NTNU – Trondheim
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Commercialization of Norwegian Wind Energy Technologies

A Multiple Case Study of Success Factors in the Product Launch Process

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- uttak av masteroppgave

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This master thesis discusses how Norwegian companies can successfully commercialize new and immature wind energy technologies. The goal is to establish a best practice model on how to commercialize wind technology products, and to provide a practical view of this topic.

A multiple and holistic case study design will be used, by exploring commercialization activities within a number of Norwegian wind energy companies. Data sources such as interviews, grey literature and journal articles will provide the foundation for the discussions.

The master thesis is organized in the following way: First, a systematic literature review will be used to present relevant theories and models of commercialization and product launch strategy. A set of propositions connected to the problem statement is then presented. Second, empirical analysis, using interviews and grey literature, will add practical aspects to the problem statement. Third, the propositions, theories and analysis are discussed, with a particular focus on testing the strength of each proposition. Finally, the thesis is concluded and strategic and theoretical implications discussed.

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Student: Jeg erklærer herved at jeg har satt meg inn i gjeldende bestemmelser for mastergradsstudiet og at jeg oppfyller kravene for adgang til å påbegynne oppgaven, herunder eventuelle praksiskrav.

Partene er gjort kjent med avtalens vilkår, samt kapitlene i studiehåndboken om generelle regler og aktuell studieplan for masterstudiet.

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Abstract

Concerns about climate changes and greenhouse gas emissions is one of the key challenges in our century. In order to obtain a greener and more sustainable future, a major portion of future energy sources must come from renewables. Today, wind power is one of the technologies that shows the greatest potential in contributing to this goal. However, innovative ideas must be successfully brought to the market and made profitable if the wind segment is to be deemed sustainable and competitive to other alternatives. This paper aims to contribute to the research on renewable technology commercialization, by addressing *how Norwegian companies can successfully commercialize new wind energy technologies.*

A multiple case study investigating six different Norwegian B2B wind technology providers through several in-depth interviews is used as a basis for analysis and discussion. Findings from each case are contrasted to each other and linked to extant literature. The aim of the thesis is to provide a holistic view of the commercialization process, and to integrate theories about commercialization and product launch strategy with practical views of corporate decision makers in various companies. The research is divided into three main parts, namely a systematic literature review, an empirical case study analysis and a chapter that discusses the findings, practical implications for Norwegian companies and theoretical implication for scholars. The study concludes with two frameworks and a set of propositions on how wind technology firms can best commercialize their products.

The research shows that wind technology providers should create a whole product to overcome the chasm between early innovators and mass-market customers. Complementary assets and services could contribute to this, in addition to provide a strong competitive market position. Furthermore, a minimal initial investment base is needed to reduce the presence of the death valley threat. Cooperation is also deemed as essential for success, and the challenge is to find the appropriate collaboration mode that fits with the overall company strategy. In addition, market orientation is also a success factor. In relation to this, market testing could increase the rate of market adoption, which in turn is translated into commercialization success. Mixed findings were found about the role of venture capital. Some types of firms may find it useful, while it is less suitable for others. The thesis also analyzes the difference in commercialization strategy with respect to whether the firm is large and mature or a start-up, and whether the innovation is radical or incremental. This topic is not well covered by extant literature. It is concluded that practitioners must take these differences into consideration when formulating product launch strategies and that scholars to a larger degree should embed this in future research. Finally, decision makers should also be aware of external factors such as competitors, the government and the fact that the wind industry is dynamic and immature.

All the findings are organized into two frameworks that can be utilized by practitioners in order to increase their company's product commercialization performance, and thus increase their competitive advantage in a demanding industry. In long-term, this can create the necessary foundation for an energy future that is greener and more sustainable.

Sammendrag

Klimaendringer og –utslipp er et av nøkkelutfordringene i vårt århundre. For å skape en grønnere og mer bærekraftig fremtid, må mer av fremtidige energikilder komme fra fornybare ressurser. I dag er vind en av de av de mest lovende energiteknologiene for å oppnå dette målet. Imidlertid må innovative ideer på en vellykket måte bli lansert i markedet og i tillegg være lønnsomme for at vind-industrien skal kunne bli betraktet som bærekraftig og konkurransedyktig sammenlignet med andre alternativer. Dette studiet har som mål om å bidra med kunnskap innenfor denne problemstillingen ved å drøfte *hvordan norske selskaper kan kommersialisere sine vindenergi-teknologier på en suksessfull måte.*

En multippel casestudie som undersøker seks norske B2B vindteknologi-leverandører gjennom en rekke dybdeintervjuer er brukt som grunnlag for analyse og diskusjon. Funn fra hvert case blir sammenlignet med hverandre og videre knyttet opp til eksisterende teori og litteratur. Målet med denne oppgaven er å gi et holistisk perspektiv på kommersialiseringsprosessen, og å integrere akademiske teorier om kommersialisering og produktlanseringsstrategi sammen med praktiske syn blant beslutningstagere i industrien. Studiet er delt inn i tre hoveddeler, nemlig en systematisk litteraturgjennomgang, en empirisk casestudie-analyse og et kapittel som diskuterer funnene, de praktiske implikasjonene for norske selskaper og teoretiske implikasjoner for forskere. Oppgaven avsluttes med to rammeverk og et sett med proposisjoner på hvordan vindteknologi-leverandører best kan kommersialisere sine produkter.

Forskningen viser at vindteknologi-selskaper bør skape et komplett produkt for å overkomme gapet mellom tidlig innovatører og massemarkeds-kunder. Komplementære produkter og serviceavtaler kan forsterke dette, i tillegg til å skape en sterk markedsposisjon for selskapet. Videre er en minimal investeringsprofil ved produktlansering nødvendig for å redusere likviditetsproblemer under oppstart. Samarbeid er også ansett for å være essensielt for suksess. Utfordringen er først og fremst å finne en samarbeidsform som passer den overordnede strategien til selskapet. I tillegg er markedsorientering vurdert som en suksessfaktor. I relasjon til dette kan markedstesting øke graden av produktaksept blant kunder, som igjen er knyttet til kommersiell suksess. Blandede data om venture-kapitals rolle ble funnet. Mens enkelte selskaper mener de er relevante og nyttige, argumenterer andre med at de ikke er det. Studiet analyserer også ulikhetene i kommersialiseringsstrategi mellom store og små selskaper og mellom inkrementelle og radikale innovasjoner. Dette er ikke et område som er godt dekket av eksisterende litteratur. Det konkluderes med at praktikere må ta hensyn til disse forholdene når de skal formulere sine produktlanseringsstrategier, og at akademikere bør ta med elementene videre i sin forskning. Til slutt må vindteknologi-leverandører være oppmerksomme på eksterne faktorer som konkurrenter, myndigheter og det faktum at vind-industrien er dynamisk og umoden. Alle funnene i oppgaven er presentert i to praktiske rammeverk som beslutningstagere i industrien kan benytte seg av for å forbedre selskapets evne til å kommersialisere nye produkter. På sikt kan dette styrke konkurransefortrinnet til selskapet i en viktig industri som er meget krevende og utfordrende.

Preface

This master thesis is the result of a study conducted as part of a Master of Science degree in Industrial Economics and Technology Management during the spring 2014 at the Norwegian University of Science and Technology. The work has been part of my specialization in Strategy and International Business Development at the Department of Industrial Economics and Technology Management. The thesis has given me the opportunity to apply theoretical knowledge from previous strategy courses in a real world case. It has been highly rewarding to take on the challenges of the renewable energy industry, and my hope is that this thesis will provide a small contribution towards a green and sustainable future.

I would like to thank my academic supervisor Associate Professor Ola Edvin Vie at the Department of Industrial Economics and Technology Management for fruitful discussions, constructive feedback and support. Gratitude is also given to the interviewees who have provided me with valuable knowledge and insight to the wind technology industry. Finally, special thanks to my father, mother and brother for eternal love and support.

Trondheim, June 5th 2014

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1. Introduction and background

1.1 Problem statement

Innovation is a commonly used buzzword in the discussion about value creation in today's society. Many in Norway call for more generation of new ideas and start-ups in order to ensure a future that is less dependent on oil and gas revenues. A very important condition to achieve this is a successful commercialization and product launch process. Indeed, Reve and Jacobsen (2001) claim that there is no lack of good ideas and innovations in Norway, but rather on the ability to transfer these into sustainable and profitable products in the market. In parallel with this discussion, there is fierce debate on how Norway should fulfill its ambitious international climate targets. The use of carbon offsets and purification has dominated the agenda, but new technology development will also be an inevitable part of the solution. In order to provide a small contribution to the two aforementioned issues, this master thesis aims to provide actionable recommendations for corporate decision makers in the Norwegian wind technology industry, as well as theoretical contributions to the extant research literature. As far as the author knows, this theme has not been thoroughly investigated by any researchers so far. Specifically, the problem statement of this study is *how can Norwegian companies successfully commercialize new wind energy technologies?* A broad and holistic definition of the commercialization process is utilized in accordance with Balachandra et.al. (2010: 1843) and Jolly (1997*: 4) (cf. section 3.2.1). By thoroughly answering the problem statement, my hope is to achieve the following goals:

- To describe how a representative sample of Norwegian wind technology firms commercialize and launch their products and what challenges they face.
- To establish a best-practice model on how to successfully commercialize new wind energy technologies in a Norwegian industry context.
- To operationalize generic theories into useful and tangible recommendations for business managers that want to create new products and value propositions in a Norwegian industry context.
- To provide theoretical contributions and modifications on established theories and models that challenge how we view the extant literature.

The focus of the thesis is on internal firm specific factors that influence product commercialization performance, such as resources and financing. These are elements that a company has under its influence of control, thus creating tools that business managers can use when developing and marketing new products. However, some attention is also devoted to external factors such as governmental support and funding. These are elements that stimulate successful conception and market introduction of new renewable energy technologies among firms in the industry. They are however not within the decision domain of companies. Thus, the focus is more on how practitioners can meet the challenges companies face in their environment and use external opportunities in their own advantage.

1.2 Why is this study relevant?

In the following sections, several arguments for why people should spend their time reading this thesis is presented. I hope that corporate decision makers, researchers and other interested stakeholders are encouraged to reflect on the bigger picture of the thesis.

1.2.1 Ensuring sustainable growth in the future

One of the great challenges of this century is how to supply energy to sustain economic growth in a world with growing population, while at the same reducing carbon emissions and ensure sustainable growth. In the past few years, several technological innovations have provided us with the means to meet these challenges and dilemmas (IEA, 2013a). However, these new and immature innovations must be commercialized in a viable and cost effective way if wind power is to be competitive with traditional and cheaper non-renewable energy sources. Energy technology companies will play an important role in this process. This study shows how the business community can be part of the solution by providing new and clean technologies to the market, instead of being the problem.

1.2.2 Meeting ambitious long-term climate targets

Norway has ambitious targets for reducing carbon emissions. The Norwegian government aims to reduce greenhouse gas emissions by 30% within 2020 relative to its national emissions in 1990, and to become carbon neutral within 2030 (St.meld. nr 1, 2009-2010). Similarly, the European Union targets a 20% reduction in greenhouse gases by 2020 (European Commission, 2013). On a long-term basis, a major portion of this effort must come from a shift from the use of fossil based energy sources, to renewable and greenhouse gas neutral energy resources. Wind power represents a renewable energy source with huge potential that is yet to be fulfilled (IEA, 2013b: 7). However, cheaper and more reliable innovations must be available in the market in order for renewables to be competitive with conventional energy, thus contributing to the ambitious targets of the Norwegian government in a sustainable manner. This study explores how this can be done.

1.2.3 Seizing the industrial opportunities in the renewable sector

IEA (2013c: 200) estimates that in the period 2011 to 2035, wind power generation will increase by 519% in its low-case scenario. In 2035, the electrical generation from renewable energy is expected to be 31% of total generation, up from 20% in 2011 (IEA, 2013c: 202). These trends show substantial industrial opportunities for Norwegian wind technology providers in the future. In order to be successful, these firms need to best commercialize their innovations, such that healthy profits and return on investments are achieved, consequently creating further business opportunities. This thesis aims to create tools for corporate decision makers on how to meet these challenges and create new market opportunities.

1.2.4 Making the theories of commercialization operational and more relevant

There is a large number of academic articles in the field of commercialization and product launch strategies, like the works of authors such as Hultink, Frattini and Easingwood (cf. chapter three). However, these are generally often simplified and with little or no customization to different industries and companies. Therefore, this study aims to make the research on commercialization more relevant and operational for wind technology providers in Norway.

Now that the problem statement and its motivation have been presented, the next step is to create an appropriate research design that answers the issue in a scientific way. The next chapter is devoted to this. Note that the methodology is placed before the literature review, which is not according to research traditions within the field of strategic management. This has been deliberately chosen, in order for the reader to get a better idea of the literature review method before actually reading it.

2. Methodology

2.1 Introduction

This part provides a comprehensive documentation about the methodology utilized in this study, and the next sections is devoted to clarify how the research question on wind technology commercialization is approached. Section 2.2 provides a high-level overview of the *case study design*, its *boundaries* and *unit of analysis*. Part 2.3 is related to chapter three about the conducted *systematic literature review*, and explains in detail the approach. The methodology for chapter four about the company case studies found in 2.4, explains how *interviews* and firm specific documents have been used as part of the research. 2.5 presents how the discussion part in chapter five uses *data interpretation, cross-case synthesis* and *rivalry explanation* to validate findings. Finally, 2.6 makes a critical assessment of the utilized methodology, and adds a couple of remarks on what can be done differently the next time such a study as this is undertaken.

2.2 Case study design and thesis structure

2.2.1 Clarification of methodical terms

The remaining part of the chapter will use a set of important methodical concepts. These are related to the quality of empirical social research. For convenience, these are first defined below (Yin, 2014: 46) and later discussed continuously throughout this chapter:

- *Construct validity:* the identification of correct operational measures for the concepts studied.
- *Internal validity:* refers to which degree the relationship between two or more elements is causal as opposed to spurious.
- *External validity:* the domain where a study's findings can be generalized.
- *Reliability:* explains to which degree the procedures can be repeated with the same results.

2.2.2 Research design

This paper is of an *explanatory* nature, because the aim is to explain how Norwegian technology suppliers best can commercialize their new innovations in a competitive and profitable manner. This makes the use of a case study (Yin, 2014) the preferred research method. Yin (2014: 16) defines a case study as an "empirical inquiry that investigates a contemporary phenomenon in depth and within its real-world context". Furthermore, it is elaborated that "case studies cope with many more variables of interest than data points, and as a result relies on multiple sources of evidence" (Yin, 2014: 17). The definition fits well with the overall theme of this thesis, as the wind energy industry is complex and many variables are likely to determine the success of various commercialization strategies. A qualitative approach with multiple sources of data, in contrast to a quantitative approach, will ensure that the uncertain variables are managed in the most appropriate way. The qualitative study

in this thesis is predominantly *normative,* but some *descriptive* elements are taken into consideration in the case company analysis to provide relevant background information.

A *multiple* case study method has been chosen, with six different Norwegian wind technology suppliers being the cases. This research design provides the opportunity to compare different cases to each other, increase external validity, and lead to more interesting findings than single case studies. It will allow further analysis into what is unique and what is common across cases, and contrast these findings to each other. In order to increase reliability of the thesis, a *case study protocol* has been used as an instrument to guide the author in carrying out data collection from cases (Yin, 2014: 84). It is an essential tool to use during multiple case studies (Yin, 2014: 84), and has helped the author to keep a consistent mental line of inquiry during the research. The case study protocol can be found in its entirety in appendix 8.1.

As shown in table 1, companies commercializing new technologies can generally be organized along two different variables: whether the product of interest is successfully commercialized or not, and whether the innovation is of a radical or incremental nature. The first variable was selected to include both best practice cases and lessons from the industry, while the latter variable gives us insight into whether commercialization strategies for incremental and radical innovations should be any different and if so, how. Referring to the first variable, commercial success is defined by the degree of customer acceptance, financial performance and technical product performance (Hultink et.al., 1997; Frattini et.al., 2012: 3). The second variable discerns between those innovations that indicate a breakthrough in the market and those that are refinements on existing technology, cf. section 3.2.2 (Debruyne et.al., 2002: 161; Walsh et.al, 2002: 343; Frattini et.al., 2012: 4). It is desirable to include at least one company from each category in table 1, in order to ensure a good spread in empirical data and to increase external validity. Furthermore, since this thesis includes both start-ups and larger and more mature firms, established firms have also been added to the data sample. Indeed, it is interesting to investigate whether there are any differences in success criteria between small and large firms. A discussion about this is provided in section 5.12.

With respect to table 1, it is hard to identify which category a firm belongs to before the interviews are conducted, especially among small companies where little public information is available beforehand. Thus, the framework has been used more as a tool for discussion, rather than a rigid way to classify each case company in this study. The discussion part in chapter five will present how success criteria and commercialization strategy is connected to the framework in table 1. Further information about how the six companies have been sampled can be found in section 2.4.

Table 1: Categories of companies commercializing technology

	Incremental innovation	**Radical innovation**
Successful product strategy	Incremental product success	Radical product success
Failed product strategy	Incremental product failure	Radical product failure

2.2.3 Unit of analysis and boundaries

The unit of analysis in the thesis is limited to Norwegian technology suppliers in the renewable wind energy sector, implying that power operators are not taken into consideration. Commercialization and product launch strategy is primary a concern among suppliers, since power producers mainly operate and maintain the products that they have purchased from vendors. Furthermore, since technology providers solely sell products to other businesses, this thesis is only concerned with *business-to-business* (B2B) aspects and not on *business-to-consumers* (B2C). Another limitation is that only products and not services are part of the analysis, as these offerings have very different characteristics. Finally, only Norwegian firms are part of the study. Consequently, the industry scope has been limited to the Norwegian market, focusing less on rest of the world. By limiting the scope to Norwegian companies, it is easier to tailor-make and operationalize the strategic recommendations, than it would have been if also international companies were regarded. However, this comes at the price of lower degree of external validity, which is deemed as a necessary trade-off in order to ensure high degree of customization of the recommendations.

Both internal company factors and external market factors determine a company's ability to successfully launch new products. However, I am only concerned with factors that constitute a variable for company's commercialization performance and that they can control and influence. For example, how governments and other stakeholders can contribute to successful market introductions is not regarded, but rather on how wind technology vendors can utilize this to their own advantage.

2.2.4 Level of analysis

According to de Wit and Meyer (2010), there are four levels of strategy, namely functional, business, corporate and network level. As shown in figure 1, the level of analysis in this thesis is at the interface between product level and firm level. For example, the cases in chapter four are mainly focused on the products of each company. However, products and firms are inevitably interconnected and dependent on each other, since product strategy constitutes an important part of the overall company strategy. Hence, the analysis is also brought to a company level. Industrial and environmental factors at a macro level are of little concern, although they are taken into consideration when having a significant impact on the companies. For example, governmental support could provide the necessary means to commercialize product innovations, and is analyzed when deemed relevant.

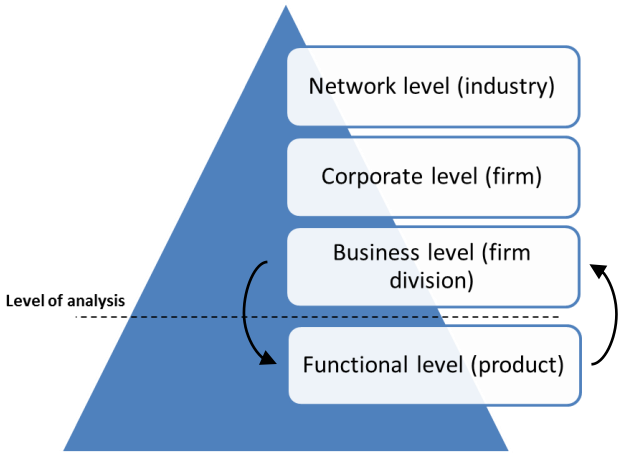

Figure 1: Level of analysis (de Wit & Meyer, 2010)

2.2.5 Thesis structure

A *deductive* method is used as a framework to organize this thesis. The method is mostly used in quantitative studies, but a similar qualitative approach has been applied during the research. According to Bryman and Bell (2011: 11), the deductive methodology is characterized by deducing a hypothesis based on what is already known within the field of interest and theoretical considerations. The *propositions* are subsequently tested based on findings from data collection. Finally, existing theory is revised based on the findings during the deductive process. However, since there is not entirely consensus in the research method literature, some may argue that this thesis is rather *inductive*. The inductive approach makes first observations, and then constructs a theory based on the data analysis (Bryman & Bell, 2011). For example, a similar study as this one by Holgersen and Lillebo (2002*), claims that their research method is inductive. Despite this, by using the definition of Bryman and Bell (2011), we can conclude that this thesis is of a deductive nature.

In line with the deductive method, the thesis is structured along these lines: First, relevant academic literature is discussed in chapter three and is used as a basis to formulate a set of propositions about how Norwegian wind technology providers can successfully commercialize their products. Second, chapter four provides in-depth empirical data from six different companies using *semi-structured* interviews. The aim of this is to bridge the gap between theoretical models and real-world industry specific cases. The propositions from chapter three are discussed in chapter five, and conclusions on the contentions are given. A particular focus is put on the strategic implications of the findings. Finally, the study is concluded in chapter six, together with a short discussion on further research questions. Most of the research has been done in an iterative manner, where the propositions have been developed in tandem with exploration of new theory and empirical findings. The methodology of chapter three, four and five is further explained in section 2.3, 2.4 and 2.5, respectively.

2.3 Literature review approach

The purpose of a literature review is to identify what is already known within a specific field of interest, and at the same time build on the ideas of other people (Jesson et al., 2011). This thesis will perform a systematic literature review, and also include some *snowballing* references. Snowballing is a technique for gathering data through the identification of an initial subject, which is subsequently used to provide with new sources (Sage, 2013). The literature review will go through the major theories of commercialization and product launch strategies in a critical way by assessing their strengths and weaknesses. In order to maintain a clear *chain of evidence* in the literature review, almost all data found is clearly cited with page number on where the exact piece of information was found. This practice increases the reliability of the thesis. Based on the literature review, a set of propositions related to the problem statement will be developed and later tested in the discussion in chapter five. Several gaps in the current theory is likely to be revealed, and the aim is to fill in this gap later in the analysis and discussion part of this paper.

Sections 2.3.1 to 2.3.3 explain the steps performed in the systematic literature review methodology, and is largely based on Jesson et al. (2011). Part 2.3.4 outlines the use of *snowball sampling* and *grey literature*, while 2.3.5 describes the role of propositions.

2.3.1 Review questions

The aim of the literature review is to answer the following generic questions, broken down into two parts:

- Theory review: How should companies successfully commercialize and launch their new product innovations?
- Empirical review: What empirical evidence is available on how wind technology providers successfully can commercialize and launch their new innovations?

The first question uses primarily peer-reviewed journal articles as sources. The goal is to utilize high quality literature in the theory review, and peer-reviewed journals provide the means to achieve this. However, the author acknowledges that a lot of empirical material about wind energy and commercialization strategy can be found in reports and other sources. Thus, the second question also includes grey literature to complement the articles.

2.3.2 Systematic search

The systematic literature search was conducted in Elsevier's database, Scopus, and Google Scholar, and was undertaken in the period from 3rd to 6th February 2014. The literature review was done with two different purposes in mind: first to give a balanced and critical review of available literature about commercialization and product launch strategies, which is addressed by the first two keyword searches in table 2, and second to find out how this empirically can be related to the wind energy sector, addressed by the four last keyword searches.

The purpose of using both Scopus and Google Scholar is to ensure a broad sweep of the available literature. Scopus is a comprehensive and reputable database, and ensures a high academic standard in the hits. On the other hand, Google Scholar provides a broader overview and often includes non-peer reviewed articles, although with lower degree of academic rigidity. The use of a third database, ISI Web of Science, was contemplated but discarded due to high degree of overlap with the Scopus database (Academic Assessment Database Tool, 2013) and limitations in available time and resources for this master thesis.

The inclusion and exclusion criteria are shown in table 2. No limitation on time period was made in the literature search, as a complete overview of the research field and its development over time was desired. Furthermore, articles with a B2B focus was emphasized, as the problem statement in this thesis is mostly relevant for sales and marketing between industry companies. The empirical review includes both English and Norwegian language, since the aim is to reveal findings in the Norwegian industry. Finally, to ensure that possible relevant empirical sources are not filtered out due to narrow inclusion criteria, findings within Europe and the renewable industry are included.

Table 2: Inclusion and exclusion criteria

	Theory review	**Empirical review**
Keywords	Commercialization strategy, product launch strategy	Commercialization strategy AND "wind energy", commercialization strategy AND "renewable energy", product launch strategy AND "wind energy", product launch strategy AND "renewable energy"
Inclusion criteria	English language, generic or wind specific theories, peer-reviewed articles from reputable journals, theory relevant for problem statement, B2B focus.	English and Norwegian language, empirical findings within Europe, renewable energy, peer-reviewed articles from reputable journals, books from academic presses, reports, B2B focus.
Exclusion criteria	Grey literature, not directly related to commercialization or product launch, service industry, theories on industries other than wind energy, non-journal articles/books.	Empirical findings outside Europe, non-renewable energy sources.

Theory review

The initial search was done in Scopus, searching for the previously mentioned keywords within titles and abstracts in the database. The keyword *commercialization strategy* gave 1906 hits, but was narrowed down to 274 hits after having limited the search to the subject area of *business, management and accounting*, language in English, and document type of articles from journals and books.

The same aforementioned search, but with the keywords *product launch strategy*, was also conducted. The initial search yielded 586 hits, ending up with 181 document results after limiting the search to *business, management and accounting*, English language and articles from journals and books.

In order to ensure a 360-degree sweep of the available literature, a search with the keyword *commercialization strategy* and *product launch strategy* was done in Google Scholar, although with fewer functionalities and options than Scopus. The first case resulted in 158,000 hits, while the latter case yielded 369,000 hits. By limiting the search to articles in English, without patents and citations the search yielded 151,000 and 357,000 hits, respectively. Due to the infeasibility of reading the abstracts of all these hits, only results on page 1 to 5 sorted by the degree of relevance was screened, representing 50 documents in each keyword search. This simplification represents the biggest deviation from this review to a systematic literature review done by the book (Jesson et al., 2011). Ideally, all of the hits should have been part of the screening process, but it would have not been feasible to go through all the hits given the time and resource constraints of this master thesis.

Table 3 gives a general overview of the theory reviewing process. In summary, 555 non-unique hits in the initial screening are scanned through by reading its abstracts, ending up with 37 articles after the first screening. In the final screening, each article was read through. Seven articles were rejected in this phase, because they provided little additional value to the problem statement of the thesis or were outside its scope. As a result, 30 articles were then finally used in the literature review in chapter three. The entries in non-italic letters in appendix 8.2 indicate these articles. The figure in parenthesis in table 3 refers to the number of overlapping articles that were found with other keyword searches. These are not taken into count in the total remaining numbers of articles.

Table 3: Number of hits before and after screening

No. of hits/documents – Theory review	Before search limitation	After search limitation	After relevance sort	After initial screening	After final screening
Scopus					
Commercialization strategy	1,906	274	274	22 (1)	18
Product launch strategy	586	181	181	12 (1)	10
Google Scholar					
Commercialization strategy	158,000	151,000	50	0 (4)	0
Product launch strategy	369,000	357,000	50	3 (8)	2
Total	**529,492**	**508,455**	**555**	**37**	**30**

Empirical review

This part of the literature review focuses on how the commercialization and product launch strategies identified in the theory review can be operationalized and used in a wind energy industry context. To keep this part relevant for Norwegian companies, only empirical findings from Europe is considered. This has been done for two reasons: to increase the number of relevant hits and the fact that the power markets in Norway and Europe are integrating into each other (NORWEA & Energi Norge, 2013). Documents from all time periods have been included in order to ensure that potentially important works are not filtered out. However, the author acknowledges that the renewable energy industry is complex and fast-paced. Therefore, a particular emphasis is put on post year 2000 articles, such that the newest and most up to date information is used.

To keep a broad industry perspective, more document types such as working papers, in addition to peer-reviewed articles, have been included in the empirical review. However, only those that are written by authors with good credentials have been taken into consideration.

The initial search in Scopus using the keyword *commercialization strategy* AND *"renewable energy"* resulted in 47 hits, and two hits after refining the search to documents in English and Norwegian within the subject area of *business, management and accounting.* In contrast to the theory review, Norwegian language was added in order to increase the amount of

empirical findings from Norway. The same approach was used for the five remaining keyword searches, and the results of these are shown in table 4.

Google Scholar initially gave 22,500 hits for the keyword *commercialization strategy AND "renewable energy".* After filtering out non-English/Norwegian results, patents and citations, the search yielded 22,100 hits. Again, to keep the review at a manageable level, the 50 most relevant documents sorted by Google Scholar was used as a base for the first screening. The same approach was used for the five remaining keyword searches, and the results of these are shown in table 4.

Table 4 gives a general overview of the empirical reviewing process. In summary, 202 non-unique hits are scanned through in the initial screening, ending up with two articles that were used in the literature review. Appendix 8.3 provides an overview of these papers. The figure in parenthesis in table 4 refers to the number of overlapping articles that were found in other keyword searches. These are not taken into count in the total remaining numbers of articles.

Table 4: Number of hits in empirical review before and after screening

No. of hits/documents – Empirical review	Before search limitation	After search limitation	After relevance sort	After initial screening	After final screening
Scopus					
Commercialization strategy AND "renewable energy"	47	2	2	0 (1)	0
Commercialization strategy AND "wind energy"	3	0	0	0	0
Product launch strategy AND "renewable energy"	2	0	0	0	0
Product launch strategy AND "wind energy"	0	0	0	0	0
Google Scholar					
Commercialization strategy AND "renewable energy"	22,500	22,300	50	1	1
Commercialization strategy AND "wind energy"	7,200	7,060	50	1 (1)	1
Product launch strategy AND "renewable energy"	27,300	27,200	50	0	0
Product launch strategy AND "wind energy"	14,200	13,900	50	0	0
Total	**71,252**	**70,462**	**202**	**2**	**2**

2.3.3 Screening and assessment

The title and abstract of each article was read through during the initial screening, using the inclusion/exclusion criteria specified in the table 2. This resulted in 39 papers, 37 from the theory review and two from the empirical review. These were printed out and read through.

After having filtered out the less relevant articles and those that did not meet the quality criteria, the final number of articles included in the literature review ended up with 32.

The primary source for assessing the quality of each article is whether the research is published in a reputable journal, the number of citations and the credentials of the authors. The impact factors for the journals used in this literature review is listed in table 5, and gives an easy assessment of the potential quality of each article, though the methods used in such metrics have been debated. As can be seen by table 5, a major part of the articles comes from renowned and reputable journals.

Table 5: Impact factor of journals used in systematic literature review (Thomson Reuters ISI Web of Knowledge: JCR, 2012)

Journal/Publisher	Impact factor (Thomson Reuters JCR)	No. of articles in literature review
International Entrepreneurship and Management Journal	5.053	1
Strategic Management Journal	3.367	1
The Review of Financial Studies	3.256	1
Technovation	3.177	2
Renewable Energy	2.989	1
Journal of Business Venturing	2.976	1
Research Policy	2.850	5
Journal of Business Logistics	2.020	1
Industrial Marketing Management	1.933	2
Management Science	1.859	1
International Journal of Research in Marketing	1.781	1
R&D Management	1.580	1
Journal of Product Innovation Management	1.572	9
Journal of Business Research	1.484	1
Business Horizons	1.416	1
IEEE Transactions on Engineering Management	0.893	1
International Journal of Engineering Business Management	Not listed	1
The Journal of High Technology Management Research	Not listed	1

Several of the articles in the systematic review provided relevant references to other useful works, and these have been included in the theory review as well. In the text, these sources are marked with an asterisk in the ongoing references. This can be regarded as snowball sampling, as explained in the beginning of section 2.3. Note that the overview in table 5 only includes articles found in the systematic literature search, and not from the snowball sampling. However, these articles are marked in italic in appendix 8.2 and 8.3.

2.3.4 Grey literature

Grey literature are all documents that is not an academic journal article, and as a result are not peer-reviewed and seldom published (Jesson et al., 2011: 54). The purpose of using such

sources in the empirical literature review is to provide more empirical data either from the wind sector or from a Norwegian industry context through the use of various reports and anthologies. As table 4 shows evidence of, the number of relevant academic articles and books about commercialization in wind power industry or in Norway is very limited, thus making it needed to move into the field of grey literature to keep a broad treatment of the problem statement.

In order to be flexible and up to date with the recent developments in the industry, a snowball sampling approach was chosen to find the relevant grey literature. This would give the author the opportunity to explore different relevant topics in a consistent way, but at the same time not be constrained by the rigidity of an academic review. The snowball sampling started off by searching for the keywords in table 2 in Google and the university library at NTNU, which in turn led to a few relevant sources written by credible authors or institutions. References from these were in turn used to arrive at the final documents, which are marked in italic letters in appendix 8.3.

2.3.5 Propositions

The literature review is used as a foundation to formulate a set of propositions, which in turn provide the basis for a theoretical framework. The propositions are used to provide a red thread throughout the case analysis in chapter four and discussion in chapter five. Although most of the articles in the literature review are generic and not necessarily related to the wind industry, the propositions are formulated specifically for the Norwegian wind technology sector. Some may perceive this as a logical gap. However, this is merely done for the sake of methodology.

2.4 Case study approach

The case study part represents the empirical findings in the thesis. The aim is to gather data from professionals with experience from commercialization, strategy and business development of wind technologies, and to get a better sense of how business is conducted in the practical world. The empirical data is then used as an important input to discuss the validity of the formulated propositions and to operationalize the theories and models from the literature review. It is also used to discuss how valid the theories in chapter three are in a Norwegian wind technology context.

The purpose of conducting interviews in the case study is to obtain “qualitative descriptions of the life world of the subject with respect to interpretation of their meaning” (Kvale, 1996: 124). Interviews were performed with both company respondents and interviewees from various external institutions. The purpose of this is to increase the amount of unbiased data, and to provide a better foundation for *data triangulation* (cf. section 2.5). Several interviews within a few selected companies was emphasized compared to single interviews with many companies. This was deliberately chosen for two reasons. First, to improve internal validity of the data from each case company, and second to bring the level of analysis to a company and

product level, rather than an industry level which would have been the case if interviews with many companies had been conducted.

A total of six different case companies and three external institutions represent the data sample. Data from one of the firms, Fedem Technology, is not as widely used as the other cases in the discussion chapter, since the empirical findings proved to be less relevant for the propositions. Approximately half to one-hour long interviews with 14 company respondents and three external interviewees were conducted during the end of February to end of April. Blaaster, Fedem Technology and SmartMotor were identified among 54 entries in Windcluster Norway's supplier database (Windcluster Norway, 2014), while Statoil/Hywind and Windflip were used based on previous knowledge about these companies. Finally, Chapdrive was included after the interviewees at Blaaster recommended further investigation of this firm as a case company. Although several of the companies are sampled because of convenience and close location to Trondheim, emphasis has also been put on finding firms that have good spread in accordance with table 1. First contact with the interviewees was initiated by the author through communication on telephone. People with different backgrounds were deliberately chosen to be interviewees, such that several perspectives are included.

A semi-structured interview approach was used. This was deliberately chosen, since it allows for flexibility and opportunities to explore interesting topics more in detail (Sage, 2013). This is in line with the exploratory nature of case studies. However, in order to provide structure and focus in the interviews, an *interview guide* was prepared before each session (cf. appendix 8.4). This was sent in advance to the interviewees, so that they would get a better idea of the topic. During the interviews, the interview guide served as a helping hand for the interviewer.

All of the interviews was conducted by one person who asked questions and took notes at the same time. This method is a threat to construct validity of the case study. The interviewer can misinterpret certain pieces of information from the interviewee, thus making wrong assumptions about the operational measures. A higher degree of consistency could have been achieved if several people had participated as observers. To remedy this potential problem, all of the summaries and transcripts from each interview was sent to the interviewees shortly after to maintain conformability of the gathered data. Minor commentaries were given as feedback, and these were implemented to the final interview transcripts.

2.5 Discussion approach

Triangulation of data from chapter four is the prime method used to arrive at conclusions regarding the propositions. The idea is to use findings from different sources, which in this case are interviews, grey literature and firm documents, to achieve *convergence of evidence* (Yin, 2014: 121). According to table 6, how strongly each proposition is supported depends on how many data sources that are consistent with the proposition. This method of data triangulation is used throughout the analysis in chapter five. This strengthens construct validity of the case study, since multiple sources of evidence provide multiple measures of the same phenomenon (Yin, 2014: 121).

Table 6: Degree of support on propositions

Degree of support	Data points
Strong support	Proposition supported by more than three firm interviewees, in addition to one or more external interviewees
Medium support	Proposition supported by two to three different firm interviewees
No support	Proposition supported by less than two firm interviewees or too many diverging data points
Inconclusive	Not enough data to conclude on anything

Cross-case synthesis is used as a technique to analyze case study evidence from chapter four. Each of the six case companies are regarded as independent research studies, and the method aims to compare findings with each other and explain potential commonalities and differences. According to Yin (2014: 164), this is likely to lead to more robust findings than single case studies. The technique is also believed to increase internal validity, as synthesizing among several cases decreases the likelihood of establishing non-causal relationships.

Finally, rival explanation is utilized to increase internal validity of the thesis. This analytic strategy tests and compares rivaling models to existing explanations. The technique is mostly used in conjunction with discussions of the case studies, as the interviewees will have different opinions and explanations of different concepts, either across or within the case companies. The approach is also used in relation to the various theories discussed in chapter three. Lastly, rival explanations is used as a mean to either strengthen or weaken each proposition. For example, propositions with few rivalling theories and findings are supported, while those that to a large degree are addressed by rivalling data are rejected.

2.6 Evaluating the research methodology

This section gives a short discussion of the strengths and weaknesses of the utilized methods in the literature review-, case study-, and discussion part, respectively. Furthermore, reflections on what in retrospect could have been differently is also included.

2.6.1 Literature review

A major strength is that the literature review has been thoroughly documented in section 2.3, which increases the reliability of the systematic search process. However, there are two weakness points that readers should be aware of. First, the literature review is done solely by one person. This increases the probability of biasedness, both in the chosen selection of articles and the analysis and synthesis of them (Jesson et al., 2011), thus posing a threat towards construct validity. Since the project thesis is done by one person alone, it has been difficult to remedy this problem. However, peer reviewing the literature search itself is a possibility that could have been utilized better during the work of the thesis. Second, the empirical literature review did not go through *all* relevant literature due to the large number of hits in Google Scholar. The simplification to only address the most relevant articles sorted

by Google Scholar was deemed necessary given the time and resource constraints of the master thesis.

In hindsight, other theories than those identified in the literature review could have been utilized. This would have led to different but complementary propositions compared to those formulated in the review. For example, the *resource-based view* (RBV) might have revealed themes such as human resources, which is not covered by this thesis. This theoretical approach is used in a study on commercialization in the Norwegian ICT-industry by Holgersen and Lillebo (2002*). Even more interesting, RBV can be contrasted with opposing theoretical models, such as the *positioning view* of Michael Porter. While the former model has *inside-out* perspective on competitive advantage, the latter has *outside-in* focus (De Wit & Meyer, 2010: 254). Thus, by using a dialectical approach to organize and compare different academic opinions, more intriguing discussions and rival explanation (cf. section 2.5) are provided. This in turn leads to proposition analysis that are addressed by several rivaling views, thus increasing the robustness of various findings.

2.6.2 Case study approach

The strength of this part is the empirical analysis of several different case companies, and that each case study relies on several interviews and sources. Considering the relatively low number of relevant wind technology providers among the 54 entries in Windcluster Norway's supplier database (Windcluster Norway, 2014), six companies provide the means to increase external validity. Another strength is the use of external interviewees to add further perspectives on a less company dependent basis. On the other hand, the issue of subjectivity is always prevalent in a qualitative study, especially those involving interviews of firm employees. The interviewees might be biased, since some may have interest in putting their own company in a good light. This is rather inevitable (Kvale, 1996: 285), but the use of several interviews within a company is believed to reduce the possibility of spurious conclusions. The case study on Chapdrive included one interviewee representing a venture capital fund as an active owner. This does also add unbiased views to the study. Furthermore, it is believed that data triangulation provides a good solution to the problem. This is because conclusions are always based on several sources, which significantly reduces the risk of ending up with spurious inferences.

Before conducting the interviews, it was decided not to tape-record them. The author felt that the use of recording devices would have been obtrusive for the interviewees. Due to sensitivity issues, it would have made them less open to share firm-specific information. Furthermore, all of the interviewees were approached through cold calls with no former relationship. Thus, the author stressed the significance of an open and comfortable interview setting to establish initial mutual trust, which was partly achieved by not recording the interviews. In retrospect, validity and reliability could have been increased by using tape-records. However, it is believed these issues have been properly taken care of through the use

of data triangulation among interviewees, thorough and clearly written interview notes, and having the interviewees review and correct the summaries.

2.6.3 Discussion

Analytic strategies such as cross-case synthesis, triangulation and rival explanation provide a strong fundament for a study with high degree of internal validity. However, additional means to achieve this are possible. Several techniques such as *pattern matching, explanation building, time-series analysis* and *logic models* could have been used in the thesis to increase internal validity (Yin, 2014: 48). However, these are methods that require significant practice to master (Yin, 2014: 142), and it has not been within the time and resource constraints of this thesis to develop these capabilities.

As pointed out in 2.4, the author met several challenges of conducting this study alone. Another one of them was experienced during the empirical analysis and discussions. It is easy to be colored by its own perceptions and opinions of the data material, and opportunities for critical academic discussions are reduced when not having a co-author to consult with during the work. This was somewhat remedied through fruitful discussions with the supervisor. Nevertheless, similar future studies will benefit from being done by at least two researchers.

2.7 Summary

This chapter started off by presenting the important concepts of internal validity, construct validity, external validity and reliability. As a final summary, table 7 shows how different methodical choices affect these terms. In general, it is believed that the set of actions below contribute to a high-quality research design, although some trade-offs are necessary.

Table 7: Impact of methodical choices on various research quality criteria

Criteria	**Positively affected by…**	**Negatively affected by…**
Construct validity	Multiple sources of evidence (data triangulation), having interviewees confirm transcript, chain of evidence	Interviews and literature review conducted by one person, interviews not tape-recorded
Internal validity	Several interviews within each case, address rival explanations, cross-case synthesis	Interviews not tape-recorded
External validity	Multiple cases, successful/failed products and radical/incremental innovations regarded	Focus on the Norwegian wind technology market, B2B and products
Reliability	Case study protocol, clear citations, thorough documentation of literature review	

The next chapter starts off the actual discussion and treatment of the problem statement by presenting a series of relevant articles and theories about commercialization and the product launch process.

3. Literature review

3.1 Introduction

This part of the thesis is organized along a thematic way, focusing less on the chronology of the articles. Development of theoretical propositions is an important part in this chapter, as they provide a common thread throughout the later analysis and discussions. In sections 3.3 to 3.6, these propositions are presented at the end of each part in an ongoing basis, and finally summarized in a theoretical framework in section 3.8.

A general overview of the literature in terms of definitions, commercialization process models, methodology, types of innovations and commercialization decisions is given in section 3.2. Central concepts such as radical and incremental innovations, strategic – and tactical launch decisions are introduced in this part. Next, section 3.3 explores the reasons why so many commercialization efforts fail. Part 3.4 constitutes the largest and heaviest presentation in this literature review. It discusses decision-making, various strategic orientations among managers, and the relationship between different strategies and product performance. Cooperation and licensing issues are then presented in section 3.5, before part 3.6 addresses venture capital (VC) funds' role in financing start-ups and new product launches. The empirical review is found in section 3.7, and evaluates what the literature says about how specifically wind technology providers best can commercialize their products. Whereas the theory review in 3.2-3.6 is not concerned with any industry in particular, the empirical review is based on articles with empirical data from the renewable energy sector and the IT industry. Finally, the literature review is summed up in a framework in section 3.8, using the established propositions in previous parts. This will provide the basis for the case studies in chapter four and discussion in chapter five.

3.2 Overview of the extant literature

3.2.1 Definition, commercialization process models and methodology

The terms product launch and commercialization are often used interchangeably in the literature, and in the rest of the thesis, I will continue to do so. There is not much controversy around the definition of commercialization. Frattini et.al. (2012: 2) uses the definition of Hultink et.al. (1997: 245), which states that commercialization or launch strategy are "those decisions and activities necessary to present a product to its target market and begin to generate income from sales of the new product". Balachandra et.al. (2010: 1843) expands on this view, and adds that the creation of the product must be self-sustaining and thrive in the market without any kind of subsidies, and at the level of other competing technologies. In the remaining thesis, I will use this definition in addition to Jolly (1997*: 4).

New product development consists of several phases. According to Balachandra et.al. (2010: 1845) the innovation chain starts with basic research, followed by applied research, development, design, engineering and manufacturing, which results into a physical device. The final stage, which is the main concern of this thesis, involves marketing and

commercialization, and is the part that often requires the most commitment in terms of time, money and managerial resources (Hultink et.al., 1998; Beard & Easingwood, 1996: 87). It is also associated with a large amount of risk, as new product launches have an expected failure rate of 30% (Beard & Easingwood, 1996: 87). Roessner (1984) outlines a simple model of industrial development made by Mueller and Tilton (1969*), expanding on the innovation chain of Balachandra et.al. (2010). Following an *innovation* and *product launch* stage with much uncertainty, the *imitation* stage opens up for entry of new firms, since uncertainty is reduced and the commercial viability of the product is demonstrated. Market intensity increases in the *technological competition* stage, before the margins reduce and products *standardize* in the fourth and final phase. In this thesis, I am predominantly interested in the innovation and product launch stage of Mueller and Tilton's model.

Complementary to the framework of Balachandra et.al. (2010), Jolly (1997*) presents a commercialization process model with a somewhat different perspective. This model is more normative than the work of Balachandra et.al. (2010). Furthermore, it has a rather broad view on the commercialization process, and this thesis uses this model as boundary and definition

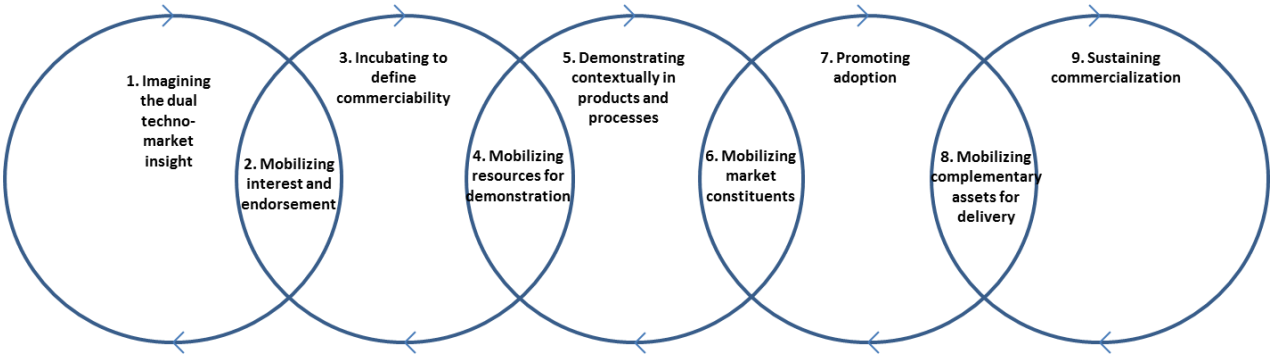

Figure 2: Technology commercialization process (Jolly, 1997: 4)*

of the product launch phase. Jolly (1997*) argues that a set of activities must be carried out in an iterative manner, if a product is to be successfully commercialized. As depicted in figure 2, the odd-numbered activities are key sub-processes that are needed for the product to be brought to the market, while the even-numbered ones refer to bridges between each sub-process that are meant to satisfy and mobilize stakeholders at each stage (Jolly, 1997*: 3). The commercialization process is started off by *imagining,* which refers to when ideas are combined with potentially attractive market opportunities (Jolly, 1997*: 3). In order to realize this opportunity, interest must be captured from stakeholders that can bring the idea further to a research and development phase (Jolly, 1997*: 13). The third point in figure 2 stresses the importance of proving that the idea fulfills a distinct need and is technically viable. The second bridge, denoting point four in figure 2, argues that substantial resources must be gathered from both actors within and outside the organization. For example, the potential of the innovation must be communicated in an unequivocal manner, such that grants and support from venture capital funds are secured (Jolly, 1997*: 6). Process five is about demonstrating the technology in marketable products, and can be regarded as the product development phase of figure 2 (Jolly, 1997*: 8). While the two previous bridges relate to

technology transfer issues, the final two bridges are market related (Jolly, 1997*: 13). Thus, point six marks the start of market-oriented activities, and emphasizes the first product acceptance among customers and other market constituents. At this point, many commercialization efforts fail (Jolly, 1997*: 10). The promotion stage aims to persuade customers to adopt the technology, and to convince the development of an infrastructure that must be in place in order to provide the technology's full benefits (Jolly, 1997*: 11). The latter point can be regarded as especially important among discontinuous innovations, which is discussed in section 3.2.2 in relation to the work of Frattini (2012). The final bridge, or point eight in figure 2, is decisive for a broader technology diffusion to mass markets. At this point, suppliers must provide the necessary complementary products and infrastructure for the full benefit of the customers (Jolly, 1997*: 13). This contention is very much in agreement with Moore (2002*) and his theory on whole product configuration (cf. section 3.3). The final sub-process is to sustain the commercialization, a phase Jolly (1997*: 11) point out to be hard due to rapid product obsolescence and constant entry of new competitors. Several propositions could have been developed from this paragraph alone, but many of the elements in Jolly's model are further discussed in the next sections. Thus, the framework is rather used to support and elaborate the formulated propositions in the next sections.

As seen in table 8, there are significantly more conceptual than deductive studies in this literature review. The latter method uses case studies and interviews to arrive at conclusions, while deductive studies construct a set of hypotheses based on extant research and subsequently test their validity on a given data sample. All of the articles below are presented in this chapter.

Table 8: Overview of methodologies used in the articles

Conceptual studies (28 sources)	Deductive studies (13 sources)
Balachandra et.al. (2010), Beard and Easingwood (1996), Benedetto (1999), Bower and Christensen (1995*), Christensen (1997*), Easingwood and Beard (1989), Easingwood and Harrington (2002), Erikson et.al. (2009*), Frattini et.al. (2012), Gans and Stern (2003), Golicic and Sebastiao (2011), Holgersen and Lillebo (2002*), Hultink and Robben (1999), Hultink and Schoormans (1995), Hultink et.al. (1997), Jolly (1997*), Laird and Sjoblom (2004), Mazzarol and Reboud (2006), Moore (2002*), Mueller and Tilton (1969*), Olleros (1986), Roessner (1984), Slater and Mohr (2006), Teece (2006), Timmons and Bygrave (1986), Teece (1986*), Walsh (2012), Widding et.al. (2002*).	Aggarwal and Hsu (2009), Debruyne et.al. (2002), Frattini et.al. (2013), Hellman and Puri (2000), Hsu (2006), Hultink et.al. (1998), Kasch and Dowling (2008), Kollmer and Dowling (2004), Langerak et.al. (2004), Lin et.al. (2006), Mu and Benedetto (2011), Talke and Hultink (2010), Walsh et.al. (2002).

3.2.2 Typology of innovations and commercialization decisions

Strongly connected to product characteristics and its related strategy, is the various types of innovations. Although researchers use different and sometimes confusing types of terms, the literature distinguishes mainly between *radical* and *incremental* innovation (Debruyne et.al., 2002: 161; Walsh et.al, 2002: 343; Frattini et.al., 2012: 4). The former refers to offerings that represents a discontinuity in the market, and further advances the technological state-of-the-art that characterizes the industry. The latter is associated with logical extensions and refinements to existing technology, and are often not regarded as a breakthrough. Although Walsh et.al. (2002) use very much the same differentiation of innovation, they use the terms *discontinuous* and *continuous* innovation. Furthermore, it is highlighted that the former evolves from *disruptive* technologies, while the latter develops from *sustained* technologies (Walsh et.al., 2002: 344). Sustained technologies maintain the rate of improvement, and are often modifications of existing value offerings, whereas disruptive technologies introduce very different "attributes from the one mainstream customers historically value" (Bower & Christensen, 1995*: 4). It is important to note that the performance of disruptive products can be worse than other, but creates value by catering to the needs of completely new customers and businesses. It is clear that Walsh et.al. (2002) separate the concepts of technology focus, referring to product itself, and innovation type, which is related to commercialization of the invention (Walsh et.al., 2002: 344).

Frattini et.al. (2012: 4) contend that the characteristics of an innovation must not only rely on the product characteristics itself, but also on the existence of an infrastructure that supports the product. Thus, a discontinuous innovation, not to be confused with the term that Walsh et.al. (2002) use, is an innovation that require a profound change in the infrastructure that supports it. On the other hand, continuous innovations work efficiently within the current infrastructure. Finally, Beard and Easingwood (1996) differs between four innovations along technology and market maturity dimensions, each of which requires its own set of strategic and tactical launch decisions. These are normal -, technology -, market – and revolutionary innovations. This article is further discussed in section 3.4.2.

Several researchers distinguish between long-term *strategic* decisions and short-term *tactical* decisions in the product launch literature (Benedetto, 1996; Frattini et.al., 2013; Hultink et.al., 1997; Hultink et.al., 1998). According to Hultink et.al. (1998: 271), strategic launch decisions define the boundaries of the commercialization effort, influence which of the tactical elements that most likely lately will maximize profit over the product's lifetime, are difficult or expensive to alter in a later stage once made and addresses the questions of what, when, where and why to launch a new product. On the other hand, tactical decisions are made relatively late in the project, can be easily modified and often considers marketing mix elements such as product, price, promotion and distribution (Hultink et.al., 1998: 272). Benedetto (1999: 532) provides support to the concept of strategic and tactical decisions, but adds *marketing information-gathering activities* as a third crucial element in developing a commercialization strategy. This is aimed at supporting the strategic and tactical launch

decisions by providing valuable customer insights, competitive intelligence and market information (Benedetto, 1999: 532). Additionally, Frattini et.al. (2013) and Hultink et.al. (1997) further elaborate the linkage between strategic and tactical launch decisions. Frattini et.al. (2013: 176) point out that existing literature stresses the prominence of consistency between the two elements. Hultink et.al. (1997: 245) show the implication of this to product strategy formulation by building a typology of four generic launch strategies (cf. section 3.4.3).

3.3 Why do so many commercialization efforts fail?

Several theories offer an explanation to why so many start-up firms fail during the launch of a new product. According to Frattini et.al. (2013: 186), the more radical the product is, the greater the likelihood of an early product exit. The well-cited work of Moore (2002*), explains why such high-technology products fail. According to him, the marketplace consists of *innovators, early adopters, early majority, late majority* and *laggards,* with each segment representing in size a certain portion of the normal distribution curve (cf. figure 3). Innovators and early adopters are easily susceptible to new high-technology products. However, the market for these segments is not very big, thus most of the value in monetary terms is found in the mass-market segments. Nevertheless, Moore (2002*: 17) asserts that these customers are fundamentally different from the early market adopters, thus demanding a different approach to marketing and selling of products. This gap in consumer behavior is termed the *chasm,* and the reason why many firms fail to commercialize their innovations in long term, is that they do not manage to cross this chasm. Moore's model is applicable for both B2B and B2C markets, thereby making it possible to use in later analysis of the thesis' problem statement.

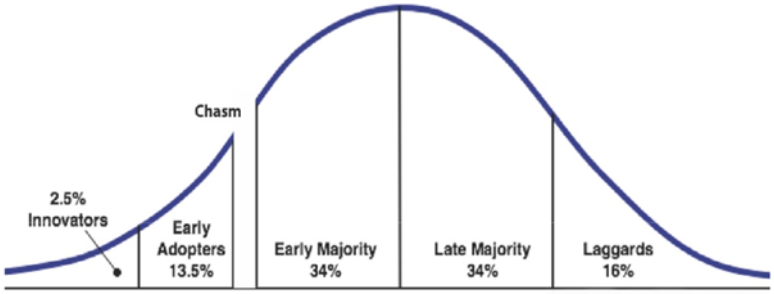

Figure 3: Customer segmentation and crossing the chasm (Moore, 2002)*

In similar fashion to Moore (2002*), Laird and Sjoblom (2004) remark that deep understanding of the customers is essential. Additionally, they contend that improper strategic partnerships, mismanagement of the project and stakeholder interests and lack of exit opportunities characterize a failed product strategy (Laird & Sjoblom, 2004: 65). One must use a disciplined approach to avoid these pitfalls. This can be achieved through a simple and timely product prototyping, lean funding of new product developments, managing expectations, considering exit opportunities up front and staying on a given track (Laird & Sjoblom, 2004: 69).

Older research by Olleros (1986), criticizes the notion that it is always an advantage to be a pioneer in the industry. Several groundbreaking innovations end up in early demise. Olleros (1986: 8) argue that the standard explanation of *size-shakeout* explaining this, i.e. that pioneering firms lose to larger companies that are standardizing and reducing the cost of the product as the industry is maturing, is not a valid reason alone. Rather, Olleros (1986: 9) claims

that it is the *burnout* of early pioneers that cause their early exit, and this is especially prevalent in the market for new radical technologies. Two driving forces are associated with this. First, market uncertainty, in terms of long payback time due to slow adoption rate, creates financial instability (Olleros, 1986: 11). The pioneer firm, especially start-ups with little up-front financing, burns cash faster than it can generate income, thus limiting how long it can stay competitive in the marketplace. This explaining factor is closely related to the term *valley of death* (Balachandra et. al., 2010: 1844), which points out that in the transition phase between product demonstration and commercialization, cost per unit is high and market penetration low, leaving many ventures out of business. The lack of a wholly developed product enhances the effect market uncertainty. This is in line with Moore's research, which states that mass markets will only adopt a whole product. Second, technological uncertainty penalizes start-ups due to incompatibilities with other products (Olleros, 1986: 14). The related formulated proposition (P1b) in next page focuses on market uncertainty and the death valley phenomenon to limit its scope and extent. Olleros (1986: 16) suggests that pioneering companies can escape the burnout trap by minimizing their initial investment base. This can be achieved through subcontracting of manufacturing work, joint ventures with established mass-marketers and licensing of technology.

The seminal work of Teece (1986*) is one of the most cited articles in the commercialization literature, and his model has been later discussed and refined in Teece (2006). I will focus on the original research from 1986, as it is well established and known among scholars. Teece (1986*: 285) attempts to explain why innovators often fail to gain economic rent from a new product, while imitators benefit. He argues that ownership of *complementary assets*, i.e. services or products used in conjunction with the innovation, help to determine the winners and losers of the product introduction (Teece, 1986*: 304). These are needed in the long term if the product is to become whole (Moore, 2002*) and survive in the market. If imitators are able to quickly copy the innovators technology, which is more likely in an environment with weak patent protection, the competitive advantage of the innovator is eroded. Furthermore, if the imitator is better positioned with respect to complementary assets, the competitive advantage may turn in favor of the imitator.

In summary, the articles in this section provide quite different views on commercialization pitfalls. Moore (2002*) is mostly centered on the importance of customers, while Olleros (1986), Teece (1986*) and Balachandra et.al. (2010) relate more of their work to products and internal firm factors. On the other hand, Laird and Sjoblom (2004) use elements of both. However, some similarities can be found. The notion of a whole product can be found in Moore (2002*), Olleros (1986) and Teece (1986*) as a crucial ingredient to cross the chasm, reduce market uncertainty and increase market survival. Norwegian wind technology companies must be aware of the dangers mentioned in this section during product commercialization. Thus, the following three propositions are postulated, where P1a is related to the work of Moore (2002*), P1b to Olleros (1986) and P1c to Teece (1986*):

P1a: *Norwegian wind technology providers should develop a whole product and cross the chasm, in order to avoid early market exit.*

P1b: *Norwegian wind technology providers should minimize its initial investment base, in order to avoid early market exit and reduce the consequences of the death valley phenomenon*.

P1c: *Norwegian wind technology providers should gain a strong position in complementary assets, in order to avoid early market exit.*

The propositions above are mostly focused on how to avoid commercialization failure. Equally important and very much related, is how companies can achieve commercial success. This is discussed in the next section.

3.4 Strategic orientation

3.4.1 Introduction

As mentioned in section 3.2.2, several authors contrast between strategic and tactical launch decisions, and this is often used as a basis to formulate various strategic orientations when commercializing products. This section analyzes this theme in depth by comparing and contrasting each article with another. The literature regarding product launch and commercialization strategies can be organized along two streams. First, section 3.4.2 examines articles of a descriptive nature. These say little about the linkage between strategy and product performance, but describe decision-making in companies. Second, section 3.4.3 discusses papers with normative characteristics and reveals the anteceding factors to product performance. Finally, section 3.4.4 summarizes the articles and establishes a set of four different propositions based on previous discussions.

3.4.2 Descriptive research

The articles of Beard and Easingwood (1996) and Easingwood and Beard (1989) provide a rather descriptive research on a group of managers and marketers in UK high technology companies. Marketing operations and decisions are investigated, and an overview of various strategies and tactics are given. Based on empirical data, the latter article divides launch tactics into market preparation (licensing, distributions arrangements), targeting (innovators, early adopters, late adopters, existing customer's, competitors' customers), positioning (price, technological superiority, exclusivity, special applications) and attack (opinion leaders, reference sites, winner image, lease of product, educating customers). Furthermore, Beard and Easingwood (1996: 96) assert that the choice of these tactics is dependent on market maturity and technological uncertainty. The final result is shown in figure 4. The second article, Easingwood and Beard (1989), shifts the focus to long-term strategic decisions, rather than short term tactical ones. They present four different groups of strategies, namely cooperation with other producers (licensing, education program), positioning of the product (approach innovators or heavy users), reducing the risk of adoption (trial without purchase, absorb the

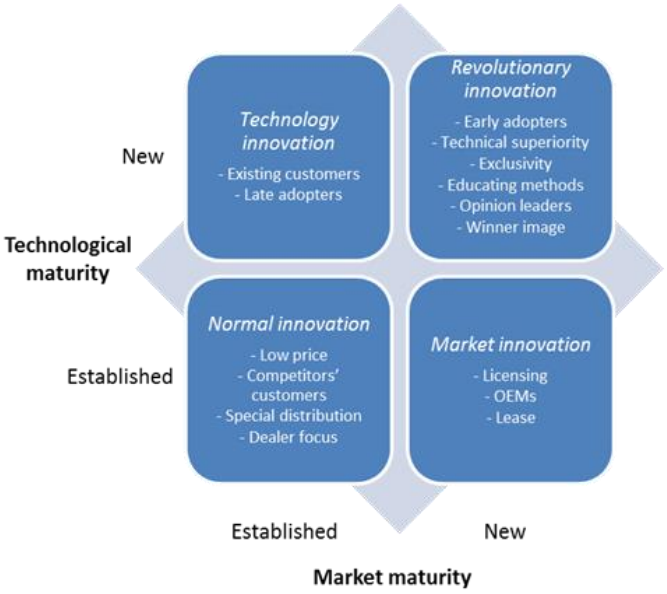

Figure 4: Launch tactics in various markets (Beard & Easingwood, 1996: 101)

risk) and winning market support (opinion leaders, winner reputation, legitimize the product) (Easingwood & Beard, 1989: 125). It should be noted that several elements, such as positioning, is overlapping with the previously discussed article, thus it is clear that the authors are not entirely consistent with the use of terms. Furthermore, the two articles can be criticized for giving few tangible recommendations to managers. First, they do not clearly distinguish between B2B and B2C marketing in their data sample, and second, the strategies and tactics are not linked to firm and product performance.

Research performed by Debruyne et.al. (2002) focuses more on external factors. The paper describes competitive reactions new product launches meet in the market. Through the study of a number of successful and failed industrial product launches, the authors conclude that two thirds face competitive reactions after its launch, implying that a competitor orientation is necessary (Debruyne et.al., 2002: 167). Furthermore, it is found that the likelihood of competitive reactions increases with incremental product launches compared to radical innovations, high marketing efforts, products using broad rather than niche strategies and in markets with high growth (Debruyne et.al., 2002). Similarly as the preceding articles, this paper is rather descriptive and does not link any research to firm or product performance. However, it proposes that companies should be competitor oriented to succeed in markets with intense competition.

The link to firm and product performance is clearer in the work by Hultink and Schoorman (1995), which too is rather descriptive in nature. They discuss the impact of tactical decisions, in terms of pricing, promotion, competitive advantage and product assortment on product success. The analysis is performed on a group of managers, where each is asked to evaluate which launch decisions they would use on a certain product to maximize its success. They find out that the result can be grouped into two clusters. The first one focuses on small product assortment and price skimming, while the second concentrates on penetration pricing, broad assortment and pull promotion (Hultink & Schoormans, 1995: 238). The research shows that there is no right or wrong answer in how a product should be launched. Decision makers emphasize different means and objectives, even when assessing the same product. The article is more interested in the decision-making among managers than explicitly analyzing the

anteceding factors of product and firm performance. This gap in theory, which was also revealed previously, is remedied by several authors in the next section.

3.4.3 Product performance and success factors

The focus in this section lies in explaining various success factors for a viable and long-term profitable product strategy. Research by Hultink and Schoormans (1995), Hultink et.al. (1997), Hultink et.al. (1998), Benedetto (1999), Hultink and Robben (1999), Slater and Mohr (2006), Talke and Hultink (2010), Mu and Benedetto (2011), Frattini et.al. (2012) and Frattini et.al. (2013), revolve around the linkages between strategies, decisions, product- and firm success. The following paragraphs will present and compare these articles in a critical manner. Several strategy typologies are introduced by each paper, but I will emphasize on those that are positively related to product or firm performance.

The papers Hultink et.al. (1997) and Hultink et.al. (1998) both distinguish between strategic and tactical product launch decisions. The former especially emphasize the importance of alignment between the two elements (Hultink et.al., 1997: 247). Four different strategies are presented, but it is the *niche innovator* strategy that maximizes product launch success. This approach targets niche markets with technology driven and innovative products (Hultink et.al., 1997: 252). Tactical decisions such as broad product assortment, skimming pricing policy and exclusive distributions are utilized. Conversely, misaligned strategies are related to low product success. Major strengths with the study, is that it is exclusively B2B related and regards both successful and failed products in the data sample. The article from 1998 is quite similar as Hultink et.al. (1997), but concentrates on the B2C industry. It finds evidence that managers do indeed use a set of generic strategies when launching products and that these influence product success to a varying degree. Furthermore, *offensive improvements* strategy was deemed more effective than innovative new products launch, in terms of customer, financial and product performance (Hultink et.al., 1998: 280). The strategy focuses on improvements on existing products in markets with few competitors in order to raise competitive barriers. The tactical decisions are associated with broad product assortment, higher prices, use of customer promotion and use of current distribution channels. This is somewhat contrary to Hultink et.al. (1997), which considers new products in its niche innovator strategy. This discrepancy is most likely explained by difference in B2B and B2C focus.

In line with several previously mentioned authors, Benedetto (1999) and Hultink and Robben (1999) do also differ between strategic and tactical launch decisions. The former also adds market information gathering activities as a central element. However, Benedetto's analysis is more relevant to this thesis, as he assesses which commercialization activities are the most critical for product success. Regarding the strategic constituent, cross-functional teams when making decisions and involving logistics and distribution early in the planning are deemed decisive for product success (Benedetto, 1999: 535). Important tactical launch decision drivers are high quality selling effort, good product launch management and launch timing

(Benedetto, 1999: 539). Finally, market testing and customer feedback are central market information gathering activities (Benedetto, 1999: 539). Despite the relevance of the article, it does not differentiate between B2B, B2C and product type, which represent several flaws in the research. On the other hand, Hultink and Robben (1999) do regard both successful and failed products in order to increase external validity. The empirical data conclude that product innovativeness, early launch timing, penetration pricing, broad product assortment and offensive launch objectives are positively related to new product performance (Hultink & Robben, 1999: 553).

The article of Frattini et.al. (2012) undertake a historical analysis on a series of successful and unsuccessful technological innovations, thus distinguishing a good commercialization strategy from a bad one. By analyzing each case, the researchers argue that successful commercialization strategies are highly dependent on context of the product and the market. Innovative launches demand a whole product, cf. Moore (2002*), good timing, careful and proactive targeting and communication of the product to early adopters (Frattini et.al., 2012: 5). On the other hand, discontinuous innovations must be supported by a well-functioning infrastructure before it diffuses into the mainstream market. This can be achieved through partnerships and alliances, which can incorporate the innovating company's underlying technology (Frattini et.al., 2012: 6). Finally, products targeted at mainstream customers must have a clear positioning, educate users through distribution channels, configure a whole product and initially use a price skimming strategy, followed by penetration pricing as the market matures (Frattini et.al., 2012: 7). The authors point out that companies must identify the degree of discontinuity and innovativeness of the product, then isolate which of the three aforementioned strategies are most relevant, and finally pick a set of decisions that maximize its effectiveness (Frattini et.al., 2012: 9). It should be noted that the authors do not *measure* the effect of each decisions on product performance, but do rather present factors that can lead to commercialization success. The focus the article has on customer positioning and communication, makes it clear that it relies its research on B2C products, which can be regarded as a weakness. A later article by Frattini et.al. (2013), do also discuss the relationship between strategic-, tactical launch decisions and product performance in the B2C industry, but through a deductive method. They conclude that there is positive relationship between investment in advertisement and use of partners on the one hand, and early market survival on the other (Frattini et.al., 2013: 183). This is especially prevalent among radical innovations compared to incremental products.

Building on the works of Moore (2002*) and Christensen (1997*), Slater and Mohr (2006) argue that companies commercializing high technology products must overcome the *innovator's dilemma* and at the same time cross the chasm. They must avoid cases where they focus too much on existing customers, and allocate more resources to understand potential customers and react to possible threats such as disruptive technologies and newcomers in the future (Slater & Mohr, 2006: 32). Furthermore, the chasm must be crossed to ensure a continuous and healthy profit stream. The authors contend that building resources to handle

these two critical problems, predominantly in the form of proactive market learning (Slater & Mohr, 2006: 32), is essential to product success.

The article of Easingwood and Harrington (2002) does also further elaborate on the research of Moore (2002*). They claim that a company must launch its high technology products twice; once when the product is introduced to the market, and afterwards before the product crosses the chasm (Easingwood & Harrington, 2002: 658). A successful initial product launch consists of comprehensive market preparation, the use of a high-level sales force to target the technology enthusiasts and visionaries, positioning the technological superiority of the product and cultivate a winner image of the value offering (Easingwood & Harrington, 2002). In the next stage, a whole product should be assembled through several complementary assets and services, such that mainstream customers easily can adopt the products. The last phase consists of the re-launch. Decisive market preparation activities are finding value-added resellers who can supply the product and cooperation with external partners to establish a market leader positions, as mainstream customers prefer to buy from market leaders. Furthermore, specific customer targeting and positioning are also crucial.

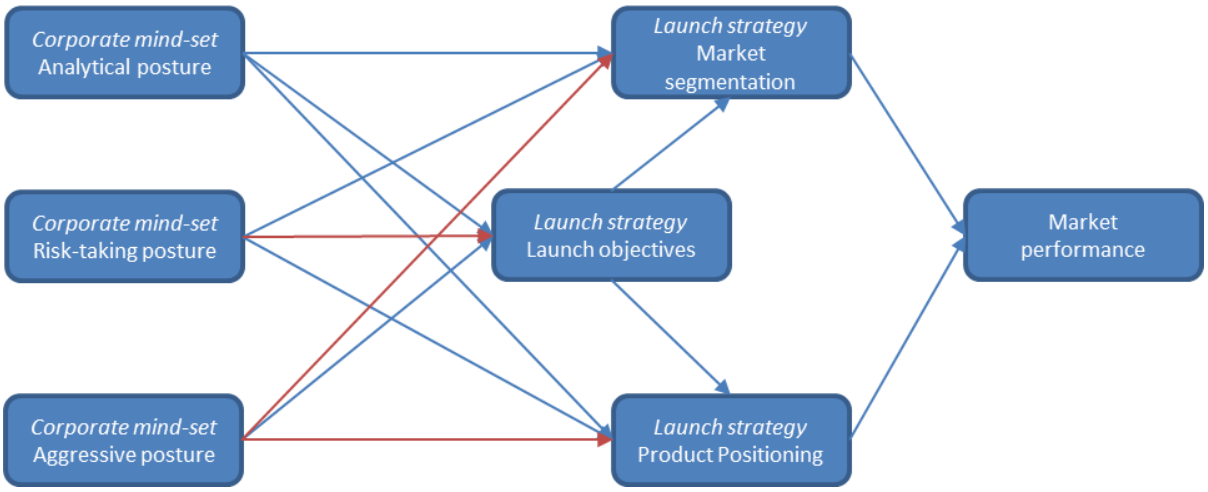

Figure 5: Anteceding factors of launch strategy and market performance (Talke & Hultink, 2010: 227)

So far, the articles mention little about the antecedents of launch strategy. Talke and Hultink (2010: 220) argue that *corporate mind-set,* i.e. the firm's general posture toward corporate behavior and performance, is a central anteceding factor to launch strategy and market performance. The impact of an analytical -, risk-taking - and aggressive posture is analyzed on product launch strategy in terms of launch objectives, market segmentation and product relationship. The influence of these launch decisions are then analyzed on market performance. Figure 5 shows the positive relationships between each element in blue lines, while the red lines mark the rejected hypotheses. As Talke and Hultink (2010: 232) point out, the implication of the study is that launch strategy alone is not enough to ensure superior market performance. In order to succeed, all activities and decisions must be rooted to the corporate mind-set of the company. On a final note, a strength with this article is that the data are exclusively based on B2B firms.

The papers presented thus far, perform most of the analysis at a micro level. In opposition, Mu and Benedetto (2011) bring the discussion of strategic orientation and product commercialization to a more holistic level. They argue that the extant literature lacks research on the impact of combining various strategic orientations. Four different strategy modes are presented. First, market orientation is defined by the organization's focus on customer segment targeting, fulfilling customers' needs and deliver superior value to them (Mu & Benedetto, 2011: 340). Second, technology orientation concentrates on the use of sophisticated technologies to create new product ideas (Mu & Benedetto, 2011: 340). Third, entrepreneurial orientation refers to which degree the firm pursuits new market opportunities, and renewal of existing markets through introduction of innovations (Mu & Benedetto, 2011: 341). Finally, network orientation reflects to what extent the firm stresses effective location of network partners, management of network relationships, and network performance improvements (Mu & Benedetto, 2011: 341). The authors find evidence that all of these strategy modes have a positive effect on product commercialization success. More interesting is their claim that the modes support each other, leading to complementary effects (Mu & Benedetto, 2011: 343). A single strategic orientation is not enough. Furthermore, the authors contend that environmental dynamism increases the importance of strategic orientations, and finally that organizational learning mediates the positive relationship between strategy modes and commercialization performance (Mu & Benedetto, 2011: 344). Although it would have been interesting to test this contention in the Norwegian wind segment, the method in this thesis is deemed less appropriate to analyze it. Other methods such as *causal mapping* might be more suitable.

Langerak et.al (2004) support the notion Mu and Benedetto (2011) have on the positive relationship between market orientation and new product performance. However, they have a slightly differing point of departure in their research. The authors do not relate market orientation to other strategic modes. Instead, the aim of the article is to reveal which activities a market-oriented culture is translated into superior customer value (Langerak et.al., 2004: 80). Figure 6 shows the accepted hypotheses marked in blue, while the red lines represent the rejected hypotheses. Indeed, Langerak et.al. (2004) support the findings of Mu and Benedetto (2011) and Lin et.al. (2006). However, it disagrees with Talke and Hultink (2010) in that there is a significant positive relationship between launch strategy

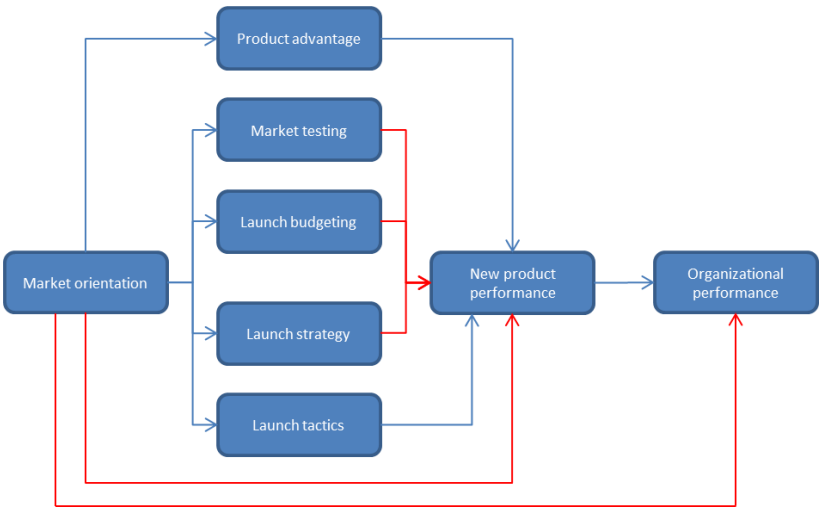

Figure 6: Anteceding factors of product and organizational performance (Langerak et.al., 2004: 82)

and product performance. Only launch tactics is related to product success. Moreover, Langerak et.al. (2010) assert that market orientation leads to product advantage, which in turn mediates product performance. Finally, they point out that a market-oriented culture can be achieved through organizational commitment to core values and to develop the necessary skills, incentives and systems to implement the core values (Langerak et.al., 2010: 89).

As mentioned in the previous paragraph, Lin et.al. (2006) find a positive relationship between market orientations, or what they term as commercial orientation, and product and firm performance. Additionally, they argue that market orientation interacting together with R&D intensity releases further synergies, as they are complementary (Lin et.al., 2006: 684). Finally, the contention that knowledge stocks of technology-based firm positively affects its performance is confirmed.

3.4.4 Summary

Section 3.4 divided the research about strategic orientation and firm performance into a descriptive and normative part. 3.4.2 presented a group of articles distinguishing between strategic and tactical launch decisions, and how these were used by managers when commercializing their products. A commonality in the research was how the tactical and strategic decisions change with respect to the degree of product radicalness. Furthermore, the lack of focus on the relationship between launch decisions and firms and product performance was criticized. Due to the descriptive characteristics of the articles in section 3.4.2, it is hard to develop propositions that are relevant for the normative nature of the problem statement in this thesis. However, Debruyne et.al. (2002) argues that competitor orientation is necessary in a market dominated by fierce competition. Thus, the following proposition related to part 3.4.2 is established:

P2: *Norwegian wind technology providers should be competitor oriented, in order to best commercialize its products.*

Section 3.4.3 discusses the important issue of the relationship between launch decisions and product success, but the literature provides no clear answer to the topic. However, most of the articles seem to agree on the importance of alignment between strategic and tactical launch decisions (Hultink et.al., 1997; Hultink et.al., 1998; Benedetto, 1999; Hultink & Robben, 1999; Frattini, 2013). Hence, the following proposition is presented:

P3: *Norwegian wind technology providers should align its strategic and tactical launch decisions, in order to best commercialize its products.*

In addition to discussing strategic and launch decisions, Benedetto (1999) adds market information gathering as a central element in the strategic planning process. In order to reflect this in the discussion part, the subsequent proposition is formulated:

P4: *Norwegian wind technology providers should utilize strong market information gathering activities, in order to best commercialize its products.*

Whole product configuration and chasm theory is discussed by another stream of research (Frattini et.al., 2012; Slater & Mohr, 2006; Easingwood & Harrington, 2002) as significant anteceding factors. This theme is very much covered by the research question in proposition 1a, therefore a new proposition is not formulated in this section.

Market orientation is mentioned by Mu & Benedetto (2011), Langerak et.al. (2004), Lin et.al. (2006) to be a decisive ingredient in product success. The following proposition is identified to reflect this:

P5: *Norwegian wind technology providers should be market oriented, in order to best commercialize its products.*

On a final note, the articles in this section agree on the major lines of what constitutes a successful commercialization strategy. However, the researchers conclude differently on *which* strategic and tactical decisions are critical for product performance. This discrepancy is most likely because of varying methods and data samples in different contexts and industries. Thus, more in-depth studies of the Norwegian wind energy industry is needed in order to get a complete picture on how Norwegian technology providers should commercialize their products. This done in chapter four.

3.5 Cooperation and licensing

A common theme in the literature is the use of cooperation in various modes as part of the commercialization strategy. While Gans and Stern (2003), Hsu (2006) and Aggarwal and Hsu (2009) provide a general analysis of various cooperation strategies, Kollmer and Dowling (2004) exclusively discuss licensing. On the other hand, Golicic & Sebastiao (2011) use a supply chain framework to illustrate strategic implications for companies launching new to the world products. Finally, Kasch and Dowling (2008) discuss the propensity to integrate or cooperate in the market. The next paragraphs in this section will further discuss and compare these articles, with a particular attention to the implications of the findings on product level.

The well-cited article of Gans and Stern (2003) discusses how product launch strategy and cooperation depend on the economic environment of the firm. They differ between *product markets* and *markets for ideas* in the commercialization environment, where the former refers to the traditional market of physical product transactions, whereas the latter denotes the selling or licensing of intangible

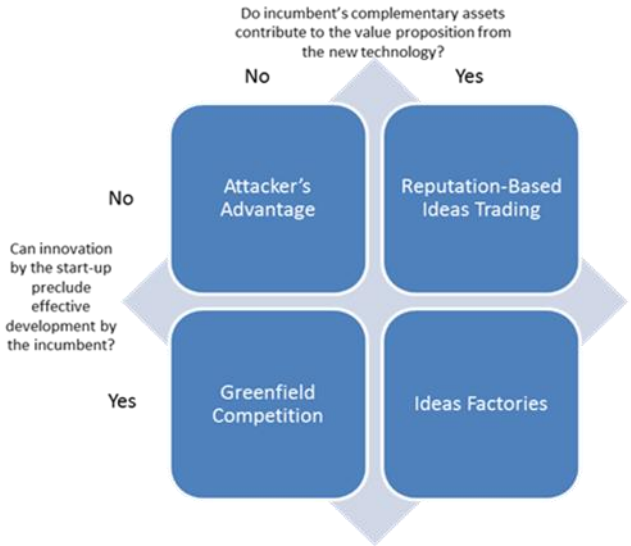

Figure 7: Commercialization strategy environments (Gans & Stern, 2003: 340)

innovations before they are produced (Gans & Stern, 2003: 334). Similarly as Kollmer and Dowling (2004), the authors stress that capabilities and complementary assets must be developed to participate in the product markets, while cooperation strategies in the market for ideas may soften competition, reduce the need for in-house investments and benefit from complementary technology development (Gans & Stern, 2003: 337). Moreover, the researchers develop a commercialization strategy framework based on two different elements of the external environment. First, the *excludability environment* measures the degree of expropriation potential of patents in the market. *Appropriability* is a related term that is used by several other authors, such as Kasch and Dowling (2008: 1767) and Aggarwal and Hsu (2009: 840). Both of these works give support to the framework of Gans and Stern (2003), namely that the degree of expropriation potential is a variable for cooperation mode choice. Second, *complementary asset environment* refers to what extent "the incumbents complementary assets contribute to the value propositions of the new technology" (Gans & Stern, 2003: 339). It is underlined that control over such costly assets is a key wedge between the capabilities of incumbents and start-ups. Thus, access to complementary assets through cooperation is often a viable alternative compared to wholly owned investments. Contrary to Gans and Stern's model, Aggarwal and Hsu (2009: 841) use governance capabilities, instead of complementary assets as the final dimension, following the resource-based view (RBV) literature tradition. As a result of the two external factors, Gans and Stern (2003: 340) identifies the environments *attacker's advantage, greenfield competition, ideas factories* and *reputation-based ideas trading,* each with its own required strategy (cf. figure 7).

According to Kollmer and Dowling (2004: 1141), liability of newness and smallness among new technology-based firms makes licensing an appropriate commercialization strategy. Conversely, smaller companies with fewer commercialization obstacles, tend to downgrade the significance of external partners, and rely more on customer responses as part of the product launch feedback process (Mazzarol & Reboud, 2006: 261). The notion of Kollmer and Dowling (2004) is further supported by Aggarwal and Hsu (2009: 835), who point out the resource constraints among start-ups. Based on empirical data from a large number of US biotechnology firms, the article of Kollmer and Dowling (2004) finds evidence that both integrated and non-fully integrated companies enjoy benefits of being part of a licensing agreement (Kollmer & Dowling, 2004: 1148). Non-integrated start-ups may choose licensing as a successful commercialization channel, since it requires less in-house sales and marketing resources, implying that integration is of less prevalence on a long-term basis. This is further supported by findings that state that the degree of licensing is independent of company age, hence a licensing and non-integrated business strategy is sustainable in the long-run (Kollmer & Dowling, 2004: 1149). However, integrated firms may also capitalize on licensing, since it can focus its internal resources on its core business by out-licensing non-core products (Kollmer & Dowling, 2004: 1148). Despite this, the authors claim that the importance of licensing perceived by decision makers in mature and integrated firms, decrease with the degree of internal sales and marketing resources (Kollmer & Dowling, 2004: 1148). It should be noted that the biotechnology industry is characterized by extensive cooperation (Kollmer

& Dowling, 2004: 1144; Aggarwal & Hsu, 2009: 837), which may reduce the external validity to other industries. Thus, the results of the study should be used with care when analyzing the Norwegian wind industry.

Hsu (2006) investigates the impact of venture capital on the cooperative strategies of commercialization. The author states that cooperative commercialization may be limited due to high search costs, potential expropriation of firm assets and know-how, unknown quality of the start-up among cooperators and start-ups' less developed cooperative relationship skills. However, based on an empirical study, Hsu (2006: 206) argues that all of these elements may be reduced with the partnership of a venture capital fund. First, involved investors can reduce search costs through information mediation with its extensive monitoring and due diligence processes. Second, lessen the fear of expropriation by participating in the fund's network, since information about opportunistic behavior among cooperators will spread faster. Third, endorsements by the venture capitalist can increase the information cooperators have about the firm, and finally the investor can transfer knowledge and experience to the start-up, thereby increasing its cooperative relationship skills.

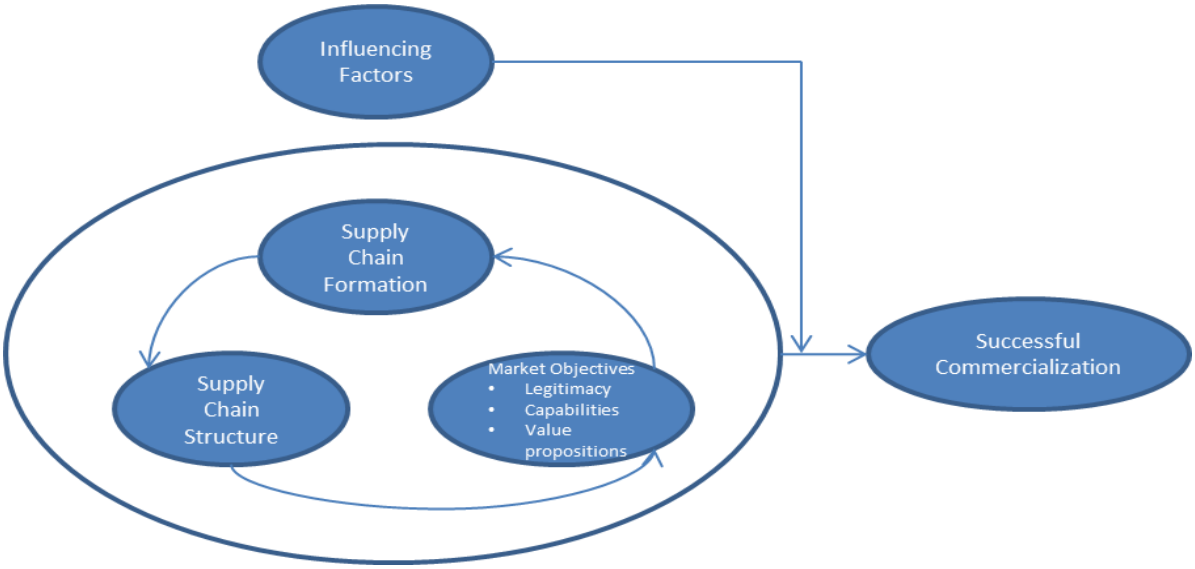

Figure 8: Nascent market supply chain strategy framework (Golicic & Sebastiao, 2011: 266)

Perspectives on supply chain management in nascent markets with new products is provided by Golicic and Sebastiao (2011). They narrow the unit of analysis to the information and material flows of product development and distribution (Golicic & Sebastiao, 2011: 255), and conduct a multiple exploratory case study on five different US companies. Based on cross-case findings from these companies, Golicic and Sebastiao (2011: 266) construct a theoretical framework for initial nascent market supply chain strategy (cf. figure 8). A supply chain strategy that combines market legitimacy, the building of supply chain capabilities and the continuous refinement of value propositions results in successful commercialization (Golicic & Sebastiao, 2011: 266). The three aforementioned elements must be pursued through an iterative process between *supply chain formation*, which is established by personal network, geographic proximity and champions, and *supply chain structure*, which consists of core and

flexible peripheral relationships (Golicic & Sebastiao, 2011: 266). This indicates that Golicic and Sebastiao (2011: 268) support an emergent and evolutionary oriented supply chain strategy. Finally, it is stressed that other influencing factors such as the stage of commercialization, access to resources and interdependence may affect the successfulness of product launch.

In summary, all of the articles agree on the causes and benefits of cooperation. However, they do have differing points of view. Gans and Stern (2003), Aggarwal and Hsu (2009), Kasch and Dowling (2008) and Golicic and Sebastiao (2011) are particularly interested in the external environment's impact on commercialization strategy. This is not very surprising, since drivers of cooperation is mainly in the domain of the external market. Kollmer and Dowling (2004) exclusively focus on licensing, and argue that both mature companies and start-ups can benefit from licensing agreements. Finally, Hsu (2006) explains how the barriers of cooperation may be reduced by collaborating with a venture capital fund. Given the all of the articles in this section advocate cooperation as positive factor in product commercialization, the following proposition is established:

P6: *Norwegian wind technology providers should cooperate with external parties, in order to best commercialize its products.*

3.6 Venture capital and financing

There is a wide amount of different types of financing sources among start-ups. Hellmann and Puri (2000: 964) outline angel investors, corporations, banks, venture capital, government and self-financing as the most important ones. A majority of the articles in the literature search focuses on venture capital, and thus the remaining paragraphs in this section will revolve around this issue.

Support from venture capital funds can be seen as a special kind of cooperation with external parties, and can provide important financial resources during a firm start-up. They carefully scrutinize potential investments before making any decisions. Once the investment deal is completed, the venture capitalists take an active ownership during the lifetime of the investment, where they continuously monitor and mentor the company. Finally, they often have a central role in guiding the exit role of the investment, such as influencing the initial public offering (IPO) of the company (Hellmann & Puri, 2000: 963). According to Timmons and Bygrave (1986: 163), several studies done in the US show that high technology ventures backed by venture capital achieve higher rates of survival and success.

Contrary to Timmons and Bygrave (1986), Hellmann and Puri (2000) differentiate between firm characteristics and financing strategy. Ex ante strategy is related to the decisions prior to financing, and can be distinguished between an innovator and imitator. Innovators are often the first ones to introduce new products, for which there are no clear substitutes in the market, whereas imitators do not follow a first-mover strategy (Hellmann & Puri, 2000: 960). On the other hand, the ex post product market outcome refers to the specific type of financing

strategy chosen (Hellmann & Puri, 2000: 964). The authors aim to find the interaction between these two elements. Based on empirical findings from Silicon Valley companies, the paper argues that firms with innovator strategy are more likely to receive venture capital financing than imitators, and also more quickly than its imitator counterparts (Hellmann & Puri, 2000: 973). Furthermore, the study also concludes that entrepreneurs consider it more important to obtain financing from venture capital funds than other financing sources (Hellmann & Puri, 2000: 978). The implication of the study is that the appropriateness of choosing an involved investor, such as a venture capitalist, depends on the firm strategy. However, since the study is conducted in California, where the venture capital environment is much more intense than in Norway, one can question the generalizability of these findings to a Norwegian context.

Several researchers have pointed out the advantages of early financing from venture capital funds. Timmons & Bygrave (1986: 169) focus on the catalytic role that venture capitalists can have in finding and combining people, technology and opportunities to bring ideas into commercial reality. In addition, the literature emphasizes on the time to market for venture capital-backed companies. Both Timmons and Bygrave (1986: 170) and Hellmann and Puri (2000: 976) find empirical evidence of reduced time to market among start-ups backed by venture capitalists, especially within highly innovative and technology intensive firms. Moreover, Hellmann and Puri (2000: 960) outlines several other benefits such as the venture fund providing mentoring, strategic advice, monitoring, corporate governance, professionalization of the firm and recruitment of senior management, while Timmons and Bygrave (1986: 162) also point out the extensive networks of venture capital firms as an important benefit. Finally, as mentioned in section 3.5, venture capital funds can limit the barriers to cooperation that new ventures might have through information mediation, participation in a large existing networks, endorsements and knowledge transfer (Hsu, 2006: 217).

On the other hand, Hellmann and Puri (2000: 960) contend that there are several drawbacks in attending to venture capital partnerships. They argue that entrepreneurs can experience loss in control of the company, time-consuming activities with investors and a high cost of capital relative to other financing alternatives can be potential costs.

The two final articles in this section is based on excerpts from the anthology *Teknologibasert nyskaping i Norge* (2009) edited by Aspelund et.al. Compared to the previous articles, the findings are exclusively based on a Norwegian environment, hence increasing their relevance to the problem statement. Although the findings are based on technology intensive start-ups, it is a drawback that the wind industry itself is not analyzed.

First, the study of Widding et.al. (2009*) investigates non-financial contributions from Norwegian venture capitalists, and is partly tied to proposition 6. Based on a survey sent to both venture capital investors and companies financed by venture funds, the authors analyze the importance of value adding activities such as *product development, marketing, organization, financial management* and *financing*. Contributions in product development

and marketing is given the lowest and second lowest scores among the five groups, respectively. Within marketing, activities such as building relationships, customer knowledge and internationalization are regarded as more significant. This is in line with the study of Timmons and Bygrave (1986), which suggests the prominence of networking as a value adding activity in VC-backed companies. Organization is given the next highest score in the survey, together with financial management. Widding et.al. (2009*: 78) points outs that strategy, professionalization and strategic alliances are rated as high within organization. On the other hand, recruitment of leaders is regarded as less important, which is in contrast to Timmons and Bygrave (1986). In financial management, activities such as budgeting and liquidity management are perceived as the most value adding. Finally, competence in financing, including valuation, exit opportunities and future financing, receive the highest scores in terms of value added. In summary, VC-backed companies rate activities that they themselves do not have competence in as highly value adding (Widding et.al., 2009*: 83). This underlines the need for companies to complement their areas of expertise.

Quite interestingly, Widding et.al. (2009*: 81) find empirical evidence that investors and entrepreneurs perceive venture funds' positive contributions to be very different. This gap is prevalent in all of the five aforementioned areas of competence. An implication of this is that firms must clarify mutual goals and interests with venture capital funds, before entering a contract (Widding et.al., 2009*: 83). Furthermore, companies need to get a good idea of venture fund's offerings, such that their bargaining power is increased during the contract negotiations (Widding et.al., 2009*: 83).

The second relevant article in *Teknologibasert nyskaping i Norge* is a study about venture capital ownership written by Erikson et.al. (2009*). It analyzes the impact of relationship-based governance versus contract-based management. Based on qualitative and quantitative data from venture-financed companies, the authors conclude that relationship-based management increases the mutual trust to each other, while there is neither a positive nor a negative correlation between contract-based governance and mutual trust (Erikson et.al., 2009*). Conflicts are less likely to occur in a relationship-based environment, and are at the same time easier to handle. Finally, the authors point out that while contracts are designed to protect against opportunism, they can nevertheless inhibit the cooperation between the entrepreneur and the investor and potentially destroy the values the collaboration was meant to create (Erikson et.al., 2009: 99*).

As a final summary, the sample of articles in this review about venture capital do generally have a positive view on it as a source of financing in start-ups. However, the appropriateness of it depends on the type of strategy the firm is committed to, and on how technology intensive and innovative the firm is (Timmons & Bygrave, 1986; Hellmann & Puri, 2000). Moreover, Widding et.al. (2009*) discuss benefits from venture capital cooperation, while Erikson et.al. (2009*) argue that relationship-based management is the most appropriate form of venture capital governance. As a result of the previous discussion, the following proposition is formulated:

P7: *Norwegian wind technology providers should cooperate with venture capital funds, in order to finance and best commercialize its products.*

3.7 Empirical review

The aim of this section is not to present any new propositions, but rather to shed light on those that I have previously established based on specific empirical findings. Papers presented in this section are thus used as part of the proposition analysis in chapter five, and must be regarded as empirical data in line with the interviews in chapter four. Only two articles related to commercialization of renewable energy was found during the systematic literature search. This assertion is supported by Walsh (2012: 32), who claims that the commercialization literature is voluminous, but lacks research on renewable energy technologies. On the other hand, a study on success criteria in the IT-sector was found through snowballing, and is presented after the articles of Balachandra et.al. (2010) and Walsh (2012). Balachandra et.al. (2010) provide some perspectives to the commercialization of sustainable energy technologies, by stating that technology diffusion follows an S-curve over time, and that the technology will be adopted differently among customers. Other than that, the article is found less relevant due to its focus on the Indian market, external market dynamics and measures that the government can undertake to increase the viability of new renewable technologies. This is not within the domain of this master thesis, and thus the article is deemed less relevant.

On the other hand, the research of Walsh (2012) fits well with the overall theme of this thesis. He asserts that the choice of commercialization strategy must be based on the type of product innovation, i.e. disruptive, discontinuous or incremental, and the commercial risk connected to the product launch, which is broken down into cost-, product- and market risk (Walsh, 2012: 33). Market dynamics is heavily focused on. The author contends that technology-push, and demand-pull are crucial drivers for the diffusion of new technologies into the market place. Technology-push refers to when emerging technologies create value offerings that convince the market that the product is needed, while demand-pull is associated when the users persuade the innovator that an innovative product is desired to satisfy the needs of the customers (Walsh, 2012: 34). Sophistication of the market is used as a proxy variable to measure the degree of technology-push, while demand growth for renewable energy is used to quantify the pull forces (Walsh, 2012: 35). Consequently, these two dimensions are used to identify four different commercialization environments, namely *innovation wasteland, innovation pull, innovation push* and *innovation nirvana*, each of which need various strategies for firms to succeed in. Based on historical data, Walsh (2012) concludes Norway to be in the innovation push cluster[1], implying a high degree of eco-sophistication and relative low renewable energy demand growth. Walsh (2012: 39) points out that this environment is characterized by strong bargaining position among technology providers due to their superior technology product ownership. Since the market is quite uncertain because of the demand,

[1] The original paper does have a few mistakes, mixing up the commercial environment of Norway. However, this has been clarified with the author through mail correspondence, and should be corrected by the journal editors.

the most appropriate commercialization strategy among start-ups is the use of strategic alliances and joint ventures with major incumbent energy firms. This contention is embodied in proposition 6, thus Walsh (2012) has not yielded any new research questions. As a summary, Walsh (2012) follows the tradition of Gans and Stern (2003), Aggarwal and Hsu (2009) and Golicic and Sebastiao (2011), when giving attention to the external market in assessing the most relevant commercialization strategy.

Snowball sampling resulted in the finding of an interesting case study by Holgersen and Lillebo (2002*), which investigates success factors among Norwegian IT companies. In terms of methodology, the work is quite similar to this master thesis. A set of propositions are formulated based on theory, and then discussed using data from interviews with seven different successful firms. Although Holgersen and Lillebo (2002*) analyze the IT-sector, the study is believed to give important empirical data to this master thesis as it focuses on Norwegian high-tech companies. Some of the propositions are in accordance with those I have previously established. First, active ownership from venture capitalists is thought to be positively related to successful commercialization. Holgersen and Lillebo (2002*) find mixing evidence of this. The interviewees argue that venture capital provides little more value than financing. This is generally in agreement with Widding et.al. (2009*), who find out that financing aspects receive higher scores than strategic value adding activities (cf. section 3.6). Second, a proposition related to marketing find support for the importance of market orientation. Successful companies are characterized by customer focus and their needs are put on the agenda throughout the organization (Holgersen & Lillebo, 2002*: 99). This is very much in accordance with several articles discussed in section 3.4.3. Third, network relations and cooperation are found to be crucial for finding capital and gaining knowledge, which was discussed in section 3.5.

The remaining four propositions differ from those that have been formulated in this thesis, mainly because Holgersen and Lillebo (2002*) use a different theoretical fundament to arrive at their propositions. First, Holgersen and Lillebo (2002*) propose that a board and management consisting of people with complementary skills is correlated with commercialization success. They found evidence of this, and add that technology and market competence are vital. Second, it is argued that good market understanding and the ability to operationalize these into tangible strategies are success criteria. Furthermore, it is believed that this can positively affect marketing and customer orientation abilities. Third, the authors contend that companies must manage organizational growth and the transition from start-up to a full-fledged professional firm. Fourth and finally, a strong organizational culture and willingness to work hard is argued to be success criteria. The last four propositions are decided not to be part of this master thesis, as the literature research has not provided any theoretical foundation for these.

There are several weaknesses with the study of Holgersen and Lillebo (2002*). First, the work is based on findings in the IT-sector, which limits the validity of using the data when analyzing wind technology companies. Second, it is only concerned with successful companies, thus

leaving perspectives on what causes failure and how to avoid this. Third, the study does not include data from people interviewed outside the case companies, which may cause several biasing issues during the analysis. Fourth, only one interview for each case company is conducted, which limits the opportunities for data triangulation within the cases. Fifth and finally, the study does not distinguish between incremental and radical innovations, for which I believe to have various commercialization success factors. These flaws are aimed to be remedied in this thesis.

3.8 Summary and theoretical framework

The aim of this literature review has been to identify theories and models of best practice commercialization strategies in the academic literature. Section 3.2 gave a short introduction to definitions and methodologies used in the commercialization literature, and discerned various types of innovations and launch decisions. Part 3.3 discussed different theories on why many commercialization efforts fail. On the other hand, section 3.4 presented models showing the success criteria in product launch strategy. These differed in focus and does not provide a converging answer to the problem statement of this thesis. Next, section 3.5 and 3.6 dived deeper into the particularities of cooperation and venture capital, respectively. The presented papers were generally positive to these elements as an ingredient in successful product launches. Finally, section 3.7 reviewed only three relevant articles, as little empirical research was found. Altogether, section 3.3 to 3.6 yielded nine different propositions. These will be tested and analyzed in the discussion part, and their accuracy will either be strengthened or reduced based on empirical findings from six case companies, three external interviews and various company documents. In order to simplify and organize further discussions, the propositions have been summarized in a single theoretical framework, as depicted in figure 9. Proposition 1a, 1b and 1c are hypothesized to lead to lower probability of commercial failure. If we assume that the outcome of product commercialization is a dichotomous variable, that is either success or failure, then lower probability of commercial failure must logically imply higher probability of product commercialization success. This relationship is shown in figure 9. The remaining propositions of 2 to 7 are postulated to be directly related to higher degree of product commercialization performance.

The research so far provides no clear answer to our problem statement on how Norwegian wind technology providers best can commercialize their products. Although a comprehensive review of academic theory literature has been conducted, there remains a clear gap between theory and industry practice. The empirical review gave us little information on how a successful commercialization strategy is developed among wind energy technology providers. My belief is that the best practice model is closely dependent on a series of company and product specific factors. Research combining academic theories and experience from the industry is needed in order to come closer to an answer. Thus, the next step is to bring the academic theory into a real life industry context, which is the aim of the next two chapters.

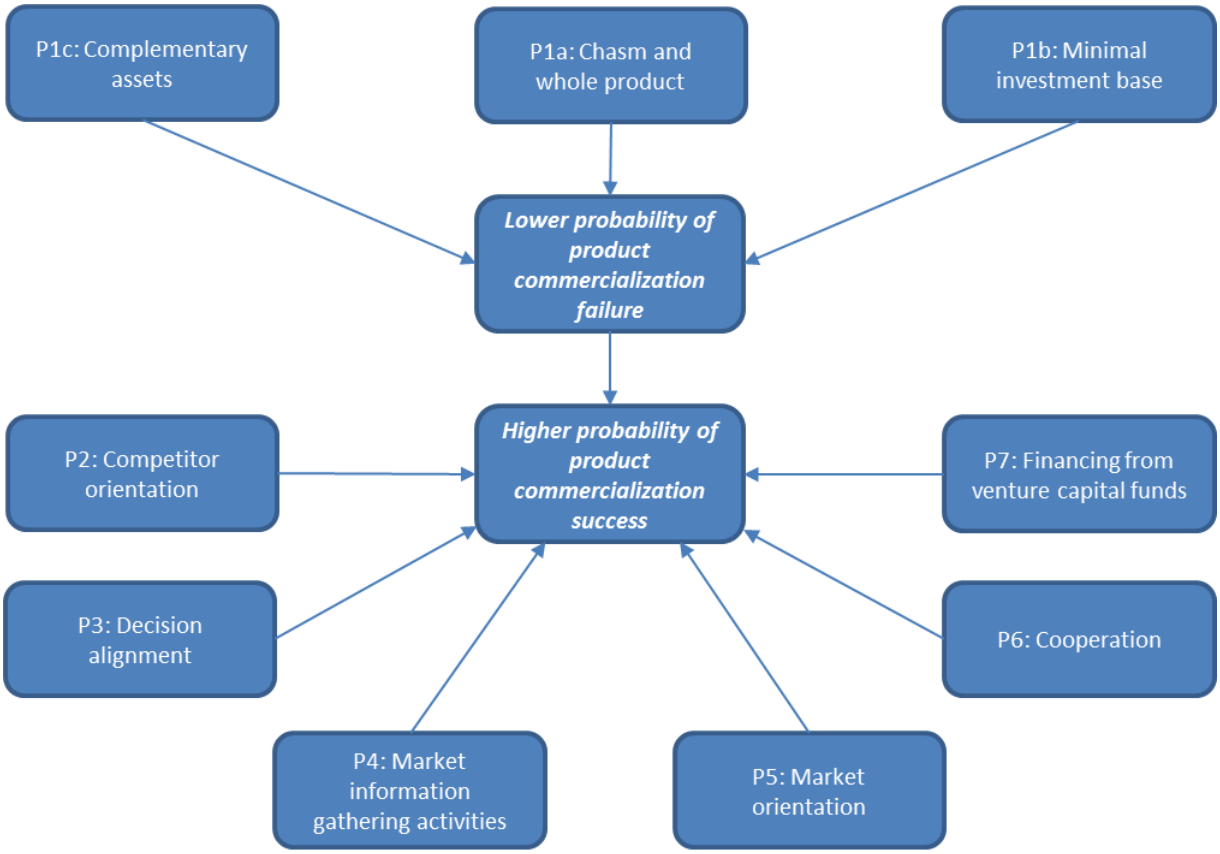

Figure 9: Propositions and theoretical framework

4. Case companies and their product commercialization

4.1 Introduction

This chapter presents six different case companies and their products, each contributing to a major portion of the empirical data in the thesis. The section includes some technical and wind specific terms and concepts, and readers who are not familiar with these should consider reading about wind energy fundamentals in appendix 8.5. It also provides some relevant background information about the industry.

Interviews and key informants are the most important sources in the case studies. However, company websites, presentations and other documents are also used when deemed relevant. In order to contrast different views and perspectives among interviewees and documents, each case company is presented holistically. Each case is introduced with a brief description of the interviewees and the firm. The information revealed during the interviews, can be grouped into seven sections, namely *product*, *strategy, financing, cooperation, competitors, challenges and lessons* and *success criteria.* In order to increase the comparability of each case, the company studies are organized along this way, although some sections for certain companies are omitted. Moreover, three external interviewees has been included in order to increase the validity of the data and provide further perspectives on product commercialization. They come from Innovation Norway, the renewable energy industry and a venture capital fund. Finally, all of the cases and the interviews are summarized and compared in section 4.11.

The case companies are different to each other with respect to several variables. First, the size and maturity of the companies vary significantly. Blaaster, Windflip and Chapdrive represent the small and young start-up firms in the sample, with less than ten employees and less than six years in the industry. SmartMotor and Fedem Technology are medium companies with 18 to 20 years in the market. As an outlier, Statoil with its Hywind project is a large and mature company with significant international operations. I believe that such mix of case companies give opportunities to analyze differences in commercialization strategy in companies with different resources, and whether there are any variances in success factors between these. Second, the companies are positioned in different parts of the value chain. A simplified value chain is illustrated in figure 10, and shows where each case company is situated. Wind power operators get supplies such as wind turbines from the product providers, or what can be termed as tier 1 suppliers. Moreover, tier 1 suppliers often buy products or services from

Figure 10: Value chain classifications of the case companies

subcontractors, which can be regarded as tier 2 suppliers. The classification of each case company will come more apparent for the reader in the product description section of each

case. Third, and finally, the companies vary in how far they have come in the product commercialization process. Using the model of Balachandra et.al. (2010) from section 3.2.1, figure 11 shows that whereas SmartMotor and Fedem Technology have finalized their product development and initiated sales and marketing, Statoil and Blaaster are still in the engineering and demonstration phase. Chapdrive is also in this stage, but is currently out of business. Finally, Windflip is still in its conceptual product development phase, but is currently on hold.

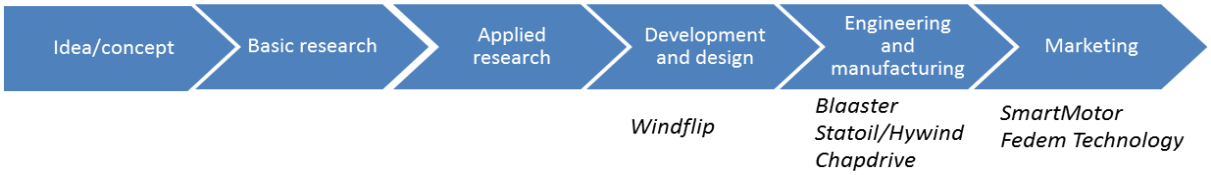

Figure 11: Case companies in their commercialization phase

In other words, Chapdrive and Windflip are historical cases in contrast to the others. I believe that this variation represents a strength in the study, as the problem statement of this thesis can be assessed based on the views of decisions makers in quite different managerial situations. Furthermore, compared to companies in the midst of their commercialization efforts, interviewees that are entering the product launch phase might be less biased by its own successes or failures.

4.2 SmartMotor – Permanent magnet motors

4.2.1 Interviewee profile

The tables below show the details of the two separate interviews conducted with SmartMotor.

Interviewee	**Sigurd Øvrebø**
Interview date	March 19th, 2014
Current position	Chief Technology Officer (CTO), SmartMotor
Previous experience	Electrical Engineer, Aker Solutions PhD in Electrical Machinery, NTNU
Interview location	SmartMotor's offices in Trondheim

Interviewee	**Trond Schwenke**
Interview date	March 19th, 2014
Current position	Director of Business Development, SmartMotor
Previous experience	Engineer, Kongsberg Consultant, Edge Consultants
Interview location	SmartMotor's offices in Trondheim

4.2.2 Firm background

SmartMotor is a spin-off company from the Norwegian University of Science and Technology (NTNU), established in 1996. They produce and sell high torque electrical machines, using a patented permanent magnet technology platform (SmartMotor, 2014). Core segments are

renewable energy, oil and gas and marine applications. Within wind energy, SmartMotor delivers its products to wind turbine producers, specifically as a central component to the power generator. Thus, the firm is a sub-contractor in line with figure 10. Currently, SmartMotor is wholly owned by the Rolls Royce group.

4.2.3 Product

Mr. Øvrebø explains that there are two main products in the wind power portfolio. One commercialized product, providing permanent magnet system motors (PMSM) to direct drive turbines, and one larger and much more radical edition, which is currently part of the development of a 10 MW wind turbine (SmartMotor, 2014). Since the latter product is still in development phase generating little revenue, and the thesis is concerned with product commercialization, the former product will be the unit of analysis for this case company. Furthermore, Mr. Øvrebø contends that the differentiating factor in SmartMotor's technology is higher efficiency and lower weight, drastically increasing the performance of the motors in direct drive turbines. At the moment, the product has been less successful in the wind energy segment, compared to other industries SmartMotor operates in (Schwenke, 2014; Øvrebø, 2014).

4.2.4 Strategy

Both Mr. Øvrebø and Mr. Schwenke contend that the commitment to wind energy has not been a success, and is not currently an area of strategic focus. However, they point out that the technology has experienced more sales in the oil and marine industries. Mr. Øvrebø states that prices on raw materials, such as magnets, soared up in 2010, which was just after the product launch of the PMSM. Together with the entry of Chinese competitors, this made it hard to establish contracts with wind turbine producers. Furthermore, he argues that Norway lacks the brand name within wind energy, as the oil and marine segments have. This has made it even harder to compete in the wind industry.

According to Mr. Øvrebø and Mr. Schwenke, the product strategy of the company has been to enter markets and segments where the PMSM fits well in with customer requirements. Final entry decision is based on market and competitor analysis. Mr. Schwenke further elaborates that creating contact networks through participation in councils and fairs, has played an important part in gathering market information and getting a general impression of the market dynamism and temperature.

When asked about the differences between early innovative adopters and mass-market customers, Mr. Schwenke claims that the distance between the segments is significant. SmartMotor has tried to cater to the needs of larger and more risk-averse customers such as the Spanish wind turbine producer Gamesa, but with little success because of little experience with mass commercialization. Yet, Mr. Schwenke emphasizes that the most important customers at this point are the early innovators, whom there are very few of. The interviewee

sees the potential and rationale behind a whole product when entering the mass market, but states that the key bottleneck is the requirement for large investments in the product.

4.2.5 Financing

SmartMotor has utilized different strategies to fund their product developments. According to Mr. Øvrebø, the firm was initially financed through local investors following its inception in 1996. In 2003-2005, the company used to finance from its own balance sheet, a strategy that did not go very well. Verdane Capital entered an active ownership stake in the SmartMotor in 2006, before being sold to Rolls Royce in 2013 (Verdane Capital, 2013). Mr. Øvrebø states that the cooperation with the venture capital fund has been very useful, in terms of business development, corporate governance, networking and to some extent competence. Furthermore, both Mr. Schwenke and Mr. Øvrebø point out the significance of commercial development programs with external partners. The strategy is to enter contracts with potential customers, who finance some of the product development costs and R&D of SmartMotor in exchange of patent rights and other benefits. Mr. Schwenke contends that this adds flexibility, minimizes the fixed cost base of the company and contributes to early cash flow. When asked about how to avoid the valley of death phenomenon, Mr. Schwenke argues that this commercial partnership model can be possible solution.

4.2.6 Cooperation

The firm has mostly followed a licensing model when cooperating with external parties. First, most of the production is licensed to partners in Central Europe (Øvrebø, 2014). Production is not part of the overall company strategy, mainly because of the need for a substantial infrastructure to facilitate manufacturing and transport. The focus is rather on engineering, product development and prototyping. Second, a licensing agreement with the Norwegian offshore wind technology provider Sway Turbine is used on more innovative products, such as a 10 MW wind turbine concept. According to Mr. Øvrebø, benefits are reduced risk and less need for capital investment. On the other hand, a major drawback is the less exclusivity perceived among partners in the industry. The proprietorship of the technology decreases the more partners it is licensed to, thus reducing the bargaining power in contract negotiations. Despite this, the strategy has been to license the technology to many, rather than few companies.

4.2.7 Competitors

Mr. Øvrebø explains that there are few direct competitors in the market, and virtually none in Norway. He contends that this is due to the unique characteristics of SmartMotor's product, implying that the company has not focused on the competitors.

4.2.8 Challenges and lessons

It is emphasized by both Mr. Øvrebø and Mr. Schwenke that one of the great challenges in the wind industry is the dominance of large and well-established actors, which often rely on proven and low-risk products. Mr. Øvrebø further points out that being a small player is a

disadvantage, and good references is a precondition if contracts is to be signed with the larger customers.

The interviewees claim that a major challenge in the commercialization process has been the value propositions of the product. Mr. Øvrebø admits that they could have been clearer in the early years of the product launch, but points out that it takes time to build clear proposals. Unambiguous value propositions would have made it easier to sell, pitch and differentiate the product in its earlier years. Related to this, Mr. Schwenke argues that a major challenge when selling has been the lack of a whole and fully developed product with specific value propositions. Instead, commercial development partnerships (cf. 4.2.5) has provided the company with revenues. However, Mr. Schwenke adds that the PMSM is currently fully developed with compelling value proposals.

Mr. Schwenke argues that many Norwegian companies are too shortsighted in their strategies. Focus on profits often come at the expense of long-term strategic decisions. Moreover, many start-ups are heavily focused on technical aspects and less on sales and marketing. Finally, he identifies high costs a potential threat to successful commercialization.

4.2.9 Success criteria

According to Mr. Schwenke, a good commercialization process is characterized by customer- and market orientation. There must be a consistency between the customer's needs and the technical innovation, and everybody needs to pull in the same direction. Niche strategies are often favorable, as focus on narrow segments can render it easier to formulate and document value propositions. Mr. Schwenke explains that SmartMotor has become more market oriented in its strategy. Specifically, use of cross-functional teams and close collaboration with customers on product specifications are efforts that increase the focus on the market and customers.

Finally, Mr. Schwenke is also concerned with the human resource perspective. A successful commercialization process needs people with impact, who can drive changes and carry on challenging implementation processes.

4.3 Fedem Technology – Simulation software for wind turbines

4.3.1 Interviewee profile

The tables below show the details of the interviews conducted with Fedem Technology.

Interviewee	**Kristian Sætertrø**
Interview date	April 2nd, 2014
Current position	Engineer, Fedem Technology
Previous experience	Engineer, Reinertsen
Interview location	Fedem's offices in Trondheim

Interviewee	Svein Gjølmesli
Interview date	April 2nd, 2014
Current position	Chief Technology Officer (CTO), Fedem Technology
Previous experience	Product developer, Inventas CEO, Fedem Technology
Interview location	Fedem's offices in Trondheim

4.3.2 Firm background

Fedem Technology is an engineering and software firm with 20 employees, located in Trondheim (Fedem Technology, 2014a). Since 1994, the company has developed and distributed software for turbine manufacturers, and since 2003 offered engineering and analysis services. Consequently, Fedem is a sub-contractor in line with figure 10. Fedem operates in the areas of oil and gas, renewable energy, marine and mechanical industries. The expertise in oil and gas has been used as foundation to further develop capabilities in the offshore wind energy segment (Fedem Technology, 2014b).

4.3.3 Product

The focus of this case is the software product Fedem Windpower, which has been developed incrementally since 2010. It is a simulation tool used for dynamical analysis of both onshore and offshore wind turbine systems (Fedem Technology, 2014c). According to Mr. Sætertrø, the software is used to analyze strength and fatigue in wind turbine components and optimization of windmill structures. Thus, the product can be used by wind turbine producers and power utilities for conceptual development and verification of the engineering design. The wind module is part of a larger software system, which can be used in marine and mechanical industries. Mr. Sætertrø argues that offering such a package is an advantage and a differentiating factor to competitors, since more comprehensive analysis can be undertaken. Finally, he contends that the need for the software is especially relevant offshore, since offshore turbines are often more complex than its onshore counterparts.

Both Mr. Sætertrø and Mr. Gjølmesli agree that the sales of the product has not been successful, but emphasizes that this has not been a focus area compared to services. Few software licenses have been sold to external users. However, the product has been useful for in-house use during engineering services for the wind power clients. In recent years, services has grown to be bigger than product sales in terms of revenues.

4.3.4 Strategy

The wind energy segment was entered in 2009, when Fedem saw market opportunities in the Norwegian offshore wind market. According to Mr. Gjølmesli, this was not part of a deliberate strategy, but rather an emergent and opportunistic one.

While around one third of the income came from the wind segment couple of years ago (Gjølmesli, 2014), the business is now only representing less than 10% of total revenues (Sætertrø, 2014). According to Mr. Gjølmesli, the wind segment is currently on hold, and up

for further strategic evaluation by the board of directors. He points out that a greater share of income has come from services the past years, which might be the future area of priority.

Mr. Gjølmesli is somewhat hesitant when asked about the cause of the little success in the wind energy segment. He contends that the market for Fedem's wind simulation program and services is limited in Norway. Furthermore, it is argued that there has been relatively little commitment from the company to the wind energy business. This is somewhat contrary to the website, which states that "renewable energy is a major focus area for Fedem Technology" (Fedem Technology, 2014b). Mr. Gjølmesli points out that there have been many different leaders in the company. However, he emphasizes that the company has hired a specific person to helm the wind energy business in the future, which might change the current status of the segment.

4.3.5 Financing

The company finances its operations from its own balance sheet and no capital from external actors has been injected into the company the past few years (Gjølmesli, 2014).

4.3.6 Cooperation

The software is sold through a distribution agreement with the Norwegian classifying company DNV GL, who sells their own and Fedem's software products in domestic and international markets (Gjølmesli, 2014). Mr. Gjølmesli points out that it is too expensive to hire an in-house sales team, thus Fedem is using DNV GL's already existing distribution channels. On the other hand, he notes that outsourcing the sales efforts might reduce the sellers' ownership to the product and the incentives to sell it. Both Mr. Sætertrø and Mr. Gjølmesli admit that few licenses have been sold, and that the cooperation has not yielded any positive returns (Gjølmesli, 2014). When asked about the cause of this, Mr. Gjølmesli speculates whether it could be something with the product's user friendliness. He underlines that the company has not yet discussed the lack of success in depth, mostly because product sales compared to services is not the key focus of the firm.

4.3.6 Competitors

The most central competitors are established actors such as Garrad Hassan (Sætertrø, 2014).

4.4 Blaaster Wind Technologies – Wind turbines

4.4.1 Interviewee profile

The tables below show the details of three separate interviews conducted with Blaaster.

Interviewee	**Camilla Jørås Larsen**
Interview date	March 27th, 2014
Current position	Administration Manager, Blaaster Wind Technologies
Previous experience	Secretary, ScanWind
Interview location	Blaaster's offices in Trondheim

Interviewee	Ove Pettersen
Interview date	March 27th, 2014
Current position	Technical Manager, Blaaster Wind Technologies
Previous experience	M.Sc. Mechanical Engineering, NTNU
Interview location	Blaaster's offices in Trondheim

Interviewee	Torolf Pettersen
Interview date	March 27th, 2014
Current position	Founder and CEO, Blaaster Wind Technologies
Previous experience	Hydropower Engineer, Kværner Founder and CEO, ScanWind
Interview location	Blaaster's offices in Trondheim

4.4.2 Firm background

Blaaster is a Norwegian wind turbine developer based in Trondheim, thus characterized as a product provider in line with figure 10. It was established in 2008 by former Scanwind founder Torolf Pettersen, and is currently owned by him and his two children, Ove Pettersen and Camilla Jørås Larsen, all of whom are interviewed in this case study. Torolf Pettersen started Blaaster after Scanwind was sold to GE Wind, and still believes in industrial wind power development in Norway. Blaaster is still in its product commercialization process. A 3 MW wind turbine prototype was installed and put into operation in 2012 in Valsneset test park in Bjugn, Norway (Blaaster, 2014), and the company plans to further expand into the market with their product offering.

4.4.3 Product

Blaaster offers gearless, direct drive wind turbines. The unit of analysis for the case company is their wind turbine platform, DL101. The main differentiating factor of their offering is lower maintenance, decreased operational expenses and low weight solutions (Larsen, 2014; Blaaster, 2014). Another value proposition is the ease of transporting the wind turbine between manufacturers and sites. The most important customers are power utilities. According to Mr. Ove Pettersen, the product can be regarded as an incremental innovation, rather than a radical one. He points out that the possibilities for radical innovation is relatively small in Blaaster, as the capital requirements for such products are large.

Part of the company strategy is the offering of a complete wind turbine product, including the tower, blades and the nacelle. Mrs. Larsen argues that it is much easier to gain access to the large and relatively risk-averse customers, when the product is complete and easy to install and operate. Furthermore, the goal is to minimize the total life cycle cost of the wind turbine, since power utilities are price sensitive. Another element of Blaaster's product strategy is that the technology can be used on wind turbines of varying size, which is termed technology platform strategy by Mrs. Larsen. This solution adds flexibility to the operations, and is also unique in the wind turbine market. It has deliberately been part of the company strategy in

order to differentiate Blaaster from competitors and to offer maximum flexibility to its customers.

In terms of product development, Mr. Ove Pettersen asserts that Blaaster has achieved its goals. The concept is within the original target cost set at the beginning of the development phase. However, a challenging commercialization process is still ahead.

4.4.4 Strategy

According to Mrs. Larsen, it initially took one year of planning, market - and competitor analysis before the company started to develop products. Market information gathering activities still play a central role. Sources such as public documents and dialogs with industry people are used to monitor the market, and especially to stay updated on the cost level in the industry (Ove Pettersen, 2014). According to Mr. Ove Pettersen, it is essential to communicate with people working in the field to get a full understanding of the market dynamism. He further asserts that reverse engineering can be used as a tool to further understand competitor's products. However, he acknowledges that the company has not been as market oriented as it should have been. A problem has been the lack of feedback from Norwegian wind power operators regarding Blaaster's products.

When asked about Blaaster's customers, Mr. Ove Pettersen claims that there indeed is a chasm between early innovators and the mass market. He points out that there are very few wind operators willing to test new and unproven technologies, which leaves a virtually non-existent early innovator segment. The market is rather dominated by mass-market players. This presents a challenge for Blaaster's product commercialization, since it is hard to transform a prototype to a fully working product that the mass market can use without a test period where the new product is adjusted and debugged. Late adopters are less inclined to take part in the test period. Due to these customer characteristics, Mr. Ove Pettersen contends that complementary services are important, and often a necessity to successfully enter the market. Related to this, he also states that developing a market for turnkey deliveries is a possible strategy.

4.4.5 Financing

The company met a challenging financing environment when it started up in 2008, in the midst of financial crisis (Larsen, 2014). No venture capital funds were willing to inject equity into the firm, thus Blaaster financed its operations the first years through own savings. In 2010, the company was granted a financial support of 32.8 MNOK by the Norwegian state enterprise, Enova, and 1.7 MNOK by Innovation Norway (Teknisk Ukeblad, 2010). The grant was part of the funding for the first turbine demonstration project in Valsneset test park in 2012. According to Mrs. Larsen, Blaaster is past the venture capital phase, and is looking for long-term industrial partner, who can financially support the company. Both Mrs. Larsen and Mr. Torolf Pettersen prefer an industrial partner rather than a venture capital fund. They criticize

the funds to be speculative and shortsighted in nature, and furthermore that they lack in-depth knowledge of the wind industry.

4.4.6 Cooperation

Blaaster uses a cooperation strategy where the manufacturing of standard components are outsourced, while product development and assembly are kept in-house (Larsen, 2014). Furthermore, it is noted that the company does not approach a licensing strategy, as the goal is to establish an industry in Norway and continue with proprietary product development. However, both Mr. Ove Pettersen and Mrs. Larsen see the potential of partnerships based on technology sharing. In exchange for financing, the customers want access to Blaaster's technology, rather than a license. This is especially prevalent among customers in countries such as India and China.

Going forward, Mr. Torolf Pettersen states that alliance building, either with financial or industrial partners, will be a prerequisite for future success. He points out that the partnering potential is small in Norway, and that they most likely will need to enter partnerships with foreign players. The focus will still be on higher commitment cooperation modes, thus excluding licensing. Production will still be conducted outside Norway, while product development will continue from its base in Trondheim.

4.4.7 Competitors

The competition in the wind turbine market is fierce, and dominated by large players (Larsen, 2014). A direct competitor to Blaaster's products is the German producer Enercon. Most of the players are based in Europe and the US, but Chinese producers copying incumbent's technology, are also prevalent. In certain sites in Norway with high wind speed, few competitors exist, and both Mr. Ove Pettersen and Mr. Torolf Pettersen point out that these are possible niche markets for Blaaster.

4.4.8 Challenges and lessons

The company is currently in a critical face, and claims that they are still in the middle of the death valley in terms of financing. The prototype concept has not accumulated any operational revenues, which will be crucial looking forward (Ove Pettersen, 2014). In order to reduce current expenses, the company utilizes a small and lean technical team, and is only focusing on the on prototype model. According to Torolf Pettersen, the prototype plays a decisive role in the late commercialization process.

A significant challenge in the market is that the Norwegian industry is rather conservative (Larsen, 2014; Torolf Pettersen, 2014). The power utilities are risk-averse, and emphasize on cooperation and procurement from large and established technology providers. This poses a challenge for Blaaster's product commercialization, and they are dependent on good references in the market in order to sell in their own products to the customers.

When asked about commercialization lessons in the Norwegian wind technology market, both Mrs. Larsen and Mr. Ove Pettersen point to the failure of the wind turbine producer Chapdrive. A thorough discussion about this case is found in section 4.7.

4.4.9 Success criteria

The three interviewees are quite unison in the assessment of what characterizes a successful product commercialization. Both Mrs. Larsen and Mr. Ove Pettersen mention the importance of solid financials. Furthermore, Mrs. Larsen stresses how essential it is to have a working prototype and product demonstration, which clearly documents the product performance. Mr. Torolf Pettersen also emphasizes that one must have the best technology in the market to succeed in the tough competition. Providing another perspective, Mr. Ove Pettersen asserts that market understanding and time to make the right decisions are key factors. Finally, Mr. Torolf Pettersen points out that start-ups need a personal drive and motivation to succeed in the business.

4.5 Windflip – Offshore wind installation barge

4.5.1 Interviewee profile

The table below shows the details of the interview conducted with Windflip.

Interviewee	**Ane Christophersen**
Interview date	April 7th, 2014
Current position	Business Acquisition, Ocean Installer
Previous experience	Co-founder and General Manager, Windflip Master in Marine Technology, NTNU
Interview location	Telephone between NTNU Trondheim and Rica Bakklandet Trondheim

4.5.2 Firm background

Windflip is a venture started up by the NTNU students Ane Christophersen and Torbjørn Mannsåker in 2010. Their offshore wind installer concept was well covered by media during the start-up. Currently, the venture is on hold, as the company awaits the market situation. The plan is to continue with the conceptual product once the market has matured and customers are more willing to use the Windflip-concept. At this point, the firm has no full time employees, despite still having financial resources available.

4.5.3 Product

The concept of the product is a barge used to transport and install floating offshore windmills, and can consequently be regarded as a product provider in line with figure 10. Whereas established technology has relied on vessels towing components to the sea, where they are finally assembled and installed, Windflip transports the whole windmill from land and installs it more conveniently by flipping the barge 90 degrees. According to Mrs. Christophersen, this reduces costs and is much more practical when installing large-scale offshore wind farms.

These value propositions have been used to position the concept in the market. Moreover, the interviewee contends that the product can be regarded as a radical innovation within the wind industry, but points out that some principles are based on known concepts used in other industries.

4.5.4 Strategy

The formal product development started as a result of dialog with Statoil's offshore wind power department. They had few other alternatives than to use towboats to transport and install their floating wind turbine, Hywind. Thus, Windflip could be used as viable substitute to the established technologies. Mrs. Christophersen claims that Windflip has been customer oriented from the beginning of with its cooperation with Statoil. However, she argues that a major challenge has been the lack of potential customers. This has inhibited further feedback from customers and the market.

4.5.5 Financing

The company has received funding from Innovation Norway, Statoil, The Research Council of Norway and private investors. Mrs. Christophersen contends that these financial grants have been critical for the development of the company. Venture capital has not been considered, due to the early start-up phase of the company.

Mrs. Christophersen argues that the death valley phenomenon has not yet been a threat. This is mainly due to low costs during the conceptual product development. However, she points out that large capital expenditures will occur once full-scale prototyping and production starts, thus increasing the risk of entering a long period with negative cash flow.

4.5.6 Cooperation

Only informal cooperation modes has been used by Windflip. Dialog with Statoil and Innovation Norway, although not exclusive, has been essential for the company (Christophersen, 2014). However, the long-term strategy for Windflip is to enter a formal industrial partnership, such that the later phase of the product development is financed. Furthermore, the idea is that the partner can bring in complementary expertise such as within marine operations, which is deemed necessary for the product to fully function.

4.5.7 Competitors

The interviewee points out that there is little direct competition to Windflip, due to an immature market with a small customer base. Offshore installation through the use of towboats is generally the method that gives the most competition to Windflip.

4.5.8 Challenges and lessons

According to Mrs. Christophersen, the major challenge has been to develop and commercialize a product with a very limited market and customer base. The original plan was to sell the concept to other companies with similar operations as Statoil's Hywind project.

However, this opportunity has withered away, as the few potential customers have chosen other methods to install their floating wind turbines. The interviewee admits that the market is not mature enough for Windflip's technology. A large number of offshore wind farms must be commissioned, before the technology is profitable. In other words, the timing of the product has not been ideal.

4.5.9 Success criteria

The interviewee contends that market orientation, close contact with customers, clear value propositions and financing are success factors for a successful commercialization. Companies that fail are often too technology intensive. Finally, based on Windflip's own experience, good timing of the product launch is essential.

4.6 Statoil/Hywind – Floating windmills

4.6.1 Interviewee profile

The tables below show the details of the three separate interviews conducted with Statoil.

Interviewee	**Jan Fredrik Stadaas**
Interview date	March 25th, 2014
Current position	Technology Manager Floating Wind, Statoil (Hywind)
Previous experience	Engineer Wind Power, Statoil (Hywind)
Interview location	Statoil's offices in Oslo

Interviewee	**Niklas Eric Indrevær**
Interview date	March 25th, 2014
Current position	Business Development Floating Wind, Statoil (Hywind)
Previous experience	Management Consultant, Accenture HR and organizational development, Statoil
Interview location	Statoil's offices in Oslo

Interviewee	**Trine Ulla**
Interview date	April 4th, 2014
Current position	Head of Business Development, Floating Wind, Statoil (Hywind)
Previous experience	Engineer, Statoil Engineer, Hydro
Interview location	Telephone between Hotel Alsterhof in Berlin and Statoil offices in Oslo

4.6.2 Firm background

Statoil is an international energy company, operating in 34 countries with 23,000 employees (Statoil, 2014a). Their focus remains on oil and gas production, with particular emphasis on the Norwegian continental shelf. In recent years, the firm has entered the renewable energy

segment, with substantial investments in the offshore wind industry, where they utilize their expertise from oil and gas. As of now, Statoil operates the Sheringham Shoal wind farm outside the British coast and plans to realize the Dogger Bank field through a consortium. Thus, the company is a power producer in line with figure 10. Innovation in the offshore wind segment is done through the Hywind project, the world's first floating offshore wind turbine (Statoil, 2014b). A full-scale floating wind turbine prototype was installed 10 kilometers of the south-west coast of Karmøy in 2009, and Statoil has been granted a lease for a demonstration park off the coast of Scotland with five floating wind turbines (Wind Power Monthly, 2013). The aim is to see of the turbines can operate as part of an array. In the remaining case study, the Hywind product will be unit of analysis, thus focusing less on Statoil.

4.6.3 Product

Unlike traditional offshore windmills that are fixed to the seabed, Hywind is a floating structure consisting of a steel cylinder filled with a ballast of water and rocks (Statoil, 2014b). According to Mr. Stadaas, the product is developed for a new market, and the aim of Statoil is to create new market space and opportunities. Hywind differentiates itself from competing alternatives by giving the opportunity to install wind turbines on deeper water depths (Stadaas, 2014). Mr. Indrevær adds that the Hywind concept offers lower cost and is less specified for each wind site compared to fixed platforms, which leads to higher potential for standardized mass production.

The Hywind project is still in its demonstration phase, implying that not all of the value propositions have been fully realized in the product. According to Mr. Indrevær, Hywind is still not a cheaper alternative to fixed installations. This is believed to be achieved through further technology development and economies of scale once mass production is initiated.

Mr. Stadaas, Mr. Indrevær and Mrs. Ulla agree that the product is an incremental innovation with elements of radicalism. Mr. Stadaas explains that Hywind primarily uses already known technology, but the fact that it is utilized in a different way and in a new market, shows some elements of radical innovation.

Mrs. Ulla contends that Hywind so far has been a technical success. The full-scale prototype in Karmøy has shown great promise in terms of high utilization and production output, despite improvement potential in cost. Future product success will depend on whether the demonstration park in Scotland can reduce the operational expenses (Indrevær, 2014).

4.6.4 Strategy

The long-term goal of the Hywind project is to operate profitably in a wind market without any kind of subsidies (Stadaas, 2014). The demonstration park in Scotland is dependent on financial support, thus the commercial goal of the company has not yet been achieved. On the contrary, the company has not yet started to commercialize the product (Ulla, 2014). As a result, short term tactical decisions such as pricing, distribution and promotion has not been made.

Mr. Indrevær explains that the customers' perspective is important in the Hywind commercialization process. Once a customer is identified, they should be followed closely by Statoil, such that a long-term relationship can be established. However, it should be noted that the Hywind concept has not yet been sold to any customers. Mr. Stadaas explains that it is a potential strategy to both use the product internally for power generation and externally as a sellable product to customers such as wind turbine producers, yards and power utilities.

4.6.5 Financing

Statoil invested 400 MNOK in the Hywind prototype, while the public enterprise promoting renewable energy, Enova, granted 59 MNOK (Statoil, 2014b). Venture capital has never been an alternative, since it is an expensive type of financing compared to capital directly from Statoil's balance sheet (Indrevær, 2014). Despite the aim to show the commercial viability of the demonstration park in Scotland, the project is dependent on tradable green certificate (TGC) schemes in order for it to be profitable (Ulla, 2014).

Mr. Stadaas and Mr. Indrevær provide different perspectives on how to avoid or reduce the effects of the death valley phenomenon. The former interviewee claims that a clear plan and a licensing strategy are necessary to achieve early income in the commercialization process. The latter interviewee emphasizes the significance of a large customer network, such that sales are not only dependent on one buyer. Furthermore, several projects and contracts in the pipeline are critical to generate a stable income stream. Still, Mr. Indrevær points out that there is a tradeoff between commitment to the product commercialization process, which costs money and resources, and flexibility and exit strategies, which are necessary if the product launch fails. High degree of commitment inhibits flexibility, as more investments are bounded in sunk costs that cannot be realized in an exit, but is on the other side necessary to succeed in the market.

4.6.6 Cooperation

According to Mr. Stadaas, cooperation with other companies in the full-scale prototyping has been decisive for the technical success of the concept. When Statoil was looking for a provider of the wind turbine, Mr. Stadaas explains that size and risk-willingness were important criteria for cooperation. Going forward, Mr. Stadaas also stresses the significance of an industrial partner that can share risk and provide economies of scale together with Statoil. As a potential risk of collaboration, Mrs. Ulla points out that too much cooperation can lead to dilution of the patent, since the vendors have more access to proprietary knowledge and assets through a partnership. Additionally, it is asserted that finding the appropriate partners is hard. Criteria such as access to new market opportunities, financing and technology collaboration are weighed as important by Statoil (Ulla, 2014).

4.6.7 Competitors

Mr. Indrevær argues that the market competition is relatively low. According to Mrs. Ulla, three other full-scale floating wind turbines have been installed in Portugal and Japan. She

admits that the competition has become stiffer, and that Hywind's head start is partially eroded away. However, she contends that competition will not be the major challenge in the future. Rather, the most potent threat is the lack of a customer base that is willing to adopt the Hywind technology (Ulla, 2014).

4.6.8 Challenges and lessons

One of the great challenges is that Statoil has to develop the immature market itself, since they are the ones creating the new market segment (Ulla, 2014). Specifically, Mrs. Ulla points out that governments in many countries grant licenses to shallow water areas, which are not appropriate for the Hywind technology. They assert that the wind technology is not mature enough for deep-water depths, thus making it necessary for Statoil to proactively influence governmental decision makers to grant licenses in deep-water wind sites (Ulla, 2014).

When asked about commercialization lessons, Mr. Stadaas criticizes Norwegian firms to lack complete understanding of the market, and for being too focused on its product. He uses Windflip as an example of a firm that has not succeeded due to bad entry timing in the market.

4.6.9 Success criteria

Both Mr. Stadaas and Mr. Indrevær emphasize market and customer orientation as prerequisites for a successful commercialization strategy. The former interviewee stresses that companies must understand what the market demands and how this will develop over time. Market intelligence and communication with customers must be prioritized in the commercialization process. In parallel, the company must be clear on the product's value propositions and competitive advantage (Stadaas, 2014). Finally, Mr. Stadaas points out the prominence of partnership and cooperation with external stakeholders such as governments. Mr. Indrevær mostly agrees with Mr. Stadaas, and especially stresses customer focus as a success criterion. He further adds that bad commercialization processes are characterized by too much focus on the technical aspects of the product.

Mrs. Ulla claims that a low cost level is critical in the wind energy business. In order to achieve this, Hywind must cooperate with companies that have expertise in areas where Statoil has not. As an example, Mrs. Ulla mentions potential cooperation with the Norwegian shipyard industry in marine operations of the offshore turbines.

4.7 Chapdrive – Hydraulic transmission

4.7.1 Interviewee profile

The tables below show the details of the three separate interviews conducted with individuals with differing relation to the former Chapdrive. While Ole Gunnar Dahlhaug and Åsmund Furuseth were part of the company management, Jostein Vik served as board member representing Viking Venture as one of several active investors.

Interviewee	Ole Gunnar Dahlhaug
Interview date	April 25th, 2014
Current position	Professor, NTNU
Previous experience	Technical leader and co-founder, Chapdrive Project Engineer, SN Power Researcher, SINTEF
Interview location	Dahlhaug's offices in NTNU, Trondheim

Interviewee	Åsmund Grytting Furuseth
Interview date	April 28th, 2014
Current position	CEO, Mobitroll
Previous experience	CEO and co-founder, Chapdrive Project Manager, NTNU Technology Transfer
Interview location	Studentersamfundet in Trondheim

Interviewee	Jostein Vik
Interview date	April 29th, 2014
Current position	Partner, Viking Venture
Previous experience	Board Member, Chapdrive Trainee, Orkla
Interview location	Viking Venture's offices in Trondheim

4.7.2 Firm background

Chapdrive was founded in 2006 as a spin-off from NTNU. The company was formally laid down in 2013. At its peak, the firm had 20 employees spread around offices in Norway, UK, Denmark and China (Chapdrive, 2012). The company provided technology for wind turbine manufacturers, and can thus be regarded as a sub-contractor in accordance with figure 10.

4.7.3 Product

Chapdrive utilized hydraulic power transmission in wind turbines, instead of the traditional mechanical gearboxes. This reduces the weight of the turbine nacelle, decreases the need for maintenance and provides the opportunity to move components from the nacelle to the ground (Dahlhaug, 2014; Furuseth, 2014, Chapdrive, 2012). Furthermore, the solution removes the need for permanent magnets and frequency converters. The result is significant cost of energy reductions of up to 20% (Chapdrive, 2012), especially among large wind turbines where the mechanical gearboxes can be very heavy. Key customers using the technology was mainly wind turbine producers.

According to Mr. Dahlhaug, the innovation can be regarded as incremental. On the other hand, both Mr. Furuseth and Mr. Vik contend that the product has radical characteristics. They argue that a completely new design for wind turbines had to be developed. Mr. Vik further adds that the technology itself might not be a radical breakthrough, but that the commercial aspects of

the product are radical. A long verification phase was needed with significant risk and downside potential.

The product underwent a lengthy development and verification process. A prototype of 50 kW size was built in 2005, while a larger test was initiated in Valsneset wind park in 2007. Installation and verification on two wind turbines was completed in 2009 (Dahlhaug, 2014). Further tests on larger turbines were planned to happen during 2014 and 2015 (Chapdrive, 2012).

4.7.4 Strategy

According to both Mr. Furuseth and Mr. Dahlhaug, an important part of the strategy has been verification and proof of concept that the product is actually working in a reliable manner. This is especially important in the wind industry, since wind turbine producers are risk-averse and operate with low margins in their production (Dahlhaug, 2014). The rationale was to present Chapdrive as an attractive investment among potential partners and venture funds (Furuseth, 2014). On long term, the plan was to sell or license the technology to customers. Since these prefer to rely on well-proven technology, Chapdrive used significant resources to finalize the product development before initiating any sales. In retrospect, Mr. Furuseth ponder on whether the sales process could have been started earlier, but underlines that it is hard to know exactly when to launch the product.

Providing perspectives from outside the company, Mr. Vik claims that the work on strategy in the company has been good. He points out that it changed a lot during the years, which was necessary. Two Danes with significant industrial knowledge and experience spearheaded the development of value propositions and had a deep understanding of end-customers' needs. Furthermore, Mr. Vik points out that Chapdrive over time developed a clear positioning strategy to operate in the market for large wind turbines, a segment with future growth potential. Within this sector, a differentiation strategy focusing on low cost and maintenance needs compared to permanent magnet motors was utilized.

Finally, Mr. Vik stresses the importance of having both market-driven and customer-driven products in the strategic product roadmap. Whereas, the former refers to offerings developing new markets that generate revenues on a long term, the latter one is related to short-term cash generation. Both of them are needed in the wind industry.

4.7.5 Financing

According to Mr. Furuseth, Mr. Dahlhaug and Mr. Vik, the venture capital environment was very favorable during the start-up of the firm. Chapdrive received 52 MNOK from Northzone Ventures, Hafslund Venture and Energy Capital Management in February 2009, and 86 MNOK from Viking Venture and Investinor in April 2010 (Adressa, 2010). Mr. Vik points out that Viking Venture used extensive time and resources before investing in Chapdrive. They decided to enter the firm when they saw potential in the technology, market and the management. Mr. Dahlhaug states that referring to the company's patents was deliberately used as a strategy

to gain support from venture capitalists, as they desire tangible proof of potential products that can generate future cash flow. According to Mr. Dahlhaug, the firm had enough financing from venture funds to avoid the death valley phenomenon. However, all of the interviewees point out that the venture capital's willingness to invest in the wind energy segment has dried up after the financial crisis. According to Mr. Furuseth, venture funds have shied away from the clean-tech sector due to high risk and long payback time.

Mr. Dahlhaug argues that the venture funds have been decisive for the development of the company. They have provided with valuable competence and expertise, financing and network relationships. Specifically, the interviewee emphasizes the entry of the Danes with extensive in-depth knowledge of the wind industry as especially helpful. These people provided leadership and direction for Chapdrive.

4.7.6 Cooperation

All of the interviewees emphasize that cooperation was a critical issue, and within this topic, we can find the key reason for Chapdrive's early demise. While the company had success with its technology on smaller prototypes, problems emerged when the innovation was to scale up to larger sizes (Vik, 2014). At this point, Chapdrive was dependent on product development of larger components, which required huge investments (Dahlhaug, 2014; Vik, 2014; Furuseth, 2014). Thus, cooperation on further technology development with industrial partners such as wind turbine producers and component sub-contractors remained the only viable option. However, the financial crisis made this challenging, as potential partners were not willing to undertake high-risk projects and instead focused on its core competence areas (Vik, 2014; Furuseth, 2014). Although Chapdrive focused its efforts on establishing a partnership during the last year of its existence, the firm failed to achieve a cooperation agreement. Since the company could not carry the investments alone, the management ultimately decided to lay down all of its operations in 2013. Mr. Vik is adamant that the company would have done well if the technology development with an external partner had succeeded. Mr. Furuseth adds that Mitsubishi has acquired a company with similar technology to Chapdrive, and is currently performing well. He claims that this shows that the Chapdrive concept is technically viable.

Mr. Dahlhaug points out that Chapdrive initially had Bosch and Hägglunds as industrial partners. The cooperation was only partly regulated through contracts, and even though Bosch and Hägglunds stayed cooperative, they were not willing to further invest into large component development (Dahlhaug, 2014).

On a long-term perspective, Chapdrive had a strategy of being part of a wind turbine producer as a subsidiary (Dahlhaug, 2014). Mr. Dahlhaug argues that most of them perform production in-house, thus making the use of vendors to procure necessary sub-components less prevalent. Hence, it is hard to approach and sell products to wind turbine producers without being a part of them.

4.7.7 Competitors

At the point when Chapdrive developed its product, the company had no other direct competitors with the same concept (Vik, 2014). However, Vik (2014) points out that several indirect competitors with other approaches to reduce wind turbine cost existed.

4.7.8 Challenges and lessons

According to the interviewees, there are several challenges in the wind industry with a number of related implications. First, wind technology customers are very risk-averse, which makes a longer and more thorough product verification phase necessary (Dahlhaug, 2014). Mr. Furuseth points out that Chapdrive did not expect the sheer amount of development efforts that went into the project. Furthermore, Mr. Vik agrees with SmartMotor's and Blaaster's contention that there are almost no early innovators in the wind segment, simply because the risk/reward ratio is too high. He points out that the oil and gas industry is just as conservative as the wind sector, but they are on the other hand more willing to invest and acquire, since the returns in the oil industry are significantly higher. Second, achieving foothold among the customers, that is the wind turbine producers, is very challenging. Dahlhaug (2014) claims that the Danes' network relations have been key in actually getting entry to these during the selling and cooperation phase. Third, he further asserts that the death valley time period is longer in the wind industry compared to other sectors. This is mainly because of long verification processes and large up-front capital investments. Fourth and finally, the wind industry is very capital intensive (Vik, 2014).

In retrospect, both Mr. Furuseth and Mr. Dahlhaug admit that the search for new partners could have been initiated earlier. The latter interviewee further asserts that the cooperation with Bosch and Hägglunds could have been more mutually committed. It was also characterized by a low degree of openness, and with no common goal and direction. Mr. Dahlhaug also points out the differences in size, and hence bargaining power between the firms as a major challenge.

4.7.9 Success criteria

The interviewees have different perspectives on what characterizes a good commercialization strategy. Both Mr. Dahlhaug and Mr. Vik stress the importance of reliable products that minimize potential downside. Mr. Dahlhaug further emphasizes cross-functional and competent teams, while Mr. Furuseth elaborates that industrial expertise is vital. Companies must have specific and clear knowledge about the product it is developing and the context it is operating within. Moreover, Mr. Furuseth argues that timing is essential and that is has to fit with the overall strategy and the product. He further adds that one must be committed to the overall strategy over a long time period in order to show results. On the same note, Mr. Vik contends that companies must be positioned for the future and focus on market- and customer driven strategies. Finally, Mr. Vik points out that capital in the companies must be allocated and utilized effectively.

Mr. Vik gives OCAS as an example of a Norwegian company that has succeeded in the wind industry. The firm produces a warning system used on windmills, such that planes avoid collision with them. This is used as an alternative to visual alert systems, such as continuous lightning, which is annoying for the environment. According to Mr. Vik, OCAS has a clear positioning strategy within a niche segment and offers compelling value propositions. The company is now a subsidiary of the Danish wind turbine producer, Vestas, which has successfully implemented the system to their products.

4.8 Venture capital interview

Interviewee	**Lars Ekström**
Interview date	March 25th, 2014
Current position	Investment Manager, Verdane Capital Advisors
Previous experience	PhD Engineering, University of Cambridge Project Manager, DNV Investment Analyst, Hitec Industries
Interview location	Verdane Capital Advisor's offices in Oslo
Company profile	The firm was the first venture capital fund established in Norway in 1985. The main focus lies on investments portfolios consisting of small to mid-cap Nordic high-growth companies, and especially within the energy and ICT sector. Currently, 30% of their portfolio is on venture capital, and the company has invested in both solar and wind energy.

4.8.1 Financing

The interviewee explains that main modes of financing among high-tech venture firms in Norway are through venture capital, and to some extent business angels, support from the government and investments from larger companies. The focus of the interview is mainly on venture capital.

Once the acquisition is complete, Mr. Ekström describes that the fund enters a phase of active ownership and cooperation with the venture's management. A 100-day plan is established to set the course for future growth, value creation and restructuring. Furthermore, a three-year strategic rolling plan is revised each year. The interviewee claims that the focus is on long-term strategic plans (3-5 years), rather than short term tactical decisions.

Benefits from venture capital financing are good access to capital, partner collaboration at an early stage of the firm development, access to industry competence and network relationships (Ekström, 2014). Specifically, it is pointed out that the active partnership can assist in the formulation and development of value propositions. Conversely, a possible drawback is the short time frame of the investments. Most of the funds of Verdane Capital's are divested after 4 to 6 years, and within this horizon significant values and profits must be realized. With respect to decision-making, this can sometimes lead to less optimal and shortsighted strategic choices.

4.8.2 Challenges and lessons

According to Mr. Ekström, one of the major challenges in the wind industry is the lack of a well-established infrastructure and value chains. This implies that product testing, which according to Mr. Ekström is an important criterion for market acceptance, financing and demonstration of value propositions, is much harder in comparison to for example the more mature oil and gas industry. Another implication is that the customer base is rather small and less willing to take on risk. This conservative market makes it harder for the technology providers to test their new products together with the customers, which is quite normal in the oil and gas industry.

One of the problems in the wind industry is that many Norwegian ventures are too technology focused rather than customer focused. Mr. Ekström contends that technology providers must understand the customers and accordingly satisfy their needs. In other words, market orientation is essential.

4.8.3 Success criteria

The interviewee strongly believes in cooperation as a mean to achieve commercial success. High performing firms know what to outsource, what to keep in-house and establish strong network relationships. Those that fail often lack appropriate technology partners and keep much of their technologies a hidden secret among external actors. Moreover, Mr. Ekström argues that high-commitment cooperation strategies such as joint ventures are more effective, since they provide a better foundation for technology collaboration, knowledge sharing and can be viewed as a stamp of approval.

Mr. Ekström emphasizes the importance of accelerated time-to-market, since early generation of cash flow is crucial for market survival. This is especially critical in the wind industry, since it is characterized by large up-front investments and dependence on subsidies.

4.9 Industry interview

Interviewee	**Jørgen Dale**
Interview date	April 7th, 2014
Current position	Business Development Manager, Scatec
Previous experience	Process Engineer, Hydro Development Engineer, Think Nordic
Interview location	Telephone between NTNU Trondheim and Scatec offices in Oslo
Company profile	Scatec is a Norwegian incubator of new renewable technologies. The firm invests, develops and commercializes high technology renewable companies.

4.9.1 Strategy

According to Mr. Dale, there is clear difference between early innovators and late adopters. Drawing from his B2C experience in Think and B2B in Scatec and Hydro, he asserts that this is

prevalent in both B2B and B2C markets. The interviewee acknowledges that complementary product services can be used as a strategy to penetrate mass markets consisting of risk-averse and late adopters.

4.9.2 Financing

Large companies finance most of their product launches through their balance, while smaller ventures rely on investments from private persons, venture funds and governmental institutions such as Innovation Norway (Dale, 2014). Mr. Dale points out that the market for venture capital has dried up following the financial crisis in 2008, as funds are more inclined to invest on more mature and low-risk firms. However, the interviewee is generally positive to venture capital funds. Close follow-up of the management, knowledge transfer and the access to network contacts are mentioned as positive results following a venture capital cooperation.

Mr. Dale outlines several models for avoiding or reducing the effects of the death valley phenomenon. First, licensing is a well-proven model that can generate early income for a start-up company. Second, additional cash can be made from providing related services before the product launch. For example, the Norwegian provider of offshore sub-structures, OWEC, provided FEED studies on offshore foundations before it later launched its own product concept (Dale, 2014). Third, commercial development similar to the strategy of SmartMotor (cf. 4.2.5), can also be used. Finally, Mr. Dale asserts that start-ups must be disciplined in its operational expenses, such that liquidity and solvency is remained.

4.9.3 Cooperation

According to Mr. Dale, licensing is the most widely used cooperation model in the Norwegian wind energy industry. Joint ventures are used to some extent, but are most appropriate for larger companies. The interviewee states that licensing provides relatively easy financing and releases capacity in the focal firm, such that they can focus their efforts on other aspects than manufacturing. On the other hand, Mr. Dale emphasizes on two drawbacks in the licensing mode. First, a challenging task is to devise a fair and proper model for dividing the revenues between the licensee and the licensor. Often, these have differing opinions and perceptions on what constitutes a reasonable revenue distribution. Second, a licensing strategy leads to less customer contact for the licensor, as more of the customer relationship is transferred to the licensee. The licensee can possibly make product alterations based on customer feedback, thus dilute the original licensed product (Dale, 2014).

4.9.4 Competitors

In the company portfolio that Mr. Dale works with, the market is characterized by stiff competition. There are many players, despite the fact that the portfolio companies operate in niche segments. Mr. Dale states that entry barriers is a major challenge for many actors in the industry. As a response to this, the interviewee points out that companies must offer better and differentiable products compared to competitor's offerings. Partner cooperation is also a

viable strategy, as the alliance can increase the bargaining power to customers when bidding for contracts.

4.9.5 Success criteria

When asked about what characterizes a good product commercialization process, Mr. Dale emphasizes the necessity to understand and satisfy customer's needs. Early contact must be established in order to incorporate their views to the product development and launch process. Furthermore, Dale (2014) asserts that Norwegian firms are often too focused on the technical aspects in the product launch, which comes at the expense of customer orientation. An implication of this is that many companies do not allocate enough resources to the sales and marketing function.

Adequate financing is also regarded as a success factor (Dale, 2014). The commercialization process is often long and resource intensive, which calls for enough money to survive the long period before income is generated. Finally, Mr. Dale argues that a skilled and motivated top management is a success criterion.

4.10 Government interview

Interviewee	**Ivar Singstad**
Interview date	April 8th, 2014
Current position	Head of Wind and Marine Renewables, Innovation Norway
Previous experience	Advisor, Innovation Norway
Interview location	Telephone between NTNU Trondheim and Innovation Norway offices in Bergen
Company profile	Innovation Norway is a government-owned firm, with the goal to promote national industrial development, innovation and internationalization.

4.10.1 Strategy

The interviewee asserts that there are great differences between innovators, early adopters and mass-market customers. The established power utilities use proven technologies, and are characterized by risk-averse behavior. Indeed, Mr. Singstad is concerned that there might be few or no early innovators in the market, which can make it hard for technology providers to test and demonstrate their innovations in the market. The result is higher entry barriers for new venture that cannot finance their product development and commercialization process from its own balance sheet.

When asked about the IPR regime in Norway, Mr. Singstad claims that the patent is only as strong as the company is willing to defend it from imitators. The firm must allocate significant resources to follow up the patent and potential lawsuits that might be initiated as a result of infringements. Moreover, the interviewee argues that patents are more easily filed in the early years of the innovation. However, companies must be aware that the patent is valid for 20

years in Norway. Wind technologies have a long development cycle, and the products should be realized before the patent period has expired.

4.10.2 Financing

According to Mr. Singstad, most of the venture capital within the clean technology sector has dried up. There were several transactions in 2008 and 2009, but significantly less after the financial crisis. The interviewee asserts that a major drawback with venture capital financing is the short time frame of the investments. Most of the technologies in the renewable energy sector have long development lifecycles, often minimum ten years (Singstad, 2014). Venture funds have shorter investment periods that must yield returns, and this could lead to differences in what venture capitalists and entrepreneurs perceive as strategically important. On the other hand, Mr. Singstad point out that venture funds can provide much-needed capital and competence to the start-up.

The industry is characterized by significant upfront capital expenditures before any income is generated (Singstad, 2014), often between 500 and 1000 MNOK. This poses a major risk of entering the valley of death. Mr. Singstad argues that companies need to generate income as fast as possible, and at the same time cooperate with external parties in order to diversify risk. He mentions SmartMotor's commercial development strategy (cf. 4.2.5) as successful model and a possible approach to avoid the lack of cash in companies' start up.

4.10.3 Cooperation

In terms of collaboration, the interviewee argues that industrial partners are often more appropriate than venture funds. They can provide long-term financing of the product development and commercialization, which smaller firms are dependent on. However, few of the larger companies in Norway are willing to enter such agreements in the renewable energy sector, as many of them concentrate their efforts on the oil and gas sector. The domestic market needs more firms that are willing to invest and collaborate with wind technology start-ups.

Mr. Singstad claims that Norwegian firms can be better at collaborating with external parties. He especially sees the potential in licensing agreements. The major rationale and benefit behind the model is that it provides the opportunity to outsource the production to companies that are more specialized in manufacturing. This is especially useful for Norwegian companies since many lack competence and resources in production, while they are good at engineering and design (Singstad, 2014). However, a fundamental prerequisite for the licensing model to function is that the technology is patent filed.

4.10.4 Success criteria

Mr. Singstad argues that market orientation, customer focus and sufficient financing are factors that characterizes a successful commercialization process. Norwegian companies could benefit from more attention to customers, as many are overly focused on the technical

aspects (Singstad, 2014). Once the product is developed and demonstrated, a competent salesforce is key to expand the product into the market. Additionally, he points out that cooperation with vendors and other actors in the value chain is a benefit once the firm scales up its production.

4.11 Summary

By using six different case companies, this chapter has shed light on how Norwegian wind technology providers commercialize their products, what they regard as success factors and various lessons in the process that others can learn from. The independent views of three external interviewees have added further perspectives and balance to the problem statement of this thesis. In order to summarize and contrast the empirical data in a simple and organized manner, findings from each case company and external interviewee is presented in table 9. It will provide the basis for the discussion part in the next chapter. Note that the table discerns between descriptive statements in italic and normative opinions in non-italic. Be aware that some statements may have elements of both, which is not reflected in the table.

Table 9: Summary of case companies and external interviewees

	Product	Strategy	Financing	Cooperation	Competitors	Challenges and lessons	Success criteria
SmartMotor	*- Incremental innovation - Less successful due to external factors*	*- Alignment between product and customers - Market information gathering - Chasm*	*- Successful VC - Commercial development programs*	*- Licensing of production - Licensing reduces risk and gives access to capital, but less proprietorship*	*- Few direct competitors*	*- Conservative and large players - Value propositions - Short-sightedness*	- Market orientation - Niche strategy - Human resources
Fedem	*- Incremental innovation - Less successful*	*- Emergent - Little commitment to wind energy*	*- From the company's balance sheet*	*- Sales distribution channel with little success*	*- Some large competitors*	-	-
Blaaster	*- Incremental innovation - Whole product - Technical success, commercialization still ahead*	*- Market information gathering - Few early innovators* - Services for the mass market	*- Government support* - Prefer industrial partners rather than VC	*- Technology sharing rather than licensing* - Aim: high commitment industrial partnership	*- Fierce competition - Possible niches with less competition*	*- Death valley - Conservative and large players - Chapdrive as example*	- Solid financials - Prototype - Best technology - Market understanding
Windflip	*- Radical innovation - Less successful*	*- Cooperation and customer orientation with Statoil*	*- Government support - Too early-phase for VC*	*- Informal cooperation* - Aim: industrial partner	*- Little direct competition, tugboats as substitute*	*- Limited customer base - Timing*	- Market orientation
Statoil	*- Incremental innovation - Technical success, commercialization still ahead*	*- Internal and external sales - Customer orientation* - Commercial goal to operate in the market without subsidies	*- Government support and company financing* - Licensing, planning and customer network important to avoid death valley	- Cooperation decisive for the technical success - Aim: industrial partner to pool risk and gain economies of scale - Drawback: dilution of patents	*- Little competition, but similar prototypes deployed in Japan and Portugal*	*- Developing an immature market - Lack of market understanding in Norwegian firms*	- Market orientation - Market intelligence and customer communication - Value propositions - Cooperation - Low cost
Chapdrive	*- Radical innovation - Long verification process - Technical success, commercial failure*	*- Proof of concept - External people with good knowledge - Differentiation and positioning* - Market and customer-driven	*- Significant VC grants - Patents to attract VC - VC decisive for company development*	*- Industrial partner required for further development - Failure due to lack of partner - Aim: being part of a larger firm*	*- No direct competitors with same concept as Chapdrive*	*- Risk-averse customer - Capital intensive - Hard to gain access to customers - Death valley*	- Reliable product - Industrial expertise - Strategy commitment - Timing - Positioning
L. Ekström	-	-	*- VC pros: access to capital, competence and networks - VC cons: short time frame*	-	-	*- Lack of established value chains - Small and risk-averse customer base - Tech focus*	- Cooperation, especially high commitment modes - Accelerated time-to-market
J. Dale	-	*- Chasm* - Complementary services to penetrate mass markets	- Positive to VC - Licensing, services and commercial partnership to avoid death valley	*- Licensing mostly used in the industry - Licensing cons: less customer contact and revenue distribution*	*- Stiff competition even in niche segments*	-	- Market and customer orientation - Adequate financing - Skilled and motivated top management
I. Singstad	-	*- Few early adopters leading to high entry barriers - Patents only as strong as the company is willing to defend it*	- Critical to VC's short investment time frame - Fast cash and cooperation to avoid death valley	- Industrial partners more appropriate than VC - Norwegian can be better at collaboration	-	-	- Market and customer orientation - Adequate financing - Competent sales force - Cooperation

5. Analysis and discussion

5.1 Introduction

This chapter brings together the theoretical models and propositions in chapter three with the empirical research in chapter four. The aim is to holistically discuss how Norwegian wind technology providers successfully can commercialize their products, and to find out whether the propositions formulated in chapter three are strengthened or weakened based on empirical findings (cf. table 6). This will result in a set of tangible recommendations for wind technology firms. The empirical analysis in this chapter combines the data from 17 different interviews. In order to conveniently get an overview of these sources, appendix 8.6 provides a complete list of all the interviewees and their associated companies.

The disposition in this chapter is as following: First, each proposition as illustrated in figure 9 is discussed separately in sections 5.2 to 5.10. Whereas the first three sections are related to how firms can reduce the probability for commercialization failure, sections 5.5 to 5.10 discuss how they can increase the likelihood for success. The focus of the chapter is shifted in the next three parts. Whereas 5.2 to 5.10 uses the method of table 6, the final sections do not necessarily rely on it and provides a general discussion across different perspectives. Part 5.11 reflects on the relationship between the propositions; whether there exists any synergies between them or if they are somehow negatively correlated with each other. As presented in chapter two, the thesis also discusses whether there are any differences in commercialization strategy between firms with differing sizes and product types. This is done in section 5.12. Moreover, 5.13 reflects on what impact external factors have on commercialization strategy and success. Finally, this chapter is summarized in 5.14 together with a revised and final framework that gives recommendations on how Norwegian companies should commercialize and launch their wind technologies.

5.2 Proposition 1a – Chasm and whole product

This proposition is related to chapter 3.3 in the literature review, and discusses the contention that *Norwegian wind technology providers should develop a whole product and cross the chasm, in order to avoid early market exit*. Relevant theory is provided by Moore (2002*). Section 5.2.1 analyzes the validity of proposition 1a based on the empirical data in chapter four. Next, section 5.2.2 connects and discusses the findings with relevant theoretical models from chapter three. The aim is to critically asses the extant literature in light of empirical findings from the Norwegian wind industry, thus providing new theoretical contributions.

5.2.1 Empirical analysis and practical implications

The existence of a chasm is largely confirmed by Schwenke (2014) (cf. section 4.2.4), Ove Pettersen (2014) (cf. section 4.4.4), Dale (2014) (cf. section 4.9.1) and Singstad (2014) (cf. section 4.10.1). The finding implies that Norwegian wind technology providers should be aware of the gap between early innovators and mass-market customers, and formulate strategies accordingly. As discussed in the theory review, whole product configuration is

needed to overcome the chasm issue and penetrate mass markets. Ove Pettersen (2014), Dale (2014) and Schwenke (2014) provide support for this contention, claiming that complementary assets and services are indeed necessary to cross the chasm and cater to the needs of risk-averse customers. However, the challenge remains on high investment costs in realizing whole products (Schwenke, 2014). The relationship between chasm theory, whole product and complementary assets is further discussed in section 5.11.1.

The theory of Moore (2002*) is closely related to customer behavior, and it is evident that there are several critical industry specific characteristics among wind technology customers. Most importantly, Larsen (2014) and Torolf Pettersen (2014) from Blaaster, Dahlhaug (2014) from Chapdrive and Singstad (2014) from Innovation Norway argue that customers such as power utilities and wind turbine producers are very conservative and risk-averse. This suggests that they can be categorized as being part of the mass-market or majority market, since they are less willing to adopt early innovations. They demand a reliable and proven product, which is completely different from the innovations the wind technology providers offer at its early product lifecycle. More decisively, Schwenke (2014), Ove Pettersen (2014), Vik (2014) and Dale (2014) state that there are almost no innovators and early adopters in the market. This has significant implications on the commercialization strategy of a company:

First, the possibilities for testing new and especially radical innovations will be lower in a market with few innovators and early adopters. According to Larsen (2014) (cf. 4.4.9), this is an important criterion for commercialization success. Section 4.4.4 exemplified this contention with Blaaster, which has challenges in testing its unproven technologies in collaboration with power utilities. This issue is even more of a problem when considering the long verification processes in the industry, which was discussed in conjunction with Chapdrive in section 4.7. Second, the possibilities for continuous customer orientation and feedback from them during the technology development are reduced, since the wind technology customers are focused on proof of concept before discussing further adoption of the product. For example, Chapdrive concentrated on verification before making efforts in selling the technology, a time period that entailed little connection with customers. Third and finally, the lack of innovators and early adopters raises the barriers to entry, particularly for start-ups. This is because the technology providers are more needed to obtain large amount of capital for proprietary development and testing on their own, when customers are less willing to engage in collaborative testing and development. Chapdrive is case in point illustrating this, as no players were eager to support their costly component development. Even though they had significant up-front capital at their disposal, it was not enough to finance the final stage of product development. This shows evidence of high barriers to enter and succeed in the wind industry, especially among those who are not granted resources from venture funds (Singstad, 2014) (cf. 4.10.1).

Based on the analysis, we can conclude that proposition 1a is strongly supported, since more than three interviewees in additional to an external interviewee back the proposition. Indeed, Norwegian wind technology providers should develop a whole product and cross the chasm.

This notion is supported by interviewees from two different companies and two external institutions.

5.2.2 Discussion and theoretical implications

The analysis in 5.2.1 shows that Moore's model must be modified in order to correctly reflect the realities of the wind sector. The bell curve does simply not fit the industrial characteristics of the wind energy segment. Hence, the model can be revised according to figure 12. It shows crudely that there are only early majority, late majority and laggards in the wind energy market, in contrast to the original model that also includes innovators and early adopters. As illustrated, the chasm is now bigger and even more prevalent.

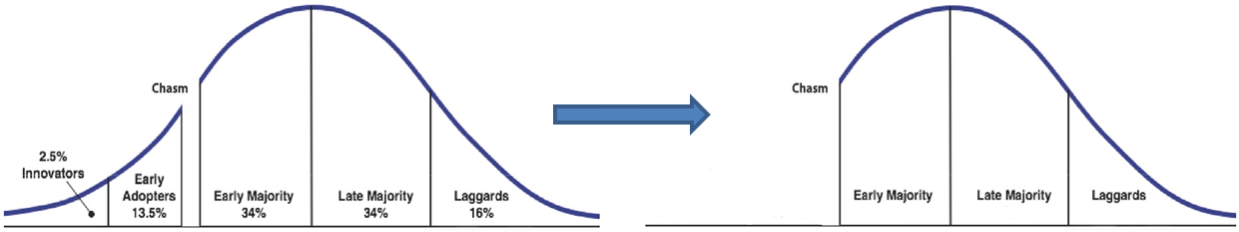

Figure 12: Adapted chasm model

Referring back to the theory review, Easingwood and Harrington (2002) agree on Moore's research. They claim that products must be launched two times. First, when entering the innovator and early adopter market. Second, the product must be modified and re-launched before mainstream customers are inclined to adopt the new technology (cf. section 3.4.3). However, this is changed in the wind sector, as there are no innovators and early adopters in the market. Now, only a single product launch is warranted. Nevertheless, this implies a tougher commercialization process, since the market adoption rate is less incremental than before. Furthermore, there are fewer opportunities for companies to adjust the product before entering into mass-markets. In other words, barriers to entry are increased.

As a final summary, proposition 1a is supported by several interviewees across multiple companies and external institutions. However, the chasm model must be customized for the wind energy business. The analysis in 5.2.1 shows several examples of case companies that have challenging issues with the chasm phenomenon. Chapdrive shows the extreme result of a market with no innovators and domination of risk-averse late majority customers. It is not implausible that Chapdrive could have still been in business today, if it had not been for few risk-willing customers in the Norwegian market.

5.3 Proposition 1b – Minimal investment base

This section discusses the proposition that *Norwegian wind technology providers should minimize its initial investment base, in order to avoid early market exit and reduce the consequences of the death valley phenomenon*. As explained in section 3.3, the term minimal investment base is used in conjunction with various cooperation strategies to pool risk and investments, and is discussed by Olleros (1986). As previously, this part starts off with an

empirical analysis and discussion of practical implications, before reflecting on how this is related to the extant theory.

5.3.1 Empirical analysis and practical implications

Multiple interviewees confirm that the death valley phenomenon is very much prevalent in the wind energy industry. One of Blaaster's greatest challenges is that it is currently in the middle of the death valley. Furthermore, Dahlhaug (2014) states that the payback period is much longer in the wind industry, due to long periods of product verification (cf. section 4.7.5). This makes the effects of the phenomenon even more present. Clearly, the death valley issue creates market uncertainty, and is a threat to the survival of young start-ups. Indeed, a prerequisite for avoiding early demise is that the death valley either is avoided or its effects minimized. Schwenke (2014) and Øvrebø (2014) provide an example on how to avoid or minimize the consequences of the death valley phenomenon. The use of commercial partnership was mentioned in section 4.2.5 as being successfully utilized by SmartMotor as the company is now past the death valley. The agreement ensures early cash flow, a minimized fixed cost base and flexibility. The strategy is endorsed by Dale (2014) and Singstad (2014) as being effective. The former interviewee further elaborates that licensing and providing complementary services before product launch can generate early income for start-ups (cf. section 4.9.2). Stadaas (2014) supports the idea of using licensing to minimize the effects of death valley (cf. section 4.6.5). Øvrebø (2014) further argues that licensing reduces risk and the need for capital investments (cf. section 4.2.6). As a final example, Blaaster uses a small and lean technical team to reduce expenses during the critical phase (cf. section 4.4.8).

Summarized, it is clear that the death valley phenomenon is strongly present and prevalent in the wind industry. It creates market uncertainty and is a threat to pioneering start-ups, and can potentially be the cause of early market exit. Five interviewees across two companies and two different external institutions, argue that this can be avoided or mitigated through risk and investment pooling. Relevant strategies that practitioners should consider are commercial partnership and licensing, and this contention should be included in proposition 1b. Based on this analysis, we can conclude that *Norwegian wind technology providers should use cooperation strategies to minimize the investment base, thereby avoiding early market exit and reducing the consequences of the death valley phenomenon.* Referring to table 6 and the sources who support this, the assertion is strongly supported.

5.3.2 Discussion and theoretical implications

Following the analysis in the previous section, the theoretical findings of Olleros (1986) is supported. As explained in section 3.3, he presents licensing, joint venture and subcontracting as possible strategies for minimizing the investment base. However, the empirical analysis only mentioned licensing as a possible strategy. This suggests that licensing might be more appropriate than joint venture and subcontracting, and that the theory of Olleros (1986) is not entirely transferable to the wind energy sector. Though, a more likely explanation is that licensing is widely used in the Norwegian wind industry (Dale, 2014) (cf. section 4.9.3.). Thus,

the interviewees are more biased towards this model compared to joint venture and subcontracting. In terms of commercialization performance, this does not imply that licensing is better than joint venture and subcontracting.

The discussion so far suggests that cooperation is important during product commercialization. Olleros (1986) argues that firms should team up in various ways with other incumbents, whether large players or smaller companies. He also adds that this must be considered, even though there are some drawbacks with cooperation. For example, licensing leads to loss of the monopolistic product position. However, in a market where the death valley phenomenon is ever looming, this is sometimes a necessary sacrifice to make. Section 5.9 further discusses the theme on cooperation, while 5.11.2 reflects on the relationship between proposition 1b and 6.

5.4 Proposition 1c – Complementary assets

In this part, we discuss the proposition that *Norwegian wind technology providers should gain a strong position in complementary assets, in order to avoid early market exit*. It is related to the framework of Teece (1986*), as explained in section 3.3. The model is closely connected to the whole product concept, which was discussed in proposition 1a. Thus, there is some natural overlap between this section and 5.2. This is further elaborated in 5.11.1. As previous, empirical analysis is presented first, before a theoretical discussion.

5.4.1 Empirical analysis and practical implications

None of the case companies provide any explicit data that lack of complementary assets leads to early market exit. However, Ove Pettersen (2014) states that they are a necessity to successfully enter new markets, which is the reason why Blaaster is considering to undertake a turnkey delivery strategy (cf. section 4.4.4). Similarly, Windflip argues that complementary expertise and know-how within marine operations is necessary for their product's success (cf. section 4.5.6) (Christophersen, 2014). The interviewee further adds that this competence must be accessed through external partners, since the company does not possess the capabilities in-house. Finally, Dale (2014) is also positive about the use of complementary assets and services, but does not clearly state that it is prerequisite for success.

As mentioned in section 3.3, Teece (1986*) stresses that firms in environments with weak patent protection regimes, i.e. appropriability, are more likely to be subjected to imitation from competitors. He further states that strong regimes is an exception rather than the rule. Singstad (2014) argues that in a Norwegian context, the patent is only as strong as it is willing to defend it from competitors (cf. section 4.10.1). This implies that Norwegian wind technology providers must allocate significant resources to patent management in order to avoid infringement and erosion of competitive advantage. This must be developed together with a strong position in complementary assets. Only then can firms gain strong and sustainable market positions and avoid entrants from copying their technology and displace the incumbent company.

As a conclusion, no empirical data that lack of complementary assets lead to early market exit was found. On the other hand, interviewees from two companies and one external institution argue they are necessary for *successful* commercialization, hence indicating medium support. Thus, Norwegian wind technology suppliers should indeed gain a strong position in complementary assets. Nevertheless, since no examples showing the relationship between commercialization failure and lack of complementary assets was found, proposition 1c must be modified to the following: *Norwegian wind technology providers should gain a strong position on complementary assets, in order to best commercialize its products.*

5.4.2 Discussion and theoretical implications

The previous analysis shows that Teece's focus on lack of complementary assets as a source of product commercialization failure is not necessarily justified. However, his theory is certainly relevant when discussing it in relation to commercialization success. This difference may be perceived as trivial, but is significant in terms of how practitioners and scholars should implement strategies and think.

As mentioned earlier in 5.4, there is a connection between Moore (2002*) and Teece (1986*). Although they both argue that complementary assets are necessary to avoid early market exit, their point of departure is somewhat different. While Teece (1986*) contends that they are essential to avoid imitators displacing the innovator's market leader position, Moore (2002*) stresses that complementary assets and services contribute to a whole product, which is critical for late majority customers. In other words, complementary assets are important both to fend off competitors and to cater to the mass market's needs. This implies that the model of Teece (1986*) is not only related to product commercialization success, but also the creation of a whole product, which in turn is associated with lower probability of commercialization failure (cf. illustration in figure 14). This notion is also discussed in section 5.11.1.

5.5 Proposition 2 – Competitor orientation

This proposition is related to the theory of Debryune et.al. (2002), which is described in section 3.4.2. Section 5.5.1 analyses the contention that *Norwegian wind technology providers should be competitor oriented, in order to best commercialize its products.*

5.5.1 Empirical analysis and practical implications

The article of Debruyne et.al. (2002) bases its argument on the fact that two-thirds face competitive reactions after the product launch, but the case companies do not provide an unambiguous picture to this statement. SmartMotor, Fedem Technology, Windflip and Chapdrive state that they have few direct competitors and none of these mentions any major reactions from competitors. Although SmartMotor experienced some challenges from Chinese entrants in 2010 (cf. section 4.2.4), Mr. Øvrebø contends that the company faces few competitors today, especially in Norway, due to unique product characteristics (cf. section 4.2.7). Windflip points out that the most viable competing alternatives are substitutes such as

tugboats. On the other hand, Larsen (2014) representing Blaaster claims that the competition in the wind turbine market is fierce, while Dale (2014) argues the same in the wind companies that he has been part of. It is apparent that the data does not lead to any conclusive answer. Since the case companies operate across quite different segments, it is reasonable to assume that the degree of competitiveness is dependent on the characteristics of the market the firm is operating in. Hence, it is not appropriate to generalize that all Norwegian wind technology providers should put efforts into being competitors oriented. Since the empirical data are too divergent, proposition 2 is not supported. The next section discusses how competitor orientation differs along the dimensions firm size and product type.

5.5.2 Discussion and theoretical implications

SmartMotor, Windflip and Chapdrive operate in niche markets, since they deliver smaller parts or solutions to wind turbines. On the other hand, Blaaster operates in a relative broad market space since they provide the whole wind turbine. It seems that the companies operating in niche markets have fewer competitors than the one in a broad market. At the same time, Debruyne et.al. (2002) stress that it is precisely in niche markets that the likelihood of competitor reaction is relatively low. Thus, there is some justification to their contention that niche-driven companies should be less concerned about being competitor oriented. Furthermore, some support to Debryune's et.al. (2002) claim that incremental innovations are more likely to face reactions than radical products, is given. For example, the radical products of Chapdrive and Windflip met little competitive resistance, which is in line with Debryune et.al. (2002). On the other hand, Blaaster's incremental innovation is fighting for survival in a market with many competitive players. However, it should be noted that the incremental innovations of Fedem Technology, SmartMotor and Statoil/Hywind have met relatively little competitive reactions. Thus, the case of Norwegian companies shows some contradictory results to the work of Debryune et.al. (2002). Debryune et.al. (2002) base their findings from the construction, chemicals and transportation industry in the US, UK and the Netherlands. It is possible that geographical and industrial differences explain the discrepancy between this study and Debruyne et.al. (2002).

In summary, the degree of competiveness varies according to which market the company operates within. Thus, propositions 2 cannot be generalized for all Norwegian wind technology companies, and is not supported. Instead, each firm must customize its own competitive strategy taking into consideration the technology and segment it is operating in. The research confirms that ventures operating in niche markets developing radical technologies are less needed to be competitor oriented. On the other hand, there is mixed support for the assertion that firms marketing incremental innovations should be more competitor oriented.

5.6 Proposition 3 – Decisions alignment

The third proposition analyzes the notion that *Norwegian wind technology providers should align its strategic and tactical launch decisions, in order to best commercialize its products.* It

is mainly associated with chapter 3.4.3. Relevant theories are presented by Hultink et.al. (1997), Hultink et.al. (1998), Benedetto (1999), Hultink and Robben (1999) and Frattini (2013). The first section starts off with an empirical analysis, while the second section discusses theoretical implications.

5.6.1 Empirical analysis and practical implications

Proposition three is a recurring theme in several articles in the theory review. Even though it is a well-established argument in the product launch and commercialization literature, it has been hard to arrive at any meaningful conclusions based on the case study analysis alone. Not enough reliable data was found during the empirical analysis, as no interviewees gave any clear answers to the questions related to the proposition. Furthermore, no one indicated decisions alignment as a success criterion when asked generally about what they considered as success factors in commercialization strategy. However, it should be remarked that some of the answers from the interviewees indicate that not all of them fully grasped the concept of decisions alignment. In other words, it is likely that some spurious results might have showed up. For this reason, these data points were not included in the case study presentation in chapter four. In hindsight, it is evident that some elements in the interview process could have been done differently. However, I believe that interviews are not the optimal research method to investigate proposition three, and that that other approaches might have yielded better results. The next section discusses this contention and its theoretical implications.

5.6.2 Discussion and theoretical implications

The most significant challenge in analyzing proposition three is that it is rather abstract, hard to bring to the surface and deeply embedded into a theoretical context. The use of semi-structured interviews as done in this thesis, increase the chances for spurious results, especially when the conceptual questions are tricky to understand among interviewees. Alternatively, the use of quantitative deductive studies similarly to the papers of Frattini et.al. (2013) and Hultink et.al. (1998) are possible. Such methodology would provide objective measures and base on statistical generalizability, thus reducing the chance of errors. However, a major weakness with such a method is the bias in *data input*. A critical question remains about how to create a survey that does not influence the respondents' answers in any particular directions.

Evidently from the previous paragraph, basing research on the answers of practitioners will always be affected by their bias. One cannot guarantee that there is perfect consistency between what they say and what is done in practice. Thus, methods such as passive *participant observations* and *causal mapping* can be used as alternatives to interviews and surveys. These approaches give an impartial view of various managerial situations (Bryman & Bell, 2011: 437). For example, the researcher could participate as a fly on the wall during strategy sessions and board meetings, hence investigating how long-term strategic and short-term tactical decisions are made in practice. The situations can be visualized through causal maps, thus providing a helpful research tool. However, the challenge remains on how to

connect the descriptive data to commercialization performance and that the study must be conducted over a longer time period in order to understand how decisions emerge and is related to product performance.

In summary, proposition three cannot be concluded in either direction. There is simply too little data available based on the case studies. However, other research methodologies are believed to be more suitable. There are pros and cons with both qualitative and quantitative approaches, and future studies should have these in mind.

5.7 Proposition 4 – Market information gathering activities

This proposition discusses the assertion that *Norwegian wind technology providers should utilize strong market information gathering activities, in order to best commercialize its products*. It is connected to the paper of Benedetto (1999), who claims that this is a crucial element in the strategy planning process, along with long-term strategic decisions and short-term tactical decisions. As explained in the theory review, Benedetto (1999: 539) regards customer feedback and market testing as central market information gathering activities. It is believed that product tests in the market, interpretation of the market test findings and studies of customer feedback are positively related to product launch success. These are important constituents in market orientation strategies, and the relationship between this and market information gathering is discussed in section 5.11.3. The next section analyzes proposition four based on the empirical data, while reflections on theoretical implications is included in 5.7.2.

5.7.1 Empirical analysis and practical implications

The case study research revealed that Blaaster and SmartMotor use activities such as participation in fairs, councils and dialog with industry players to stay updated on the market dynamism and trends. Although both Schwenke (2014) and Ove Pettersen (2014) argue that these are important activities, they do not explicitly state that they are critical for product commercialization success. However, interviewees from two different companies and one external institution emphasize the criticality of product testing and verification (Ekström, 2014; Larsen, 2014; Dahlhaug, 2014). For example, Larsen (2014) stresses that product demonstration and a working prototype is necessary to achieve market acceptance, and thus commercial viability (cf. section 4.4.9). Furthermore, Dahlhaug (2014) emphasizes that customers in the wind industry demand proof of concept before adopting new products. Market testing is a tool to demonstrate and show proof of concept to customers and achieve product verification. It can contribute to higher probability of market adoption, since customer's feedback are incorporated continuously during the product development and testing. This will in turn lead to higher likelihood of commercial success. In other words, market testing and the knowledge gained from it should be a decisive component in market information gathering strategies. Along this line, Norwegian wind technology providers should be aware of the challenges. Ekström (2014) points out that conservative customers lead to less willingness to test innovative products (cf. section 4.8.2), while Dahlhaug (2014) stresses

the long verification processes (cf. 4.7.4). Consequently, firms should allocate significant resources to the market testing process such that the activity perseveres throughout the long and complex verification process.

In summary, only empirical evidence that market information gathering is an important activity in some Norwegian wind technology firms was found. The interviewees did not necessarily state that they are a source to product launch success. On the other hand, two firm interviewees and one external interviewee argue that product verification and demonstration is critical. In line with table 6, this contention is thus mediumly supported. Good market testing routines leads to higher likelihood of market acceptance, since feedback from the customers are actively used to improve the product. This in turn leads to higher probability of future sales, and consequently commercial success. Thus, we can reformulate proposition four to the following: *Norwegian wind technology providers should utilize strong market testing activities, in order to increase likelihood of market adoption and consequently commercial success.* Note that the revised proposition results in a second layer, as illustrated in figure 14 in section 5.14.

5.7.2 Discussion and theoretical implications

As previously analyzed, the notion of market information gathering activities is somewhat different in the wind energy market, compared to the theory of Benedetto (1999). Empirical studies show that market testing is a more prevalent success factor than other activities that Benedetto (1999) outline. Thus, a theoretical implication is that Benedetto's theory cannot be generalized to the wind industry. Certain constituents are more valid than others in the wind sector. The fact that market testing is deemed a more of essential criterion to commercialization success than other activities can be explained by industry specific factors. For example, the risk-averse behavior of customers increases the need for market testing in order for them to adopt new products and technologies. Their demand for a proof of concept makes the use of market testing even more relevant and appropriate.

5.8 Proposition 5 – Market orientation

The fifth proposition is related to the notion that *Norwegian wind technology providers should be market oriented, in order to best commercialize its products.* It discusses the role of market targeting, understanding customers and delivering value to them. Relevant extant theory was presented in section 3.4.3 with researchers such as Mu and Benedetto (2011), Langerak et.al. (2004) and Lin et.al. (2006), and in section 3.2.1 by Jolly (1997*) as well. The latter author explains that many commercialization efforts fail in the aspects of market orientation, thus showing how critical proposition five is. In the next section, proposition five is analyzed based on empirical data in chapter four, before a theoretical discussion in the section after.

5.8.1 Empirical analysis and practical implications

Proposition five is to a large degree confirmed by several sources in the case studies, such as Schwenke (2014) (cf. section 4.2.9), Christophersen (2014) (cf. section 4.5.9), Stadaas (2014)

(cf. section 4.6.8), Indrevær (2014) (cf. section 4.6.8), Ekström (2014) (cf. section 4.8.2), Dale (2014) (cf. section 4.9.4) and Singstad (2014) (cf. section 4.10.4). When asked generally about what a successful commercialization strategy consists of, all of the aforementioned interviewees answer market and customer orientation independently from each other. This indicates a strong support for proposition five, both from several respondents within the case companies and external interviewees.

The interviewees provide different perspectives to proposition five. Schwenke (2014) argues that there must be consistency between the technical innovation and customer's needs, and he states that the whole organization must be committed to this (cf. section 4.2.9). Stadaas (2014) elaborates that firms must understand their customers and how their needs change over time. Market intelligence and communication with customers must be prioritized. Furthermore, the case of the hired Danes in Chapdrive shows that leaders with in-depth market knowledge and understanding of customers can have a very positive impact on the organization (cf. section 4.7.4). Vik (2014) provides another successful example in section 4.7.9 where he mentions OCAS, a company with a clear customer and targeting strategy coupled with compelling value propositions. Finally, Singstad (2014), Schwenke (2014), Stadaas (2014), Ekström (2014), Dale (2014) state that Norwegian companies are too technology and product focused during the commercialization phase, and that they must be more market oriented. This wide consensus among several corporate decision makers and industry interviewees illustrates one of the major challenges in the Norwegian wind energy industry. It is apparent that the wind technology providers must reorient themselves from the product itself and more to its customers.

The case of Windflip provides valuable insight to the notion of market orientation. As explained in section 4.5.4, Christophersen (2014) contends that the company was customer oriented from beginning through the cooperation with Statoil. However, the lack of relevant customers in an immature market inhibited further feedback from customers and the market. Windflip entered the market early, which in hindsight contributed to the fact that the firm today is on hold. There are two lessons from this experience. First, Norwegian technology providers must get feedback from *several* customers in order to reflect the market as realistic as possible. Second, they must enter the market in a time when there are enough potential customers to get a correct sense of the market's needs. Firms that choose to develop their own markets with few existing customers and little infrastructure must be able to navigate in a complex landscape with little available customer information.

Proposition five is not only confirmed by several sources in this thesis, but also by the study of Holgersen and Lillebo (2002*), which was presented in section 3.7. Recall that this section was not used to formulate propositions, but rather to elaborate them based on specific empirical findings found in the literature review. Thus, the following argument must not be perceived as circular reasoning. Based on interviews of Norwegian IT companies, the authors conclude that successful firms are characterized by market orientation and good understanding of the customers. This culture permeates throughout the whole organization.

Although the study is within the ICT industry, it is reasonable to transfer the findings to the wind energy industry. Both of the sectors are technology intensive, competitive and the research by Holgersen and Lillebo (2002*) is performed in Norway. The findings further confirm the findings in the case study research in chapter four.

The discussion so far confirms that market orientation is vital for commercialization success. Thus, the next question is what firms can do to be market oriented. The previous section about market information gathering activities provides some means to achieve this. A thorough presentation of this can be found in section 5.11.3, where relationship between the propositions are discussed.

As a conclusion, proposition five is strongly supported. Indeed, *Norwegian wind technology providers should be market oriented, in order to best commercialize their products*. Seven interviewees from three case companies and three external institutions confirm this. Note that all of the external interviewees are in agreement with each other. Furthermore, the proposition is backed by Holgersen and Lillebo (2002*). Still, as was pointed by five interviewees, Norwegian companies have potential for improvement within this area.

5.8.2 Discussion and theoretical implications

The theory on market orientation is to a large extent confirmed to be crucial for product commercialization. In other words, this study is one of many works that argues the prominence of focusing on customers and delivering superior value to them. Due to the large degree of consensus, it is not unlikely that the same conclusions can be drawn from other geographical markets than the Norwegian industry. Furthermore, the literature on market orientation is dominant in both B2B and B2C industries, thus making it very much possible that proposition five is also relevant for commercialization in other industries than wind energy.

5.9 Proposition 6 – Cooperation

This proposition discusses the assertion that *Norwegian wind technology providers should cooperate with external parties, in order to best commercialize its products*. The contention is mainly related to section 3.5 in the theory review. Researchers such as Holgersen and Lillebo (2002*), Gans and Stern (2003), Kollmer and Dowling (2004), Hsu (2006), Aggarwal and Hsu (2009), Golicic and Sebastiao (2011) and Walsh (2012) provide different perspectives to this issue. The contents in these articles are synthesized together with the findings from the case studies. As before, 5.9.1 discusses the validity of the proposition using empirical data, while 5.9.2 is devoted to theoretical models and implications.

5.9.1 Empirical analysis and practical implications

The first paragraph below gives a short description of cooperation modes used by the case companies in chapter four. The second, third and fourth paragraph discuss the role of cooperation as a success criterion, and which collaboration modes are the most appropriate. The fifth paragraph provide some more insights and lessons from the Chapdrive case that are

relevant for practitioners. In the paragraph thereafter, it is argued that cooperation should not only be done across firms, but also with various stakeholders. Finally, this section concludes on the validity of proposition six.

The case study companies from chapter four utilize a wide variety of cooperation modes. SmartMotor uses a licensing strategy (cf. section 4.2.6), while Fedem Technology has outsourced its distribution channels to DNV GL (cf. section 4.3.6). Windflip used a rather informal cooperation mode consisting of knowledge sharing with Statoil (cf. section 4.5.6). During its existence, Chapdrive had some industrial partners with varying degree of success (cf. section 4.7.6). On the other hand, Statoil/Hywind and Blaaster do currently not have any formal collaborative agreements, but both aim to enter high commitment industrial partnerships (cf. section 4.6.6 and 4.4.6 respectively). It seems that Norwegian wind technology providers use an even mix of high and low commitment collaborative strategies. On the contrary, Dale (2014) contends that licensing strategies are most widely utilized (cf. section 4.9.3).

Several interviewees including Ove Pettersen (2014) (cf. section 4.4.6), Torolf Pettersen (2014) (cf. section 4.4.6), Larsen (2014) (cf. section 4.4.6), Stadaas (2014) (cf. section 4.6.6), Ekström (2014) (cf. section 4.8.3) and Singstad (cf. section 4.10.4) support the notion of proposition six. Evidently, Norwegian wind technology providers should enter cooperative agreements in order to successfully commercialize their products. Start-ups often lack the resources and knowledge to operate alone in a complex and dynamic market. Cooperation provides the means to share knowledge, pool risk, gain resources and finances and achieve scale and synergies. However, the respondents disagree on what cooperation mode is the most effective and appropriate. On one hand, Torolf Pettersen (2014), Larsen (2014) and Ekström (2014) argue that high commitment modes such as industrial partnership and joint ventures are more effective than low commitment strategies such as licensing. For example, Ekström (2014) contends that they provide better basis for technology collaboration and knowledge sharing. Blaaster prefers industrial partners because they can provide long-term financing. This is contrary to the works of Kollmer and Dowling (2004) and Aggarwal and Hsu (2009), which state that licensing is appropriate for both integrated and non-integrated start-ups. They argue that liability of newness and smallness make licensing more relevant for small ventures. It is clear that there is some gap in the strategic thinking between scholars and practitioners. On the other hand, Singstad (2014) especially sees potential in licensing, as it provides opportunities to outsource manufacturing, which are activities that Norwegian wind companies have less competence within. This is supported by Dale (2014), but he also points out that licensing leads to lower customer contact (cf. section 4.9.3), which in section 5.9 was found to be critical for successful commercialization. Furthermore, Schwenke (2014) states that licensing reduces risk and need for capital investments, but that it also decreases the proprietorship of the technology when licensed to several partners (cf. section 4.2.6).

The empirical review in section 3.7 also gives support to proposition six. The article of Walsh (2012) constructs a framework that identifies which commercialization strategies are the most

suitable in various environments. Norway is found to be an innovation push cluster characterized by high degree of market sophistication and relatively low renewable energy demand. Due to demand uncertainty and strong bargaining positions among technology providers, innovation push clusters call for use of strategic alliances and cooperation with major incumbent firms. The interviewees have mostly emphasized internal firm specific factors when arguing that cooperation is a prerequisite for commercialization success. However, Walsh (2012) has shown that there are external factors as well that justifies the use of collaboration across firms. Furthermore, his research also specifies which type of firms technology providers should cooperate with, namely large and well-established incumbents. This is indeed because smaller firms reduce their risk when allying themselves with larger players in a market with high degree of uncertainty and complexity. Still, Norwegian technology providers must recognize that entering partnership with large incumbents are difficult in practice, as the case of Chapdrive clearly shows evidence of. Finally, Holgersen and Lillebo (2002*) also provide relevant empirical findings in a Norwegian context. They argue that network relations and cooperation are decisive for finding capital and gaining knowledge. This is in line with the case of Chapdrive and the hired Danes, which was mentioned in section 4.7.8.

Appropriability is a relevant term when discussing which cooperation mode to utilize in different external environments, and is mentioned by Aggarwal and Hsu (2009), Kasch and Dowling (2008) and Gans and Stern (2003). For example, Ulla (2014) points out that close collaboration can lead to dilution of patents, since the partner gains access to proprietary knowledge and assets. In business environments with little patent protection, the chance of expropriation in such cooperative modes is larger. There are pros and cons with both high and low commitment cooperative strategies. As the discussion so far shows, there is no clear answer to what modes are the most effective. Norwegian wind technology providers need to analyze its strengths, weaknesses and environment, before assessing which collaboration method is the most effective and relevant for the company.

Chapdrive provides an important lesson for Norwegian wind technology providers. The firm had all the prerequisites to succeed in the market; a promising technology, a strong and committed management, financing from venture funds and support from knowledgeable people. Yet, the company ended up exiting the market after only seven years in business. As discussed in section 4.7.6, much of this explained by the lack of partnership agreements. Chapdrive was dependent on larger industrial players to scale up its technology, and did not have the resources to pursue the large investments alone. The case shows how important it is for Norwegian companies in the wind industry to engage in cooperation, in one form or another. Earlier identified industry characteristics such as high up-front investment costs, long verification processes, fierce competition and risk-averse customers reinforces this assertion. As a result, firms should have a clear and committed strategy to engage in partnerships. As the case of Chapdrive shows evidence of, the process must start early since it takes time, and

managers must persevere long periods with few fruitful results. Section 5.9.2 explains that venture funds can be helpful in this process.

Firms should not only cooperate with other companies, but also with external stakeholders. In addition, substantial resources must be gathered from them, such that the product is further financed in its development and commercialization process. Elaborating this, Stadaas (2014) exemplifies that Statoil works closely with governments in relation to wind site licenses (cf. section 4.6.9). On the other hand, Indrevær (2014) calls for the need of large customer networks, such that sales are not only dependent on one buyer (cf. section 4.5.5). A relevant contact network can be established through participation in councils and fairs (Schwenke, 2014) (cf. section 4.2.4).

In summary, proposition six is strongly supported by a majority of the interviewees, both among the case companies and the external industry respondents. *Norwegian wind technology providers should indeed cooperate.* However, it is clear that both scholars and practitioners do not agree on what the most appropriate cooperation mode is. Thus, the central strategic question that managers in the wind industry must consider is not *if* to cooperate, but rather on *how* to cooperate. This decision must be based on analysis of the firm's strengths, weaknesses and external environment. Even though we cannot conclude on how Norwegian wind technology providers should cooperate, we can nevertheless state that they indeed should cooperate with both firms and other stakeholders in order to best commercialize their products.

5.9.2 Discussion and theoretical implications

The empirical analysis support the contention of Holgersen and Lillebo (2002*), Gans and Stern (2003), Kollmer and Dowling (2004), Hsu (2006), Aggarwal and Hsu (2009), Golicic and Sebastiao (2011) and Walsh (2012) that firms should cooperate in order to successfully commercialize new products. The analysis also supports the notion that there is not a simple answer on how to cooperate, and that firms must individually assess which mode is the most appropriate one.

The Windflip technology can be regarded as a discontinuous innovation (cf. section 3.2.2), since the product has little supporting infrastructure to diffuse into mainstream markets. Frattini et.al. (2012) and Jolly (1997*) recommends companies experiencing this to enter partnership agreements to overcome the challenges of discontinuous innovations. An interesting connection to the work of Gans and Stern (2003) can be found here. They argue that costly complementary assets often is the key wedge between the capabilities of start-ups and incumbents. Consequently, the use of cooperation is a viable alternative to wholly owned investment in order to access complementary assets. This supports the view of Frattini et.al. (2012) that cooperation should be utilized when commercializing discontinuous innovations.

Recall in the previous section the challenges that Chapdrive had in finding a commercial partner to support their technology development. In accordance with Hsu (2006), venture

funds can be an important resource during this demanding phase. He argues that active investors reduce search costs by utilizing its own networks, lessen expropriation potential and enhance cooperative relationship skills among the companies it is involved in. However, Chapdrive was owned by several venture funds and still did not manage to engage any industrial partners that could bring them to the next step in commercialization. Thus, venture capitalists alone cannot guarantee the achievement of successful collaborative agreements. The finding also implies that the recommended strategy of Hsu (2006) will not always succeed. The relationship between venture capital and cooperation, i.e. proposition six and seven, is further discussed in section 5.11.4.

5.10 Proposition 7 – Financing from venture capital funds

Proposition seven reflects on the contention that *Norwegian wind technology providers should cooperate with venture capital funds in order to best finance and commercialize its products*, and is associated with section 3.6 in the theory review. Relevant theory is provided by Timmons and Bygrave (1986), Hellmann and Puri (2000), Hsu (2006), Widding et.al. (2009*) and Erikson et.al. (2009*). Section 5.10.1 empirically analyzes the validity of proposition seven, discusses pros and cons of venture funding and tries to explain the differing opinions between the interviewees. Finally in 5.10.2, the empirical findings are discussed in relation to a selected number of theoretical models.

5.10.1 Empirical analysis and practical implications

Multiple sources provide support for proposition seven. Based on own experience, Øvrebø (2014) and Dahlhaug (2014) are positive about VC cooperation. Both argue that they are useful in terms of financing, networking and competence, while the latter interviewee further states that they have provided help regarding business development and corporate governance. Specifically, venture funds can through their networks provide references and entry into larger firms that wind technology providers can cooperate with. In other words, the major challenge of conservative customers in the wind industry, as discussed in section 5.2, are mitigated with the use of VC. The venture capital interviewee Ekström (2014), argues that benefits from venture financing are good access to capital, early stage partner collaboration and network relations. Dale (2014), being a respondent from an external institution, provides a more neutral view. He mentions close follow-up of management, knowledge transfer and network access as positive effects of VC. All of the aforementioned arguments are in line with Timmons and Bygrave (1986), Hellmann and Puri (2000) and Hsu (2006).

On the other hand, a number of sources point out several drawbacks with venture capital collaboration. Larsen (2014), Torolf Pettersen (2014), Singstad (2014) provide some critical remarks. The two first interviewees representing Blaaster prefer long-term industrial partners rather than VC for financing. They argue that venture capitalists are shortsighted in nature and that they lack in-depth knowledge of the wind industry (cf. section 4.4.5). The venture capital interviewee, Ekström (2014), along with Singstad (2014) agree that the investment time frame might be too short, which can lead to less optimal strategic choices. Moreover,

Holgersen and Lillebo (2002*) state that venture capital provides little more value than financing. This is contrary to the research of Timmons and Bygrave (1986), Hellmann and Puri (2000) and Hsu (2006).

It should be noted that venture fund financing is not appropriate for all companies. For example, Statoil is large enough to finance its commercialization processes from its own balance sheet. Venture capital would then just be an expensive type of financing. However, for those start-ups that consider venture capital, there are a couple of elements they should be aware of. First, as stated by Vik (2014), Furuseth (2014), Dahlhaug (2014), Larsen (2014), Dale (2014) and Singstad (2014), venture funding within the wind industry has significantly dried up after the financial crisis. This implies that managers must expect a much tougher financing environment in the future. Second, decisions makers must allocate significant resources into persuading venture capitalists that their firm is a good investment. Venture funds use meticulous means to identify the right investment objects. Chapdrive's method of referring to patents to gain support from VC can be a reasonable approach.

In summary, there are quite mixed views on the effects that venture funds have on commercialization performance. This is in line with the conclusion of Holgersen and Lillebo (2002*). Although several sources argue that they have a positive effect, others question this assertion. Thus, proposition seven cannot be confirmed on a general basis. It seems that that the appropriateness of venture capital cooperation is dependent on corporate strategy. Norwegian wind technology providers must analyze on an individual basis whether venture funds provide enough value added to justify time and resources used during the agreement. In next section, this contention is discussed in relation with the theory in 3.6.

5.10.2 Discussion and theoretical implications

The empirical findings from the case interviews are more divergent than the discussions in the venture capital literature, which views venture funds as mostly positive. However, it should be noted that the sample of VC-relevant articles in the literature review is rather limited, and that inclusion of more papers could have revealed several works that are critical to venture funds. Nevertheless, a major weakness with the sample of VC literature is that it is far too general. It does not discern between various firm and product characteristics when recommending start-ups to enter VC agreements. Future research should take this into consideration. Another relevant observation is that the papers of Timmons and Bygrave (1986), Hellmann and Puri (2000) and Hsu (2006), which are based in the US, are generally positive to VC. On the other hand, the article of Widding et.al. (2009*) based in Norway, is more balanced and critical. A possible explanation is that the US venture capital environment is better functioning than the Norwegian one. However, more research in this topic is warranted before any conclusions are drawn.

The work of Hellmann and Puri (2000) provide a possible explanation for why the case study companies disagree on whether venture funds are positively correlated to commercialization performance. They contend that the appropriateness of choosing active investors depend on

the firm strategy. As apparent from the firm descriptions in chapter four, the companies have quite different business strategies. For example, Blaaster refrains from licensing and focuses on long-term industrial relationship, thus making the shortsighted investment periods of venture funds less relevant. On the other hand, SmartMotor focuses on licensing and are less concerned about long-term industrial partnership. As a result, this company relies on venture fund and are generally positive to them. The examples show support to the contention that the decision to enter into VC agreements is dependent on firm strategy and long-term goals.

While the venture capitalist Ekström (2014) is rather positive to venture capital, other firm interviewees are less. This shows some support to the finding of Widding et.al. (2009*) that investors perceive their contributions as more value adding than entrepreneurs do. However, more research is warranted in order to come at a final conclusion.

5.11 Relationship between selected propositions

So far, little has been said about the relationships between the previously discussed propositions. This part aims to analyze findings and implications across the elements in the theoretical framework in figure 9. In other words, this section brings the discussion to a holistic level. Note that the method in table 6 used to conclude on the degree of support in findings is not necessarily used in neither this section nor in 5.12 and 5.13. First, 5.11.1 reflects on the relationship between the chasm theory, whole product (P1a) and complementary assets (P1c). Second, 5.11.2 elaborates on the tie between minimal investment base (P1b) and cooperation (P6). Third, 5.11.3 discusses the connection between market information gathering activities (P4) and market orientation (P5). Finally, the link between cooperation (P6) and financing from venture funds (P7) is analyzed in 5.11.4. The resulting findings and conclusion are implemented into the revised framework in 5.14.

5.11.1 P1a and P1c – Chasm, whole product and complementary assets

Section 5.2 concluded that the chasm is very much prevalent in the wind industry, and that firms need to create whole products to cross this gap. It also referred to the statements of Ove Pettersen (2014), Dale (2014) and Schwenke (2014), who all argued that complementary assets and services are needed to cater to the needs of the mass-market customers. Obviously, a parallel can be drawn to section 5.4 about proposition 1c. Here it was concluded that a strong positions in complementary assets is needed to achieve successful product commercialization. Based on the discussions so far, complementary assets not only strengthens the company's current market position by fending off potential competitors, but it is also a precondition to cross the chasm and enter larger mass markets. Thus, we can conclude that there is a positive relationship between proposition 1a and 1c. However, note that the relationship is only valid *from* P1a *to* P1c, as reflected in figure 14.

5.11.2 P1b and P6 – Minimal investment base and cooperation

As concluded in section 5.3, minimizing the company's investment base is necessary to avoid or mitigate the market uncertainty of the death valley phenomenon. Furthermore,

cooperation was found to be the most appropriate approach to achieve this. On the other hand, cooperation was in section 5.9 concluded to be necessary for commercialization success. Since it is also contributes to minimize initial investments and pool risk, proposition six has a positive impact on proposition 1b. This is illustrated with an implication arrow from P6 to P1b in figure 14. The case of the early demise of Chapdrive is an example of a firm that did not manage to pool large investments costs due to the lack of cooperators. From this lesson, it is clear that Norwegian wind technology providers should reduce up-front investment costs as much as possible in order to reduce the likelihood of early market exit. In this respect, cooperation is a viable strategic option.

5.11.3 P4 and P5 – Market testing and market orientation

Section 5.7 found that specifically market testing activities are related to commercialization success, while the notion of market orientation was confirmed in 5.8. In this section, it is argued that proposition four and five are interrelated and mutually support each other. Market testing activities lead to a higher degree of market orientation. Widespread use of market testing provides more contact to customers and increased understanding of their needs. Consequently, firms are provided with a better understanding of the market and are thus more inclined to make strategic decisions that are customer- and market driven. This is in line with Stadaas (2014) in section 4.6.9, who points out that market intelligence and communication with customers should be prioritized as part of the market strategy. Conversely, I believe that market orientation has positive impact on market testing. Firms with a corporate mind-set that focuses and values market orientation are more likely to undertake market-testing activities. Based on this discussion, we can state there is an implication arrow both ways between proposition four and five, as illustrated in figure 14.

On a different note, the article of Mu and Benedetto (2011), which was presented in 3.4.3, argues that several strategic orientations are complementary and support each other. For example, it is believed that market and network orientation are related to each other. A connection between this and empirical findings in chapter four can be found. Schwenke (2014) argues that market information from networks are important to get a good picture of market dynamism and temperature. In other words, networks provide the means for gaining market knowledge, which in turn leads to increased market orientation. Thus, the research of Mu and Benedetto (2011) is somewhat empirically supported by Schwenke (2014).

5.11.4 P6 and P7 – Cooperation and venture fund financing

As explained in section 3.6, venture fund financing is merely a special case of cooperation. As evident by the discussion in section 5.10 about VC, most of the interviewees focus on the non-financing benefits of VC cooperation. For example, Widding et.al. (2009*) argue that venture funds can through their networks provide references and entry into larger firms that wind technology providers can cooperate with (cf. section 3.6). This network aspect is also supported by Øvrebø (2014) and Dale (2014). Hsu (2006) further contends that venture capitalists reduce cost of searching potential cooperators, lessen expropriation potential and

improve cooperative relationship skills (cf. section 3.5). All of this indicates that VC has a positive impact on cooperation. Their active involvement reduce the efforts of finding new partners and enhance the cooperative relationship. As opposed to the three former sections, this relationship is not illustrated in figure 14, since proposition 7 is not supported.

5.12 Differences in product and firm characteristics

Surprisingly, the extant literature says very little about how commercialization strategy varies with different types of companies and products. Thus, this section aims to contribute to close this theoretical gap. As presented in 2.2.2, this is part of the research design. First, variations between radical and incremental innovations are analyzed in 5.12.1. In accordance with table 1, this is discussed in relation to whether the product strategy is successful or not. Second, in 5.12.2, variations between start-ups and mature firms are reflected on and is related to the latter case. Finally, theoretical and practical implications are holistically discussed in 5.12.3.

5.12.1 Incremental innovations compared to radical innovations

The forthcoming discussion is associated with table 1. Based on the summary in table 9 and the discussions so far in this chapter, we can organize the case companies according to table 10. Note that the degree of success in product strategy is solely related to how the offering performs in the wind industry. For example, the analyzed products of SmartMotor and Fedem Technology have success in other sectors they operate in, but not in the wind industry, which I am concerned about. Finally, observe that it is too early to conclude on the degree of product strategy success in Blaaster and Statoil/Hywind. Although their innovations have achieved technical success, their products are not yet launched. The question about commercial success is still open.

Table 10: Categorization of case companies

	Incremental innovation	**Radical innovation**
Successful product strategy	-	-
Failed product strategy	SmartMotor Fedem Technology	Chapdrive Windflip
Too early to conclude on the degree of product success	Blaaster Statoil/Hywind	-

The most interesting finding revealed by table 10 is that no companies in the case sample seem to have succeeded with their product commercialization. Furthermore, there are equally many failed cases in both incremental and radical innovations. However, the radical cases represented by Chapdrive and Windflip are currently out of business, while the incremental innovations are not. Although we cannot conclude or generalize based on this finding alone, this supports the contention of Frattini et.al. (2013: 186) that the more radical the product is, the greater likelihood of an early market exit.

Differences between successful and failed strategies have been discussed in depth throughout the thesis. Thus, the rest of this section focuses on variations between incremental and radical

innovations. Summary of the arguments in the next paragraphs is provided in table 11 in section 5.12.3. First, as already discussed in 5.5, incremental innovations face more stiff competition, and must therefore focus more on being competitor oriented than companies marketing radical technologies.

Second, section 5.2 pointed out the importance of verification and product testing. It also emphasized the non-existence of early innovator customers. Risk-averse customers shun adoption of radical technologies, thus firms commercializing these kind of products will experience higher barriers to succeed in the market. Chapdrive illustrates this contention very well. Moreover, it is reasonable to assume that radical products have longer verification phases, an assertion that is supported by the case of Chapdrive (cf. section 4.7.3). Since we have already argued that product testing is critical before launch, this means that radical products will suffer longer time to market. In turn, this implies that the death valley gap is further widened. This is critical, since radical innovations are more likely to require more investments. In other words, the combinations of long time to market and large up-front investments significantly increases the payback time. The strategic implication of this is that companies commercializing radical technologies must be even more aware of liquidity issues during product development.

Third and related to the previous paragraph, recall that market testing is a tool to demonstrate and show proof of concept to customers and achieve product verification. This is often done in collaboration with the customers. However, they are also risk-averse, as explained in 5.2.1. This means that testing radical innovations are tougher than incremental products, since conservative customers want to avoid the uncertainty of breakthrough technologies. This contention is supported by Ekström (2014) (cf. section 4.8.2). Furthermore, start-ups will have a hard time to test their innovations together with risk-averse customers, since they have a less proven track record and experience in comparison to large and mature firms. The customers would choose the safe alternative rather than the new option.

Finally, radical innovations are often rather discontinuous because new technologies have little supporting infrastructure to be accepted by the market. According to Frattini et.al. (2012: 7), supporting infrastructure is needed before the product diffuses into mass markets. The case of Windflip, a radical innovation, illustrates this in section 4.5.6. They were in need of complementary expertise such as marine operations to provide infrastructure before product launch. Hence, complementary assets are key for commercialization success, and to a larger degree for radical innovations. These can be acquired through partnership and strategic alliances (Frattini et.al., 2009: 6). Thus, Norwegian wind technology providers should make efforts in identifying potential cooperators with complementary assets.

5.12.2 Mature firms compared to start-ups

Among the case companies, Statoil, Fedem Technology and SmartMotor can be regarded as relative large and mature players, while Chapdrive, Blaaster and Windflip are small start-ups.

An obvious difference between these types of players is that large firms have much more financial resources. For example, Statoil has financed most of its Hywind product development from its own balance sheet (cf. section 4.6.5). Hence, they are able to burn more cash before income is generated compared to start-ups. Clearly, mature firms are less affected by the death valley phenomenon and can undertake investments on expensive radical technologies to a greater extent. This means that proposition 1b about minimizing the initial investment base is less relevant for large corporations compared to start-ups.

Another implication of resource differences is that the barriers to entry are lower among large and resourceful companies. They can to a greater extent test their products in-house and without the need of cooperators, which on the other hand is necessary for start-ups. Furthermore, financing from the balance sheet is much cheaper than venture capital. VC has thus not been a viable alternative for Statoil (Indrevær, 2014) (cf. section 4.6.5). Large companies with established routines and management are also less likely to benefit from the active ownership of venture funds. Therefore, VC is less of a precondition for success among mature firms compared to start-ups. This is in line with extant literature, which is mainly concerned with VC financing of start-ups and small companies. Finally, the appropriateness of various cooperation modes are likely to differ with firm size. For example, Dale (2014) argues that licensing is especially appropriate among start-ups seeking to generate early income. However, the contention lacks empirical testing and must be further researched.

5.12.3 Theoretical and practical implications

Following the discussions in the two previous sections, we can summarize the findings in table 11. As illustrated, five of the originally nine formulated propositions have various practical implications for different corporate decision makers. Essentially, Norwegian wind technology

Table 11: Differences in propositions between firm and product type

Firm and product typology	**P1b**	**P1c**	**P2**	**P4**	**P7**
Incremental and start-up	Important	Important	Important in some cases	Hard to perform	Appropriate
Incremental and mature firm	Less important	Important	Important in some cases	Less hard to perform	Less appropriate
Radical and start-up	Very important	Very important	Less important	Very hard to perform	Appropriate
Radical and mature firm	Important	Very important	Less important	Hard to perform	Less appropriate

providers should be aware of which category of firm and products they belong to. Strategies must then be formulated accordingly and in line with table 11. It shows which strategic elements decision makers in different firms should prioritize. For example, start-ups commercializing radical innovations should allocate significant time and resources to minimize initial investment base, gain a strong position in complementary assets, while competitor orientation should be less prioritized. They should also recognize that it is harder to perform

market testing compared to firms with incremental innovations. VC is appropriate, but the decision to enter such partnership must be evaluated together with other company strategies. The next few paragraphs provide a holistic discussion on product and firm differentiations, together with practical and theoretical implications.

First, certain propositions and theories discussed in this study are more valid when they are utilized in specific settings and contexts in the wind technology industry. Table 11 implies the need to differentiate the theories in chapter three with respect to various firm and product variables. The selection of extant literature in chapter three is too general and neglect how fundamentally different start-ups, mature firms, radical and incremental innovations are. This leads to rather generic recommendations for practitioners, which are less customized to the realities they face. For example, the research of Timmons and Bygrave (1986) does not differentiate the appropriateness of venture funding with respect to product radicalness and firm size. They are generally positive to VC, but the empirical research shows that VC is more relevant for smaller start-ups and companies that do not desire industrial partners (cf. the discussion about Blaaster). However, it should be noted that Hellman and Puri (2000) discern between innovators and imitators, but not on firm size and product radicalness (cf. section 3.7). Furthermore, neither Teece (1986*) nor Olleros (1986) provide any insights into firm and product differentiation in their respective theories on crossing the chasm and minimal investment base.

Based on the previous discussion, the major theoretical implication is that future literature to a greater extent should take into account the differences between various firm and product specific factors. Only the theory of Debruyne et.al. (2002) (P2) does this to a certain degree. The theories on minimal investment base (P1b) (Olleros, 1986), complementary assets (P1c) (Teece, 1986*), market testing (P4) (Benedetto, 1999) and venture capital (P7) (Timmons & Bygrave, 1986; Hellmann & Puri, 2000; Hsu, 2006; Widding et.al., 2009*; Erikson et.al., 2009*) should be revised. At least, researchers should investigate whether the framework in table 11 is valid across other industries than the wind technology segment. Moreover, it is not unlikely that the theories of crossing the chasm (P1a), strategic alignment (P3), market orientation (P5) and cooperation (P6) also need revisions, since they also do not discern between product and firm characteristics. However, no specific findings and implications about this was found. Thus, future research should investigate further into these works before making any final conclusions.

Second, it can been seen from table 11 that small companies and start-ups should rely more on external players and actors than larger and more mature firms should. Thus, start-ups are to a higher degree at the mercy of external factors than big firms to succeed with product commercialization in the wind sector. For example, small companies like Windflip are more dependent on initial funding in order to not suffer early demise due to the death valley phenomenon. Venture capital is an appropriate way to acquire capital and competence in early stages, but as previously discussed, the decisions to enter such agreements must be in

accordance with the overall company strategy. Nevertheless, a strong venture capital environment with solid competence on renewables is needed to contribute to a healthy and sustainable industry. Furthermore, a question is whether the start-up supporting schemes in Norway are adequate, and if they are not, the government should contemplate on what new measures should be undertaken. Today, most of the public support mechanisms are provided through monetary grants, but start-ups should also be given advices on strategic issues such as cooperation, financial management and access to networks. Innovation Norway do offer these services to entrepreneurs (Innovation Norway, 2014), but a critical review of their effectiveness should be done. However, this theme is somewhat outside the boundary of this study, and should hence be a topic for further research.

Third, companies commercializing radical innovations should focus on internal issues such as developing and providing complementary assets, performing market testing activities, reducing initial investment base and less on external forces such as competitors. This is because wind technology firms launching radical offerings to a larger degree enter uncontested market space, which is less mature than other markets. Internal capabilities must be built in order to successfully develop these segments. Finally, start-ups with radical products should be especially aware of death valley issues.

5.13 Considering external factors

Throughout this thesis so far, external environmental factors have played a minor role compared to internal factors. However, in accordance with 2.2.3, it is within the scope if this study to investigate factors that constitute a variable to firms' commercialization performance. As opposed to internal factors, companies have little control over this and must form their commercialization strategy accordingly. This section discusses this and focuses especially on the strategic implications for practitioners.

Figure 13 shows which external factors that affect product commercialization process in firms. First, as discussed in section 5.2, risk-averse and conservative customers is an external force that makes it challenging to conduct market testing on innovative products. Specifically, they should be aware of the lack of early innovators, which increases barriers to entry and likelihood of succeeding on long term. Corporate decision makers must take this into account when formulating their market- and customer driven strategies. Industrial partnerships that collaborate on product development and market testing can be a possible solution to the challenge. Second, the empirical analysis revealed that several companies such as Blaaster,

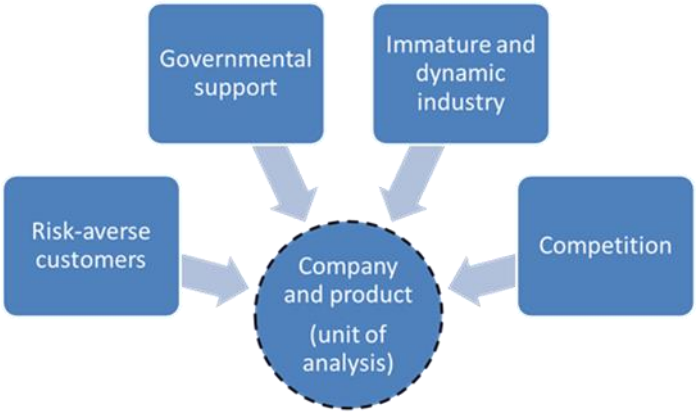

Figure 13: External factors influencing product commercialization

Statoil/Hywind, Chapdrive and Windflip have received funding from governmental bodies such as Innovation Norway and Enova. Thus, it is clear that stakeholders such as the government are willing to support new and innovative ideas. Therefore, a strategic implication is that Norwegian wind technology providers should make efforts in applying for governmental support. This is especially important in the early phase of start-ups when the threat of death valley is present. Furthermore, the recommendation is in line with Stadaas (2014) who claims that a success criterion is the cooperation with external stakeholders (cf. section 4.6.9). Third, some of the case study companies operate in immature and uncertain market segments. This is especially the case for Windflip, Statoil/Hywind and to some extent Chapdrive. The two aforementioned companies have created and developed new market spaces, which for Windflip led to a less successful product launch. On the other hand, Blaaster operates in an established industry with fierce competition. SmartMotor's investments in the wind segment ended up with little return, mostly because of rising costs on permanent magnets, which is an important input factor in motors (cf. section 4.2.4). Magnet is a commodity, thus SmartMotor had little control over its own costs. From this, we can generalize that the wind industry is uncertain, dynamic and complex. This might also explain why many of the case companies have not succeeded with their product commercialization. Fourth, as can be seen in table 9, competition intensity is rather mixed among the companies. Proposition 2 in section 5.5 concluded that companies marketing incremental innovations face more competition. The strategic implication is that Norwegian wind technology companies with incremental products should be more competitor oriented than those with radical innovations.

5.14 Summary and revised framework

This chapter has analyzed and synthesized the theory from chapter three together with the empirical data from chapter four. Specifically, section 5.2 to 5.10 discussed each of the nine formulated propositions. Some of them were found to be strongly supported by empirical data, while others lacked enough evidence to be confirmed. The results are summarized in table 12. Note that it includes the revised propositions from this chapter, and not the originally formulated ones. Furthermore, 5.11 brought the discussion to a holistic level and reflected on the relationship between the previously supported propositions. Based on the aforementioned sections, the theoretical framework in figure 9 is revised and presented as a final generic model in figure 14. The structure is similar as the initial framework, but some propositions have either been altered or removed. Explanation of each element and its relating implication arrows was presented in each proposition's respective section. The generic model will provide a useful tool for both practitioners and scholars. As far as the author knows, such a model in a Norwegian industry context does not exist, and is thus a new contribution to the research on product commercialization. Although the model is generic, practitioners should take into account the variations in certain propositions between firm and product type, as previously illustrated in table 11 in section 5.12. It provided an illustration on how various companies with different product characteristics should differentiate its strategy

in order to maximize the likelihood of success. This topic has not to a significant extent been researched by scholars, and this thesis provides insight into this issue. Finally, section 5.13 considered external factors in relation to the problem statement of this thesis. Although it is not the main focus of the study, it is clearly a variable influencing product commercialization.

Table 12: Propositions and results

Proposition	Result
P1a: *Norwegian wind technology providers should develop a whole product and cross the chasm, in order to avoid early market exit.*	Strongly supported
P1b: *Norwegian wind technology providers should use cooperation strategies to minimize the investment base, thereby avoiding early market exit and reducing the consequences of the death valley phenomenon.*	Revised → Strongly supported
P1c: *Norwegian wind technology providers should gain a strong position on complementary assets, in order to best commercialize its products.*	Revised → Mediumly supported
P2: *Norwegian wind technology providers should be competitor oriented, in order to best commercialize its products.*	Not supported
P3: *Norwegian wind technology providers should align its strategic and tactical launch decisions, in order to best commercialize its products.*	Inconclusive
P4: *Norwegian wind technology providers should utilize strong market testing activities, in order to increase likelihood of market adoption and consequently commercial success.*	Revised → Mediumly supported
P5: *Norwegian wind technology providers should be market oriented, in order to best commercialize its products.*	Strongly supported
P6: *Norwegian wind technology providers should cooperate with external parties, in order to best commercialize its products.*	Strongly supported
P7: *Norwegian wind technology providers should cooperate with venture capital funds, in order to finance and best commercialize its products.*	Not supported

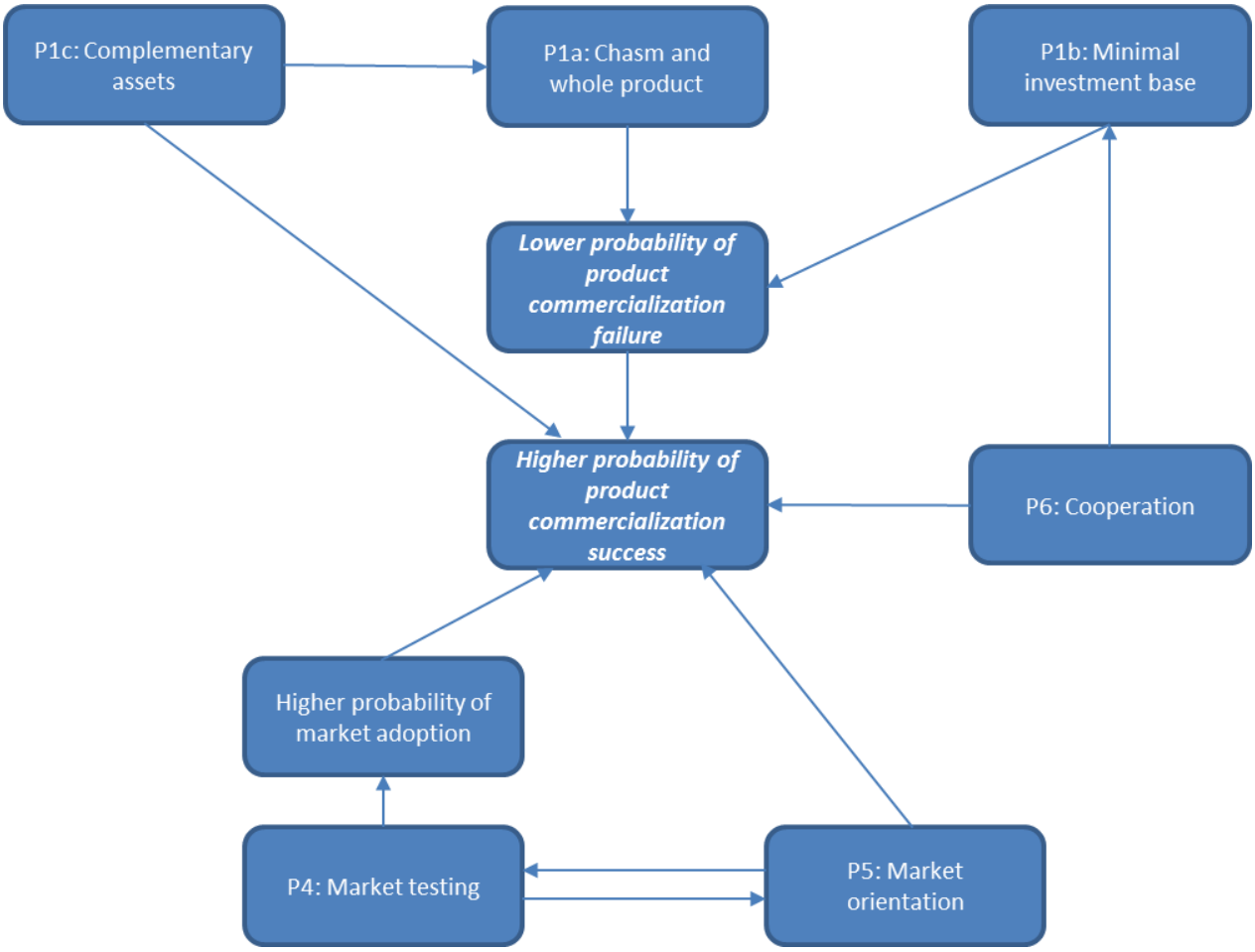

Figure 14: Revised generic commercialization model

6. Conclusion: implications and further research

This final part provides a bird's eye view and conclusion of the thesis. The overarching goal of the work has been to study how Norwegian wind technology providers best can commercialize their products, a topic that has not been investigated thoroughly by researchers. Through analysis and synthesis of theoretical articles, company interviews and firm documents, a holistic and practical picture of product commercialization in the wind energy sector has been provided. The frameworks in figure 14 and table 11 is my contribution to an important field of research. Section 6.1 summarizes the strategic and practical implications of the discussions in chapter five, while 6.2 sums up the implications of the theories in chapter three in relation to the empirical findings. Finally, further research areas of interest are identified in 6.3, before the thesis is rounded off with a couple of concluding remarks in 6.4.

6.1 Strategic and practical implications

The discussion of the propositions in chapter five yielded several strategic and practical recommendations that are relevant for corporate decision makers in the wind energy industry. Due to the chasm phenomenon, which is further reinforced by risk-averse customers and few early innovators, Norwegian wind technology providers should develop whole products. This reduces the likelihood of early market exit. Complementary assets are believed to contribute to a whole product, in addition to strengthening the competitive position of the company. In accordance with proposition 1b, Norwegian wind technology providers should minimize its investment base when developing and commercializing new products. The death valley phenomenon is very much present in the wind industry and its market uncertainty effects can be reduced through cooperation with partners.

Even though the degree of competition varies in the wind industry, firms should take their behavior and market positions into account when developing and marketing new products. This applies especially to firms with incremental innovations. Furthermore, the discussion of proposition four concluded that Norwegian wind technology providers should be aware of how critical market testing and product verification are. Strong market testing activities are needed to increase the likelihood of market adoption, and thus commercialization success. They also impact how market and customer oriented firms are, which is concluded to be highly important for commercialization success. Wind technology providers must ensure that feedback from a representative customer base is incorporated into the product, and that the whole organization is committed to satisfy their needs. Next, cooperation is essential for commercialization success. Corporate decision makers must not address the question of whether to collaborate or not, but *how*. There are pros and cons with various cooperation modes, and practitioners should base their decisions on an analysis of the company's strengths, weaknesses and external environmental. Finally, mixed support was found for venture funding. Whether the company will benefit with such a relationship depends on firm characteristics, the corporate strategy and its long-term goals. However, corporate decision

makers should be aware that venture capitalists could provide better foundation for cooperation with other firms.

On a final note, managers should take into consideration the size of the company and what type of technology it is commercializing when launching new products. Small companies are often at the mercy of external factors to succeed, and should thus focus on turning these elements into their own advantage or mitigate them. Specifically, start-ups are more susceptible to the death valley phenomenon, and should cooperate to reduce this risk. Due to their size and lack of equity, they should also consider venture capital agreements to a larger extent than large corporations should. Moreover, radical innovations experience longer payback time, more challenges in terms of market adoption and market testing, and need substantial complementary assets in order to have a supporting infrastructure. Since companies with radical technologies often enter uncontested market space, they should focus on internal resources and capabilities to develop the market. Finally, managers should also be aware of external factors such as the government and an immature and dynamic industry. It was argued that start-ups are more reliant on government support, both in terms of monetary grants and strategic advices.

6.2 Theoretical implications

Following the discussion of the empirical data, there are a number of theoretical implications in this thesis. First, due to industry specifics such as risk-averse and conservative customers, the chasm model of Moore (2002*) must be revised for the wind sector. The non-existence of early innovators implies that opportunities for early sales are smaller, while barriers to entry are higher. In other words, the chasm has even more serious consequences in the wind industry. Second, 5.3.2 argued that licensing is the most used and proven cooperation model in the Norwegian industry when the aim is to pool risk and investments. Thus, the suggestion of Olleros (1986) that joint venture and subcontracting are also relevant might be less prominent in a Norwegian industry context. Third, Teece (1986*) contends that the lack of complementary assets is related to early market exit. However, no support for this assertion was found. Rather, in a Norwegian context the theory must be revised as the empirical analysis found that a strong position in complementary assets is related to commercialization success instead. The work of Teece (1986*) was also found to be closely related to Moore (2002*) and the concept of whole product. Fourth, mixed empirical support is given to the theory of Debruyne et.al. (2002). The notion of higher competition in niche markets were supported, while the assertion that incremental innovations face tougher competition than radical ones was not found to be entirely supported.

Fifth, this study did not find any meaningful data about the decisions alignment proposition, but argued that passive observation and causal mapping might be appropriate methods for future research. Sixth, in the wind industry, market testing is found be more important than other market information gathering activities referring to the article of Benedetto (1999). This implies that his theory is not entirely transferable to the wind industry segment. Industry

specific factors such as risk-averse customers explain this. Seventh, the case study companies confirm the notion that the commercialization literature have on the prominence of market orientation. This is in line with the extant literature, and it is not unlikely that the proposition is valid in other industries and geographies as well. Eight, both empirical data and theory confirm that the important decision to make is not whether to cooperate, but which modes that are the most effective. Finally, the interviewees are more critical to venture capital than the literature is. This implies that their significance is not as prominent as the theory claims. The theory should to a larger degree discern between various firm and product characteristics when recommending and discussing venture capital. Since the US literature is generally more positive than the Norwegian papers, it could be that the Norwegian venture capital environment is less functioning than the US one.

Last but not least, the theories in chapter three were deemed to be at a too generic level of analysis. Few of them consider the fundamental differences between start-ups, large and mature firms, radical and incremental innovations. The final propositions in figure 14 are more valid and sensible when considered together with the findings of table 11. The theoretical implication is that future research to a larger extent should discern between firm and product specific variables. This will make the commercialization literature more relevant and less generic for corporate decision makers.

6.3 Further research

Not all relevant elements have been analyzed and discussed in this thesis. These should be subject to further research. The following issues are of special interest. First, too little relevant data was found to conclude anything about the proposition on decision alignment. A case study was deemed a less appropriate method to analyze this proposition, making other methods such as passive observation and causal mapping more relevant. Second, a number of success criteria presented by the interviewees (cf. table 9) such as human resources, value propositions, product launch timing, management and cost was not analyzed, since it fell outside the scope of the propositions. The relation between these elements and commercialization performance should be analyzed. Third, the role of patents and how they relate to firm strategy has not been fully explored, and should also be subject to further discussions. Fourth, the thesis has focused less on product strategy elements such as differentiation and positioning. Again, this is not within the scope of the propositions, and is a possible area of further research. Fifth, a different theoretical framework can be used in similar studies as this one by other researchers. This would have most likely led to different propositions. For example, Holgersen and Lillebo (2002*) utilize a resource-based view (RBV) to formulate their propositions. RBV argues that valuable, rare, inimitable and non-substitutable resources provide the foundation for sustainable competitive advantage. This theoretical framework could have led to more emphasis on internal factors such as human resources and knowledge as sources of commercialization success. Sixth, it is not unlikely that the chasm theory (P1a), strategic alignment (P3), market orientation (P5) and cooperation (P6) should be differentiated with respect to firm and product variables. However, no specific

findings and implications were found in this thesis. Future research should look deeper into this. Seventh, more research on support to start-ups is warranted, and especially on how effective Innovation Norway is and what they can do differently. Finally, the fact that this study is limited to the Norwegian wind technology industry reduces the external validity of the thesis. Thus, scholars can extend the research to other geographies and industries. I would recommend future researchers to look into whether table 11 and figure 14 can be generalized across other industries and geographies.

6.4 Concluding remarks

Norwegian companies launching new wind technology products will inevitably face a though and competitive environment. Historically, few firms have succeeded with their commercialization strategies, a trend that is not unlikely to continue in the future as more players discover the market opportunities in the renewable sector. Still, future prospects of success in the wind technology market is not *that* gloomy. This study shows that a number of measures can be undertaken to increase the likelihood of commercialization success. In other words, there is certainly hope that sustainable values can be created in the clean energy industry.

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8. Appendix

8.1 Case study protocol

Last revised 29.03.14

- *Problem statement:* How can Norwegian companies successfully commercialize new wind energy technologies? There is little research available within this field, thus a holistic approach is used in order to shed light on a rather complex topic.
- *Goal:* to establish a best practice model on how to commercialize wind energy technologies, and give tangible recommendations to firms launching their new products. Discuss commercialization strategies among existing Norwegian companies. Operationalize academic theories.
- *Relevant topics:* venture capital, financing, B2B marketing, product strategy, customer targeting, value chain strategy, competiveness, strategic alliances and cooperation, market orientation, new product, innovation diffusion, distribution channels.
- *Case study:* holistic multiple case study, using five case firms. The case firms are chosen in order to reflect the whole dimension of radical to incremental products and successful to failed products. However, the choice is also based on convenience.
- *Unit of analysis:* supplier industry (technology providers), new technologies, Norwegian companies, both domestic and abroad, both start-ups and mature companies, introduction phase in the product lifecycle, focus on wind energy.
- *Level of analysis:* main focus on product level, but company and sometimes industry level are regarded when deemed relevant.
- *Methods:* data triangulation, cross-case synthesis, systematic literature review, propositions, final model built on the strengthened propositions, discussing rivalling models to mine.
- *Literature review keywords:* commercialization, product launch strategy.
- *Research tools:* case study protocol, interview guide, personal notes, key informants.
- *Data sources:*
    - In order to increase construct validity, multiple sources of evidence is used.
    - Findings from the case companies: Statoil (Hywind), Blaaster, Windflip, Fedem Technology and SmartMotor.
    - Publically available information on the case companies, e.g. websites, press releases etc.
    - Semi-structured interviews with case companies, in addition to control interviews with a venture capital fund, an industry- and a government interviewee. Minimum twelve interviews. Use of key informant approach and case study draft reviews to ensure data consistency. Focus on interviewees with a firm knowledge of the problem statement, and also people with various backgrounds. For interview questions, see the separate interview guide.
    - Grey literature from IEA, EWEA, IPCC and Center for Sustainable Energy Studies. Use of snowball sampling to find relevant documents.
    - Journal articles – Scopus and Google Scholar databases. Using only peer-reviewed high-quality articles.

- Traditional measures of data quality is used (Yin, 2014):
    - Internal validity: rival explanation, cross case synthesis.
    - External validity: less important and outside the scope and intention of the thesis.
    - Construct validity: convergence of multiple data sources using triangulation, key informant reviews of the case study drafts, chain of evidence.
    - Reliability: use of case study protocol, clear and specific citations of where the exact piece of information was found.

8.2 Overview of articles used in literature theory review

Author(s)	Title	Year	Journal	Method	Theoretical background and perspective
Aggarwal V.A., Hsu D.H.	Modes of Cooperative R&D Commercialization by Start-ups	2009	Strategic Management Journal	Deductive	TCE, RBV and cooperation
Beard C., Easingwood C.	New Product Launch: Marketing Actions and Launch Tactics for High-Technology Products	1996	Industrial Marketing Management	Interviews and survey	Technology-orientation rather than market-orientation
Benedetto C.A.	Identifying the Key Success Factors in New Product Launch	1999	Journal of Product Innovation Management	Survey	Strategic and tactical decisions
Bower, J.L., & Christensen C.M.	*Disruptive Technologies: Catching the Wave*	*1995**	*Harvard Business Review*	*Conceptual*	*Disruptive and sustaining technologies*
Christensen C.M.	*The innovator's dilemma: when technologies cause great firms to fail.*	*1997**	*Publisher: Harvard Business Review Press*	*Conceptual*	*Disruptive and sustaining technologies*
Debruyne M., Moenaert R., Griffin A., Hart S., Hultink E.J., Robben H.	The Impact of New Product Launch Strategies on Competitive Reaction in Industrial Markets	2002	Journal of Product Innovation Management	Deductive	Competitive reactions
Easingwood C., Beard C.	High Technology Launch Strategies in the U.K.	1989	Industrial Marketing Management	Conceptual, interviews and press analysis	Various strategies for radical innovations
Easingwood C., Harrington S.	Launching and Re-launching High Technology Products	2002	Technovation	Conceptual	Chasm-theory, whole product
Erikson, T., Sørheim, R., Berg-Utby, T.	*Relasjonsbasert eierstyring i venturekapital-finansierte teknologibedrifter*	*2009**	*Publisher: Tapir Akademisk Forlag*	*Interviews and survey*	*Venture capital, cooperation*

Frattini F., De Massis A., Chiesa V., Cassia L., Campopiano G.	Bringing to Market Technological Innovation: What Distinguishes Success from Failure	2012	International Journal of Engineering Business Management	Historical analysis	B2C, strategies for successful commercialization
Frattini F., Dell'Era C., Rangone A.	Launch Decisions and the Early Market Survival of Innovations	2013	Journal of Product Innovation Management	Deductive	Product survival, tactical and strategic launch decisions, B2C
Gans J.S., Stern S.	The Product Market and the Market for "Ideas": Commercialization Strategies for Technology Entrepreneurs	2003	Research Policy	Conceptual	Commercialization environment
Golicic S.L., Sebastiao H.J.	Supply Chain Strategy in Nascent Markets: The Role of Supply Chain Development in the Commercialization Process	2011	Journal of Business Logistics	Multiple case-study	Supply chain issues, relationships
Hellmann T., Puri M.	The Interaction Between Product Market and Financing Strategy: The Role of Venture Capital	2000	The Review of Financial Studies	Deductive	Venture capital and financing
Hsu D.H.	Venture Capitalists and Cooperative Start-up Commercialization Strategy	2006	Management Science	Deductive	Venture capital and cooperation
Hultink E.J., Robben H.S.J.	Launch Strategy and New Product Performance: An Empirical Examination in The Netherlands	1999	Journal of Product Innovation Management	Survey	Lunch strategy, market characteristics, product performance
Hultink E.J., Schoormans J.P.L.	How to Launch a High-Tech Product Successfully: An Analysis of Marketing Manager's Strategy Choices	1995	The Journal of High Technology Management Research	Survey, cluster analysis	Impact of pricing, promotion, competitive advantage and product variety on product success
Hultink E.J., Griffin A., Robben H.S.J., Hart S.	In Search of Generic Launch Strategies for New Products	1998	International Journal of Research in Marketing	Deductive	B2C, strategic and tactical launch decisions, generic strategies

Hultink E.J., Griffin A., Hart S., Robben H.S.J.	Industrial New Product Launch Strategies and Product Development Performance	1997	Journal of Product Innovation Management	Survey, interviews	B2B, strategic and tactical launch decisions, strategies and product performance
Jolly V.	*Commercializing New Technologies: Getting from Mind to Market*	*1997**	*Publisher: Harvard Business Press*	*Conceptual*	*Theory review*
Kasch S., Dowling M.	Commercialization Strategies of Young Biotechnology Firms: An Empirical Analysis of the U.S. Industry	2008	Research Policy	Deductive	TCE, RBV, property tights theory, cooperation
Kollmer H., Dowling M.	Licensing as a Commercialization Strategy for New Technology-based Firms	2004	Research Policy	Deductive	Licensing
Laird I., Sjoblom L.	Commercializing Technology: Why is it so Difficult to be Disciplined?	2004	Business Horizons	Conceptual	Strategies to avoid commercialization failure
Langerak F., Hultink E.J., Robben H.S.J.	The Impact of Market Orientation, Product Advantage, and Launch Proficiency on New Product Performance and Organizational Performance	2004	Journal of Product Innovation Management	Deductive	Market orientation, product performance, customer value
Lin B.W., Lee Y., Hung S.C.	R&D Intensity and Commercialization Orientation Effects on Financial Performance	2006	Journal of Business Research	Deductive	R&D orientation, commercialization orientation, firm performance
Mazzarol T., Reboud S.	The Strategic Decision Making of Entrepreneurs Within Small High Innovator Firms	2006	International Entrepreneurship and Management Journal	Conceptual, survey	Rent configurations, strategic environment, innovation management
Moore G.	*Crossing the Chasm*	*2002**	*Publisher: Harper Collins*	*Conceptual*	*Chasm, whole product*

Mu J., Benedetto C.A.	Strategic Orientations and New Product Commercialization: Mediator, Moderator and Interplay	2011	R&D Management	Deductive	Strategic orientations, commercialization performance
Mueller, D.C & Tilton , J.E.	*Research and Development Costs as Barrier to Entry.*	*1969**	*The Canadian Journal of Economics*	*Conceptual*	*Industrial development*
Olleros F.J.	Emerging Industries and the Burnout of Pioneers	1986	Journal of Product Innovation Management	Conceptual	External uncertainty, market survival
Roessner J.D.	Commercializing Solar Technology: The Government Role	1984	Research Policy	Conceptual, review	Industrial development, government
Slater S.F., Mohr J.J.	Successful Development and Commercialization of Technological Innovation: Insights Based on Strategy Type	2006	Journal of Product Innovation Management	Conceptual	Chasm-theory, innovator's dilemma, strategic orientation
Talke K., Hultink E.J.	The Impact of the Corporate Mind-set on New Product Launch Strategy and Market Performance	2010	Journal of Product Innovation Management	Deductive	B2B, corporate mind-set on market performance
Teece D.J.	*Profiting from Technological Innovation*	*1986**	*Research Policy*	*Conceptual*	*Complementary assets, imitators*
Teece D.J.	Reflections on "Profiting from Innovation"	2006	Research Policy	Conceptual, review	Profiting from Innovation framework
Timmons J.A, Bygrave W.D.	Venture Capital's Role in Financing Innovation for Economic Growth	1986	Journal of Business Venturing	Conceptual, review	VC performance, decision-making
Walsh S.T., Kirchoff B.A., Newbert S.	Differentiating Market Strategies for Disruptive Technologies	2002	IEEE Transactions on Engineering Management	Deductive	Disruptive and sustaining technologies
Widding, Ø., Landsgård, M. Sørheim, R.	*Smarte penger? Ikke-finansielle bidrag fra norske risikokapitalister.*	*2002**	*Publisher: Tapir Akademisk Forlag*	*Survey*	*Venture capital, cooperation*

8.3 Overview of articles used in empirical review

Author(s)	Title	Year	Journal	Method	Theoretical background and perspective
Balachandra P., Nathan H.S.K., Reddy B.S.	Commercialization of sustainable energy technologies	2010	Renewable Energy	Conceptual review	Technology diffusion, market dynamics, external factors stimulating commercialization
Holgersen, N., Lillebo, H.	*Kommersialiseringsstrategi: «Hva gjør de beste?» - norske gründere avslører sine forretningshemmeligheter!*	*2002**	*Publisher: Gründerparken*	*Interviews*	*Success criteria in commercialization*
Walsh P.R.	Innovation Nirvana or Innovation Wasteland? Identifying Commercialization Strategies for Small and Medium Renewable Energy Enterprises	2012	Technovation	Conceptual	Market dynamics, commercialization strategy based on innovation type and commercial risk

8.4 Interview guide sample

Dato: Tirsdag 25. mars, Statoil Fornebu

Intervjuobjekt: Jan-Fredrik Stadaas og Niklas Eric Indrevær, Statoil

Problemstilling:

- Hvordan kan norske selskaper best kommersialisere nye vind-energiteknologier?

Avgrensninger:

- Fokus på forretningsutvikling og konkurransestrategi, mindre på tekniske forhold.
- Fokus på B2B, på produktnivå (utelukkende på Hywind).
- Norske forhold, men gjerne i en europeisk kontekst.
- Fokus på faktorer som bedriften selv kan påvirke.

Generelle spørsmål til Hywind:

- Hva er din bakgrunn?
- Fortell mer om produktet med tanke på kundesegmenter, differensiering, distribusjon, prising og promotering.
- Radikal eller inkrementell innovasjon?
- Har produktet oppnådd kommersiell suksess? Har det nådd målene deres?
- Hvordan har dere planlagt kommersialiseringen med tanke på markedsføring, prising, distribusjon, promotering, marked, kunder og posisjonering?

Proposisjon-spørsmål:

Norwegian wind technology providers should develop a whole product and cross the chasm, in order to avoid early market exit.

- Er det stor avstand og forskjell mellom tidlig segmenter og massemarked? Har dere opplevd problemer knyttet til dette?
- Hvor mye har tilhørende service og komplementære produkter å si for salg til mer risiko-averse kunder?

Norwegian wind technology providers should minimize its initial investment base, in order to avoid pioneer burn-out and early market exit.

- Hvor viktig er fleksibilitet og reversibilitet i investeringene?
- Hvordan unngår dere «the valley of death»?
- Hva er de mest sentrale truslene ved oppstart og konkurranse med større selskaper?

Norwegian wind technology providers should gain a strong position in complementary assets, in order to avoid early market exit.

- Hvordan er IPR regimet i Norge?
- Er det mange imitatorer i markedet?
- Hvor viktig er det med komplementære produkter og service i deres produkt?

Norwegian wind technology providers should be competitor oriented, in order to best commercialize its products.

- Hvor stor konkurranse er det i markedet?
- Hvor sterk er konkurranseresponsen?

Norwegian wind technology providers should align its strategic and tactical launch decisions, in order to best commercialize its products.

- Hvordan foregår planleggingen av langtids korttids strategier for dere? Er dere bevisste på sammenhengen mellom disse?

Norwegian wind technology providers should utilize strong market information gathering activities, in order to best commercialize its products.

- Hvordan samles inn markedsinformasjon hos dere? Er dere bevisste på dette?

Norwegian wind technology providers should be market oriented, in order to best commercialize its products.

- Hvor viktig er kunder, respons til markedet? Markedsorientering?

Norwegian wind technology providers should cooperate with external parties, in order to best commercialize its products.

- Har dere inngått noen lisensieringsavtaler?
- Andre former for samarbeidsavtaler med eksterne parter? Fordeler og ulemper?

Norwegian wind technology providers should cooperate with venture capital funds, in order to best commercialize its products.

- Hvordan er produktet finansiert?
- Har samarbeid med noen private equity fond vært med i bildet?
- Har finansieringen vært tilfredsstillende?
- Andre mulige alternativer?

Generelle industri-spørsmål:

- Hva skiller en god kommersialisering fra en dårlig en?
- Hva skiller vind-industrien fra andre segmenter dere er inne i?
- Hva er viktige faktorer for suksess?
- Hvor er forbedringspotensialet blant norske bedrifter?
- Hva er viktige ressurser for å kommersialisere et produkt?
- Spesielle utfordringer knyttet til kommersialisering av vindenergi?

8.5 Wind energy basics

8.5.1 Introduction

This appendix provides some basic background information about the wind industry. Readers that are not familiar with the sector will gain the necessary knowledge to understand the analysis and discussions in chapter four and five. Not all industry details are included in this appendix, but rather the essentials needed to appreciate the contents in this thesis. However, note that an overview of the wind technology value chain is given in 4.1 instead of here, and provides an understanding of who the customers in the industry are. First, section 8.5.2 gives a short introduction to the Norwegian market and its current status. Second, 8.5.3 provides details about wind turbine design and related technicalities, which is fundamental in order to understand the products of case companies such as Blaaster, Chapdrive and SmartMotor. Third, part 8.5.4 presents current trends in wind technology innovation and development. Finally, 8.5.5 provides the references used in this appendix, and can be regarded as further reading material for those who are interested.

8.5.2 The Norwegian market

Although Norway has one of the best wind blowing conditions in Europe spread over a large area (NVE, 2013a), the Norwegian market for wind power is small and still immature compared to countries such as Denmark and Germany. Referring to figure A-1, accumulated wind power production was 1 569 GWh in 2012, while installed capacity mounted to 704 MW (NVE, 2013b: 5). This represents 1.1% of total electricity generation in Norway in 2012. This low rate is explained by the fact that Norway has access to cheap hydropower, and that wind power needs to be subsidized in order to be profitable (NORWEA & Energi Norge, 2013). However, this is expected to change in the near future. According to NORWEA & Energi Norge (2013), another 97.5 MW will be installed in 2013, leaving a total production of around 2 000 GWh. In addition, several onshore concessions was granted by the Norwegian government in

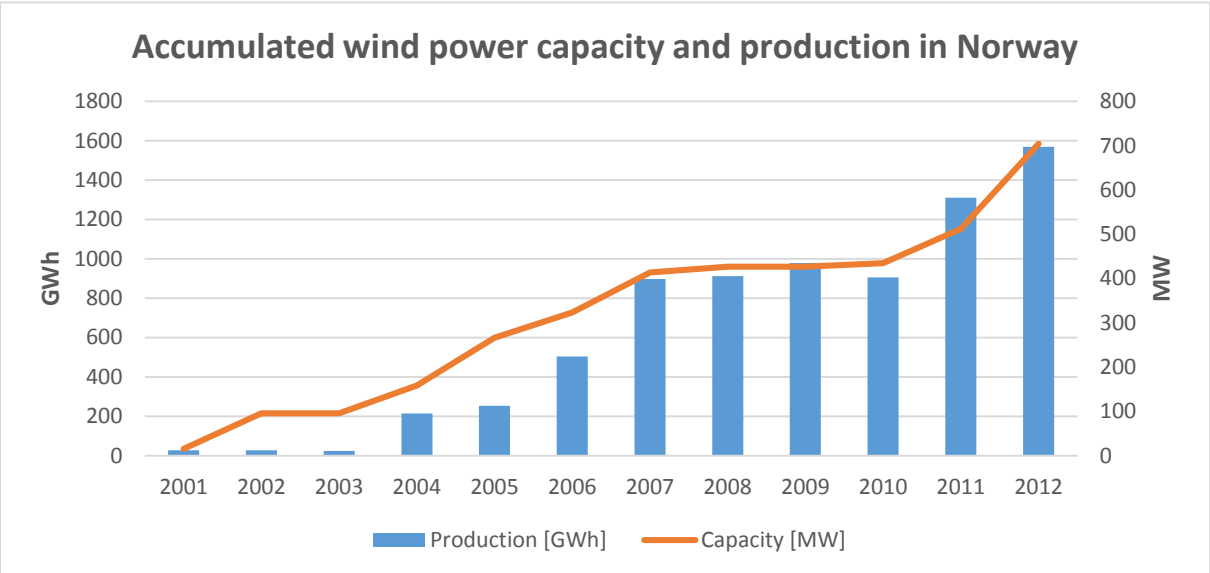

Figure A-1: Accumulated wind power capacity and production in Norway (NVE, 2013a)

August 2013 in mid-Norway. The permissions involve the building of eight wind farms with a potential of 1 300 MW capacity and 3 700 GWh electricity (Ministry of Petroleum and Energy, 2013). If these concessions are developed by the operators, Norway's output from wind energy will drastically increase in the future.

8.5.3 Wind turbine design

In the past 30 years, wind power technology has developed tremendously fast. In the 1980s, commercial wind turbines produced 50 kW and had a rotor blade diameter of 15 meters (UCS, 2013). Today, typical onshore wind turbines have a capacity of 1-3 MW with a rotor diameter of around 100 meters. Even larger turbines can be found offshore, which are scaled up to a capacity of 3-7 MW (SBC Energy Institute, 2013: 13). The larger size compared to onshore turbines is mainly because operators wants to offset the higher cost in building foundation and installation. The trend in increasing turbine and rotor size is expected to continue in the future, with capacities and rotor blade diameters reaching 10-20 MW and 150-250 meters, respectively (UCS, 2013).

A major trend within the offshore segment is that wind turbines are installed on deeper water depths and farther away from the shore (EWEA, 2011: 27). Most of the projects that have come online so far have water depth less than 20 meters and are situated less than 20 km from the shore. Newly consented projects are expected to be built on water depths exceeding 60 meters and more than 60 km from the shore (EWEA, 2011: 27). The design of the wind turbine varies with the use and appropriateness. The most common type has three blades with the axis horizontally oriented to the ground, but vertical designs do exist. As seen in figure A-2, a wind turbine consists of three main parts: the tower, the rotor blades and a machinery house behind the blades called a *nacelle* (UCS, 2013). The components transforming mechanical to electrical energy are situated inside the nacelle. The blades are attached to a low-speed shaft that runs into a *gearbox*. The shaft rotates at a low speed, but with a high torque. The gearbox increases the numbers of rotations, thus reducing the torque. A high-speed shaft is connected to a *generator*, which converts the mechanical energy to electricity (UCS, 2013). However, some small-scale turbines utilize a *direct-drive* system, which eliminates the need for a gearbox.

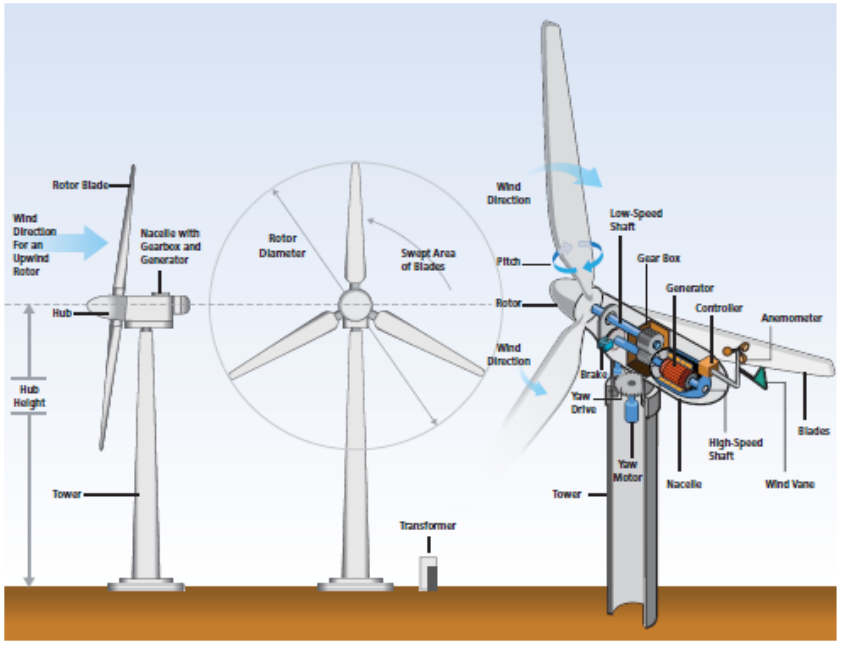

Figure A-2: Wind turbine design (IPCC, 2012: 552)

These turbines avoid mechanical problems associated with gearboxes, but are on the other hand significantly heavier and more expensive (AWEA, 2013). Significant R&D in reducing weight and increasing performance of drive trains has been undertaken (SBC Energy Institute, 2013: 29). Finally, electricity is transmitted from the generator down the tower to a transformer at the base of the tower (SBC Energy Institute, 2013: 11). This is connected to the central power grid via cables. The wind turbine design itself is very much the same in both onshore and offshore sites.

Wind is the most important input factor for wind turbines. Energy content of the wind is proportional to the cube of the win speed, thus small fluctuations in wind speed yields a great change in energy output (IEA, 2008: 1). Therefore, a good wind speed site is crucial to the financial viability of a project (IEA, 2008: 1). Since wind speed increases with height, taller towers allows more energy to be produced (AWEA, 2013). The wind is fairly unstable, thus wind turbines are equipped with a *yaw drive*, which allows the turbine to be oriented in the same direction as the wind flow. Furthermore, the blades can be rotated by a *pitch drive* to reduce the amount of lift when wind speeds become too great (AWEA, 2013).

8.5.4 Innovation and technology development

Traditionally, R&D on wind has focused on three objectives: maximizing energy capture, minimizing cost per unit of capacity and meeting grid requirements (SBC Energy Institute, 2013: 27). The first point is driven by access to better wind resources and better exploitation of lower-quality resource sites. To influence these drivers, R&D has developed larger wind turbines with variable speed and better resistance to extreme environmental conditions (SBC Energy Institute, 2013: 27). The second element is driven by reduced investment-, O&M-, and production costs. To satisfy this, innovation has come up with solutions such as lighter components, gearless turbines and pitch systems to avoid excessive fatigue (SBC Energy Institute, 2013: 27). The final point is driven mainly by system stability, voltage control and predictable forecasts. Better computational tools, communication and pitch control are main contributors to this (SBC Energy Institute, 2013: 27).

In 2011, global R&D spending in wind energy was 1.2 billion USD compared to 4.1 billion USD in solar energy (SBC Energy Institute, 2013: 34). Corporate R&D expenses has remained flat in the period 2008-2011, while public funding has fluctuated. However, more R&D has been pushed in the direction of offshore innovations. This is evident by the fact that offshore accounted for the largest share of wind-related patents between 2000 and 2010 (SBC Energy Institute, 2013: 34). Thus, it is reasonable to assume that offshore is much more innovation intense than onshore.

According to EWEA (2009a: 7), there is a greater profitability of innovative designs for the offshore market than for the onshore market. In addition to the fact that offshore wind turbines are driving towards larger capacities than onshore turbines, foundation design is an important axis of R&D development (SBC Energy Institute, 2013: 30). Operators can capitalize greatly from improvements within these areas. Specifically, offshore wind turbines requires

innovations in weather resistance, floating structures, ease of maintenance and increased reliability to drive down costs (SBC Energy Institute, 2013: 30). The Hywind pilot project 10 km off the southwest cost of Norway, the world's first floating offshore wind turbine, is an example of a recent innovation in the offshore industry (Statoil, 2013).

8.5.5 References and further reading

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8.6 Overview of interviewees

Interviewee	**Position in case firm**	**Case Company**
Sigurd Øvrebø	Chief Technology Officer (CTO)	SmartMotor
Trond Schwenke	Director of Business Development	
Kristian Sætertrø	Engineer	Fedem Technology
Svein Gjølmesli	Chief Technology Officer (CTO)	
Camilla Jørås Larsen	Administration Manager	Blaaster
Ove Pettersen	Technical Manager	
Torolf Pettersen	Founder and CEO	
Ane Christophersen	Co-founder and General Manager	Windflip
Jan Fredrik Stadaas	Technology Manager	Statoil/Hywind
Niklas Eric Indrevær	Business Development	
Trine Ulla	Head of Business Development	
Ole Gunnar Dahlhaug	Co-founder and Technical Leader	Chapdrive
Åsmund Grytting	Co-founder and CEO	
Jostein Vik	Board member (Partner, Viking Venture)	
Lars Ekström	Investment Manager	Verdane Capital Advisors
Jørgen Dale	Business Development Manager	Scatec
Ivar Singstad	Head of Wind and Marine Renewables	Innovation Norway