entrepreneurial activities; *"In 2003, the special waste of which we base our core business, became classified as hazardous waste and opened up an opportunity where we were able to make money on handling that waste"*. The new rules and regulations made a unique opportunity for the cleantech start-up to earn money by making renewable energy out of the hazardous waste.

The signals sent from the cleantech start-ups in the later growth stage and the receivers differ from what was found in the early stage. Therefore, the following is proposed:

Proposition 2b: *The signaling at the subsequent growth stage will most likely consist of sustainability and social capital signals. Customers and investors will be the most likely receivers of this signals.*

4.2.3 Summary of signals sent

To summarize, we have observed that the start-ups signalize several different signals, where some signals were sent more frequently to certain external parties. The main difference between the early stage start-ups and the growth-stage startups is the changed focus from signaling technology qualities towards investors in the early stage, while in the growth stage, mainly social capital and environmental signals are sent to customers. The fact that social capital signals seem to be that important may have to do with all of the start-ups have other businesses as customers. Why sustainability is a favored signal might come from the regulations imposed on the market and the difference in legitimacy. An illustration of the different signals sent according to stage and legitimacy may be found in figure 6.

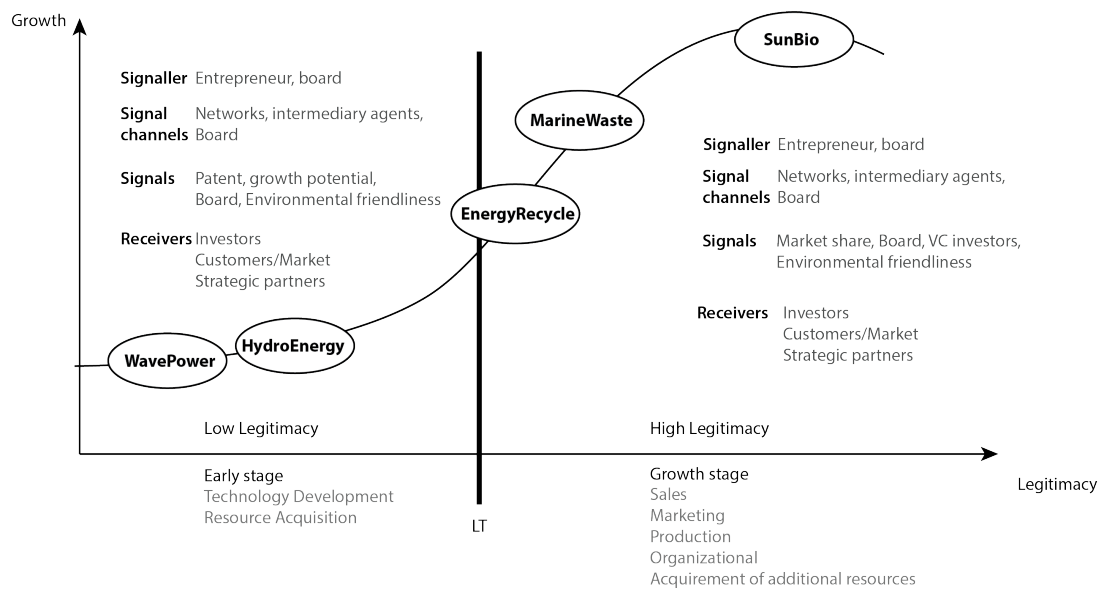


Figure 7: Case start-ups put in the context of the Conceptual Framework. (Source: Authors).

The findings indicate that increased legitimacy increases the use and effect of sustainability as quality signal. Therefore, the following is proposed:

Proposition 2c: *Environmental Sustainability is more important as a signal when the startup has reached the legitimacy threshold.*

4.3 Signaling methods

In order to understand how the cleantech start-ups sent their signals, the specific signaling methods were investigated. The findings showed that one thing that all of the cases include, is the use of multiple signals. This implies that each receiver received several different signals from each individual start-up. It was found to be important for the start-ups that the signals had the same consistency and were complimenting each other. For example, WavePower used both patents, expert statements and calculated market potential to show investors that the technology was scalable, had important application areas and positive return on investment (ROI). It is also found that multiple signals were crucial for one of the investors on the receiver-side. Before the investor decided to invest in a cleantech start-up, five critical criteria were considered before investment: 1) An unique technology, 2) global market potential, 3) big growth potential, 4) good market experiences, 5) professional and well-run company. The multiple signals indicate that the start-ups intended to demonstrate more than one strength, thus increase their legitimacy and the likelihood of being taken serious by the receiver. Based on the fact that all of the start-ups were found to send multiple signals, the following is proposed:

Proposition 3a: *Clean-tech start-ups signal multiple signals to external parties to strengthen their legitimacy.*

Proposition 3b: *Consistency and complementarity of the signals will most likely amplify the effect of signal multiplicity on a clean-tech start-up's legitimacy.*

Analyzing the signaling methods also revealed several differences in how the different start-ups signaled towards external parties in the early- and growth stage.

4.3.1 The role of the board

The CEO of WavePower stated; “The whole point of the board was to use people who have the networks that are required, we completely depend on the board being out there using their network. They use their existing network and make new relations, without them we wouldn't be able to speak to people”. Unless the entrepreneur has the right contacts by herself, finding the right board with the right network might be crucial. With networks within the industry and the financing sector, such as VCs and other investors, the board is one of the most important way to access customers, funding and partnerships. This was especially true for WavePower,

where the CEO was the only one on the founding team and had very limited experience in the energy sector.

While the members of the board and their experience are important signals sent to the start-ups' receivers, they also fill a role as signalers. Our findings suggest that both early and growth stage start-ups leverage the networks and personal relations of the boards to signal unobservable qualities to important receivers. The CEO of EnergyRecycle made a similar comment about their own board; *"They have the contacts in the industry which we operate in, and their network also contributes when we need financing to get the liquidity we need in order to keep going"*. The board of EnergyRecycle is mostly consisting of their VC investors which are specialized in investing in cleantech. Having industry experience greatly helps the start-up when shifting their focus from product development to reaching out to customers and enables EnergyRecycle to signal with higher legitimacy. The importance of the board's ability to signal was also found in the start-ups that had reached further into the growth stage. In the case of MarineWaste, their customers and partners operated in an extremely consolidated industry where personal contacts and networks were essential for survival. In their case, being able to signal consistency through a board with strong ties to the central actors in the industry is one of the biggest factors for their success so far.

Proposition 3c: *The networking capability of the board of clean-tech start-ups enhances their ability to signal towards investors, customers and other potential strategic partners*

4.4.2 The use of formal and informal networks as signalers

When HydroEnergy searched for funding, they sent their business plan to potential investors through a broker. The broker, operating in their formal network both provided an extended network as well as a higher level of legitimacy making their business plan more trustworthy. This was also confirmed by the investor who received the business plan from the broker; *"There was a broker who sent us an email with an investment case, or a teaser as they call it, about HydroEnergy. We experienced it as something interesting and new as it was within our investment mandate and we asked for more information."* (CEO, HydroEnergy). For a start-up in the early stage, the use of a broker provided a unique way to signal legitimacy. Another example from the same case demonstrates that HydroEnergy attended an investor forum where they were able to pitch in front of investors. The investor forum enabled the start-up to reach a greater audience of investors otherwise difficult being a start-up with limited network and

resources, which also gave them a higher perceived legitimacy. WavePower on the other hand, signaled that their technology was proven to work through a legitimate research partner. Having experts confirming their technology seems to be an important part of why they got their first investment.

The five cleantech start-ups used several different methods and means of communications to get in touch with external parties. While the most common way of signaling was through personal contact, some of the signals were found to be conveyed by other means, such as strategic partners and broker agents. The findings suggest that there is a difference between the early and late stage start-ups when it comes to the use of formal and informal networks when signaling.

The later stage start-ups on the other hand, were mostly able to exploit informal networks and personal relations in order to signalize towards potential partners. This may be the reason why they were not found to be using formal networks to the same degree as the early stage start-ups. The growth stage start-up MarineWaste had chosen an active signaling strategy towards external parties, by participating in trade fairs to meet the market, traveling around to shipping offices to meet industry colleagues, and used their network to establish collaborations. Given their legitimacy, MarineWaste was not dependent on their investors or strategic partners to signal in the same degree as the early stage start-ups and meeting partners in person seems to enhance their impression and legitimacy. SunBio, one of the other start-ups in the growth stage, gave the shareholders important board positions, and when contacting external parties, they used their shareholders' broad industry experience. The CEO of SunBio stated; *"We leverage our personal network at a high degree when it comes to contacting customers, suppliers and investors"*. The high legitimacy of SunBio's experienced board, proves to replace their need to contract other professionals in their formal network to signalize towards external parties.

To summarize, the early stage start-ups depended on either their investors or other strategic partners more than the growth stage start-ups who were able to leverage their own personal networks for the same purpose. Thus, the following is proposed:

Proposition 3d: *Cleantech start-ups in the early stage external agents (e.g. external board members, brokering organizations) to a larger extent compared to cleantech ventures in the growth stage.*

5. Discussion

The purpose of this thesis was to examine how clean-tech start-ups signal in order to achieve important milestones. Until now, few studies have been performed on the topic of cleantech entrepreneurship and signaling. To close parts of this gap, the following research question was asked to investigate the signaling process of cleantech entrepreneurial ventures: *How do cleantech start-ups signal to achieve important milestones in different growth stages?* Analyzing the answers through a case study has provided interesting and novel insights, as well as certain implications both for the practitioners and the theory within signaling and entrepreneurship. More precisely, our findings indicate that there are several differences in how cleantech start-ups signal according to which stage they are in. This section will discuss the main findings, relative to the theory, policy makers and practitioners (start-ups and investors), and finally, limitations and future research will be presented.

Due to the limited number of cases in our sample, the conclusions and findings should be treated with care. However, since little is known about cleantech start-ups, our investigation represents a useful addition to the cleantech literature and may provide a foundation for later empirical studies. Our study contributes by providing greater insight into how cleantech start-ups signal towards external parties for reaching important milestones. These milestones are important steps towards achieving growth in cleantech start-ups (Nunes et al., 2013).

5.1 Implications

The findings imply that the cleantech start-ups often have little information about the receiver-side company prior to sending signals, and are therefore found to send un-optimized signals. These un-optimized signals were having less effect than what the start-ups intended. If a signal is interpreted as weak or negative by the receiver, the feedback would therefore be negative, causing the start-up to not achieve the intended milestones. On the other hand, the difference in information and knowledge also affect the receiver of the signal in a negative manner. For example, if an investor gets the wrong information and a misapprehension of the start-up's values, this might lead to that the investor overlook important investment cases.

5.1.1 Clean-tech start-ups signal differently according to stage and legitimacy

The findings indicate that there is a difference between the most common signals sent during the early stage and the growth stage which is in line with the dominant tasks related to the present stage, and level of legitimacy presented in the proposed framework in the theory chapter. This notion is strengthened by the fact that the technology signals were predominantly signaled to mostly investors in the early stage, and in the growth stage, sustainability and market signals are sent mostly to customers and investors. Signaling technology qualities in the early stage was also regarded as a requirement for the investors which stated that the most influential signal were the ones describing the technology, such as patents. The importance of this finding is that cleantech startups should not be treated different from other high-tech startups in the entrepreneurship literature in terms of signaling in the early stage. Comparing to the study done by Zhang and White (2013), the early stage start-ups also seem to suffer the same symptoms by being new entrants and therefore having low levels of legitimacy as the PV firms in China. This might imply that next generation cleantech start-ups in Norway will be able to benefit from the established legitimacy of present day cleantech start-ups.

Based on our case analysis it seems like cleantech investors often are skeptical about the technology based on different reasons. Reasons can for example be 1) that many other has tried to solve the same problem earlier without success, 2) the technology might be complicated and challenging to develop and commercialize. The skepticism towards long term and complicated technology development is more or less in consistent with the Masini and Menichetti (2012) findings, except that our findings showed that technology signals like patents can be decisive for an cleantech investments and perhaps more important than the team.

Cleantech is an extremely wide term, and can describe almost any type of business and industry (Pernick & Wilder, 2007). Therefore, future research could benefit from narrowing down to specific industries, such as PV solar energy, wind energy or wave energy. Not only would the results be of better relevance for the included start-ups, but it would also be possible to do cross-industry studies within cleantech to examine if what holds for one type of cleantech also holds for others.

5.1.2 The significance of environmental signals

The growth stage start-ups seemed to have a higher success with the signaling of environmental signals than the early stage start-ups. This implies that signaling in clean-tech start-ups may be

similar to other start-ups until Legitimacy threshold is reached. After the clean-tech start-ups has reached the legitimacy threshold, it may take advantage of being “green” and sending environmental sustainability signals compared to start-ups in other industries. Since the findings indicate that the environmental signals have less impact than the technology signals in the early stage, this might be significant for how early stage cleantech start-ups may improve their signaling strategy. By focusing more on signaling how their technology performs and that there exists a true market potential seems to be more fruitful than signaling the environmental impact of their technology in the early stage. The finding is also somewhat contrary to the findings of Look (2012) and Masini & Menichetti (2012) who suggested that VC investors investing in cleantech were mostly preoccupied in the revenue model. To further understand the psychology of environmental signals, the authors suggest that future research may combine the latest research on climate communication and what is called the psychological climate paradox. The psychological climate paradox is relevant since it describes the phenomenon where the more information the general population get about the climate change, people seem to care less (Stoknes, 2014). This calls for new and more creative strategies to how cleantech should use environmental sustainability signals to achieve important milestones.

5.1.3 Multiple signals

While signaling theory mostly has studied signaling with the intention of positive outcomes (Connelly, et al., 2011), few studies have touched upon how entrepreneurs signal several intentions through the same signals. To increase the efficiency of signaling, firms may signal multiple signals to the same receiver (Balboa & Marti, 2007). Our study implies that early stage start-ups might have great value of sending multiple signals and they can increase their legitimacy in an efficient manner. When a cleantech start-ups sends many signals to the same receiver, the signals seem to amplify each other, and thus they get stronger. Our findings have shown that investors on the receiver-side, consider several signals before investing in cleantech start-ups, thus, the multiple signals seem to be especially important for investors. The reason why multiple signals are efficient comes from the fact that it both enhances each signals’ observability as well as it is an effective way to reduce signal cost. When sending multiple signals, it is also important that the signals are consistent and complementary to each other as well as the true qualities of the start-up. When the cleantech start-ups signaled consistent signals, it was less chance for the receivers to misinterpret the signals. This is something found to be true for other entrepreneurial ventures as well (Gao, et al., 2008). However, keeping the consistency in the signals when using several channels as well as intermediary agents can

become a problem, especially for the early stage start-ups who change their message more frequently than growth stage start-ups. Future research should take into account how the signals change over time, and perhaps include a longitudinal axis in order to see if the consistency stays over time.

5.1.4 Board as mediators of signals

Previous research on signaling theory has mostly focused on how firms gain legitimacy by signaling their board as a unobservable quality (Certo, 2003). The board often has industry or entrepreneurial experience which acts as positive signals towards important potential partners. However, little research has been performed on how the board act as the signaler. From our findings we suggested that the board may act as an important mediator of signals, especially due to their own personal relations and networks. As all of the start-ups in this study were found to use their board to convey signals, this may have some interesting implications for both theory and practitioners. First, signals from the boards increases the signal observability and thus the cognitive legitimacy of the start-up. Second, when the high legitimacy board members signal qualities of the start-up, there is a higher probability that the quality signals will be accepted by external actors who are familiar with the board members, thus increasing their sociopolitical legitimacy.

5.1.5 Networks as important mechanism in signaling

Zimmermann and Zeitz (2012), states that legitimacy is a resource that enables the entrepreneur to both gain other resources, as well as reducing the effects of liability of newness and risk of failure. Our findings imply that start-ups in the early stage with low legitimacy use agents to signal higher legitimacy towards external parties. This is appropriate in relation to the theory, stating that new ventures have low levels of legitimacy, depend on the cooperation of other organizations, and often struggle with the competition from other established ventures (Stinchcombe, 1965). Therefore, this might imply that early stage cleantech start-ups should use agents in a larger degree when signaling. Cleantech start-ups in the growth stage with higher legitimacy, are found to use the start-up's own networks and relations in a greater extent, when signaling. As the board is found to be central for network connections and relationships, this might indicate the importance of establishing and using the board to a greater extent for cleantech start-ups entering the growth stage. By actively using board connections, early stage clean-tech start-ups may reduce dependency on other organizations related to networks when trying to reach potential important signal receivers.

6 Conclusion

In this study, the authors explored how cleantech startups signal to achieve important milestones in different growth stages. The process of addressing this research questions was divided into several steps. First, the authors performed a literature study on the most relevant literature and constructed a framework combining the theories. Second, the authors performed a qualitative case study with five Norwegian cleantech start-ups and three important partner companies. And lastly, the authors analyzed and discussed the findings from the case study before proposing a new framework for signaling strategies used in cleantech start-ups before pointing to possible future research.

The research question enabled to study the underlying reasons for why the start-ups signal and give insight on the internal goals and motivations, how the signals may be characterized, and finally how the signals are signaled to the receivers. By studying this underlying reasons, the authors identified several verifications of extant literature and theories as well as some new discoveries. The most significant finding was the difference of how well environmental signals performed in the early and the later growth stage and to which degree the legitimacy affected the signaling process of the start-ups.

7 Limitations and future research

Our study has a number of limitations which will hopefully be addressed by future research. With only five cases, and three respondents on the receiver-side, the findings are most probably not representative for the cleantech industry as a whole. The majority of the interviews were conducted with the CEOs or founders of the start-ups, however as the most of the questions were related to actions or events from the past, the answers relied on the memory and the presence of the one responding. Having only been able to interview three of the receivers, this study has primarily been conducted through the start-up point of view. For further research will it therefore be interesting to focus on the receivers of the signals in a greater extent. This will provide better insight into the asymmetric relationship between the signaler and receiver and be critical for identifying how, why and what types of unintended signals that are signaled. Further, not all of the interview subjects were working with the start-ups during some key events. This may have led to false recollections or that the answers were modified to reflect the current position of the start-ups (Pasupathi, 2001). To get a better understanding of how cleantech startups can take advantage of their environmental qualities, it will be interesting and important to examine in greater extent what effect environmental signals have. However, the focus of our study was on clean-tech start-ups only. Hence, future research may investigate whether start-ups in other industries perform similar signaling until Legitimacy threshold, and compare whether clean-tech start-ups have additional advantage of being green by sending out environmental signals after reaching the legitimacy threshold compared to other start-ups. Another further research suggestion is to examine in greater extent how intermediary agents can be used for the benefit of startups. It will then be the most relevant and interesting to look at early start-ups, given that our findings indicates that this way of signaling is most prominent for startups with low legitimacy. As stated earlier, this study tried to include the receiver-side information in order to see if the interpretation was correlated to the intention of the signals. However, with only three respondents on the receiver side, this was not successful. Future research should also try to include the interpretation of the signals to find correlations. however, one must be cautious of when the signals are sent and received. In this study it was experienced that the entrepreneurs often had no or little recollection of the specifics of signals sent in the past, or that the entrepreneur had left the company. Therefore, by doing a study over time, future research would be able to take into account the changes in the management team and

one would be able to record signals as they happen without relying on the memory of the individual entrepreneurs.

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APPENDICES

Appendix I - Interview guide: cleantech companies

I. Which role do you have in the company? ₁ General Manager (CEO) ₂ Other, please specify.....
.....

II. Do you want to receive a summary of the findings from this study? ₁ Yes ₂ No

Part A. About the company

A1 Organization number or company number:.....

A2 Please describe the phases the companies technology (product or service) has been through or are in now and fill in the year the milestone was reached or are planned to be reached:

• When was the first patent application filed (or year expected submitted)? ₁ Yes → Year: ₂ No

• Has Proof of concept been completed? ₁ Yes → Year: ₂ No

• Do you have a prototype which works in a real environment (or eventually planned year)? ₁ Yes → Year: ₂ No

• When was the first product/service fully developed (eventually planned year)? ₁ Yes → Year: ₂ No

A3 In which stage of the lifecycle is the company in now? (**only one cross**).

₀ *Early stage*: We are considering the commercial potential and strengthen intellectual property rights. We are searching for for patent or tries to protect the fundamental technology for our produkt/service.

₁ *Development stage*: In this stage is the product/service developed and is in limited degree introduced on the market. The turnover is low.

₂ *Establishment/Introduction stage*: The company's product/service becomes progressively more introduced on the market.

₃ *Growth stage*: The company is growing strong and investments can be necessary for further development. The company's product/service have been introduced on several markets, and the turnover is increasing.

₄ *Maturity phase*: The turnover is flattening out, and the company has reached the amount of customers who are likely to be relevant whiten todays main business area.

A4 How has your business grown over the past three years?

| | 2013 | 2014 | 2015 | Estimate for 2016 |
|--|------|------|------|-------------------|
| Number of FTEs | | | | |
| Number of patents | | | | |
| Number of products / services | | | | |
| Sales Revenue | | | | |
| % export turnover | | | | |
| Research and development (% or 1000 NOK) | | | | |

A5 Has the company received external funding from any of the following, eventually when?

| | Have received money | Year |
|--------------------------------|---------------------------------------|-------|
| • Family | <input type="checkbox"/> ₁ | |
| • Seed money | <input type="checkbox"/> ₂ | |
| • Private investors | <input type="checkbox"/> ₃ | |
| • Major industrial players | <input type="checkbox"/> ₄ | |
| • Venture capital-investors | <input type="checkbox"/> ₅ | |
| • Others, please specify | <input type="checkbox"/> ₆ | |

A6a Has the company had international activity?
₁ Yes ₂ No

A6b In case the internationalization, in which country, and when did the company get their first deal or sales outside of Norway (or eventually, working to establish a deal)?

| | | | |
|---|-----------|--|-----------|
| <input type="checkbox"/> ₁ Deal Country | Year..... | <input type="checkbox"/> ₂ Sale Country..... | Year..... |
|---|-----------|--|-----------|

Signals: Human capital within the leader team:

| B9 How is the background of the management team? | In very small extent | | | | | | | In very largely extent |
|--|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|------------------------|
| • Functional background (f. example sale, finance etc.) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | |
| • Industrial background | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | |
| • Education background (different universities, majors) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | |
| • Personality (different creativity level, action orientation) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | |
| • Age | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | |
| • Experience from establishment | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | |
| • Leder experience | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | |
| • International experience (worket abroad, foreign) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | |

Signal receivers and use of social capital within the leader team:

| B11 To what extent has the leader team used personal relations/network towards the following: | In very small extent | | | | | | | In very largely extent |
|---|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|------------------------|
| • Customers | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | |
| • Suppliers | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | |
| • Competitors | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | |
| • Distributors | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | |
| • Industry and / or government support organizations | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | |
| • Authorities on a local, regional or national level | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | |
| • Universities, colleges, research institutes | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | |

C3 How many board members have the following background: Venture capital investors

External members (not employees, not team members) Representing large industrial players

Experts (law, finance, sale etc.) Politicians, academics or socially committed people who have power and repute

C8a When had the company eventually recruited an external board member which is highly regarded in the industry (or in the corporate environment)? Year: Never

| C8b What qualities / qualifications by an external board member has been important for your business?: | Not important | | | | | | Very important |
|--|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| • Experience as external board member | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| • Experience as director or deputy director | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| • Degree from a recognized university | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| • Social network / contacts | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| • Industry experience | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| • External board member is associated with a prestige institution or organization | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| • Financial experience | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| • Experience from work in startups | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

Part B. About the companies (signal) strategies in historical perspective

About the business:

- How is the business model (how do you earn money or plan to earn money)?

Signaling strategies:

- (4a) How did you approach the first market? How did you enter the market you are in now / the main market?
 - How did you do it in relation to competitors, did you have a unique strategy that was different from your competitors or industry standards?
 - Has this changed since? Helped previous experience from the industry to enter the market? Eventually in what way?
- (4b) Do you have external investors in the business? If yes, how did you contact/make you attractive for the investors? How do you explain to them what your company does? Any strategy that you think has worked well for you?
- (4c) When trying to close the first deals with suppliers or attracting (first, pilot, important) customers?
 - How have you been able to convince them that they should work with you? Could you give us some examples? What was unique about your approach (compared to competitors or what is the norm in the industry)?
 - Are some of your customers depended on you today, in that case what are you doing to build on the relationship you have?
- (4d) How did you approach your first strategic partner (first pilot/most important)?
 - How did you get your partner to choose you over others? Do you have any examples? What was unique about your method of difference from competitors or industry standard?
 - Is some of your partners depended don you today, if so, what are you doing to build on the relationship you have?

Learning process:

- (5a) Now, in retrospective, what actions do you think that could explain your current business situation? Would you recall any specific actions you did, or that a partner of the company did that changed (for good or not) how the company was evolving?
- (5b) If you had the chance to go back in time, what would you do differently with regard to a) approaching and get int ouch with investors, b) suppliers, c) customers etc.? Could you give us examples?

Thanks for your help and time. We look forward being able to share some of the research insights. We would also appreciate if we could do a short follow-up in case we have doubts when transcribing the interviews. We might also send some short email questions if we are confused with some of our notes, thanks again for your time!

Appendix II - Interview guide: receiver-side

- 1) **Can you tell us about your company?**
 - a) Which kind of companies do you normally invest in?
 - b) What kind of investment requirements do you have?
- 2) **How were you aware of the start-up company?**
 - a) How did you perceive the company?
 - b) Did you perceive anything positive or negative?
 - c) How did the startups difference from competitors/similar companies?
 - d) Did they have a unique strategy, unlike the competitors or the industry standard?
 - e) Why did you invest in the startup company?
 - f) Have any of the qualities changed since the investment?
- 3) **How did the startup get in touch with you?**
 - a) How did you get in touch with the startup?
 - b) How did the first meeting go (eventually the decisive meeting)?
 - c) How did they describe their own business?
- 4) **How have you maintained the communications with the startup company?**
 - a) How often do you speak together?
 - b) Has the message changed over time?
 - c) Was the description (ref. 3c) the same as the startups real qualities?
 - d) Did the description of strategies/plans match with the work conducted in retrospect?
- 5) **What made you decide to enter into an agreement with startup company?**
 - a) Product/service (technology/patent)
 - b) Management/board
 - c) Existing (or future) market position or other external factors
 - d) Composition of their strategic partners
 - e) Other unique characteristics
- 6) **How important is the startup company for you?**
 - a) Are you depending on the startup company?
 - b) How does the startup build on your relationship?
- 7) **How has the startup investment affected your company today?**
 - a) Do you have examples?
- 8) **If you could turn the time back, is there anything you would do differently in terms of the investment?**
 - a) Do you have any examples?

Appendix III – Case Study Codes

The coding for the interviews went through several iterations as new codes and combinations emerged. Here are the initial codes based in the theoretical framework.

1) EARLY STAGE DOMINANT PROBLEMS

- a) Technology development
- b) Resource Acquisition

2) GROWTH STAGE DOMINANT PROBLEMS

- a) Sales
- b) Marketing
- c) Production
- d) Organizational
- e) Acquirement of additional resources

3) SIGNALS

- a) Social capital
- b) Market
- c) Technology

4) SIGNALLER

- a) Entrepreneur
- b) Network

5) RECEIVER

- a) Investor
- b) Customer
- c) Market
- d) Strategic partners