Commercial success factors for startups

A comparative case study research exploring commercial success factors for Dutch startups in the sustainable energy industry

By

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Colophon

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Preface

From the age of 16 I was drawn to the subject of entrepreneurship and the success stories of startups. I was interested in this topic because I started with entrepreneurial activities myself at this age. The first time I came in contact with actual research that was applied on entrepreneurial success was during my bachelor thesis. Together with the research programme ''onderhoud je marktpositie'' we studied how Dutch small and medium enterprises in the maintenance, repair and overhaul sector of the aviation industry could improve and consolidate their performances and processes. When in September this year Geerten van de Kaa, current professor in the field of strategy and innovation at Delft University of Technology, gave me the opportunity to work on the subject of the success of entrepreneurial commercialization and the strategies that are related to this, I immediately accepted the assignment for my thesis. It gave me the opportunity to approach the topic of entrepreneurial success from a new angle, concerning new literature streams and to research a new technological industry.

In February I started my thesis research in order to obtain the degree of Master of Science from the two-year full time Master's programme Management of Technology at Delft University of Technology. At times my research has been intensive, due to the difficulties of convincing startups to participate and the time constraints of writing this thesis within five months. Since I had the personal objective to perform this qualitative research in the most reliable and valid way I possibly could, I increased the sample size to deliver more generalizable results. This led to many everlasting evenings and nights collecting additional data, processing transcriptions, analyzing the data and writing the thesis. Nevertheless I look back at a very interesting time with a satisfied feeling, in which I think this thesis created value by closing the gap in scientific literature and by implicating the practical relevance for startups.

I could never complete this thesis without the help of others. Initially I would like to thank the supervisors who helped me during my research. I want to thank Jaco Quist, professor in the Technology Dynamics and Sustainable Development department, who taught me a lot about how business models could affect the characteristics of a company in a sustainable energy sector. His extensive feedback during different periods in the progress of my thesis, helped me to sometimes take a step back and to take an out of the box approach in the assessment of my findings. I also would like to thank Victor Scholten. His technology-based entrepreneurial knowledge helped me not only to discover the actual relevance of this research from both a scientific and practical perspective. He also supported me in the selection of relevant startups as a sample for this research and with the interview framework. I want to thank Cees van Beers, who taught me to express the importance of generalizability and the academic relevance of this research. I thank Geerten van de Kaa in particular, who intensively guided me in his role as the first supervisor of my thesis. During my research we had regular meetings, discussing the progress of the thesis. His approach of supporting me with adequate feedback after finalizing each section of this thesis resulted in a very effective cooperation. With his help I was able to finalize my report within the period of five months. Besides sharing his knowledge from his field of technology dominance, networks, platform wars and strategic management he also taught me a lot about how to perform and formulate this research in a scientific manner.

I want to thank all the founders of the ten startups for participating in this research, in alphabetic order of the companies: Remi Blokker from Bluerise, Marnix ten Kortenaar from Dr. Ten, Arjan Heinen from E-traction, Job van Roekel from Easypath, Crijn bouman from Epyon, Loes de Waart from Iungo, Yousef Yousef from LG Sonic, Paul van Ham from Multi Tool Trac, Mark Boeren from Pathema and Twan Heetkamp from Twan Heetkamp Trailers. Due to their interest in the topic and willingness to participate in this research, I discovered novel insights, leading to the results of this thesis.

My family and girlfriend have always been there for me during the struggles and prosperity of this thesis. At last I would like to thank my father in law, Rob de Ruiter, and my sister, Marjolein Leferink, for providing me with textual feedback.

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Executive summary

Various scholars have defined a set of factors that positively affect the outcome for a firm to achieve technological dominance in an emerging market. These scholars however focus their research on incumbent organizations. Similarly, whilst entrepreneurship literature acknowledged several important success factors, the context in which commercialization of new technologies and standards emerge is discussed insufficiently. Startups are particularly interesting from a technological perspective since they initiate the establishment of new industries, which is especially observed in the sustainable energy industry. Here, new technological developments such as solar panels including payment services, electric vehicles, alternative energy and energy regulation systems require new standards. Empirical research explaining this phenomenon from the perspective of startups is lacking. Consequently, the organization and implementation of new technologies and market standards by startups in order to be successful is not well understood. This raises the question of what factors enable technological startups to survive despite the lack of resources and capabilities that incumbents possess?

The analysis within this project is based upon the conceptual framework introduced by Suarez (2004) on the technology dominance process of incumbents. Therefore the following research question will be answered: *How can startups in the sustainable energy industry become successful in commercializing a high technology product in an emerging market during the initial phases of the technology life cycle?*

The literature works of evolutionary economics, network economics, platforms, technology management and the entrepreneurial stream provide the basis for this research. Ten semi-structured interviews conducted with Dutch startups in the sustainable energy industry form the empirical component of this thesis. Using the technology life cycle as interview framework in each interview the relevant factors, experienced by the startup, are categorized in the first three phases. The results show that twelve relevant factors in specific phases of the technology life cycle were selected as a necessary condition by all participants in order for them to reach commercial success with a high technology product.

Two general factors that enable a competitive advantage, covering all three phases were identified: a multidisciplinary team composed of individuals with different expertise and a strong iterative learning orientation. In phase one, the R&D build-up, flexibility is essential to ensure adaptive capabilities until the technology has convinced the market. Furthermore financial strength requires the startups to be able to pre-finance the development costs made. Brand reputation is a prerequisite in this first phase to convince potential customers. It is necessary for startups that are willing to share their proprietary technological knowledge, to build alliances to ensure increased capacity, expertise and brand reputation. In the technical feasibility phase marketing communications are a prerequisite to ensure subsequent production scale-up. Additionally, complementary products/services are necessary to be able to fulfill the requirements of customers by delivering a complete package. During the third step of the technology life cycle, the creating the market phase, it is important for startups to change their flexible approach into a more goal driven focus. This is necessary to ensure the decisiveness in the decision-making process to be able to create revenues. This is in line with the required factor of scaling up production. It allows startups to become more financially secured. Furthermore the timing of entry is a prerequisite in the third phase of the commercial success process to ensure in-time customer satisfaction. At last the startup will need a launching customer to be able to gain recognition from the market in order to reach commercial success with a high technology product.

These findings resulted in novel insights concerning the allocation of commercial success factors for sustainable energy startups in the technology life cycle. The first recommendation towards startups in the sustainable energy industry that aim to become commercially successful with the implementation of a new technology into a market is to use these twelve findings as a guiding tool when processing each phase of the technology life cycle.

Additionally, this research found a differentiation of the conceptual framework presented by Suarez at the startups. The second recommendation towards startups in the sustainable energy industry is to use this new conceptual framework and process the technology life cycle in a different manner. The startup should begin with an additional prior step, which is called phase 0. In this phase the startup should use its capabilities to detect a technological problem and a market need to solve this problem. Moreover, startup managers must identify their potential customers first and be aware whether these future customers are actually in a need for the technological solution. Arguments for this new phase are to reduce uncertainties and to increase the reliability of becoming commercially successful. Hereafter the startup can process the R&D phase as given by Suarez (2004). After the R&D phase both the technical feasibility and the market creation phase should be processed in a parallel manner, in which the transition between phase one up to three is inferior. Arguments for the parallel transition are that this allows a quick market introduction. It decreases the time spend on testing, allowing the startup to become more financially secured. Instead, testing with the customers is advised to determine whether the technology is technical feasible and to improve the product.

Table of Content

1 Introduction

The objective of this introduction chapter is to give complete empirical arguments, filled with proofs throughout, to convince the relevance of this research and to indicate the driving force for the rest of the document. First a problem description will indicate both the scientific and the practical relevance of this research (**1.1**). The objective describes the purpose of this study (**1.2**). The research questions are the basis for the data collection and arise from the objective of the study (**1.3**). Furthermore a definition of the core concepts of this research is given (**1.4**). At last an outline framework of this research is represented (**1.5**).

1.1 Problem statement

Various scholars have defined a list of factors that positively affect the outcome for standard dominance (Schilling, 1998; Schilling, 2002; Suarez, 2004; van de Kaa, 2011; Shapiro, 1999). However, the current literature, methods and case studies on factors that determine the outcome of technology battles focus on battles between incumbent organizations. The question arises how is it possible that startups are able to survive along these powerful incumbent companies with a new technology? This chapter aims to answer the question why this is a problem and therefore why this research is important. This issue can both be interpreted as a scientific (**1.1.1**) and a practical problem (**1.1.2**).

1.1.1 Scientific problem

Literature in the field of technology management indicates factors that positively affect the possibility of reaching technology dominance for incumbent organizations by reaching commercial success in an emerging market. Technology dominance is, in existing literature, defined as ''the selection of a single technology standard in a particular industry or market''. This standard may be embedded in a single product configuration, a particular process in which services or products are being provided or in the architecture of a family of products (Schilling M. A., 1998). The factors are extensively researched by multiple researchers based on two major fundamentals: environmental versus firm-level factors and the difference of technology dominance factor importance during the technology life cycle (Schilling, 2002; Schilling, 1998; Shapiro, 1999; Suarez, 2004). These publications however only focus on incumbent firms. While the much smaller startup firms are able to compete with these incumbents and become technological successful in an emerging market, it is however still unknown how this is possible without having the resources of incumbents. Entrepreneurial literature is available (Dyer, Gregersen, & Christensen, 2008), but they do not clarify specific commercial success factors during their process to reach this success.
The scientific problem is that there is no literature available that elaborates on the current incumbent technology dominance knowledge, for startups. The existence of a knowledge gap in the construction of theory between incumbent dominance factors and commercial success factors for startups creates this problem.
This research therefore contributes to the development of theory. By studying the factors that determine successful commercialization for startup companies in an emerging market, the interaction between theories of social network and technology dominance can be researched. This results in new, integrative scientific knowledge concerning startup success factors. Potentially, this research also results in solving contradictory findings when looked at the dominance factors for incumbent organizations, that offers boundary conditions for startup companies.

1.1.2 Practical problem

The impact of startups and the importance of their socio-economic contributions have been a challenge for several years. Startups do not only create new industries and invented revolutionary technology over time, they also generate economic welfare and new jobs. The U.S. Census Bureau and the Economics and Statistics Administration (ESA) within the Department of Commerce, identifies that in the U.S. the very youngest firms (until one year of age) account for 15% of all job creation and young firms (between two and ten years old), create 25% of the jobs in the USA. Combined this means that startup firms generate 40% of all jobs in the USA between 1998 and 2011 (annex I) (U.S. Bureau of the Census, 2012). In 2013 the startups' contribution to the total number of job became historically low, in which incumbent firms are already recovering from the recession of 2008-2009 (Annex I) (U.S. Bureau of the Census, 2015). But what makes these startups especially interesting from a technological perspective is that they initiate the establishment of new industries. Especially in the sustainable energy industry new technological developments have entered the market due to startups, creating new business models. Examples are

the increasing technological development of solar panels including the applied payment services, electric vehicles, alternative energy and energy regulation systems, all of which require new standards. The lack of empirical research that focuses on startups regarding this phenomenon makes it difficult for startups to gain understanding in how to organize and implement these new technological developments and standards into the market in a way that results in commercial success.
There are some assumptions we can make on the factors that determine commercial success for a startup company based on logical sense. For example the resources a startup company has access to and the known practical factors of incumbent firms. Additionally, the entrepreneurial literature that is available does provide several factors that positively influence the commercial success of startups. However it does not focus on the context of commercialization of new technologies and the development of new standards that explains the importance of these factors during the initial phases of the technology life cycle. So how is it then possible that these startups, without having the capabilities and resources of incumbents, are able to survive in this environment of larger competing organizations and existing technologies? By studying in practice what factors actually contribute to the successful position of a startup firm during the different phases of the technology life cycle, this study will generate a contribution to managerial practices in these areas. This research aims to bridge the knowledge gap based on the already existing scientific knowledge to help startups in practice.
This research is particularly important because the results allow managers of startups to have competitive advantages compared to incumbent organizations by increasing their chances on achieving commercial success in an emerging market. The owners of the problem are initially the startups themselves. However, the government functions as a more overarching problem owner. This research report aims, from a practical perspective, to give startups insights on relevant success factors during the different phases of the technology life cycle, to help them increase their chances on success (Gans, 2002).

1.2 Research objective

This chapter aims to answer the question of ''what'' will be researched and it clarifies when this research is completed. The objective of this research is to gain profound and complete insight into different technological management processes in particular space and time (Doorewaard, 2010). This objective can be obtained by means of contributing qualitatively to both scientific knowledge and solve the practical problem discussed earlier. In practice this means the objective is to determine a set of factors that contribute to startups in a sustainable energy industry at becoming commercially successful with a technology during the different phases of the technology life cycle in an emerging market (van de Kaa, 2011). This explorative research is of an inductive type. During this research the search of a theory, combined with the gathered data, will fill the knowledge gap. This knowledge gap in the literature and empirical studies is the foundation of this research. The starting point is the highly respected conceptual framework presented by Suarez (2004) that focuses on the technology dominance process of incumbents. By using this framework and applying it empirically in ten success stories of sustainable energy startups this study resulted novel insights. It delivers a valuable academic contribution to the question how sustainable energy startups manage to become commercially successful by implementing a new technology in the market. The academic contribution of this research lies in gaining an understanding of how startups apply a new technology in the market and become commercially successful by linking the existing conceptual framework for incumbents and literature for startup success into practice. Secondary objective is to elaborate on the literature by generalizing a set of factors for sustainable energy startups in practice. A final objective of this research is to combine both scientific and practitioner data to determine how small sustainable energy startups can become successful in the market with their developed technology by obtaining a significant market share. By gathering empirical data from startup firms, this study aims to combine practical data that shows what factors startups and incumbents deem as important to reach their commercial success in the market. It therefore can be stated that this research is of a fundamental type, which will generate knowledge by trying to comprehend how a specifically occurring problem in an organization can be solved (Doorewaard, 2010). In other words, to contribute to existing scientific knowledge by filling up the knowledge gap concerning incumbent dominance factors. This generated knowledge however, can be applied later on in a business setting by managerial practices. Therefore this research could indirectly solve an indirect second problem. Namely, increasing the socio-economical contribution of startups by giving startups the knowledge that increases their chances on becoming successful.

1.3 Research Questions

The research question is logically deducted from the research objective and formulated as follows: ***How can startups in the sustainable energy industry become successful in commercializing a high technology product in an emerging market during the initial phases of the technology life cycle?***

This research aims to answer this question with the help of data that is collected from startups concerning their process of reaching commercial success. This data can be too diverse for each different case when there is no focus area. A preliminary literature study makes it possible to focus on a particular phase of the success process and monitor the second data-collecting phase of this thesis. The answer of sub-question 1 forms the basis of the data collection. The literature concerning incumbent technological commercial success will be used to determine the focus on relevant success factors for startups. By using the literature, relevant variables that result in commercial success will be determined. This leads to the definition of the first sub-question.

Sub-question 1: *Which factors determine technological commercial success for incumbents during the different stages of the technology life cycle?*

After the determination of the main concepts of successful technological commercialization and a selection of relevant factors to reach this success, this information will be used to collect the practical data. With the help of startups that already reached a form of commercial success, a historical process will indicate what factors were important for each individual case. This leads to the following sub-question.

Sub-question 2: *Which factors determine technological commercial success for startups during the different stages of the technology life cycle?*

The factors that are derived from the case studies indicate a set of relevant factors for commercial success for startups. The studies factors are likely to be related to the factors that are studies in the literature research.

Sub-question 3: *How do the results from the case studies of startups relate to the literature and what recommendations can be derived from it?*

The reason for the establishment of the sub questions is based on the motivation to (a) indicate what type of knowledge is required for answering the main research question and (b) to understand which material (data) needs to be gathered for the research project.
The motivation for answering the first sub question is to derive at a set of known factors, influencing the chances on commercial success. Factors that contribute significantly to a firm in gaining technological commercial success are considered as relevant. The objective for the second sub question is to gather the data itself and the motivation for the third sub question is to link and evaluate sub question one and two (Doorewaard, 2010).

1.4 Definition of terms

This paragraph aims to clarify the meaning of the most important terms that will be used during this research. To secure the consistency and thoroughness of the results, it is necessary to be exclusive in terms of definitions. Potential indistinct terms are being defined which prevents ambiguous thoughts later in the research. Also for readers of whom the terms might be obscure this information provides direct explicitness.

- **High technology product**: The definition of a high technology product can be approached from different literature streams. For example from a industry-based, firm-based or life-cycle based view. The definition based on the product however is related to the amount of research and development (R&D) that is used for the development of the technology. A high technology product therefore is ''a product in which the technological development is synonymous with the technology products or production''. The R&D is consequently synonymous with the development of the technology, the development of the know-how of the product and R&D functions have to be identified as a source of the technological innocation process (Hansen & Serin, 1997). Steenhuis & de Bruijn ellaborate on this view by combining the different literature streams described above, adding two dimension to the definition. First, a high-tech product should have a certain amount of complexity in both the process of development as well as in the product

itself. Secondly, the product should have a form of ''newness'' that causes changes in an industry (Steenhuis & de Bruijn, 2006).

- **Startups**: A startup is an institution created by humans that is designed to create new products or services under conditions of extreme uncertainties (Ries, 2011).
- **Commercial success**: Commercial success of a startup is defined in terms of its survival. Literature shows that the survival of a firm is used to operationalize technology dominance (Van de Kaa, 2012). Since a startup needs to become commercially successful in order to become dominant in a particular market, commercial success is defined in terms of survival of the startup and its ability to process the phases of the technology life cycle (Christensen, Suarez, & Utterback, 1998; Suarez & Utterback, 1995). In the forthcoming part of this report both the terms of technology dominance and commercial success will be used. When referring to the term technology or standard dominance, the focus is laid on how incumbents reach success with a technology. When referring to the term commercial success, the focus is laid on startups, since the chances for a startup reaching technology dominance is exceptional.
- **The Technology life cycle**: is generally defined as a process of different phases that describes the technological progress or innovation (Ortt & Delgoshaie).

1.5 Report structure

This report is structured in three main parts. Besides this introduction chapter, there are four remaining chapters that will fall into these three parts (**Figure 1**).

Part 1: Literature study
The first part, consisting of chapter 2, contains the theoretical part that aims to answer both research question one and two. Here a wide range of literature works will be discussed to critically assess and answer the first two research questions. This part is also functioning as a direction for the second part.
Part 2: Empirical work
This second part, consisting of chapter 3 and 4, form the empirical work of this research. First, chapter 3 describes the overall design of this research. This chapter will indicate what methodological issues are involved, the unit of analysis to be involved and the methods of assessing the cases. Here the focus is on the semi-structured interview technique. After completing the research design, the actual interviews will take place. The actual results of these interviews will be described in chapter 4. This chapter will bring together all the results that are obtained during the case studies and will therefore automatically answer the third sub-question. After processing the results, a relation will be made with the literature review to answer the fourth sub-question.
Part 3: Conclusion, discussion and future research work
The final part is also the final chapter. Here, in chapter 5, the main research question will be addressed and answered that will result in several propositions. Furthermore, this chapter indicates the boundaries that have arisen during this research. This chapter continues by giving some implications and introduces recommendations for further research work on a number of areas.

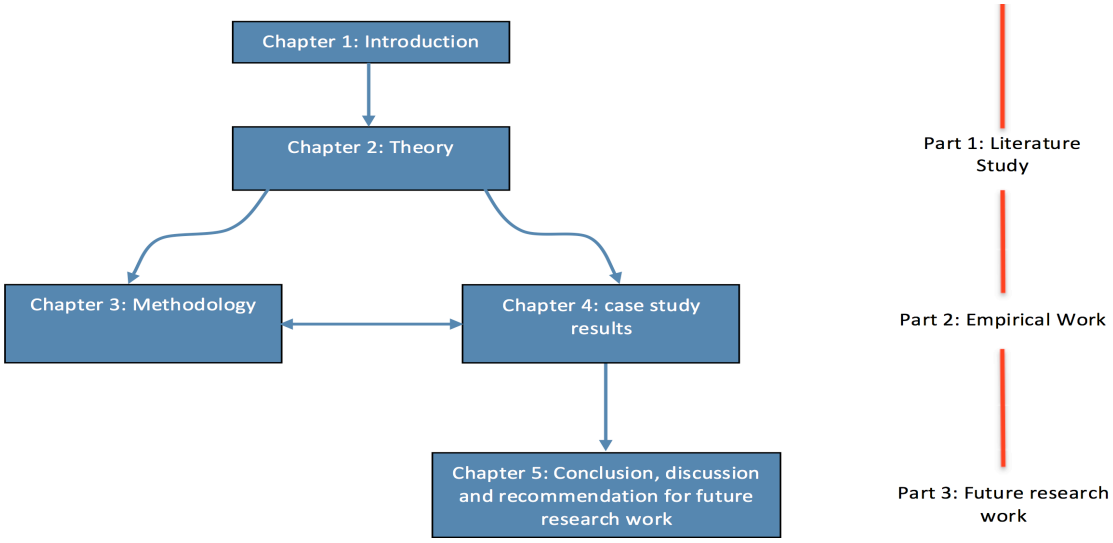

Figure 1 Thesis Structure

2 Theory

With the help of a literature study, this chapter aims to answer the first sub question of this research: *Which factors determine technological commercial success for incumbents during the different stages of the technology life cycle?* Also to elaborate on this, further research will be performed to indicate already known factors that influence entrepreneurs in the process of becoming successful in the market with their product/service.
This theoretical chapter is structured in such a way, that most important concepts of market success will be taken into account. It is therefore important to take different literature streams into account. To reach saturation of all relevant knowledge for a particular research the importance of using different literature streams is clearly explained by scholars. The examination of different relevant literature works clarifies what issues have already been examined and what their implications are (Peng, 2010; Polonsky, 2008). Analyzing each of these literature streams results in factors that answer sub question one.
The first literature stream focusses on the evolutionary economics. This stream focusses on the likelihood that a particular technology becomes dominant based on a natural selection process. The dynamics of how a technology becomes succesfull in a particular industry forms the basis of this research and is therefore important to concider (**2.1**). The network economics stream focusses on environmental factors that infleunces the chances on succes. Characteristics of the market plays an important role in the market succes proccess of a firm. These factors can hardly be influenced by the firm itself (**2.2**). Combined with the evolutionary economics, these streams inidicate the inexplicable factors for succes. Next the research stream of platforms will be analyzed to indicate the explicable dominance factors for incumbent (**2.3**). There is a need to explore the factors from the platform literature works because its concepts point out the importance of market acceptance, an important condition in order to become commercially successful (Van de Kaa, de Vries, & Rezaei, 2014). The stream of technology management focuses on the achievement of success by means of firm level factors. These are factors that are initiated by the firm and therefore influences by the firm. Furthermore this stream indicates the importance of the technology life cycle, which will be used as a framework for this research (**2.4**). Annex V presents an overview of the dominance factors derived from the literature study. After indicating the dominance factors for incumbent, the already known factors for entrepreneurs will be studied to be able to link incumbent dominance factors to entrepreneurial success (**2.5**).

2.1 Evolutionary Economics

As described by T. Veblen evolutionary economics base their view on an economical organization that is constantly involving in a process of continuous transformation, in which the behavior of stakeholders is determined by individuals and society as a whole community in a path-dependent nature. This path dependent nature can be explained by actions that influence the present (Veblen, 1898). Also, according to the literature stream of evolutionary economists, natural selection will determine the survival of a firm (Arthur W.B., 1989). An evolutionary concept of technological change consists of a technological breakthrough (also called discontinuity), followed by a period in which there is intensive technological variation and competition, the so-called era of ferment. This leads to the selection of a dominant design. After this selection there is an era that contains incremental changes in the technology followed by a new technological discontinuity (Anderson P., 1990; Abernathy W.J., 1978). Technology dominance is defined as ''the selection of single technology standard in a particular industry or market'' (Schilling M. A., 1998). Other scholars elaborate on this by stating that dominance is reached when at least 50% of new installations use the technology (Suarez, 2004; van de Kaa G., 2011). This concept of technological change is based on reviews of ancient evolutions such as the wheel, steam engine and bicycles and other fundamental needs, introducing the need for technological variation, selection and incremental improvement (Basalla, 1988; Pinch, 1987). Various scholars have integrated dominant designs in technological evolution research streams. They determined that the emergence of a dominant design is the most important in the evolution of an industry, stating that this process is a transformation from a fluid phase to a specific phase (Utterback, 1994; Dao, V. and Zmud, R. 2013). Other scholars elaborated on Utterbacks' idea by stating that there is a tendency for active learning among engineers to improve performance and the nature of the evolutionary process due to customer selection (Henderson and Clark, 1990; Clark, 1985). Jordan stresses the importance of dominant design factors, since it assists firms in detecting or influencing the emergence of a dominant design. This knowledge than can determine the success of failure of a firm (Jordan, 2001). The difficulty of these factors is situated in the complexity that the process of dominant designs can be influenced by political, organizational and social groups (Tushman, 1992; McGrath, 1992).
Scholars in the research stream of evolution economics also describe several factors that affect the determination of a dominant design, which are somewhat inexplicable and uncontrollable by firms. According to some research-

ers the process of a dominant design is considered to be a black box that contains of a lot of factors that are hard to be identified and controlled (Lee J., 1995; Suarez F.F., 1995; Jordan, 2001). First there are external institutional forces that can negatively affect a technology dominance outcome such as regulations, associations but also cooperative actions from suppliers, customers and vendors (Anderson P., 1990; Farrell J. and Saloner, 1985; Gallagher, 2007; Smit, 1998). Some technology standards are forced to exists within a cooperation of competitors with different interests, partial agreements. This tension might result in a firm not willing to share its proprietary technology as a standard (Garud, Jain and Kumaraswamy, 2002). Smit and Pistorius analyzed a practical example of an electronic initiation system that is heading to become dominant. Besides (controllable) technological factors, they state that market, social and economic aspects have influenced the emergence of this dominant design. The so-called sociopolitical forces are hardly to be influenced and predicted, since there are a lot of stakeholders (customers, suppliers, governments both national and international) that have a certain amount of interest and preference for a dominant design (Smit, 1998). Researchers elaborated on this by stating that the tightness of the relation between a supplier and customer can influence the outcome of a dominance design (Liker, J., Kamath, R., Wasti, S., Nagamachi, M., 1996). The importance of these relations is also explained in the sense of social capital (Burt, 1992). It is for instance critical for the transfer and creation of knowledge (Levin & Cross, 2004). Other scholars however say that governmental institutes can also decide to stimulate a certain technology, which can eliminate barriers that will positively affect the result of a technology battle (Teece, 1986). Also the bandwagon effect is important, which is an effect, originated by producers producing important complementary products, that increase the value of the system and attracting more users (Khazam J., 1994).

2.2 Network economics

The literature stream of network economics indicates the importance of network externalities in the emergence of a dominant design. Network externalities, also called network effects, are applicable in cases when an increase in the number of users of a particular technology, product or service increases the value of that technology, product or service (Katz M.L., 1985; Farrell J. and Saloner, 1985; Rohlfs, 1974; Birke and Swann, 2006; De Vries, 2011; Gallagher, 2007; Jordan, 2001; Smit, 1998). For instance in the mobile phone industry, in which the utility of an individual user increases as he or she can access more people. This factor is in line with another factor that describes the demand for compatibility and complementaries concerning the technology (David P., 1990; David P., 1985; Funk, 2003; Gallagher, 2007; Jordan, 2001; Smit, 1998). Teece elaborates on this complementary factor by stating that the chance of imitation of a particular technology is also affecting the chance for becoming dominant. The easier a technology can be imitated, the higher the chance that profits will go to owners of complementary assets. Therefore a prior position or connection with the infrastructure and owners of these complementary assets is of importance (Teece, 1986). Moreover, scholars state that there is a clear positive relation between availability and variety of complementary goods and the increase of the installed base, which lead to standard dominance (Van de Kaa, De Vries, & Van den Ende, 2015). Relationships within an organization are also important. Network economics state that weak internal ties in an organization lead to high knowledge sharing within teams. Contradictory, strong ties in an organization allow knowledge sharing between other subunits in the organization (Hansen M. , 1999). Furthermore the (communication) relationship between producers and consumers is a factor that is mostly out of control of the developer of the technology (Smit, 1998). Regimes that have strong or weak appropriabilities can influence the success of a firm if this firm has a contradictory view compared to the regime (Funk, 2003; Srinivasan, 2006). For example, an audio format that is licensed and controlled by a single firm (Hill, 1997). On the other hand in an environment where patents or other forms of intellectual property rights are absent, producers and developers can freely use ideas and concepts from competing design, while these technologies are being tested in the market. For example in the case of the emergence of IBM PC as a dominant design was mainly achieved due to the open architecture, which allowed the usage of the standard DOS operating system, other standard components and technological public documentation (Khazam J., 1994). The outcome of a dominant design is therefore based on the experimentation and the interchange of ideas between producers and developers (Utterback, 1994; Anderson P., 1990; Henderson, 1990; Gallagher, 2007; Suarez F.F. and Utterback M.J., 1995). Another unforeseen factor is the first-mover advantage of which a firm can have no influence on if the firm is unfamiliar about this situation (Lee J., 1995). The risk of potential switching costs for producers and consumers, entry barriers and historical events can also influence the adoption of a technology (Lee J., 1995).

2.3 Platforms

A platform is defined as a set of components that communicate with each other and support the evolvement and variety within a system (Baldwin, 2009). Two platform perspective can be identified. The engineering perspective searches for the effects of a platform on innovation processes, in which the strategy and economic stream of researchers try to understand how platforms become dominant in the market (Van de Kaa G., 2014).
This second part of the literature research focuses on the technological platform from an economics' perspective, which introduces platform dominance factors that are explicable. They generally state that the success of an innovating firm is dependent on the influences of other stakeholders in the innovating ecosystem and the network orchestra between them. An innovation ecosystem is defined as a technological platform that contains of a combination of complementary firms, developers and a ''platform leader'' that has a central role within this system (Adner, 2010; Nambisan, 2011; Baldwin, 2009). Cusumano and Gawer elaborate on this principle by stating that a platform leader is dependent on both economic forces from the outside world and the research and development (R&D) activities from complementary partners but also customers (Cusumano, 2002; Sawhney, 1998). Sang et al. elaborates on this based on the Web 2.0 example by stating that there are more components for an organization to become platform leader, such as innovation ability (the ability to solve essential problems within an industry), efficiency (by improving R&D results, cutting labor and advertisement costs) and connectivity (technological connectivity as in application interfaces but also societal openness with usage rights) (Sang, 2010). This platform leader can appear between different organizational forms: between companies itself, across supply chain and between innovational ecosystems in an industry (Gawer, 2014). Adner explains this principle with an example of Airbus, a leader in the aviation innovative ecosystem who has faced internal challenges to design and develop the new A380. Beyond the internal challenges, Airbus was highly dependent on the challenges of others in the ecosystem such as component suppliers, infrastructure companies (airports), maintenance and training institutes, governmental issues and customer demands (Adner, 2010). Gawer combines and bridges the literature streams of the platform economics with the engineering systems, conceptualizing platforms as markets and as technological architectures, deriving at a concept of platforms as evolving organizations (also called meta-organizations), which operate together including firms, ecosystems and supply chains. The architecture focuses on the manner in which roles and activities are being divided between platform stakeholders (Tee, 2009). Gawer continues with hypotheses that introduce factors that affect the outcome of commercial success. The more open a platform the more agents are being attracted to the ecosystem of the platform. This allows the platform leader to have more choice due the access of more complementary producers (Boudreau, 2010;). Sang et al. give the example of Google, who made its platform available for other complementary firms by opening their software source (Sang, 2010). Whenever there is a weak appropriability regime however, the technology is not protected from duplication (Teece, 1986; Baldwin, 2009). On the other hand scholars found that a proprietary platform is more likely to achieve dominance compared to an open source platform. This is possible because of the two-sided platform pricing strategy. For example Microsoft, who licenses the operating system initially to its users but also charges royalty fees for developers of applications for the operating system (Economides, 2006; Rochet, 2003). The decision between an open or proprietary environment occurs repeatedly when a platform is being developed, since both approaches clearly have a possibility of success (Eisenmann T., 2008; West, 2003). Agents can also turn against the platform standards and become competitive. This competitiveness is depending on the managerial governance of the ecosystem. If platforms contain of collaborative governance, this will increase the willingness of complementors to invest in the platform in a stimulating manner (Gawer, 2014). Van de Kaa and de Bruijn elaborated on this principle by studying the successful ICT IEEE 802.11 platform, a combination of standards for wireless networks, and analyzed the organizational disturbances during its development. Based on governance literature strategies such as ensuring enough participant incentives, aim to reach a majority consensus, continuous participation and directional steering with the help of rules during platform decision making processes will increase the chance to overcome these disturbances (Van de Kaa and De Bruijn, 2015). Whenever multiple platforms compete with each other for market acceptance, platform battles may arise. Authors that study platform wars have investigated the importance of factors for winning such a platform battle and becoming dominant (Van de Kaa G., 2014; C. Shapiro, 1999).
Furthermore researchers have extensively analyzes the effects of specific factors on technology dominance. As discussed above, authority factors have been indicated as important for platforms dominance by several researchers. However one particular literature work explores this factor more specifically by opening the black box of China's governmental institutions and shows that a government is not always capable of influencing market acceptance. This is due to the structure, power and local competition of governments and since a government can not always operate as a single agent (Van de Kaa, Greeven, & Van Puijenbroek, 2013). Other specific factors for

dominance work focuses on committees in a case of ICT platform development. Here a set of four recommendations stresses the importance of committees to reach platform dominance; focus on (1) decision-making processes, (2) create participant incentives, (3) if necessary apply hierarchical interventions and (4) stimulate a well-designed decision-making process (Van de Kaa and De Bruijn, 2015). Furthermore the standard's characteristics and dynamics of platform networks are highly influenced by the flexibility of the standard. Standard's flexibility can highly influence the attraction of network actors, facilitate the growth and variation of a network, which eventually will affect further adoptions of the standard (Van den Ende, Van de Kaa, Den Uyl & De Vries, 2012).

Various platform wars scholars focus on the completeness, relevance and relations between factors. Platform leaders are found to selects a combination of various control modes in the section of strategic, technological and network factors in order to reach market dominance and control the platform. These choices depend on the position of the platform leader to be a follower or a first entrant. In the first case a more distributed network control will allow flexibility, variety and price differences. In the second option a centralized network control will set high prices and technological quality, reduce the flexibility of the platform and limit variety (Den Hartigh, Ortt, Van de Kaa and Stolwijk, 2016). Other scholars derive at the following critical factors for dominance in a network-based platform; switching costs, installed base and complementary goods and the importance of the relation between them. These factors are a strategic consequence of more general and traditional factors such as building entry barriers, effective network management, pricing strategies, brand recognition, continuous innovation and asset protection (Gallagher and Park, 2002). Later scholars elaborated on this research by adding network effects as an important factor. According to Gallagher, the combination of switching costs and network effects can tip over a decision for a standard to be chosen (Gallagher, 2012; Van de Kaa, De Vries & Van den Ende, 2015). More scholars attempt to complete the framework of relevant dominance factors to increase the understanding of format battles (van de Kaa, 2009). A large derived set of factors is divided under five main pillars. The factors that can hardly be influenced by firms are also called ''market characteristics'' and two forms of firm level factors can be defined; ''format support strategy'' and ''characteristics of the format supporter''. Format support strategy contains factors that are only strategy related such as the pricing and communication to the market. The characteristics of the format supporter contain factors that are more related to the current strength of supporting company such as reputation and financial position. The factors under ''Characteristics of the format'' focus on superiority for the technological product/service compared to competitive products/services and is expected to have more chance to become dominant in the market. This category contains factors such as the characteristics of the technology and compatibility with other products. There is however another framework category made, called ''other stakeholders''. This categoty contains of institutes, situated outside the group of standard supporters, that influence the outcome of the technology battle for example regulating institutes. This set of factors is confronted with empirical data to determine the relevance of it (Van de Kaa and De Vries, 2015; van de Kaa, van den Ende, de Vries & Van Heck, 2011).

Platform economics furthermore add weights to the factors that are derived in the literature described above. The type of platform for instance can influence the importance of particular factors. Three types of platforms are being defined; subsystem platforms, evolved subsystem platforms and system platforms in which the components are the subsystems and the novel product is the complex system as a whole. Subsystems enable communication within the level, evolved subsystem platforms have realized this communication between subsystems and system platforms have specifically been developed to communicate between subsystems. Compatibility, installed base, brand reputation and pricing strategy are the most important factors for subsystem platforms. Technology superiority, diversity of the network, learning orientation and entry timing are most important for system platforms and flexibility, judiciary (judicial power), financial strength and commitment are explicitly important for evolved subsystem platforms (Van de Kaa, De Vries & Rezaei, 2014). Empirical studies show that the determination for a dominance outcome is not only determined by path dependent factors. The results show that, based on three technology battle cases, there is a diversity of scores for dominance factors. The highest score, with an average weight of 0.1897 is determined by diversity of the network and the lowest score of 0.0398 is allocated to the learning orientation factor (Van de Kaa, Van Heck, De Vries, Van den Ende, Rezaei, 2014). Empirical research based on photovoltaic technology battles show that pricing strategy and technological superiority have the highest impact on the process of becoming dominant and the appropriability strategy and financial strength have the lowest impact (Van de Kaa, Rezaei, Kamp and De Winter, 2014).

To maintain a dominant platform position, the platform leader will have to incorporate constant monitoring of the needs of complementors and users to keep them motivated to stick with the platform (Suarez, 2012). Network externalities are also from the point of view of the network economics an important factor for platform success (Casey, 2012; Katz M.L., 1985; Cenamor, 2013; Cusumano M., 2011; Eisenmann, 2011; Sang, 2010; Zhu, 2012). These network effects can be initiated due to technological superiority and known brand names (Hogendorn, 2009). For the adoption of a platform by individuals it is important to have enough complementary and varietal

products available that fulfill the demand of the end users (Cenamor, 2013; Sawhney, 1998; Srinivasan A., 2010). This can be achieved by attracting high-status developers, which will increase the likelihood of platform success (Srinivasan A., 2010). Scholars also stress the importance of standardization for core components and/or interfaces of the technology. This is important because without it, the developers of the technology are likely to be overwhelmed by the complexity of different types of components within the system (Murmann, 2006). Switching costs can protect incumbents by deterring standalone firm from entering a particular platform market (Eisenmann, 2011). Timing of entry is an important factor when firms try to build a shared platform. When incumbents recruit other stakeholders to the platform too early, they might be ignored. If they are too late, the platform might be already developed elsewhere (Eisenmann T., 2008). This thought is in line with the effective planning principle, which aims to conserve the development of the technology but still deliver distinctive products to the market (Robertson, 1998).

2.4 Technology management

The fourth stream of literature is focussed on the area of technology management ellaborating on the literature stream of evolutionary economics. This literature section concerns the relevance of factors during particular phases of the technology life cycle (Anderson, 1990; Tushman, 1997). Suarez elaborated on this concept in 2004 by dividing the cyclus in more extensive phases (**Figure 2**). Phase I indicates the build up of R&D. This phase determines the key characteristics of the technological field. Here the different technological trajectories are being created. Followed by phase II that concerns the technical feasibility. This phase allows the firms to asses whether they are in the position of fighting in a technology battle independently. Phase III is all about creating the market. Due to the launch of a first commercial product, there is an irreversible change from technology factors to market factors. Phase IV focusses on the battle itself. Here the customer bases will begin to have impact on future customer decisions. The last phase (V) is about the post-dominance part of the process. At this moment in time, there is a clear dominant technology that has emerged into the market. Competition after becoming dominance in concidered to be intense (Suarez, 2004).

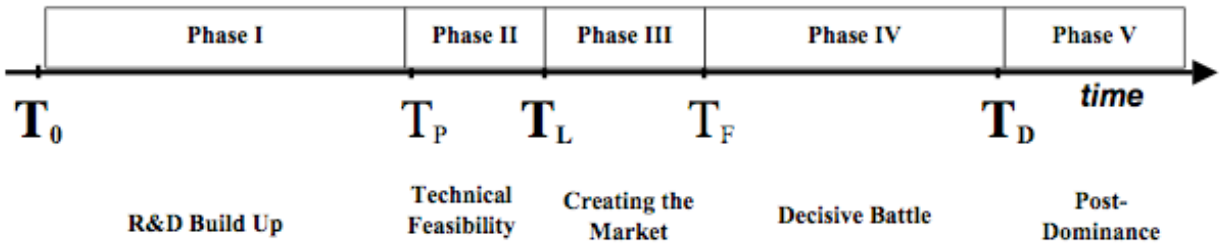

Figure 2 Phases in the process of technological dominance (Source: (Suarez, 2004))

Suarez concludes his research with a table that describes the factors that are important in a particular phase of the process of technological dominance (Annex IV). This clarifies that each phase seems to relate to a different mix of firm and environmental dominance factors. Annex IV shows the factors that have the strongest effect on the particular phase they are situated in. The conclusions of Suarez are based on observations of dominance battles. The higher the R&D intensity the more likely that a dominant design emerges (Srinivasan R. L., 2006). The performances of a firm will be enhances when they apply strategic maneuvering activities to build alliance networks (Soh, 2010). Entering an industry in de pre-dominant design phase, a firm has the advantage of more time to experiment and to build up R&D and to allocate users for the technology (Suarez F.F., 1995; Khazam J., 1994). Contradictory, other scholars found that there is enough opportunities for late entrants that switched to the dominant design and still want to benefit a great market share (Tegarden, 1999). Uijl and de Vries explain this with the case of the Blu-ray versus HD-DVD battle. Even do HD-DVD was first to enter the market, the strategic maneuvering of Blu-ray supporters determined that the battle would be won by Blu-ray (Den Uijl, and De Vries, 2013; den Hartigh, Ortt, van de Kaa, & Stolwijk, 2009). Surprising is also that this battle was not determined by consumers but by supporters. Different strategies have been developed during the phases of the lifecycle. Rong et al. introduces an open platform strategy in the beginning of the cycle to create the product design and process sustainability. Followed by a dominant platform strategy that aims to increase volume and to control the industry. Last the opportunistic strategy to apply the technology in niche applications for renewal (Rong, 2013). As technological challenges might decrease during the phases of the technology life cycle, the contractual challenges with major stakeholders can become more important (Adner, 2010). Business network composition and structures can also change during the different phases of the technology life cycle. Empirical research show that firms such as Microsoft and Oracle deliberately search and create a business network around their technology and that they are aware of the im-

portance of this. However the authors stress that networks alone are not always enough. The strategic decision-making processes during the phases are of high importance to be able to become dominant (Den Hartigh, Ortt, Van de Kaa and Stolwijk, 2011).

2.5 Entrepreneurial success

This section of the literature review focuses on entrepreneurs that reach technological commercial success and the factors that led to this. Limited research has been conducted based on commercial success factors for entrepreneurs or with a different point of view. In addition the entrepreneurial literature that is available does provide several factors that positively influence the commercial success of startups. However it does not focus on the context of commercialization of new technologies and the development of new standards that explains the importance of these factors during the initial phases of the technology life cycle. For example some available research has focused on the personal consequences of an entrepreneur becoming successful (Alstete, 2008). There is however some literature that is in line with this research. Entrepreneurship literature has shown how firm level factors such as a multidisciplinary team composition of individuals with different expertise could affect startup performance, due to their size and limited resources. This has been confirmed by a literature study, in which scholars from the entrepreneurial stream state that the technology to be exploited in the market has to comply the experiences of the team (Stuart & Abetti, 1987). Additionally scholars explain the importance of the role and diversity of industry research experience in a startup team and the qualities of the individuals in the team. In the early development of a startups' technology, the team conducts research to commercialize the scientific invention. Hereafter this same team should transform their scientific view into academic entrepreneurial view (Van der Steen, Ortt, & Scholten, 2010). Consequently the human capital of startups is determined to be an important resource due to the initial lack of experience and skills within the startup team. Team members that have prior experience from the startup industry are considered to increase the understanding within a new startup concerning the management of relationships with investors, distributors, suppliers and customers. This increases the value of the team characteristics and it results in more business opportunities (Scholten, Omta, Kemp, & Elfring, 2015). Consequently, startup managers must identify their potential customers first and be aware whether their future customers are actually in a need for the technology (Bower & Christensen, 1995; Christensen & Rosenbloom, 1995; Christensen C. , 1997). Furthermore literature concerning the reasons for failing startups indicate factors such as ''cash run outs'', great concepts but no products, strategy gaps, inefficient team compositions and inadequate advise from experts (Entrepreneur.com, 2014; Kaiser & Muller, 2013). Startups however can occupy a central position in the technology platform during the predominance phase of the technology life cycle to create a competitive advantage (Soh, 2010). The literature indicates that there is also a difference in how startups are being financed and in particular what type of startups is affected by financing. The sizes of startups have an effect in their financing concerning empirical research. The larger the startup the more likely it is that these firms have a proportional higher debt compared to smaller startups. Furthermore internal characteristics such as the structure, future orientation and asset structure influence the financing aspect of startups (Cassar, 2004). Many universities provide facilities in the prior stages of a new startup. Other scholars state that these universities are the driving force behind the success of a startup. Different explanations are compared for institutional variation in new startup formation coming from universities. The following categorizations are determined: the concentration of venture capital in the geographical location, the reliance of the research facilities of the universities, development concerning funding opportunities and university policies (Gregorio, 2003). Additionally entrepreneurial literature that focuses on sociology explains the importance of understanding entrepreneurial behavior, which is strongly determined by social situations. The creation of new social contacts and interactions in a network positively influences the development of a technology (Carsrud & Johnson, 1989). Social constructivism indicates that the development is socially situated, in which knowledge is constructed by means of interaction with others. This van guide entrepreneurs in their decision making process of becoming successful (Trivedi, 2010).

Literature works have also indicated the results of different environmental strategies that have an effect on the commercial success of startups. In general the key aspect of firms that are commercially focused, have to make a decision in choosing between a competitive of cooperative strategy. The same decisions hold for startups that are situated in hostile or benign environments. These choices on its own affect the outcome of the likelihood of commercial success (Gans, 2002; Covin & Selvin, 1989). This is in line with the importance of alliances with larger corporations to become successful together (Soh, 2010). The decision for entrepreneurial firms whether to cooperate with larger firms or not is initiated due to the lack of capabilities of these smaller firms, lack of decision-making skills and brand reputation (Aldrich and Ruef, 2006). Furthermore the role of building alliances to sustain legitimacy and gain network externalities are also reasons to collaborate with other companies (Podoynitsyna, Song, Van

der Bij, & Weggeman, 2013). Scholars stress the importance of legitimating activities for startups to reduce hazard of venture disbanding and to stimulate the transition towards other organizing activities (Delmar & Shane, 2004). Marketing, distribution, manufacturing and other organizational resources are major components for a firm to be able to commercialize a new technology successful. Larger companies could help these firms by investing in them and give them the financial capability they need (Alvaiez and Bainey, 2001). Other scholars confirm these ideas with the help of empirical research. Small companies in the biotechnology firms are compared by their cooperation with larger firms, which resulted in a quicker Initial Public Offering (IPO) for cooperative startups compared to non-cooperative startups (Stuart, Hoang and Hybels, 1999). Alvaiez and Bainey however state that alliances with larger companies are not always beneficial for the entrepreneurial firm, since the larger company often appropriates the value of the entrepreneurial firm. Five strategies are determined that can appropriate more value and still be able to alliance with larger partners: (1) Go it alone, (2) slow down the rate of learning of the larger firms, (3) come up with contracts to define the contractual relationship, (4) build trustful relationships and (5) bring additional resources to the alliance besides the particular technology. This indicates a clear distinction in the ''friendliness'' towards the larger firm (Alvaiez and Bainey, 2001). Other scholar in particular stress that a startup should never go it alone under the condition that (1) the alliances are configured to an efficient network that provides the startup with sufficient information and capabilities that reduces the costs, complexity and conflicts and (2) to try to ally with the potential future rivals to increase learning and prevent future rivals (Baum, Calabrese and Silverman, 2000). Elaboration on the importance of a startups' network, explains the influence of it on the commercial success of a startup with a high technology product (Scholten, Van de Kaa, & Trott, 2016).

3 Methodology

The objective of this research is to study factors that influence the chance on commercial success for startup firms. The aim of this chapter is to discuss the guidelines to perform this research and to secure the quality of this research. First the type of research is being discussed (**3.1**). The unit of analysis indicates why and what group is selected to perform the empirical part of this research (**3.2**). After collecting the empirical results the data has to be collected and analyzed according to a particular methodological procedure (**3.3 & 3.4**).

3.1 Type of research

Due to the characteristic of this research the most applicable strategy to perform this research is a case study approach (Annex III) (Doorewaard, 2010). Concerning the main research question, this would be the proper strategy since this research is both theory and practice aimed. Additionally it allows interpretation from the startups. Furthermore the main question of this research is to answer a ''how'' type of question. The qualitative approach of the case study strategy makes is possible to observe the startups and allow the entrepreneurs to explain what is important according to them. According to R.K. Yin (2003) a multiple-case replication would be most suitable for this type of research.
The starting point of this research is the literature review that contains of key publications listing a set of factors, currently known for incumbents, searched by backward and forward search methods. With the help of ISI web of knowledge, the most applicably articles based on the amount of citations were used for the search. The distinction made is based on different types of literature streams such as the evolutionary economics, network economics, platform economics, technology management and entrepreneurial literature. This selection was made to indicate the difference between inexplicable from explicable success factors and to specify entrepreneurial success factors. Also a differentiation is made to distinguish literature based on weights of factors, the effects of factors, completeness, relevance and relations between factors. The derived technology life cycle will be used as a starting point for testing phase of this research.
The literature review for commercial success factors for startups defines three main variables. Initially a set of known factors, the independent variable, will determine the commercial success, dependent variable, of an incumbent organization. However the characteristics of a startup, the moderating variable, might influence this causal diagram (**Figure 3**). In this case the moderator is a qualitative variable that affects the strength and or direction of the relation between the independent and dependent variable (Baron, 1986).

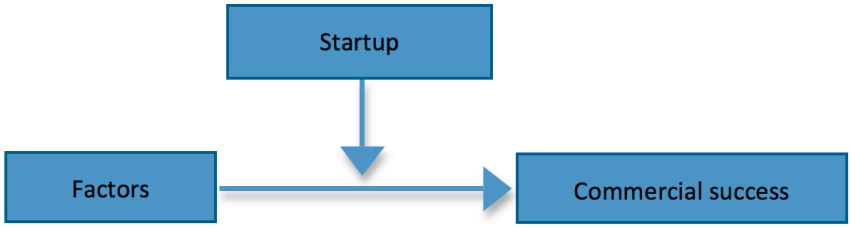

Figure 3 Prior derived causal diagram

According to Dul and Hak (2008) a theory-oriented research results in a small selection of variables and to such a simple causal diagram, which will act as guidance during the empirical part of this research. After the results, this causal diagram can be further developed or even be changed to a completely different model. After exploring the literature no propositions are found, this research is defined as a theory-building research. Since three main concepts are known this research is also stated to be a proposition building research. The known variables will determine the type of research that should be executed. Initially the independent variable (factors) and relation between the independent and dependent variable are unknown, the dependent variable is known. This position will lead per definition to a comparative case study. Another possible flow is that the independent factors are actually known if, after the empirical part of this study, it becomes clear that factors for incumbents are identical for startups but that the relation between dependent and independent variable is unknown. This position will also state that a comparative case study should be applied, however an experiment could also be applicable in this case. In any of these conditions a comparative case study is applicable and thus this will be the basis of the empirical part of this study. The choice to perform multiple case studies is made to overcome the problem of the impossibility to generalize with case studies in general (Dul and Hak, 2008). Other scholars elaborate on this by stating

that this type of case study is especially appropriate for new topic areas (Eisenhardt, 1989; Doorewaard, 2010; Yin, 2003) (Annex III). Following this process will eventually lead to the composition of propositions as an end deliverable of this research. This summarizes the method for each sub question (**table 1**).

Table 1 Type of research per sub question

Sub research question	Type of research
1) Which factors determine technological commercial success for incumbents during the different stages of the technology life cycle?	• Literature review
2) Which factors determine technological commercial success for startups during the different stages of the technology life cycle?	• Comparative Case study: semi structured interviews • Literature study
3) How do the results from the case studies of startups relate to the literature and what recommendations can be derived from it?	• Comparative Case study: semi structured interviews • Literature review

3.2 Unit of analysis

The unit of analysis identifies the major entity that will be analyzed in a particular study and indicates what the focus level of this research will be (Yin, 2003). The unit of analysis for this research is the Dutch sustainable energy startup industry. By selecting the energy market, this research covers two necessary conditions. First, the presence of many startups in this industry that are located in The Netherlands. Secondly, enough startups that reached a success position with their technology in this industry to be able to get enough data through interviews. To gain a high external validity and to be able to generalize for the Dutch sustainable energy startup community, participating startups were found in dispersed geographical areas in The Netherlands (**Figure 4**). The reason for this is to minimize geographical bias and thus maximizing the generalizability for the Dutch sustainable energy startup population. This prevents the risk of certain outcomes to be biased by environmental factors in clusters or regional innovation systems. Specifically in the startup community, ecosystems can be hazardous for the reliability and validity of case study research due to the influences of governments, industries or universities. The selection criteria for the unit of analysis are based on three aspects. First the units should be comparable to each other (van de Kaa G., 2014). Secondly the unit should have reached a form of commercial success in order to be able to go through the trajectory of reaching this success. Third, In order to gain valuable data, it is important to first make a selection between the different stages a startup is positioned. Some startups are simply too immature resulting in no data to be gathered. These startups have never entered the market or have not made any attempt. Therefore technological startups that are in particular interesting for this multi-case replication all need to have entered the market, reached success and be aware of the factors that, according to them, caused this success. Historical cases are therefore most relevant. Another aspect for choosing the unit of analysis lies in the accessibility of both primary and secondary data from the group. Furthermore the technological startups positioned in the sustainable energy industry, have proven to be very successful in the market. This makes these startups researchable to ''go back-in-time'' and determine their trajectory to commercial success. Initially the focus was laid on Yesdelft startups as the unit of analysis. However it became clear that these startups were not willing to participate (Annex II). Secondary data was gathered to select historical success stories of other sustainable energy startups in The Netherlands (annex VI). This resulted in a sample size of ten participa-

Figure 4 Geographic dispersion of the unit of analysis

tion units as analysis in this research: Bluerise, E-traction, Dr. Ten, Easypath, Epyon, Iungo, LGSonic, Multi Tool Trac, Pathema and THT. The selection criteria for this non-random sample are based on their level of success, newness of the technology and amount of investment (Annex VI). Secondary sources show that there is a difference in the level of success. Epyon and THT for example are two companies that extent the others based on profits. However all startups are able to survive. Some startups have a larger installed base, others have more investors that support the technology financially and other startups make more use of subsidies to survive. Every startup won at least one award, indicating that entrepreneur experts experience the startup as commercially successful. The selection of the ten units is not only based on their relevant commercial success trajectory, but also on their willingness to participate. Furthermore due to time constraints, a single interview is held per startup. In every case the founder of the startups is interviewed. More specific information regarding the technology of the participating startups is given in the case analysis.

The non-randomly selected sample size of ten units is based on choices between strong generalizable data and feasibility of this study due to the available time. Considering the five months period of research time, this means that choices have to be made concerning the depth/quantity ratio of the case studies. With ten cases, the identification of the process for success can be done much more precise compared to a larger sample. Furthermore, it is important that each case is being selected carefully to make sure that (a) the results are consistent compared to each other (a literal replication) or (b) results give contrasting outcomes for predictable reasons (a theoretical replication). By starting with ten case studies, it becomes clear what startups interpret as being important for them to successful commercialize a technology. These set of cases are sufficient replications to convince the researcher and the reader of a general phenomenon. If the outcomes of the cases are somewhat contradictory, the initial propositions have to be revised and retested with another set of cases (Yin, 2003). While performing the case studies, the measurements have to be reliable. That is, the measurements have to contain a certain amount of quality in the sense of consistency and repeatability. The construct validity, which shows whether the field research measures what the research claims, has to be taken into account. Furthermore the quality of the research is based on the external validity in which the results of this research should generalize for the whole Dutch sustainable energy startup community. Third, the internal validity is only important in studies that are searching for a causal relationship. Since this study searches for the effects of some particular actions, in this case the actions taken by the startups, internal validity is of high importance. This ensures the quality of cause-effect relationships (Trochim, 2006).

3.3 Data collection

By interviewing relevant sustainable energy startups that have become commercially successful with a technology, this study aims to combine both primary and secondary data that shows what factors startups deem as important to reach their commercial success in the market. Primary data will be gathered with the help of semi-structured interviews and observations. This means that a formal interview will be held, which is guided through structured questions and topics by the interviewer, but that there is the ability to deviate from the interview guide whenever this is ought to be valuable (Bernard, 2006). This approach of the case study strategy makes it possible to observe startups and allow the entrepreneurs to explain what is important according to them. Technology management scholars recognize the essence of a technology life cycle in order for a technology to become dominant in an emerging market (Anderson, 1990; Tushman, 1997). Suarez (2004) elaborated on this principle by dividing the cycle in more extensive phases resulting in the respected technology life cycle. Having more than 120 citations only on Web of Science (webofknowledge, 2016), his conceptual framework forms the basis and input of this research. The interview guide and interview framework (**table 2**) are derive from the conceptual framework (annex VII). This framework will indicate what factor influences the commercial success of a startup during different phases of the technology life cycle (Suarez, 2004). Since it is unlikely that a startup will reach a market dominance position and thus more than 50% market share, the focus will be laid on the initial three phases of the technology life cycle: R&D build up, technical feasibility and creating the market.

Table 2 Interview framework

	Phase 1 R&D build up	Phase 2 Technical feasibility	Phase 3 Creating the market
Inexplicable factors	*Factor X*		*Factor X*
Explicable factors		*Factor X*	
Entrepreneurial factors	*Factor X*		*Factor X*

To ensure the relatedness of the causal diagram, this methodological research approach aims to prevent a retrospective bias. In other words to make sure that the conclusions of this research are actually based upon actual factors that were truly experienced by the startups, instead of biased success stories that do not represent what happened in reality. Since the empirical part of this research looks back at how startups processed the different phases of the technology life cycle, there is a chance that the answers to the questions are influenced by a preference towards a particular perspective or ideology. This has been secured as much as possible by asking factual questions and communicating this risk with the participant, explaining the importance of gaining factual instead of subjective data. If this means that the truly expressed information might be confidential or that it would create a negatively appearance of the startup, it was clarified that their data could be processed anonymously. Additionally to control the validity and reliability of the responses given by the participants, triangulation methods are applied to randomly verify the answers of the participants. This multivariable analysis would for example indicate experienced retrospective bias when the same participant would express contradictory statements in secondary sources.
The interviews will be conducted in a face-to-face or Skype setting. Each interview started with showing them the interview framework and by asking them whether they agreed with the phases of the technology life cycle. Whenever this cycle is clarified the interviewee is asked open questions to let them describe the factors that resulted in their successes in chronological order. This way the interview guideline secures this research for consistency and reliability (Annex VII). To prevent biased interviews the interviewees did not received any in debt question prior to the interview. Based on the type and moment in time, the particular factor will be placed in the correct cell of the interview framework. All interviews will be tape-recorded and transcribed. The amount of collected data and thus the amount of interviews will be based on the saturation principle. This means that the data will be gathered until no new information about this particular subject emerges in repeated cases (Sekaran, 2009).

3.4 Data analysis

After each interview takes place, the content of the tape-recording will be transcribed prior to analyzing the data. The interviewees came up with several commercial success factors, implicitly or explicitly. Only factors that actually contributed to the commercial success of a startup were included in the research. The implicit factors were translated to the terminology that is being used in the literature. To do this in an unbiased manner, the result of each interview will be provided back to the interviewee to be checked on consistency. During the assessment the secondary success data will be used to compare the outcomes of the interview. The interviews will be compared based on the similarity of factors between different cases. Since both practitioner and scientific literature will be researched, combined with the multiple case studies, this allows triangulation of the multiple data sources. Secondary to the primary source, market reports, company press releases, chamber of commerce data and interviews conducted by others found on the internet were used to increase validity through triangulations (Lewis, 1998; Dul & Hak, 2008). The third source concerns the interviews itself. These three different sources of data will show whether there is consistency in the results. Only when the interviewee explains that a particular factor or event contributed to the success of the company and the additional data confirmed this, it will be noted as a success factor. Interviews held in Dutch are being translated into English. The transcripts are shared with the interviewee to correct errors. Whenever required by the interviewee the interviews are being processed anonymously.
After completing each interview and the transcription, the data will be analyzed according to the coding principle (Sekaran, 2009). Coding qualitative data organizes raw data into conceptual categories (Miles, 1994). This process describes three steps that start with open coding. In this process the whole transcription will be analyzed critically in which specific factors will be categorized. During the second coding step, axial coding, the relation between the specific factors will be created. Indicating not only the links between the factors, but also the direction in which they affect the chance for a startup to become successful. The last step, selective coding, concludes the analyzing process by identifying and explaining the relations, which will be the foundation of the theory development. This process is monitored by trying to find a compromise between the so-called confirmation bias, here the researcher tends to pick out data of its own ideas and the construct validity. It is the objective of the researcher to translate terms into the scientific concepts (Miles, 1994). At last the results of each individual will be checked on consistency by applying a cross case analysis (Dul, 2008). The cross case analysis forms the basis of the discussion chapter, in which all the factors that are 100% corresponding between all startup will be transformed into propositions. Whenever there is an 80% or 90% similarity according startups, it is researched whether the respected factor can be explained in a specific context of this group.

4 Results

This chapter aims to answer the sub question*: Which factors determine technological commercial success for startups during the different stages of the technology life cycle?* In the results chapter in total 10 startups are analyzed to show what factors are important for their success (**4.1 – 4.10**). The analysis part of each case is structured by means of the interview framework, which initially indicates the answers of the interviewees on the questions supported by quotes. Secondary to this primary source, market reports, company press releases, chamber of commerce data and interviews conducted by others found on the internet were used to increase validity through triangulations (Lewis, 1998; Dul & Hak, 2008). The cross case analysis will compare the results of each individual case to determine consistency between these cases (**4.11**).

4.1 Bluerise

Bluerise, located in YesDelft, is a company that develops solutions to generate energy from the ocean. It currently grew to four permanent employees and additional interns (Magnet.me: Bluerise, 2016). In 2012 they won the Dutch Climate-KIC Business Competition, including a €35.000 voucher to be used to connect with partners for further development. Furthermore they became finalists in the Postcode Lottery Green Challenge (Postcode Lottery Green Challenge: competition finalists, 2014). Additionally in 2012 Bluerise has been registered in the International Kairos Society, a list 50 of worldwide network of entrepreneurs that will change the world positively (Yesdelft, 2012). This shows that experts in the field of entrepreneurship think that Bluerise has a high potential to become commercially successful since the select the winners based on market potential (climate-kic.org, 2012). The thermal energy retracted from the ocean is used for cooling, fresh water and sustainable electricity. They have two dominating technologies: the Ocean Thermal Energy Conversion (OTEC) and Seawater Air Conditioning (SWAC) besides some complementary add-ons in their portfolio, which utilize the ocean resource (Bluerise, 2016). According to the founder it all started as follows (Annex IX). 'In 2009 I came in contact with Berend Jan Kleute, who was at that time active with a large player called E-concern in search for a sustainable energy project in the Caribbean. After contacting him we decided to start Bluerise in 2010 and established in the incubator of Delft University of Technology. The choice to locate us here in Yesdelft was made very deliberate to be able to make use of the knowledge and experience around the university. We were one of the first here and during the development of our products we increased the team. This was around two years after we started. These persons are not only students and experts at the TU Delft but also shareholders with the right mind-set and skills. Around this period of time we also searched for funding, besides personal financing and political subsidies. My means of consultant feasibility studies in our field of work we ware able to finance the project from our own perspective. Currently we are busy with some projects, of which cooling Curacao Airport using cold seawater is the most known.' From the interview it became clear that Bluerise started their business with the Curacao Airport customer. This indicates that a clear early business model and first pilot customer is important to build up credibility and commitment for the company. The interviewee clarified that it was most important to determine first whether there is a market for your product and that the first three phases do somewhat proceed parallel to each other. This is contrary compared to the technology life cycle that is presented by Suarez (Suarez, 1995).

'What path dependent, also called inexplicable factors, contributed to your commercial success and where are they located in the technology life cycle?'

'Our success certainly depends on some external factors such as politics, customers, the economy and oil price. An example here is the climate agreement in Paris of December 2015. Here 195 countries decided that the world should become more sustainable, which increases the chance for us on success.'
Another factor in which Bluerise has a lack of influence on is its installed base. As explained by the founder 'we will need a certain amount of users to be able to have a feasible business case. This is due to the amount of investments are accompanied with our products. This is already the case for Curacao Airport with our Seawater District System.'

'What explicable factors, factors you deliberately control, contributed to your commercial success and where are they located in the technology life cycle?'

'Choosing the location at the incubator of Delft University of Technology was one of our first deliberate choices that helped our success process. The knowledge and experience here at Delft in general is of great help for our development. Especially in the R&D phase we have the most use out of the university. This is also the moment where you have to think about securing your technology based on patents'. This indicates that appropriability aspects play a role in the first phase of the technology life cycle. 'Additionally, choosing the right shareholders, partners, funding projects and subsidies with the right skills and mind-set is important for us. Furthermore it is very important for us to start with a customer in the beginning. The timing of entering these first customers of your market is also important, but for us it is hard to tell when the time is right. It is important to ask the question from the start of your company: is there even a market for your product and what are the costs for this technological solution for this particular problem?' Secondary sources confirm their close relationships with customers (Bluerise, 2016). Secondary sources show that Curacao Airport is their launching customer having a potential 2.5 million passengers using the airport. Furthermore Bluerise stated that ''the timing could not be better. We are on the edge of starting up one of the most impactful energy technology in history'' (Greenchallenge, 2014). This shows that launching customers are of high importance in the first phase and thus creating the market occurs from the start. 'Besides, after having selected your market area, a goal-driven focus is also of importance'. Another secondary source can confirm the fact that Bluerise is initially targeting markets that have a certain need to solve a particular problem. As Remi explains in another interview ''the application that we are targeting now is for tropical islands. This is because they have a high electricity price. They are small, so they do not have a lot of options. But also because this is a stable energy source, other than wind a solar. Furthermore this allows the island not to be limited by seasons (Plug Me In, 2016). In addition Diego Acovedo, VP business development at Bluerise, states in the green challenge pitch ''we attack the main market need in the tropics: Air conditioning'' (Greenchallenge, 2014). The founder continues, 'however you have to secure that you do not scale up you production from the lab right away into a practical environment. Due to technological risks you should scale-up your production at a later phase. The Seawater District System at Curacao Airport is a perfect platform for us to conduct the pilot. All the ideal infrastructures are present here. In the future we are willing to cooperate with oil and gas parties. Another important factor is marketing. Since the second phase we are relatively much present on events, competitions and conferences. Additionally from the start of our company, in our business-to-business communications, it was important for us to realize the aspects that we promised to our customer. This was especially necessary for our brand reputation and credibility'. Secondary sources show that in the first phase it was important to build alliances with Priva to realize the development of the electricity installation at the Curacao Ocean Ecopark (Privagroup, 2015).

The founder states that technology superiority is important in the early phase of the technology cycle. However, later Bluerise chose to further develop their company by their so-called add-ons complementary to their two dominant products. Additional products such as, desalination, agriculture, aquaculture and other technologies, indicate that complementary products are of importance in a later phase.

'what are factors according to you that explicitly are important for startups, that possibly are not of importance for incumbents and where are they located in the technology life cycle?'

According to the founder, financial strength is not always controllable by a firm but one of the most important aspects in order to become successful, 'as a startup everything is about cash flows and this is especially the case at the start of founding your company. This also accounts for your team composition and the orientation on learning. These last two are essential during the whole process of your commercial success, but have to be applied consciously. Also here accounts; if you do not secure the processes around these factors, your will never learn effectively as an organization. In our case we gain a lot of knowledge from graduates and interns and the knowledge that is generated from this has to be secured in order to maintain it in the organization'. 'Flexibility is also a factor that is included with a startup, that can be very helpful when you need to change your direction quickly. However, there are some downsides to it. At some point, when your market area is clear, you have to focus on one particular thing and follow your strategy'.

Table 4 Commercial Success Factors Bluerise

Phase I R&D build up	Phase II Technical feasibility	Phase III Creating the market
Team composition	Team composition	Team composition
subsidies	Complementary products	Launching customer
Business models	Business models	Scaling-up the production
Technology superiority	Installed base	
Learning orientation	Learning orientation	Learning orientation
Financial strength	Political subsidies and political view on sustainability	Political subsidies and political view on sustainability
Brand reputation	Universities	Timing of entry
Building alliances	Expertise	Oil price
Marketing	Marketing	Marketing
Flexibility	Flexibility	goal-driven focus
Credibility		
Appropriability aspects		

4.2 E-Traction

E-traction, located in Apeldoorn, is a predecessor in the radial flux motor industry (E-traction, 2016). Their organization grew in employees with 19 in 2010 to 32 employees in 2013 (Company.info: E-traction, 2016). Furthermore in 2013 their total active was 4.7 million. In 2014 E-traction had a consumer market of more than 100 busses. Secondary sources indicate that E-traction is quickly growing. According to Peter de Neef, the new CEO of E-traction, 'in 2014 we had hundred vehicles using our technology. Within five years this will increase to more than thousand vehicles' (carriereverhalen.nl, 2014). For their technology ''The Wheel'' E-traction won the Mercedes-Benz BlueEFFICIENCY Award. This award was given to the best innovation concerning sustainable mobility (pvmagazine.nl, 2014). In 2014 they were positioned as third in the MKB Innovatie Top 100 list (Mkbinnovatietop100: E-traction, 2014). A company will only be placed in this list if their revenues and their employees increased during the years. Later, in 2015, Frost & Sullivan awarded E-traction with the Global Technology Leadership Award in the Global Commercial Vehicle Electric Propulsion System Market (Frost & Sullivan, 2016). This shows that entrepreneur experts recognize E-traction as commercially successful company (mkbinnovatietop100, 2014). Their most known invention is TheWheel, an electro engine directly situated on the wheel of a vehicle. Since January 2004 city busses equip this technology. The founder of E-traction Arjan Heinen who made this technology applicable for present cars, busses and other vehicles, has reinvented the idea of Porsche, which contained of the same principle. After graduating from the Dutch HTS as mechanical engineer and working at several companies, Arjan started purchasing and selling vehicle parts. During this period he created an interest in electrical vehicles and knowledge about batteries. From this moment on his multidisciplinary of his team grew and in their spare time they focused on transformation of conventional vehicles to electrical vehicles. Around 1995 the idea to increase the efficiency of electrical vehicles by means of engine efficiency was incorporated in their business. His calculations showed that 50% of the energy is lost in the engine and the powertrain. In 1998 drawing were included to the idea and left at the notary office. In 2000 the idea was mature and received enough support base according to Arjan, which let to start of the project (Annex X).

When discussing the technology life cycle with Arjan he expressed that he experienced a deviation of the presented model, 'first there is a prior phase to the R&D phase where the idea and concept are being developed. In 1998 I found that 50% of the energy for vehicle transportation is lost in the drive assembly. That is what led to my idea for our product: The Wheel. So when looking at the technology life cycle I would like to add a phase prior to the R&D build up phase, namely that a problem arises that needs to be solved. During this phase you have to find a problem that can be solved with your product'. This is confirmed in a secondary source. Here E-traction explains that the problem of space, weight and noise pollution in the cities (Frost & Sullivan, 2010). 'At some point we had a set of wheels that had to be implemented under vehicles and this is when the technical feasibility phase started for us. After the R&D phase I experienced the technical feasibility and creating the market phase as a parallel process. This means that the wheels we developed were tested under a vehicle to be driven until something broke down to be improved again. During this phase however, phase 3 plays an important role as well. Because when you start driving with your initial prototypes you are already creating the market. These are the hardest phases of this model; you are convincing people of the necessity and removing the errors of your product during testing'.

'What path dependent, also called inexplicable factors, contributed to your commercial success and where are they located in the technology life cycle?'

The success of E-traction was dependent on some external forces that were somewhat uncontrollable by the organization. Arjan explains that in his case he was depending on the local authorities to accept his product. As he comments, 'eventually our local authority Apeldoorn agreed to let the 28 current city busses, now containing our prototype radial flux engine, drive in the city'. This indicates that a launching customer was very important to E-traction in the market creation phase in order for become success. Another path dependent factor is surprisingly the timing of entry. Normally this is a factor that is within control of the entrepreneur but according to Arjan, in his case, it is a factor that became important subsequently. He continues, ' I think that you have to follow your hart and feeling. Afterwards the timing of entry was very important, but we simply did what felt good at that moment in time. Since the filing of our patent in 2001 we directly started because you have roughly 20 to 22 years to exploit that patent'.

'Another factor that is uncontrollable by the firm is that when you agree with an investor that you have become dependent on the investor. It takes patience and persistence to continue. Furthermore oil price is an important factor. We had a great business case when the oil price was high. Now that the oil price is much lower is becomes harder to convince investors'. It is clear that this factor is in line with the political view on sustainability

'What explicable factors, factors you deliberately control, contributed to your commercial success and where are they located in the technology life cycle?'

The introduction of Arjan already indicates that appropriability strategies are very important to E-traction from the beginning on in the technology life cycle order to become commercially successful. To be able to patent his product, financial strength is important. As Arjan explains, 'before we were able to patent our product a lot of time and money had to be invested. To be able to this a support base was necessary in the earliest phase. If you do this successful, in this phase you will end up with an ambassador that is able to support your product and can get you into contact with necessary people to help you further.' It became clear that this is important until the second phase. Secondary sources verify this. The annual report of E-traction of 2013 describes that the company applied for additional funding of 2.3 million with the 'Rijksdienst voor Ondernemend Nederland' under the so-called 'innovatiekrediet' for further development of the in-wheel motor technology. This was approved in September 2014 (KvK: E-traction Annual Report, 2013). Additionally, 'we incorporated suppliers and distributors to include them in the project, which can gain more financial strength'. This is in line with the commitment toward suppliers and distributors. Arjan explains, 'During the R&D phase I already contacted key suppliers and asked them to collaborate and to sign a non disclosure agreement. This turns into the commitment towards customers in a later phase'. Secondary sources indicate this as well. An interview with Peter de Neef reveals a major partner called Ziehl-Abegg who is allowed to produce and sell The Wheel in Europe (stedendriehoekinnoveert.nl, 2015). This clearly shows that brand reputation and building alliances where important in the beginning of the technology life cycle. Furthermore technology superiority is of importance in the first phase. 'Looking at our product we drastically reduce noise, fuel consumption etcetera. Our tests showed that 80% of all operators chose our product over conventional transmission'.

Arjan continues, 'when the relations have been made with important stakeholders, business models become important. At this technical feasibility phase marketing plays a role and it is important to also use your current business to finance your marketing activities. From this phase I always checked whether I could enroll for events, conferences and competitions to win prices. My advice would be to simply always take part on these events'. During this second phase of the technology life cycle E-traction also faced another problem. 'At some point our customers asked us how are we going to apply these radial flux motors under our vehicles? This was an issue and at this moment we developed a complementary product to support the initial main product, namely the rear axle'.

Not only in the first phase but also in the last phase brand reputation was important to E-traction. 'During the creating of the market, you will also need to increase the brand reputation. This allows you to attract more investors with more appropriate information. Moreover in this phase it is also important to grow with your customers and to scale up production. We currently also see that customers imitate each other to have a more sustainable city by using busses with our technology'. This indicates that the bandwagon effect plays a role during the third phase. He continues, 'this is helpful but also a dangerous factor since it forces us to scale up production. Further-

more in this last phase pricing strategies become important. According to Arjan, 'there are always tricks to apply strategies to your prices. Especially due to the flexibility of a startup we can also adopt to the demands of the customer. For example we had a customer that wanted to shift the prices between the product and R&D services due to financially beneficial reasons for the customer. We could simply do this, as long as the total price stays the same'. An additional interview with Roel van de Pas, the Operations Director, clarifies this. He states, 'The collaboration and customer interaction are performed in every layer of the company' (carriereverhalen.nl, 2014). Related to this in the third phase is the compatibility. As the founder states, 'one of our most important arguments for our technological success is that it is compatible with existing technologies. During the communications with our customers in the market we build The Wheel according to conventional vehicle transmissions. This allowed our customers to drop the original transmission from the vehicle and replace it with our product'.

'what are factors according to you that explicitly are important for startups, that possibly are not of importance for incumbents and where are they located in the technology life cycle?'

'First I would like to imprint every entrepreneur that he/she should never let down its initial business due to an investors' interest or any other input. Furthermore in general team composition and learning orientation are important entrepreneurial factors. I always had a team that was dedicated to work on our technology. The people that did have no trust in the technology and intended to leave the organization. The ability of persistence and trust of your team in the technology is essential. Moreover we have always had this statement; we do not make mistakes, we make variations. Mistakes are always present, but it is essential to learn from them and to use this knowledge to improve your product. Together with the team composition this is primary over the whole phase of the technology life cycle'.
In the last phase the following factors are important according to Arjan, 'at some point in time you will have to focus. When you have the right expert and financial person in your team who say's: now we are going to focus on this particular product.' This shows that flexibility of a startup is important, however when the market is created a goal driven focus is important.

Table 5 Commercial Success Factors E-traction

Phase I **R&D build up**	**Phase II** **Technical feasibility**	**Phase III** **Creating the market**
Financial strength	Suppliers and distributors	Oil price
Support base	Business models	Compatibility
Ambassador support	Ambassador support	Bandwagon effect
Appropriability strategies	Political view on sustainability	Scaling up production
Building alliances	Marketing communication	Pricing strategy
Brand reputation		Brand reputation
Flexibility	Flexibility	Goal-driven focus
Team composition	Team composition	Team composition
Persistence	Persistence	Persistence
Learning orientation	Learning orientation	Learning orientation
Technology superiority	Patience	Timing of entry
Commitment to suppliers	Commitment to suppliers	Commitment to customer
	Complementary products	Complementary products
		Launching customer

4.3 Dr. Ten

Dr. Ten, located in Wezep and founded by Marnix ten Kortenaar, is a startup focusing on product- and process innovations within markets of water, chemicals, nourishments and sports but specialized in the energy industry. In 2013 this startup had five employees (Company.info: Dr. Ten, 2016). It now has grown to 7 employees (Dr. Ten, 2016). Currently four demo sea salt batteries are used in the market (Rtlz, 2016). In another interview the founder of Dr. Ten states that in 2020, 500.000 households will use the sea salt battery (Management Team.nl, 2015). Furthermore in 2013 the startup won the Jan Terlouw Innovatieprijs with a price of € 10.000 (Kiemt: Jan Terlouw Innovatieprijs, 2013). Dr. Ten has also been included in the MKB Innovatie Top 100 list at place 60 (Mkbinnovatietop100: Dr. Ten, 2015). Using the facilities of the TU Delft and at partners, Dr. Ten has developed innovative batteries, solar cells and water purification systems. Their most recent energy related product the Glycerol fuel cell transforms redundant glycerol, created during the production of biodiesel, into power. The idea al-

ready succeeded the feasibility study. Furthermore the Ministry of Economic Affairs already adopts their Solar Air Fuels, containing of a process in which air is collected in a chemical liquid form. The most successful technology, the sea salt battery is a battery that is made from minerals, carbon particles and salts that are extracted from the sea and other natural sources. The battery will be improved further, but is already has a energy density of 30 Wh/kg and a lower cost price compared to any other battery. Operating world wide, Dr. Ten won the ''Jan Terlouw Innovatieprijs'' in 2013 (Dr. Ten, 2016).
Marnix explains how he started his business, 'being a chemist, promoted in physical chemistry in Delft, I worked eight years for larger companies such as Essent, Friesland Campina, DSM and as a lecturer at Delft University of Technology. Hereafter, in 2008 I decided to start my own business. During this period I was at an orphan home in Africa, North Namibia, with some solar cells to see whether we could help the locals. After a short research I found that, even after 200 years of research, there are still only two types of batteries available on the market, being Lithium and lead acid. I thought by myself, this is not sustainable enough for me. I started to request for funding and subsidies but also from my home garage applying commercial R&D for the innovation. The governmental RVO subsidies were granted in 2009, which allowed me to perform applied research with additional students. This initiated the development of our products (Annex XI).
The story above already indicate an initial phase prior to the R&D phase of the technology life cycle (Suarez, 2004), but when specifically asking the founder of Dr. Ten whether he agreed with the model and whether it is applicable for his success process with Dr. Ten he comment the following, 'when I was in Africa standing besides poor people who did have no access to electricity I was touched by it and I thought: is there no possibility to create an efficient sustainable battery for these people?' When asking him that this clarifies that a problem is a perquisite to the R&D phase he confirmed, 'Yes, this is true, however in our case this was a problem that was already being signalized by the market.

'What path dependent, also called inexplicable factors, contributed to your commercial success and where are they located in the technology life cycle?'

Brand reputation is both in the first and the last phase of the technology life cycle is an important factor. For Dr. Ten this is unexpectedly classified as a path dependent factors that is explained as follows, 'we did not explicitly put effort in brand reputation, instead it was created by the environment. Before others have something to say about your product or company you actually want to be able to represent your branding according to your personal view.
Furthermore in the market creation phase launching customers are experienced as a path dependent factor, 'we certainly see the advantage of our launching customers, but you are dependent on them. In our case we received from two befriended network companies an order at way too high prices and too high work hour rates'.
When asking the founder what inexplicable factors helped the startup in their success process during the last phase he stated that they also benefit from a big fish, 'One of the largest energy players in the world is supporting our technology and demanding an upscale in our production'.

'What explicable factors, factors you deliberately control, contributed to your commercial success and where are they located in the technology life cycle?'

In the R&D build up phase the following explicable factors were discussed, 'we were fortunate to be able to build alliances. We have had a lot op people who helped us out during difficult periods. For instance we once were not able to co-finance a subsidy project with 150 thousand euro's, in which befriended entrepreneurs signed their signature to warrant for us. These become partners for life'. Secondary sources show that financial strength and building alliances is indeed important to Dr. Ten. In 2013, in presence of Prime Minister Rutte, Dr. Ten signed a cooperation agreement with high-tech leader Agam, who will financially support Dr. Ten for further developments (Dr. Ten, 2013). Furthermore in 2013 Dr. Ten also signed a trade agreement with Word Vision in presence of minister Ploumen (Dr. Ten, 2013). As Marnix stated in another interview, 'I really underestimated the access to capital' (Rtlz, 2016). Furthermore in the first phase according to Marnix patents are a must in order for a startup to become commercially successful, 'When you, as a startups, lack patents and demo orders of your product, it becomes very difficult to scale-up the production. During commercial conversations with banks and multinationals they will only ask for three things: do you have customers, a product and a patent?' He explicitly states that appropriability strategies are important not specifically to protect the product from imitation, but to be able to convince and build trust with investors in order for them to collaborate with a startup. This is important in the early phase of the technology life cycle. Additionally, in the startups business it is all about the relations between hu-

mans. It is therefore crucial to create trust and be committed towards your customers in this phase. This allows you to build credibility for your company'.
After commenting the activities of Dr. Ten in their activities to promote their product and applying marketing communication during events, conferences and competitions Marnix elaborates a bit contradictory. Initially he states, 'marketing communications are not the most important. This factor plays a part in the second phase. What is more important in the initial phase is that you, as an entrepreneur, know who you are and what message you want to give to the world'. Later in the conversation he admits, 'when you put a particular hat on and communicate this, people will recognize you with that hat. Furthermore a clear communication on your website and a representative personality is important, especially in 2013 during the technology feasibility phase.
Another explicable factor in this second phase are the complementary products, 'I spend a lot of time flying around the world to collect the most durable and inexpensive complementary materials to create a complete product'.
Explicable factors in during the market creation are as follows, ' in 2014 we entered the market and the timing of entry to do so was fundamental. Especially due to the orientation on sustainability being an important aspect on the political agenda during this period. Here we also applied business models as a fitting strategy when entering the market'.
As discussed above scaling-up production is considered to be important. Marnix further clarifies, 'currently we are in the up-scaling phase, which is especially important in the last phase of the technology life cycle. This is a crucial moment. We really have to be able to produce large amounts. Here technology superiority plays an important role as well. For example we are currently receiving orders from India to deliver 20 million batteries, however we simply cannot deliver these amount right now'.

'what are factors according to you that explicitly are important for startups, that possibly are not of importance for incumbents and where are they located in the technology life cycle?'

'We are very flexible to do what we feel is doing the right thing. Progressive insight is build into our organization. This flexibility allows us to stay innovative and dynamic enough to dive into new opportunities. In that sense we do not fix our reference frame for the whole year, however later on in the process we determine to focus and simplify a particular subject. That is, to be able to reach a market that commercially will pay off. Serendipity, or in other words the coincidence to find a relevant application while searching for other solutions, is related to this and has always have been important in our success process'. This indicates that flexibility is important for the first two phases of the technology life cycle, but when reaching the market creation phase simplicity and a goal-driven focus should be adopted in order become commercially successful.
Moreover, two factors are experienced as crucial during all the phases of the technology life cycle. 'as a small organization you work very close on each other. You should be able to dare to act as a team even if some of your team members are not completely pleased with the activities. I explicitly composed my team based on the people that fit me. Additionally the learning orientation is also crucial. There are periods during the process of success in which we were thrown back and you will have to recover. Our organization is based on the learning by doing principle, which requires one thing; to keep on swimming'.

Table 6 Commercial Success Factors Dr. Ten

Phase I **R&D build up**	**Phase II** **Technical feasibility**	**Phase III** **Creating the market**
Progressive insight	Progressive insight	Progressive insight
Serendipity	Serendipity	Serendipity
Dynamic / adaptive / speed	Complementary products	Launching customer
Flexibility	Flexibility	Simplicity & Goal driven focus
Building alliances	Marketing communications	Scaling-up production
Credibility /trust	Technology superiority	Technology superiority
Brand reputation		Brand reputation
Commitment		Timing of entry
Team composition	Team composition	Team composition
Appropriability		Big Fish
Learning orientation	Learning orientation	Learning orientation
Financial strength	Financial strength	Business models
Universities		Pricing strategy
		Political view on sustainability

4.4 Easypath

Easypath, located in Steenwijk and founded in 2006 by Job van Roekel, initially started with producing and delivering bicycle paths as concrete elements using an innovative construction to prevent thresholds and road bumps, which are sustainable in maintenance. Since 2013 Easypath started with a sustainable innovation called Thermopath followed later by another technique called the Solarpath. Thermopath is a sustainable innovative bicycle path that contains of a heating circuit underneath the path and uses surplus heat to heat up the path when temperatures reach freezing point. Solarpath uses solar panels in the bicycle paths to produce electricity to supply surrounding traffic lights or buildings the necessary energy (Easypath, 2016). In 2015 Easypath was placed 35 in the MKB Innovatie Top 100 (MKB Innovatie Top 100: Easypath, 2015).
According to the founder of the company Easypath started as follows (Annex XII), 'We started in 2006, but actually Easypath has developed from an existing company called Nedabo, a company that has 50 years experience in elementary reinforcements. Due to this experience and knowledge we had a lead to potential competitors when we started developing and delivering bicycle paths. The ability to learn and they ahead of your competitors with your knowledge is therefore also important'. He stated that the timing of entry was important during the market creation because it was also this moment in time that governmental institutions searched for more sustainable bicycle path solutions. Cooperation has been a very important aspect for the current commercial success of Easypath. As stated by the founder, 'due to the alliances we had in the early phase with the company called Leicon Verkeersgeleiding and local authorities such as the local government of Wageningen and Ede we were able to scale up the production in a later phase, which resulted in 70 projects of our conventional bicycle paths. The implementation of our products however excels depending on the environment. In peaty-like environments our product surpasses other products. Together with its sustainable duration we really are superior. We also try to take most work out of the hands of the customer and if needed we can do the maintenance as well'. This indicates that both a superior product and complementary services are important for their success.

When asking the founder whether he agreed with the first three phases of the technology life cycle he claimed that this actually differs per type of product. First of all the R&D phase is not as long as indicated by the timeline of Suarez (Suarez, 2004). It becomes clear that this phase is shorter. During the technological feasibility phase, they are also already trying to create the market with local governments with the help of pilots, such as the one in Wageningen. In this sense the last two phases are processed parallel to each other. Secondary sources also show that a prior problem solution phase is necessary for Easypath. The founder states, 'We are constantly searching for innovative solutions and new applications' (Platformruimteenlicht.nl, 2015).

'What path dependent, or inexplicable factors, contributed to your commercial success and where are they located in the technology life cycle?'

'The fact that we had such a large installed base with are conventional bicycle paths, and thus our brand reputation, helped us to convince these parties to help us with the pilots of Thermopath ans Solarpath'. This indicates that a previous installed base was important to Easypath in order to be have feasible business with their new products.
Due to the fact that we delivered what we promised we created trust, which was important to us. We also see that the government is much more willing to invest in sustainable bicycling paths. Since the initial investment of our paths is much higher compared to conventional paths, it is not always easy to convince the long-term pay-back time of our products. The political view on sustainability helps us here to overcome this gap. Furthermore 'the ability to pilot our Thermopath and Solarpath products in Wageningen and Rotterdam, helps us in creating brand reputation and credibility. Whenever one local government agrees with our product we see other local governments following their steps in applying sustainable bicycling paths as well'. This indicated that the bandwagon effect is occurring on a later phase as well. The founder further explains that their launching customer called Lab op straat acts as a large billboard, promoting the Solarpath product in the densely populated areas such as Rotterdam. Secondary sources confirm this (Verkeerinbeeld, 2015; Stadshavensrotterdam, 2016). From his story it became clear that in the case of Thermopath, the local governments are willing to connect small villages with each other so that in the case of freezing temperatures, the villages stay connected with each other, denoting that the value of a Thermopath is increasing when other local villages apply this product as well. Network effects are thus an important factor when Easypath enters the market.

'What explicable factors, factors you deliberately control, contributed to your commercial success and where are they located in the technology life cycle?'

'Cooperation, not only with local governments, but also with innovating parties is very important for us. This was important in the beginning when we needed the necessary financing, but also in later phases for their expertise and knowledge. We also have a lot of parties that work for with us to do the engineer, drawing and work in the field. Furthermore the conferences and events are very important to promote our product. The people there are our potential customers. This allows us to build up brand reputation. These platforms such as slappebodems.nl are helping us promoting our product'. His statement, besides confirming secondary sources, explains that marketing communications are important during the technical feasibility phase (Slappebodem, 2012). Furthermore Business models in the sense of mapping our potential market and customers, a business plan with costs estimates did help was of the things we did before entering the market'. Secondary sources clarify that financial strength is important to Easypath. A minute with the mayor and city counsel members of Ede shows the investment of € 327.625 for a thermopath pilot in the particular local authority (Ede, 2016).

'what are factors according to you that explicitly are important for startups, that possibly are not of importance for incumbents and where are they located in the technology life cycle?'

'Flexibility is always important for a small entrepreneur. We have the possibility to switch and change to our environment quickly. Technological knowledge is also very important. Furthermore you have to be persistent. You start with an innovative idea, but during the phases of your success you will enter some obstacles, which you will have to overcome in order to become successful. Therefore later in the technology life cycle we focused on the customer demands. Being able to adjust to your customer demands is a necessary condition in the third phase. At that time commitment towards your customers also plays an important role. Additionally I constantly learn and have to improve my products. As an entrepreneur you always want to make sure to have a lead of two to three years compared to your competitors. When finalizing the last phase, you immediately have to start at phase one again to come up with a better product. This should be the driving force of a startup'. This indicates the presence of a constant learning orientation factor.

Table 7 Commercial success Factors Easypath

Phase I **R&D build up**	**Phase II** **Technical feasibility**	**Phase III** **Creating the market**
	Political view on sustainability	Scaling-up production
Building alliances	Business models	Technology superiority
Brand reputation	Previous installed base	Bandwagon effect
Credibility		Network effects
Trust	Complementary services	Timing of entry
Financial strength	Expertise	Expertise
Flexibility	Flexibility	Focus
Technological knowledge	Technological knowledge	Commitment
Persistence	Persistence	Persistence
	Marketing communications	Launching customer
Learning orientation	Learning orientation	Learning orientation

4.5 Epyon

Epyon, located in Rijkswijk, is a company that is founded in 2005 and started as a quick charging system developer. Since 2011 Epyon is part of the large multinational called ABB. Before this Epyon grew in employees from 24 in 2008 to 28 employees in 2010. At this time they had total assets of € 6,7 million (Company.info: Epyon, 2010). In this year Rabobank also provided Epyon with a loan of € 500.000. Press releases show that in 2010 Epyon had raised € 7 million based on five investors, to scale up the operations (Autoblog.com, 2010). Other sources confirm their growth. In the year 2009 to 2010, the sales of Epyon rose in tenfold (phidelphi.com, 2010). The demand of the quick charging stations will reach 1.6 million globally in 2015 according to Pike Research (Theengineer.co.uk, 2011). Their road to this success however was not straightforward. Recently we see a lot of startups having a very interesting idea aiming to create a new type of market for their technological product. Mostly, these companies

fail because it is very difficult to convince and create this new market. Epyon however is a typical startup that, along other parties, succeeded in created a totally new market for quick charging systems in the electric vehicle industry (ABB, 2011). According to the founder the idea all started at Delft University of Technology during graduating (Annex XIII). 'During one of the last graduation courses I wrote a business plan about quick charging batteries. With an associate student, we eventually found a partner at the faculty of electrical engineering that was able to make a prototype. When he succeeded to make a prototype of an adjusted laptop adapter, we knew that it was possible to charge a battery very quickly. This was the ''prove of principle'' for us.
At that time we were searching for an application for our product. It was really a technology push from our side and at some point we ended up at a mobile telephone charging company in China. We made some quick charging powerbanks, but this market ended up to be very hard to sell our product in. Until that moment we financed ourselves with consultancy projects, subsidies and loans at the bank. At some point during our Chinese customer Eneco and a forklift truck supplier approached us. This was due to the media attention we received at that moment in time. The media was also a method for us to have marketing communications during the second phase'. This indicates that brand reputation was an important factor at the beginning of their success process. Furthermore, 'eventually we decided to continue with the forklift truck supplier. They were the party that were willing to invest in our technology, so that we could produce a forklift truck quick charger. At that time it suddenly became a market pull. Around 2007-2008, we started doing pilots with this company and we raised a Venturing Capital investment of 1 million euros besides our 1.2 million euros of bank loan'. Financial strength therefore was important to Epyon in the beginning of the success process. The founder continues 'Within a year we had the product for the forklift truck supplier, until in 2009 we were approached by the two Japanese electric vehicle producers: Nissan and Mitsubishi, another technology push of parties who were searching for a partner to produce quick charging systems for electric vehicles. The oil price also had a large influence on this push. Together with our investors we decided to focus on this new market'. At this moment Epyon even raised a second round of funding of in total 7 million euros. The founder stated that partnering at this point was of high importance. 'Now we also had to get experienced management partners in the team. This resulted in finding our very experienced CEO Hans Streng. Eventually in 2011 ABB was willing to take over and purchase Epyon. This really helped to boost up our credibility in the last phase. In the initial phase however, the credibility of the company is in line with the commitment towards the customer. As the founder states, 'commitment is very important for a startup since it results in necessary credibility. People start taking you as a startup more serious when you act the way you promised'.

After asking the founder of Epyon whether he agreed with the technology life cycle he stated that the first three phases are somewhat a simultaneous process. He explains, 'as a startup you are searching for a niche in the market where you can grow. It is not as linear as is given in the figure here. We had a technology of which we thought: Were can we apply this? If there is no market for our technology, then it stops. Thus as a startup it is always a mixture of planned introduction in the market and coincidence, figuring out and searching. What is actually special about a startup is that the creating the market phase occurs very early in the process. We had to convince people in the beginning that our product worked. Furthermore I think that phase 1 and 2 as given here are more cyclic. You build up your R&D and at the same time you are convincing people that it works. From the battle on it indeed become a linear model'.

'What path dependent, or inexplicable factors, contributed to your commercial success and where are they located in the technology life cycle?'

As indicated by the story of the founder of Epyon, two major parties were influencing the success of Epyon. Nissan with their first electric vehicle and the energy supply companies, indicating that their launching customer was important in the last phase. According to the founder, 'The market is mostly steered by the electric car manufacturers and the subsidies given by the government. These subsidies are partly given because of the political view on sustainability. The manufacturers determine the standard, together with the governments they eventually determine who is becoming a big partner and therefore commercially successful. As a startup you have no influence on what the car manufacturers are doing'. During the interview the founder explains that their timing of entry, at the moment when Nissan started with the production of electric vehicles, was essential for their success. 'Furthermore the battery manufactures were also influencing our success. Complementary and compatible goods are therefore very important in our success. In the case of the technology push of Nissan however has a positive influence on our success to push our technology in the market'. This shows that big fish players and political subsidies are were important to Epyon in the last phase. The founder also explains the importance of a previous installed base, 'after the time that we were situated in the electric vehicle market of Nissan, this previous installed base helped us to become successful to the European and American electric vehicle market'.

'What explicable factors, factors you deliberately control, contributed to your commercial success and where are they located in the technology life cycle?'

The strategies of Epyon to become successful as a startup were especially focused on creating brand reputation. The founder of Epyon says, 'as a startup you constantly have to put your company and technology in the picture. You have to make other companies and investors enthusiastic about your idea. Also, the players that enter the market first mostly create a market. Because of this, we had a lot of influence in standardizing the product. Our business model was also an important, especially during financing. Secondary sources confirm the importance of building alliances in the first phase. As Crijn explains in another interview, 'as a small organization, we need partners. The industrial market thinks that small companies are too vulnerable perform business with' (TU Delft, 2008).

'what are factors according to you that explicitly are important for startups, that possibly are not of importance for incumbents and where are they located in the technology life cycle?'

'100% focus is very important. As a startup eventually you really have to focus on one thing. Focus on customers and the market, and try not to focus on internal processes. However the strength of a startup is also about flexibility and thus the ability to change your plans multiple times per year if necessary, with the necessary speed'. This factor is complementary to the ability to learn as a startup according to the founder. He continues, 'team composition is number one and always important. Without a good team there are no chances for success. At the time that our startup contained 25 people, we decided that we had to include more experienced employees to gain knowledge of how to approach the market'.

Table 8 Commercial success Factors Epyon

Phase I **R&D build up**	**Phase II** **Technical feasibility**	**Phase III** **Creating the market**
Brand reputation	Experienced allies	Credibility
Financial strength	Complementary goods	Oil price
Building alliances	Compatibility	Compatibility
Supplier	Supplier	Supplier
Commitment		Timing of entry
Flexibility	Flexibility	Scaling-up production
Business models		Focus
Team composition	Team composition	Team composition
Learning orientation	Learning orientation	Learning orientation
	Political view on sustainability	Big Fish
Technology superiority		Previous installed base
Marketing communications	Marketing communications	Political subsidies
		Launching customer

4.6 Iungo

Iungo, located in Zwolle, is a company that develops hardware and software specifically aimed at connecting measurements and circuitry devices to give insight in personal and company related energy consumption. Its personal energy controllers' objective is to conserve energy this way and prevent sneak current. The small device, positioned in the meter box, is connected to energy, gas, water and if applicable to solar panel meters (Iungo, 2016). The company currently has 4 employees (company.info: Iungo, 2016). In 2015 they reached the 68th place in the MKB Innovatie Top 100 (MKB Innovatie Top 100, 2015). They currently have 500 users. Loes de Waart, one of the two founders of Iungo stated that their technology was developed due to stupidity of current technologies. As the founder explains, 'in 2011 we started with the development and this had everything to do stupidity of the communication between heating systems at home. I used to open the sliding doors during spring, a season in The Netherlands where the temperature is just under the boundary value of the thermostat, which triggered it to turn the heater on while it is completely unnecessary' (Annex XIV).
The story above shows that an initial problem caused the founders to think of a technological solution to serve a potential market need, indicating that a prior phase is a prerequisite to the R&D phase. Additionally when the founder was asked whether the technology life cycle is relevant for their success process the founder declared, 'In

our case it is different compared to this model in the sense that these phases are realized in a much more entangled manner instead of a linear process. The first phase, R&D build up indeed started in 2011. In 2013 we had a pilot of 80 homes in The Netherlands using our product, indicating they had a large launching customer base from the technology feasibility phase on. The technical feasibility however is a much shorter process and already integrated during the R&D phase due to the fact that we are consumers of our own technology, our confidence and knowledge of our product and a lack of financial support. After that we already quite quickly started selling our product because we were convinced that we needed to enter the market quickly, again due to financial restrictions. In short, we start with phase one and two but quite rapidly phase 3 is introduced. Currently we are in phase four, the battle, having more than 500 users of our products and competing against other platforms such as the Toon'. Secondary sources also confirm that a prior problem and market need is essential. As the founder states, 'more and more consumers and firms want to use energy in a sustainable manner and pay less for energy usage' (peoples-business, 2015).

'What path dependent, also called inexplicable factors, contributed to your commercial success and where are they located in the technology life cycle?'

'This is very clearly the stimulation of sustainability by the government. It is a factor that is complete out of our hands but it certainly positively influences our success. This was already important from the beginning of our company. This political vies on sustainability lacked when we proceeded during the process'.
Due to the limited financial strength, Iungo has struggled to conduct marketing activities. Now that Iungo is situated in the market with their products, they primarily have to build brand reputation based on positive reviews of customers. 'our website has always been very important to communicate our brand to the outside world, however now that we have a customer base, we can create more credibility among customers by delivering a free helpdesk service and allowing customers to give feedback on different platforms. All the feedback we have received currently is positive. This credibility is important during the whole technology life cycle'. It became clear that this feedback platform, besides Facebook, their website and mainly word of mouth strategies are the main marketing communications Iungo can deliver. The bandwagon effect has therefore, according to Loes, always been important to them.

'What explicable factors, factors you deliberately control, contributed to your commercial success and where are they located in the technology life cycle?'

'From the first phase on financial strength was important to is. However, we were able to succeed with minimal budgets and we still exist'. Earlier in the conversation it became clear that Iungo had experienced some difficulties in convincing investors, leading personal investments until 2014. This might be related to their minimal business models. As she explains, 'we chose a very simple business model, which constantly changed during the process, leading to frustration for potential investors. Even do we know that our product is superior, this was our point of attention in the R&D phase'. This correlates with the initial flexibility of Iungo in the first phase of the technology life cycle, 'from phase two, while implementing the pilot it became important to keep focus on the most important products and services by directly solving the problems our customers were experiencing'.
Complementary products are necessary during the complete process of the technology life cycle. As the founder clarified, 'this focuses not only on the internal development of complementary product and services, but also the dependency of complementary energy, gas, water and solar panel meters'. This is identical for the compatibility of these systems.
During the implementation of the prototypes in the technical feasibility phase, Iungo already applied pricing strategies. According to the founder, 'our hardware contains the most advanced components but our prices were kept low during the prototype phase'. It became clear that this was important to create a customer base, in which later in time economies of scale could be applied. Afterwards their strategy to enter the market early on, right after the R&D phase, was crucial to survive with the help of word of mouth. This indicates, besides the lack of influence Iungo had on it, that the timing of entry is important in the third phase. Clearly the fact that word of mouth has been experienced to be very helpful to Iungo, during the pilot phase the bandwagon effect should occur. Furthermore, this gave them the ability to scale-up production, currently having 500 measurement products delivered. To be able to be financially stable in this third phase, without major investors, their installed base is also of high importance.
Due to the lack of employees and the pressure to finish the product quickly to enter the market, the founders of Iungo did no spend much time on marketing communications in the first phase. From phase two, when implementing the prototypes, they found that it was important to do so. However the brand reputation is important

during the whole technology life cycle, 'we lacked brand reputation in the first phase, but I do admit that it is important to have a brand reputation in this phase in order to convince investors'.
Unusually, the founder of Iungo states that building alliances became important during the third and fourth phase of the technology life cycle. Their relations with resellers around the country that sell their products confirms this (Iungo, 2016).

'what are factors according to you that explicitly are important for startups, that possibly are not of importance for incumbents and where are they located in the technology life cycle?'

During the complete technology life cycle two major entrepreneurial factors are important to Iungo. 'As the founders of the company, together with my partner, we are forced to learn with our team. Constant learning is necessary to become successful. Furthermore the team composition is very important. We would like to have more capacity, but this is financially not always possible. The trust between the team members allows us to do what we do, even if 100% quality is not always available. These factors are always important. We are very committed to our customers, from the start of the technology life cycle until now by means of a free helpdesk and adequate software updates to improve the quality based on customer feedback. This commitment is due to the effort our teams puts into the customer relationships'.

Table 9 Commercial success Factors Iungo

Phase I **R&D build up**	**Phase II** **Technical feasibility**	**Phase III** **Creating the market**
Financial strength	Launching customers	Launching customers
Business models	Pricing strategy	Complementary services
Political view on sustainability	Political view on sustainability	Timing of entry
Complementary products	Complementary products	Complementary products
Team composition	Team composition	Team composition
Technology superiority	Marketing communications	Marketing communications
Credibility/trust	Credibility/trust	Credibility/trust
Commitment	Commitment	Commitment
Brand reputation	Brand reputation	Brand reputation
Compatibility	Compatibility	Compatibility
Flexibility	Focus	Focus
Learning orientation	Learning orientation	Learning orientation
Bandwagon effect	Bandwagon effect	Bandwagon effect
		Scaling-up production
		Building alliances
		Installed base
		Economies of scale

4.7 LG Sonic

LG Sonic, located in Zoetermeer, is a company that is founded in 1999 that produces algae control systems and since 2010 made progress in 52 countries with more than 10.000 products (LG Sonic, 2016). Due to its large amount of completed projects the founder interprets his company as a scale-up instead of a startup, which indicates that scaling up production was a necessary condition in the third phase. In many of the cases, the startup starts with technological engineers that come up with a particular technology, solving a particular problem in society. Additionally, some startups use their prior technology and knowledge to search for a new problem in society in which their technology provides the solution. This is certainly applicable for LG Sonic says the founder with a business background. LG Sonic has international experiences since 1999 as a manufacturer of algae control systems. In 2014 the startup grew to seven employees (Company.info: LG Sonic, 2014). Also in 2014 LG Sonic won the Shell Livewire award with a price of € 10.000 (lgsonic.com, 2015). Furthermore they placed 19th in the MKB Innovatie Top 100 with their MPC-Buoy innovation (MKB Innovatie Top 100, 2015). Additionally LG Sonic won the Aquatech Innovation Award in 2015 as well (WSSTP, 2015). Currently they have more than 10.000 products in

more than 52 countries implemented (LG Sonic, 2016). As the founder explains (Annex XV), 'at that time we had a product called the ultrasonic algae control which was implemented in the koi pool industry. During this period, there was a lot of competition and pricing decreased over time. Since our intention was to grow, this forces us to search for another industry. As a team of four persons at that time in 2010 we asked ourselves; how can we use our algae knowledge to solve new problems?' This eventually led LG Sonic to focus on the large drinking lake industry with drink water producers as potential customers. The process to get there was long and difficult. The founder explains, 'we wanted to grow and by asking ourselves which industry would appreciate our knowledge, experience and by using our connections, we found that the large drinking water pools could be interesting. Initially, the owners of these pools and producers of the drinking water were not interested. They stated that our initial product was only applicable for the prior industry we came from and even that the product was too cheap for them. We persisted by asking them why they were not interested in buying our product'. Eventually they were willing to share their current problems in the field, which turned out to be the expensive processing costs of their conventional manner of extracting chemicals (used to remove algae from the waters) from the water before turning it into drinking water. 'This was the moment at which we knew the problem is not removing the algae from the water, but reducing the costs of this process by providing the customer a complete package including monitoring services'.
The initial step for LG Sonic was not to R&D and determine the technological feasibility of the technology at first as stated by Suarez (Suarez, 2004), but to search for the need of solutions in new industries by asking potential customers what there problems were in their current processes. After showing the founder the technology lifecycle model, he confirmed that this model was certainly not applicable in his case. He stated, 'our first step was explicitly to search and then focus on one particular market. You do not create your market after you developed your product. The technical feasibility of our product took place parallel next to the process of creating the market and contacting a selective group of potential future customers, by implementing their demands right away. This is in line with the importance for us to enter the market quickly. This way we eventually came up with a total package, delivering not only our product but also the service of monitoring. No other company is able to deliver this complete package'. This indicates that in the R&D build up phase the technological superiority played an important role. Furthermore extended they their product with complementary services. The founder explains, 'we extended our initial product by applying a monitoring services, that included multiple additional data for improving the quality of the lakes, including software services such as updates'.

'Why is it important to start with a selective group of potential customers and how did your reached and convinced the large players abroad?'

'I have an explicit believe in the theory which is called; shoot with a bullet before you shoot with a cannon. Of course eventually you have to focus on a particular industry, but in the beginning we shot at different industries. At some point in time one of our bullets hit the target in the drinking water industry. This is what happened with a bit smaller player in Polen. Here we were able to conduct a successful pilot in their waters with our technology by means of very low price for them. This was necessary in order to convince the larger players in the U.S., to create a relation of trust and commitment. These are actually our representatives'. This large U.S. player in the market became their big fish in the third phase. 'Our business case now shows that our position abroad is much stronger than staying inland.' This clarifies that focus on a market is important, but only at a later stage after the startup has found a solution for a particular problem in a particular market and found a launching customer, which was the project in Polen during the third phase. Also building maturity, trust, commitment, credibility and brand reputation. The importance of these factors in the beginning of the technology life cycle does not differ compared to incumbents as stated by Suarez (Suarez, 2004). Secondary source indicate that building alliances is also an important aspect to LG Sonic (TWST, 2015).

'What path dependent, or inexplicable factors, contributed to your commercial success and where are they located in the technology life cycle?'

'The fact that we do something positive for the world of course helps us in the process of becoming commercial successful. The world wants to quit the chemical approach of controlling algae. Sustainability becomes more and more important. This is also how we were able to raise European subsidies to let universities help developing our product. However first of all you products need to have economical reasons for your customers to buy it. It has to lower their costs'. At the time LGSonic knew they had an interesting product, solving a particular market need, and having the support from universities and political subsidies, they had to contribute financially by investing personal money. As the founder explains, 'the development and our first prototype had to be financed by ourselves'.

'What explicable factors, factors you deliberately control, contributed to your commercial success and where are they located in the technology life cycle?'

One of the explicable and controllable factors are the events and competitions LG Sonic participated in. As the founder however stated, 'these events and competitions are only applicable in the second phase, after you have some customers and conducted a successful pilot and proved other that you are able to solve a particular problem'. This shows the importance of market communications in this phase. 'Furthermore the business models were important are important in the past phase'. From the second phase on, during our pilots we were taking pricing strategies into account. Especially in the beginning we were able to keep our prices low and at the time that our product was accepted by our testing customers, we could ask the applicable price according to the production costs'.

'what are factors according to you that explicitly are important for startups, that possibly are not of importance for incumbents and where are they located in the technology life cycle?'

'team composition make or brake your product. Initially flexibility as an entrepreneur is essential. You should be able to find a product that is applicable in a new or current environment. As indicated earlier, our goal-driven focus in the last phase on the drinking lake industry with drink water producers as potential customers was very important. Partnering with distributers, software companies, developers and suppliers. We also deliberately try to outrun potential future competitors. The faster we enter the market, the stronger we will become due to the increasing accuracy of our algorithms for monitoring the water quality. This can only be done by adjusting our products to the demands of our customers.' This indicates that learning orientation is of high importance for these startups over the whole process of the technology life cycle and flexibility only in the first phase.

Table 10 Commercial success Factors LG Sonic

Phase I **R&D build up**	**Phase II** **Technical feasibility**	**Phase III** **Creating the market**
Building customers alliances	Business models	Commitment
Technology superiority	Representatives	Scaling-up production
Brand reputation	Brand reputation	
Credibility	Credibility	Credibility
Political subsidies		Launching customer
Team composition	Team composition	Team composition
Financial strength	Complementary services	Complementary services
Pricing strategy	Pricing strategy	Timing of entry
Learning orientation	Learning orientation	Learning orientation
Flexibility	Flexibility	goal-driven focus
Universities	Marketing communication	Big Fish

4.8 Multi Tool Trac

The Multi Tool Trac, Located in Wageningen, is a custom build electric tractor that increases agriculture utility for farmers. The unique track width allows farmers to constantly use one specific wider path, resulting in a controlled traffic farming solution that increases the available area for agriculture. The variable track gauge of 3.20 to 2.25 meters allows the tractor to drive on public road as well. The extraordinary long wheelbase results in a unique visibility of the driver and stability for the machine. Finally the electric power train serves high torque and precision driving. Together with Van Boessenkool, Wissels Techniek and launching farmer customers Paul van Ham started the project in 2009 (Multitooltrac B.V., 2016). In 2015 Multi Tool Trac has been registered to place 51 of the MKB Innovatie Top 100 (MKB Innovatie Top 100: Multi Tool Trac, 2015). This indicates that entrepreneur experts indicate the startup as successful. They had a third place at the Bronzen Sikkel Awards (Verum, 2014). Furthermore they were third candidate of the Accenture Innovation Award (Accenture, 2014). Additionally, in 2014 Multi Tool

Trac raised € 436.350 of funding by the 'Europees fonds voor regionale ontwikkelingen' (boerenbusiness, 2014; Trekkerweb , 2014). They currently have sold six of a series of ten tractors (Rtlz, 2016).

During the interview we discussed the technology life cycle and it became clear that an initial problem and customer need by the farmers started the project (Annex XVI). When asking the founder of the Multi Tool Trac whether he agreed with this model he declared, 'It all started with a problem in 2009 when I spoke with farmers about a so-called Controlled Traffic Farming method. With this method the wheels of the machines follow a predefined track. This results in increasing profits, better quality, less environmental impact and lower production costs (Innovatiecooperatie, 2016). However from a technological point of view, this application has some difficulties because the mechanics have to be adapted to this new standard. Involving the farmers in this process was important to us'. From his story it is clear that the configuration of the farming vehicle mechanics is the initial problem that had to be solved. In this case an initial problem is therefore a prerequisite for the first phase of the technology life cycle: the R&D build-up. Moreover, Paul explicitly speaks about the alliances not only with the future farmer customers, but also the alliances with Van Boesenkool and Wissels Techniek early on in the technology life cycle indicate the importance of building alliances and customer involvement. As he proceeds, 'I am always trying to dig into the real question or problem of the problem owner and than the actual question is: how am I going to solve this problem on an affective manner. This means that in our case, you should add a problem identification phase before or in parallel above the R&D build-up. Furthermore when we had our first prototype in the technical feasibility phase, we already were busy creating the market, which exceeds the second phase. This is also were we stand now: creating the market. We adapted a more the iterative process. This means that we followed this technology life cycle process, however every time we were in a new phase we returned to the former phase in order to continue in this process. This might seem disorganized and chaotic, but it is how we processed it'. His partner confirms this in a secondary source. As Eelco Osse explains, 'our Multi Tool Trac is developed for a specific customer group within the agriculture. Especially in the biological agriculture technological advantages can be reached with the Multi Tool Trac' (International Business Forum, 2016).

'What path dependent, also called inexplicable factors, contributed to your commercial success and where are they located in the technology life cycle?'

'Subsidies are important to us. We gained two subsidy rounds from the government to support the development of our product. The political view on sustainability helped us with this. The government aims to support more and more sustainable projects. This is something we have no control upon. The attention we received from the media helped us to attract these subsidies.' This indicates that brand reputation is an important factor in the R&D phase.
During the technical feasibility Multi Tool Trac stumbled upon some social difficulties. The social acceptance became essential during this phase. As the founder puts is, 'technological and juridical it was not problem to have a rack gauge of 3.20 meters. The local village people however expressed that they did not appreciate tractors driving the public road with such a width. We eliminated this barrier by creating a variable track gauge'. Paul continues, 'another uncontrollable aspect that surprised us were the amount of companies we needed to realize our business, such as suppliers. The cooperation has not always been pleasant due to poor deliveries of components. We do however see, due to our brand reputation, that other supplier call us to deliver the necessary components'. He explains that he currently sees a sort of bandwagon effect where new suppliers heard from others about our project that want to participate as well. This clarifies that the relation between suppliers are important for a coherent cooperation resulting in success. During that last phase the seven farmers became important as launching customers.

'What explicable factors, factors you deliberately control, contributed to your commercial success and where are they located in the technology life cycle?'

The following explicable factors are important in the first phase of the technology life cycle. 'To be able to attract the subsidies we started in the R&D phase with business models. We had a serious business model, indicating how we would market the electric tractor. He continues, 'an electrical power train is the most effective form of transmission. This electric transmission also allows us to control it by means of software such as power management, accelerations levels etcetera. However this also means that during the technical feasibility phase we were also dependent on the suppliers of small innovative electro engines as complementary goods'. This shows that technology superiority has been important in the first phase of the technology life cycle. Furthermore, ' financial strength is naturally very important. I have to pay every engineer working on our product. Also our commitment towards our customers is important. Currently our customers have to wait longer than we expected. Besides,

commitment from the suppliers towards us is also essential. Compatibility was the main requirement of our customers in order for us to develop the tractor. This was already fundamental from the R&D phase'.
During the technical feasibility phase the marketing communications started. He explains, 'we have always been very open to communicate what we were doing. Since we had an extraordinary new product people wanted to interview us, place us in newspapers or on blogs. In a later stage we started paid marketing strategies'.
In the last phase of the technology life cycle pricing strategies are important. As the founder puts it, 'I think it is important to start with a save price, high enough to cover the costs and gain interest. Another aspect that was important in this phase was the timing of entry. If we had waited ten more years, other developers would have made the electrical tractor. We really have to scale-up right now and force our product into the market in order to prevent our product from ''bleeding to death'' ', indicating that scaling up production is essential in the third phase of the technology life cycle.

'what are factors according to you that explicitly are important for startups, that possibly are not of importance for incumbents and where are they located in the technology life cycle?'

'I think that it is important to have multifaceted people around you having knowledge about a brought aspects of the technology around you when you operate in a small development group, such as we do. These team members with different expertise are important during all the phases of the technology life cycle'. Identical, learning orientation is an aspect that takes place in all the phases. According to the founder, 'we are the first taking this route of the electric tractor, however we do whatever we can to learn from other electrical vehicle companies such as Tesla'. Moreover flexibility, 'since we are such a small organization we can change our year plan numerous times in one year.' Furthermore it became clear that Multi Tool Trac is currently focusing on improving the prototype variant of the electric tractor in phase three and four.

Table 11 Commercial success Factors Multi Tool Trac

Phase I **R&D build up**	**Phase II** **Technical feasibility**	**Phase III** **Creating the market**
Involving the customer	Social acceptability	Pricing strategies
Financial strength	Distributors and suppliers	Bandwagon effect
Subsidies	Marketing communications	Marketing communications
Political view on sustainability	Timing of entry	Timing of entry
Brand reputation		
Building alliances	Complementary goods	Scaling-up production
Expertise	Expertise	Expertise
Flexibility	Flexibility	Focus
Learning orientation	Learning orientation	Learning orientation
Team composition	Team composition	Team composition
Launching customers	Launching customers	Launching customers
Compatibility		
Commitment		
Business models		
Technology superiority		

4.9 Pathema

Pathema, located in Goirle, is an innovative and dynamic organization that delivers and develops sustainable water purification technologies. Their products distinguish themselves from conventional methods due to sustainable, chemical free, energy and water saving processes. The IVG-C CoolWater system allows chemical free exploitation of cooling water, which results in financial and sustainable advantages (Pathema, 2016). Pathema is a company that explicitly wants to stay small. It still had only two employees and total assets of € 180.389 (Company.info: Pathema, 2014). Furthermore in 2014 Pathema won the PIP award with their IVG-C Coolwater technology (Jaarbeurs, 2014). In 2015 they were placed 75 in the MKB Innovatie Top 100 (MKB Innovatie Top 100, 2015). In 2015 they had a dozen of customers (TNO, 2015). The founder explains their trajectory of how they found the right application for their technology (Annex XVII), 'from the beginning we already where ''shooting'' at different indus-

tries to find an applicable market for our idea. We knew the characteristics of our solutions so we tried the fire department, the greenhouse industry, but eventually the most relevant market was right in front of us. Our current operating market of skating rinks used cooling towers to reduce the water temperature. This is a mechanical process that is initiated by compressors that heat up during the process. When we applied our new product on these cooling towers we found out after a period of time that the cooling towers were much cleaner when checked for maintenance. Tarnish and incrustation in the form of limestone, corrosion and legionella decreased significantly. This immediately triggered us to make a prototype and to focus on the cooling water industry. At this time we immediately had a launching customer'. This story indicates that the founders were deliberately searching for a market need, in which Pathema could solve a particular problem with their technology.
When asking the founder of Pathema whether the technology life cycle is appropriate for their success process the founder explains that they actually started with finding an applicable market for their product. He responded, 'If I look at this process as a timeline, the first phase is much shorter as is indicated in this figure of the technology life cycle. Besides phase two and three are a mixture of a parallel process. This is important because as a startup, we want to access the market as quickly as possible. We want to incorporate the customer promptly as possible in our decision-making process'. Also in secondary source interviews Pathema explains that they searched for a sustainable solution. As the founder explains, 'the main distinction between the conventional method and our method is that we are chemical free' (Mkbservicedesk, 2015).

'What path dependent, also called inexplicable factors, contributed to your commercial success and where are they located in the technology life cycle?'

'We are not specifically dependent on complementary products, we are able to get all necessary complementary materials to create our product and it is a separate product, which is in no need of external products. Due to the fact that our product needs servicing however, we are forces to apply complementary services besides our products. This is also why we are currently trying to sell our product in a lease format. Furthermore we are dependent on our suppliers. The conventional method of water purification systems is based on chemicals, these parties heavily influence our customers reducing our potential to become successful'.
'When we implement our products at locations of our customers, we are dependent on legislation and certificates. For example legionella control plans. The user has no knowledge about this type of legislation, which forces us to deliver a complete product including the certificates and approval by the government.
From the third phase of the technology life cycle Pathema was heavily dependent upon big fish players in the market. As the founder clarifies, 'in our case the big fish did not helped us in our commercial success process, however they blocked us from entering the market by offering lower prices for comparable products/services. On the other side we see only since this third phase, that word of mouth plays an important role. Others see how much a particular company is saving with our product, creating interest to apply it at their systems as well.

'What explicable factors, factors you deliberately control, contributed to your commercial success and where are they located in the technology life cycle?'

During the first phase of the technology life cycle the following controllable factors were necessary for Pathema. 'It is important that our technology is applicable and therefore compatible to currently existing systems. This is something we took into account during the development of the first phase. We also involved the end-user into this process. By letting the customer influence the development process and testing phase we could improve our product effectively. This is in line with the commitment and credibility towards our customers'. Secondary sources confirm this (Mkbservicedesk, 2015). Moreover the first phase, the brand reputation is experienced as crucial by Pathema. According to the founder its customers mainly determine their brand reputation and since their customers are involved into the development process from phase one, also brand reputation is an fundamental aspect here. Additionally, 'building alliances with larger organizations is not in the scope of our business, we do however collaborate with local water treatment companies. Furthermore we see that during the development phase we progressively increase trading collaborations with our partners in Sweden and the U.S.'.
From the second phase of the technology life cycle until the third, launching customers were crucial to Pathema. The founder explains, 'for our first prototype we immediately had a launching customer. Furthermore we had good contacts with the university of Eindhoven to perform lab testing' (Mkbservicedesk, 2015). Another firm level factor for Pathema during the second phase is the pricing strategy, 'since our prototypes we have always tried to keep our price constant, based on pay-off time. Besides, initially we have sold our product on a no-cure no-pay basis to gain trust in our customers'.

Financial strength is a factor that is of important to Pathema during the complete technology life cycle. As the founder puts it, 'it is very hard for a startup to gain financial strength. This was also the reason for us to enter the market quickly. Financial strength was important to us during the initial phase, however the banks simply did not understand what we were actually doing. During the financial crisis these banks were too afraid to finance our product. To continue on this financial crisis topic, we are pleased that we entered the market during this moment in time. Because after our development the market started to grow again, increasing our chances on commercial success'. After asking the founder about their current position in the market he commented the following, 'we are currently in the market phase were we are very busy to scale-up our production. This means that we build larger systems, producing more and increasing the quality etcetera'. The last firm level factors is in the third phase is technology superiority. The founder further explains, 'we are not aware of any other product that can deliver the same results, with the same energy and financial savings, besides a legionella free process'. Additionally in the second and third phase the market communications play an important role. As the founder explain, 'the end user simply wants to become more ''green''. The media increases this thought and create an oil slick effect for our product within the marketing. An effect we could never generate ourselves. We do however try to communicate our product and the importance of it as much as possible on events and competitions'.

'what are factors according to you that explicitly are important for startups, that possibly are not of importance for incumbents and where are they located in the technology life cycle?'

'As a small entrepreneur you have to capture every opportunity that crosses your path. We can never win it in the sense of capital, but we can win in in the sense of speed. This required us to be very flexible and to keep our eyes open. However when you found the right application you have to focus. At this moment in time you sometimes have to disappoint customers who ask you to differentiate from the product or services. Furthermore concerning the team composition, we have no ambition to grow larger than ten FTE. However our team composition of complementary employees is important. There are a lot of things that we outsource, such as cleaning services in which the multidisciplinary of our team composition is important. Moreover, learning orientation is a surety for our commercial success. In 2008 I did not even knew what a cooling tower was. These are all things we have learned during the process. What is especially important for this factor is to actively learn from your customers. By being at their location, seeing what goes wrong we are able to learn and quickly improve'.

Table 12 Commercial success Factors Pathema

Phase I **R&D build up**	**Phase II** **Technical feasibility**	**Phase III** **Creating the market**
Flexibility	Focus	Focus
Compatibility	Launching customer	Launching customer
Team composition	Team composition	Team composition
Building alliances	Building alliances	Timing of entry
	Complementary services	Complementary services
Involvement of end-users	Involvement of end-users	Legislation and certificates
Financial strength	Financial strength	Financial strength
	Universities	Big Fish
Brand reputation	Suppliers	Brand reputation
Learning orientation	Learning orientation	Learning orientation
	Marketing communications	Marketing communications
		Commitment / credibility
		Bandwagon effect
		Technological superiority
		Scaling-up production
	Pricing strategies	Pricing strategies

4.10 THT

Twan Heetkamp Trailers, THT in short, founded in 2005 and located in Venlo was initially a young trailer rental company. It currently has a fleet of 2000 trailer. In 2009 the development of the New Cool started. The New Cool is a cooling trailer in which the conventional diesel engine is displaced by an energy engine. This energy is delivered by braking energy of the engine and the brakes itself. During the interview however the founder explains that during the technical feasibility phase, they needed an additional source of energy to deliver the necessary electricity to power the cooling trailer. By using solar panels on the roof of the trailer the company used complementary goods to finalize their own product. The replacement of the diesel engine saves 30 l. diesel per day, prevents the CO2 emissions into the environment and reduces noise pollution to the minimum. The New Cool is developed due to a market demand for sustainable trailers. Since 2015 the New Cool is active on the public road (thtrailers, 2016). THT grew from 5 employees in 2010 to 10 employees in 2014. Furthermore they had € 48,5 million total assets and a profit of € 2,9 million in this year (Company.info: THT, 2014). Additionally in this year they won the Trailer Innovation Award (Solarmagazine , 2014). In 2015 THT received a 26th place in the MKB Innovatie Top 100 (MKB Innovatie Top 100, 2015). This is also the year that THT won the Innovaward with their NewCool (Ondernemend Venlo, 2015). The company with their NewCool technology has several users of which one is very well-known in The Netherlands. According to secondary sources Albert Heijn in driving with the trailers (Wijlimburg, 2015).
When asking the founder of THT whether he agreed with the technology life cycle he stated, 'in this model I see a linear process, however in our case this is parallel process instead (Annex XVIII). You start with an idea indeed thereafter we determined if the technology was feasible but at the same time we are searching for an applicable market. Furthermore, prior to the first phase we know that there are some problems of potential end-users and our product could solve this problem. I found out that the lack of a fixed price, combined with the fluctuating oil price was a problem for my current customers.' This indicated that due to his previous installed base, he knew that there were some issues in this particular market that he could solve with this technology. This installed base however, also acted as his launching customer. He founder explains, 'of course I had a customer base due to my prior business of trailer rental. These customers were willing to buy the first New Cool's because they knew me. I think that if I would have asked a stranger to buy our product, it would be much more difficult to become successful in the market.

'What path dependent, also called inexplicable factors, contributed to your commercial success and where are they located in the technology life cycle?'

The success of the NewCool is partially due to the previous customer base, which was build during the earlier business of THT in the trailer renting industry. The founder elaborates on this, 'this factor was especially important in the first phase since I build-up a customer group with the explained problem. These customers eventually were testing the NewCool and they paid to use this product. If I had asked this to strangers it would never become so successful. Additionally, the fact that we could save 30 l. of diesel per day per trailer also influenced the politics. The oil price later on in the model also contributes to this. Besides, the EU came up with new regulations showing that they aim for zero emission in the large cities of Europe by 2030. This of course helps us. At last we were dependent upon the supplier for the development of the NewCool. Having good relationships with our suppliers is crucial in order to receive the necessary components'.
Another path dependent factor is the regulation. According to the founder, 'the legislation is currently more aimed at the load of trailers. With conventional trailers, the weight is situated on one particular point in the trailer, causing the rear axle to be overloaded. These days the government is strictly checking these overloaded trailers to give fines. Our product allows a diffusion of the load, reducing the fines for trailer users.

'What explicable factors, factors you deliberately control, contributed to your commercial success and where are they located in the technology life cycle?'

From the first phase of the technology life cycle it became important to have financial strength. As the founder puts it, 'without my Swedish partner I would never have been able to start with the New Cool. The development of this product requires much capital. I started with a business model on one A4 and he helped me financing it. This is in line with the brand reputation, credibility and commitment that have been build-up with the customers'. Furthermore building alliances is an important aspect to THT. The founder explains, 'we needed the cooperation with partners such as TMC, TRTA, TPTS, VALX assen and TRS in order to develop the NewCool. More importantly we

currently have a partnership with Carrier, a large American player in this industry, who aims to exploit our product in the U.S.'. This shows the importance of a big fish in the second phase of the technology life cycle who is, in the third phase, able to scale up the production in collaboration with the startup. He continues, 'it is important that we are working together with this large player because they are experts in making series of a particular product'. Furthermore, 'During the second phase, from 2012 until now, I have won several prices and I have learned that marketing is really the key to success. Of course being superior with the technology is important, but at the same time and later on it always becomes a marketing game. I have seen several American developers selling an enormous old product, but still be able to ''throw a green sauce over it'' making people believe it is an environmental friendly product'.
'Based on the regulation issues as explained earlier, the timing of entry became important in the last phase. Would I have started this project five years later, it would have been too late'.

'What are factors according to you that explicitly are important for startups, that possibly are not of importance for incumbents and where are they located in the technology life cycle?'

'During all the phases of the technology life cycle it is important to keep learning. Furthermore the connection between our team members was essential during all the phases. Initially, when starting with the idea of the New-Cool, there were a lot of uncertainties. But our team has always kept trust in its potential to eventually make it successful. Moreover, I have always been very flexible toward my customers. Whenever a customer who initially was renting a trailer eventually wanted to buy the trailer they knew that this was possible at THT. Compared to the larger players, I was to only one who could deliver this flexibility. This flexibility however is especially important in the first phase of the technology life cycle'. Indicating that a more goal driven focus is essential during the last phase.

Table 13 Commercial success Factors THT

Phase I **R&D build up**	**Phase II** **Technical feasibility**	**Phase III** **Creating the market**
Financial strength	Big Fish	Compatibility
Learning orientation	Learning orientation	Learning orientation
Building alliances	Marketing communications	Marketing communications
Credibility	Complementary products	Regulator
Flexibility		Goal-driven focus
Previous installed base	Technology superiority	Technology superiority
Supplier		Scaling-up production
Business models		Oil price
Grant factor / network		Timing of entry
Brand reputation		
		Launching customer
Political view on sustainability		
Commitment	Commitment	Commitment
Team composition	Team composition	Team composition

4.11 Cross Case analysis

Prior tot the cross case analysis of commercial success factors, the participating startups have been compared based on their level of success (Annex VI). Based on secondary sources it is interesting to see is that there is a difference in the level of success. Epyon and THT for example are two companies that extent the others based on profits. However all startups are able to survive and process the first three phases of the technology life cycle. Some startups have a larger installed base, others have more investors that support the technology financially and other startups make more use of subsidies to survive. Every startup won at least one award, indicating that entrepreneur experts experience the startup as commercially successful. This clarifies that all startups are successful.
Multiple factors are matching between the cases, indicating that there is a set of factors that are experienced by all participants in this research as important during the process of their commercial success. This allows the development of new theory.
The process of the technology life cycle as determined by Suarez (Suarez, 2004), however is by all participants seen as not completely applicable. Some of the participants state that the second and last phase occur simultaneously, resulting in a more parallel model. Their argument for this is that a startup has a close relation with is customers and investors, which results in constant adaption of their technology to complement their technological feasibility and customer demands. Additionally the startups state that an additional problem-solving idea prior to the R&D phase is the starting point of a startup. Due to the high (financial) risks a startup has, they are careful in spending their resources. These startups make sure that there actually is a market and customer for their product, before building-up R&D.
This cross case analysis respects the first three phases of the technology life cycle that is presented by Suarez (2004). Indicated by green, this factor is experienced as important in the first phase of their commercial success. The color yellow shows that the factor is experienced in the second phase and the red color shows what factor is most important at the last phase of their success process.
The following analysis shows necessary conditions for a startups' commercial success, indicating that the dependent factor, commercial success, exists if there is a specific value of corresponding factors (Dul & Hak, 2008). Three types of rows separate the following matrix. The first row indicates the case, which are the startup participants in this research. The rows in the middle show necessary conditions to become commercially successful. The last row indicates whether the startup is commercially successful or not (**Table 14**).

Factor \ Case	Bluerise	E-traction	Dr. Ten	Easypath	Epyon	Iungo	LG Sonic	Multi Tool Trac	Pathema	THT
Timing of entry	X	X	X	X	X	X	X	X X	X	X
Team composition	X X X	X X X	X X X		X X X	X X X	X X X	X X X	X X X	X X X
Goal-driven focus	X	X	X	X	X	X X	X	X	X X	X
Flexibility	X X	X X	X X	X X	X X X	X	X X	X X	X	X
Brand reputation	X	X X	X X	X	X	X X X	X X	X	X X	X
Credibility/trust	X		X	X	X	X X X	X X X		X	X
Commitment		X X X	X	X	X	X X X	X	X	X	X X X
Learning orientation	X X X	X X X	X X X	X X X	X X X	X X X	X X X	X X X	X X X	X X X
Marketing communication	X X X	X	X	X X	X X	X X	X	X X	X X	X X
Financial strength	X X	X	X X	X	X	X	X	X	X X X	X
Building alliances	X	X	X	X	X	X	X	X	X X	X
Technology Superiority	X	X	X X	X	X	X	X	X	X	X X
Bandwagon effect		X		X		X X X		X	X	
Subsidies	X				X		X	X		
Universities	X		X				X		X	
Launching customer	X	X	X	X	X	X X	X	X X X	X X	X
Big Fish			X		X		X		X	X
Installed base	X			X	X	X				X
Business models	X X	X	X	X	X	X	X	X		X
Complementary goods/services	X	X X	X	X	X	X X X	X X	X	X X	X
Scaling-up production	X	X	X	X	X	X	X	X	X	X
Political view on sustainability	X X	X	X	X	X	X X		X		X
Oil price	X	X			X					X
Pricing strategy		X	X			X	X X	X	X X	
Expertise	X			X X	X			X X X		
Network effects					X					
Compatibility		X			X X	X X X		X	X	X
Appropriability	X	X	X							
Support base		X								
Ambassador support		X X								
Persistence		X X X								
Patience		X								
Suppliers and Distributors		X						X	X	X
Progressive insight			X X X							
Serendipity			X X X							
Dynamic /speed/adaptive			X						X	
Economies of scale						X				
Customer involvement								X	X X	
Social acceptance								X		
Legislation and certificates									X	X
Grant factor										X
Succes	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**

Table 14 Cross Case Analysis

5 Conclusion and Discussion

This chapter aims to answer the sub question: *How do the results from the case studies of startups relate to the literature and what recommendations can be derived from it?* Besides, it answers the main research question: *How can startups in the sustainable energy industry become successful in commercializing a high technology product in an emerging market during the initial phases of the technology life cycle?*
In this theory building research it has been found that several factors are experienced as important in order for a startup to become commercially successful with a particular technology. This indicates the existence of a causal relationship between specific factors having a positive influence on commercial success. This chapter will contain propositions that are based on the results chapter and on the phases of the technology life cycle (Dul & Hak, 2008). These propositions contribute to theoretical and managerial implications. Limitations in this research indicate the manner in which this research is restricted. This forms the basis for suggestions for further research.

Formulation of the propositions
The cross case analysis resulted in a set of factors that were experienced as necessary for the startups in order for them to reach their commercial success (table 14). Based on theoretical framework of Suarez this thesis derived twelve propositions during different phases of the technology life cycle (Suarez, 2004). Initially however, two factors are experienced as essential during all the phases of the technology life cycle.

Technology life cycle
In general two commercial success factors were experienced as important during the complete process of the technology life cycle: a multidisciplinary team composition and learning orientation. According to the startups the team composition is essential in order to reach commercial success. This has been confirmed by an additional literature study, in which scholars from the entrepreneurial stream state that the technology to be exploited in the market has to comply the experiences of the team (Stuart & Abetti, 1987; Van der Steen, Ortt, & Scholten, 2010). As all of the multiple employee startups declared, the team composition is crucial when it comes to diversity and flexibility. The founder of Bluerise elaborated on this, 'It is important to have flexible and adaptive individuals in our team that can collaborate and work in numerous positions in our organization (Blokker, 2016). The founder of LGsonic furthermore states that a team should be united (Youseff, 2016). The importance can be clarified by prior literature studies that show how team compositions can affect the performance of a startup (Kaiser & Muller, 2013; Entrepreneur.com, 2014). Due to their limited size and resources efficient teamwork by team members with different expertise is essential.

Proposition 1: a multidisciplinary team, in which its complementary individuals differ in expertise, is a prerequisite in every phase of the technology life cycle in order for a multiple employee startup to reach commercial success with a high technology product.

The iterative orientation on learning is also considered to be a requirement for all the participants, in which it can be stated that this is important during all the phases of the technology life cycle. This factor is important to gain competitive advantages. Open-mindedness and willingness to share knowledge also contributes to this factor, which is also distinctively present in all phases. Furthermore startups indicate the necessity of it in order to stay ahead of potential future competitors. Constant learning with your customers is important in order to get a head start of at least two to three years. This means that sometimes you go back to the R&D phase to improve based on the customer demands, which should be the motor of your company (van Roekel, 2016). Scholars in the field of entrepreneurship can clearly acknowledge this importance. Literature studies show that a competitive advantage is essential, in order to gain a competitive advantage starting from the initial phase of the technology life cycle (Soh, 2010; Baum, Calabrese and Silverman, 2000). This is in line with additional research that presents barriers lacking the ability to entrepreneurial innovation in the sustainability industry. Weak networks referring to little interactions between the startups and innovation parties, hinders the innovation since the partners do not know each other well and will not engage in the exchange of knowledge, learning and collaboration (Klein Woolthuis, 2010).

Proposition 2: Iterative learning orientation is a prerequisite in every phase of the technology life cycle to ensure competitive advantages in order for a startup to reach commercial success with a high technology product.

Phase I

From the interviews and research it can be learned that the first phase of the technology life cycle is the most uncertain one for the startup. At this moment in time the startup has an idea of what they can solve for a particular community, but the boundaries for this solution are still quite transparent. Other startups state that this is the phase where it is important to be adaptive to the environment until the market adopts the technological application, and than be goal-focused. Learning by doing is important in this phase (ten Kortenaar, 2016). This makes it important to be flexible in decision-making boundaries during this particular phase. Platform economics confirm this thought. The characteristics of the standards and dynamics of the platform networks are highly influenced by the flexibility of the standards. This flexibility can influence the attraction of network actors and facilitate growth that eventually will affect further adoptions of the standard (Van den Ende, Van de Kaa, Den Uyl & De Vries, 2012).
Furthermore in this phase, startups are doubtful whether they are financially strong enough to support their R&D. As explained by one of the participants, 'you need capital in order to be able to continue the development of the technology' (van Roekel, 2016). Also pre-financing orders is indicated as important. This financial strength factor is contradictory compared to the incumbent platform literature, which summarizes financial strength as one of the lowest impacts on technology dominance (Van de Kaa, Rezaei, Kamp and De Winter, 2014). According to these scholars this factor is explicitly more important for evolved subsystem platforms. On the other hand entrepreneurial streams do emphasize that financial strength is a necessary capability in order to become commercially successful (Alvaiez and Bainey, 2001; Cassar, 2004). This shows that there is a clear difference between the necessary factors between incumbents and startups.
Brand reputation is considered to be very important in phase three. The entrepreneurial literature stream confirms this by expressing the importance of convincing customers by means of the technology (Aldrich and Ruef, 2006). In order to be able to convince potential customers, a startup must begin with its reputation from the founding of the company (Bouman, 2016). Scholars in the field of platform economics imprint the importance of brand recognition to be determinant for the decision of a standard to be chosen (Gallagher and Park, 2002; Van de Kaa, De Vries & Rezaei, 2014; Hogendorn, 2009).
Brand reputation is related to the ability of building alliances. Achieving trustful relations with suppliers and distributors are necessary in order to reduce the uncertainty of reaching commercial success and therefore increasing the chances on success. It is important to select these parties early on in the technology life cycle (van Ham, 2016). This principle is backed-up by literature works from the entrepreneurial stream. Startups we have to decide whether to implement a cooperative of competitive strategy, which will affect the outcome of success (Gans, 2002; Covin & Selvin, 1989). Other scholars from this stream explain this relation by stating that brand reputation can be increased when collaborating with incumbents (Aldrich and Ruef, 2006). Only one participant, Iungo, has stated that these relations became important from the creating the market phase on and only with resellers. Iungo attended the first and second phase deliberately all by itself and thinks that alliances only with resellers become important in the third phase due to the fact that Iungo cannot deliver the demands that large incumbents such as Gamma ask for. The importance of these relationships is clarified by the evolutionary economics. They state external institutional forces exist that can negatively affect a technology dominance outcome such as regulations, associations but also cooperative actions from suppliers, customers and vendors (Anderson P., 1990; Farrell J. and Saloner, 1985; Gallagher, 2007; Smit, 1998). Iungo was placed in this position because the potential alliances they talked to asked percentages that were to high compared to their margin (de Waart, 2016). Evolutionary economics explain what causes could lead to a non-cooperative organization. Some technology standards are forced to exist only within competitive environments due to different interests or partial agreements. This tension might result in a strategy of a firm that is not willing to share its proprietary technological knowledge as a standard (Garud, Jain and Kumaraswamy, 2002). Proposition 6 concerning building alliances is therefore placed in the context of firms who are willing to share their proprietary technological knowledge with their alliances. The following propositions can be derived for the first phase of the technology life cycle:

Proposition 3: Flexibility is a prerequisite in the first phase of the commercial success process to ensure adaptive capabilities until the market has been convinced by the technology in order for a startup to reach commercial success with a high technology product.

Proposition 4: Financial strength is a prerequisite in the first phase of the commercial success process to ensure pre-financing in all the development costs made in order for a startup to reach commercial success with a high technology product.

Proposition 5: Brand reputation is a prerequisite in the first phase of the commercial success process to convince potential customers in order for a startup to reach commercial success with a high technology product.

Proposition 6: Building alliances is a prerequisite in the first phase of the commercial success process for startups willing to share their proprietary technological knowledge to ensure increased capacity, expertise and brand reputation in order for a startup to reach commercial success with a high technology product.

Phase II

Whenever the R&D phase is finalized, the startup enters the technical feasibility phase. During this phase the following factors are important. First it is necessary to include the customer in the decision-making process during the perfection of the development (Heinen, 2016). In order to be able to scale-up the production in a later phase, marketing communications plays an important role as a follow-up on the brand reputation factor. For incumbents the market aspects heavily influence the emergence of a dominant design. Since the preferences and interests of important stakeholder such as customers, suppliers and governments it is important to exert influence on these socio-political forces by means of marketing communications (Smit, 1998). Platform scholars also indicate the imporatnce of market acceptance in relation with marketing communications (Shapiro, 1999). The attitude towards a particular technology or company by potential customers and governments is a powerfull force controlling the outcome of a dominant design (Liker, J., Kamath, R., Wasti, S., Nagamachi, M., 1996; Teece, 1986). This has also been confirmed by entrepreneurial literature stream (Alvaiez and Bainey, 2001). By use of participating in competitions, attending conferences and events, the startup tries to present and sell its product as much as possible (Boeren, 2016).

Technological startups design complex technology often requiring additional components that cannot be developed in-house due to a lack of capacity or knowledge. They are therefore dependent upon suppliers to complement the total product (van Ham, 2016). Moreover, during the second phase of the technology life cycle, startups are partly in the market to test and pilot their product. During this process they face additional requirements initiated by customers, which may not have been taken into account during the development phase. This idea is backed up by scholars in the field of strategic management that confirm the necessity of a large installed base, which allows developing complementary products that in turn positively influences the fulfillment of customer demand (Chilling, 1998). An example is the radial flux engine of E-traction that, during testing, required an additional rear axle to support multiple applications of the engine on vehicles to please the customer (Heinen, 2016). Teece elaborates on this complementary factor by stating that the imitation chance of a particular technology is also affecting the chance for becoming dominant. The easier a technology can be imitated, the higher the chance that profits will go to owners of complementary assets. Therefore a prior position or connection with the infrastructure and owners of these complementary assets is of importance (Teece, 1986). Complementary products are therefore important in the second phase. Complementarity can also be realized in the form of services. Scholars state that, to maintain a dominant platform position, the platform leader will have to incorporate constant monitoring of the needs of complementors and users to keep them motivated to stick with the platform. This is critical in order to fulfill the demand of the end users (Suarez, 2012; Cenamor, 2013; Sawhney, 1998; Srinivasan A., 2010). This is exactly what happened in practice at the participating startups. Pathema for instances faced, during this second phase, difficulties with future customers not being able to apply Pathema's product in their environment due to regulatory issues. Pathema therefore decided to include maintenance services in their business model as well as the service to arrange all the regulatory certificates (Boeren, 2016). This is comparable to what other scholars in the literature stream of platforms indicate. They elaborate on this principle by stating that a platform leader is dependent on both economic forces from the outside world and the research and development (R&D) activities from complementary partners as well as customers (Cusumano, 2002; Sawhney, 1998; Sang, 2010; Gallagher and Park, 2002). Additional research in the field of entrepreneurship clarifies this. In order to reach market success entrepreneurs have to provide customer with various services, providing technical assistance, consulting on problems and arrangements (Das, 2013; Kotler, Keller, Abraham, & Mithileswar, 2007). Eventually the factor complementary product/services is a prerequisite of providing a complete package based on the requirements of future customers. Evolutionary and network economics elaborate on this by stating that implementing complementary products is essential to increase the value of the system and to improve user attractiveness towards the technology (Khazam J., 1994; David P., 1990; David P., 1985; Funk, 2003; Gallagher, 2007; Jordan, 2001; Smit, 1998; Teece, 1986). This suggests:

Proposition 7: Marketing communications is a prerequisite in the second phase of the commercial success process to ensure subsequent production scale-up in order for a startup to reach commercial success with a high technology product.

Proposition 8: complementary products/services is a prerequisite in the second phase of the commercial success process to ensure the provision of a complete package based on the requirements of future customers in order for a startup to reach commercial success with a high technology product.

Phase III

In the third phase of the commercial success process the market is being created and by doing so, the flexibility of the first two phases shifts to a more goal-driven focus. Flexibility can therefore become a pitfall when entering the third phase. Entrepreneurial scholars, who state that commercially focused firms will have to make decisions in a later phase such as the choice to become a cooperative of competitive company, confirm this (Gans, 2002; Covin & Selvin, 1989). Furthermore it is important not to proceed with all the ideas that were present in the first phase, but to focus on the customer group that is interested in this particular product that can deliver revenues by scaling up the production (Youseff, 2016). Entrepreneurship literature indicates that the company focus is often adapted to competing products (Van der Steen, Ortt, & Scholten, 2010). These two factors are related to each other. Platform scholars support this principle. The shift to a goal driven focus is clearly determined by the maturity of the technology and the position of the platform leader being a follower or first entrant. In a more centralized network control prices will be set, quality will be increased and s limit to variety will reduce the flexibility of the platform (Den Hartigh, Ortt, Van de Kaa and Stolwijk, 2016; Van de Kaa and De Bruijn, 2015).

A goal-driven focus is in line with the necessity to scale up the production. This result is backed up by the literature on incumbents (Suarez, 2004; Farrell and Saloner, 1985). Additionally scholars in the field of strategic management confirm the necessity of a large installed base, which allows developing complementary products that in turn positively influences the fulfillment of customer demand (Chilling, 1998). Whenever the startup chooses to exploit one specific product/service, it allows the small company to increase the production sales. Furthermore the build up cooperation with alliances in the first phase, increase the possibility of scaling up the production (van Roekel, 2016). It is important to scale up the production, because in the third phase, the startups are in a need of financial security. By increasing the sales, revenues increase, which allows the startups to survive (De Waart). Consequently scaling up the product in the market is a necessity in order to prevent the product from ''bleeding to death'' (Van Ham). This factor is in line with the need to increase the installed base as is indicated by the platform literature. Increasing the installed base is a strategic consequence for other factors such as financial strength (Gallagher and Park, 2002).

Timing of entry for startups in the sustainable energy market is also crucial in order to become commercially successful. The financial crisis from 2008 is an aspect that has been mentioned several times by the participants, sometimes this event was in their favor and sometimes it was experienced as a disadvantage. Furthermore the current low oil price has also influenced the importance of the timing of entry into the market for the sustainable energy companies. Another company stated that they would have wanted to enter the market later, but that they were forced, due to financial pressure, to start selling their product early (de Waart, 2016). Literature works from the technology management stream express that the chances on survival for a firm are dependent on the timing of entry (Suarez & Utterback, 1995). Not only from a financial perspective, but also to be able to fulfill the need of the customer in time and prior to potential competitors, the timing of entering the market is important (van Ham, 2016). Platform literature stresses the importance of timing of entry (Van de Kaa, De Vries & Rezaei, 2014). Moreover, timing of entry is necessary to consider when firms try to build a shared platform. When incumbents invite other stakeholders to the platform too early, they might be ignored. If they are too late, the platform might already be developed elsewhere (Eisenmann T., 2008; Robertson, 1998).

Launching customers have a high influence for al the participating startups indicating that it is essential for their commercial success. Literature from the platform stream indicates that a platform leader is dependent on the first customers (Cusumano, 2002; Sawhney, 1998). It is therefore also necessary to be aware of the customer demands. These results comply with the prior literature study (Adner, 2010). Mostly befriended parties or customers from prior businesses allow the startup to launch a product on their market, which gives the startup the opportunity to gain recognition from the market (ten Kortenaar, 2016). Scholars state the importance of launching customers in order to create an installed base quickly (Shapiro & Varian, 1999). Research focused on incumbents elaborated on this by stating that the tightness of the relation between a supplier and customer can influence the outcome of a dominance design (Liker, Kamath, Wasti, Nagamachi, 1996). The following propositions can de derived for the third phase of the technology life cycle:

Proposition 9: Goal driven focus is a prerequisite in the third phase of the commercial success process to ensure decisiveness in the decision-making process and create revenues in order for a startup to reach commercial success with a high technology product.

Proposition 10: Scaling up production is a prerequisite in the third phase of the commercial success process to ensure financial security in order for a startup to reach commercial success with a high technology product.

Proposition 11: Timing of entry is a prerequisite in the third phase of the commercial success process to ensure in-time customer satisfaction in order for a startup to reach commercial success with a high technology product.

Proposition 12: A Launching customer is a prerequisite in the third phase of the commercial success process to ensure recognition from the market in order for a startup to reach commercial success with a high technology product.

Limitations and recommendations for further research

During the interviews, the startups were confronted with the technology life cycle, prior to in-depth relevant factor questions. After explaining each of the phases of the technology life cycle, the startups were asked whether they agreed upon the model. All participants responded that they disagreed with the model and that it was not fully applicable in their environment. Based on the results it appears that the initial three phases of the five-phase technology life cycle, found by Suarez, are generalizable for the startup community (Suarez, 2004). Each individual phase is considered to be of importance for a technological startups' commercial success. However they are not generalizable when it comes to the sequence of these phases. Additionally the startups presented a prior phase, to be performed before the first R&D phase. In order to generate the presented propositions and preserve oversight in the processed sequence, the conceptual framework given by Suarez is respected. It is however worth noting that this aspect has limited this research from applying the conceptual framework into practice. Moreover, in total all of the startups participating in this research declare that an additional phase, prior to the R&D build-up, should be added. Either an initial problem or a specific market need has to be present in order to even start with the R&D build up. Additionally, a second discussion arises during the presentation of the technology life cycle. The participants stated that phase two and three of the technology life cycle is being encountered in a parallel manner instead of a linear process. This means that the startups combine all of the second and third phase to process them parallel during a particular moment in time. Furthermore retrospective bias has been limited as much as possible as indicated in chapter three. It can however never be certain that all responses were factual.

This research has focused on one particular industry, the sustainable energy industry in The Netherlands, to find out what the commercial success factors are for this specific industry in this country. A limitation however is that this industry does not necessarily represent the whole startup community. In the future, new industries can be researched concerning this topic and compared to the results of this industry to see whether generalization for the startup population is possible. It can therefore also be important to perform this research in other countries.

A set of ten cases is used as a sample for the sustainable energy industry in The Netherlands. Precautions on generalizability have been taken by selecting sample units geographically diffused over The Netherlands. Due to time constraints during this graduation research, there is a restriction in the amount of interviews that can be used. The question remains however, whether this is sufficient to represent the sustainable energy startup population in The Netherlands. Additionally, some factors for commercial success might be biased due to the particular chosen sustainable energy industry. For example the oil price was interpreted multiple times as an important factor in different phases linked with the timing of entry. As such, the current political focus on sustainability. Important to notice is that these factors are likely to be of importance due to the sustainable substitution for oil-generated energy and are thus industry related. Another important aspect is that it is challenging to find a set of Dutch startups that have equal commercial success. It can therefore not be guaranteed that these startups experience the exact same commercial success. This research however aims to perform a precaution sample selection by having several criteria for commercial success (Annex VI). The criteria used aim at a selection of startups that are commercially successful or have a high potential to become commercially successful. An aspect to systematically compare the startups more explicitly is by means of business models. Researchers claim that business models have a high influence on the strategy a company chooses. They state that a business model is a useful framework and research technique to indicate how business is done based on different categories (Osterwalder, Pigneur, & Tucci, 2005). Furthermore business models clarify the link between internal activities such as R&D and outward activities such as distribution, marketing communications and managing partnerships (Bocken, De Pauw, Bakker, & Van der Grinten, 2016). Other scholars argue that the value of business models lies in its ability to frame the actions of a firm (Mason & Spring, 2011). Due to time constraints and the scope of this research, business models have not

been taken into account in this research. It is therefore unknown whether the characteristics of the startup potentially have an influence on the factors for commercial success. Additional research can therefore be performed in which the focus is laid on business models to compare the startups and investigate whether business models affect commercial success factors.
Difficulties were experienced in finding startups willing to participate in this research. Out of the 20 startups in total contacted 11 were willing to participate in this research. Arguments for refusing the participation were: ''we are currently too busy and'' and ''these activities do not contribute to our revenues, which are of more importance at this moment''. They also stated that they already received numerous invitations for this type of research.
It should be emphasized that the findings of this thesis are preliminary in nature. To increase academic validity, future research should extent these findings. This explorative theory-building research resulted in propositions that can be used by sustainable energy startups with a technology aiming to become commercially successful. The recommendation for future research is to transform the presented propositions of this thesis into verifiable hypotheses to test them on new industries, other countries and with larger sample sizes to increase generalizability.

Theoretical contributions
The results of this thesis have theoretical implications for the entrepreneurship and technology management literature. This research fills the gap between these two literature steams by academically contributing novel insights to how entrepreneurs in a startup environment can become commercially successful using highly respected conceptual models from technology management literature. The initial scientific problem is the lack of literature that elaborates on the current incumbent technology dominance knowledge, with a focus on startups. As discussed in the theoretical section of this research, most of the scientific contributions so far focus on the large incumbents. The existence of a knowledge gap in the construction of theory about commercial success factors between incumbent organizations and startup companies creates this problem. This research therefore contributes to the development of theory. By studying the factors that determine successful commercialization for startup companies with a technology in an emerging market, the interaction of both theories and practical relevance are researched. This results in new, integrative scientific knowledge concerning startup success factors. Two main aspects contribute to both literature streams. First of all, technology management scholars recognize the essence of a technology life cycle in order for a technology to become dominant in an emerging market. For instance Anderson (1990) and Tushman (1997) initially showed the cyclical model for technological change in which a technological discontinuity is followed by a design competition and one particular design becoming dominant. Hereafter an era of incremental changes will improve on the dominant design after which a new technological discontinuity will emerge. Suarez (2004) elaborated on this principle by dividing the cycle in more extensive phases resulting in the respected technology life cycle. Having more than 120 citations only on Web of Science (webofknowledge, 2016), this model is therefore used as the foundation of this research. It is however not found that post literature studies test the sequence and completeness of this conceptual framework in for example case studies. Besides, the model focuses on incumbents and therefore it is unknown whether the framework is applicable for startups.
It appears that the initial three phases of the technology life cycle, proposed by Suarez (2004), are recognized by the startup sample of this research concerning their commercial success process. However the sequence of the first three phases and the amount of phases in the conceptual model differentiates in practice. Based on the differentiation between the proposed framework of Suarez compared to the interviews held in this research two main theoretical contributions, focused on the sequence of the model, are derived. First I can state that, according to all participating startups, the detection of a technological problem and a market need to solve this problem is a prerequisite phase, called phase 0, prior to the R&D build-up phase in order for a startup to reach commercial success with a high technology product. After this, at T0, the organization starts by applying R&D on the technology. Arguments for this are that startups experience competition against other technologies leading to high risks and because startups lack financial strength, although this is very important to them. To increase the reliability that they will commercially succeed, an initial problem or specific market need is required. Interesting is that other researchers, in the field of sustainable entrepreneurship in the Dutch Construction Industry, find similar results. They explain that when there is a lack of initial market demand, the costs remain high and economics of scale cannot be achieved. Entrepreneurs need the certainty that the market becomes sufficiently large to overcome this demand quantity problem (Klein Woolthuis, 2010). Others state that unmet marketplace needs are the principal inspiration of a startup venture strategy (Osborne, 1995). Furthermore, startup managers must identify their potential customers first and be aware whether their future customers are actually in a need for the technology (Bower & Christensen, 1995; Christensen & Rosenbloom, 1995; Christensen C. , 1997).
Secondly I can state that, according to 9 out of 10 participating startups, the trajectory of phase two and three of the technology life cycle should be processed in a collateral manner, in which the transition between the first three phases is inferior, in order for a startup to reach commercial success with a high technology product. After apply-

ing R&D within the organization the company arrives at Tp. This indicates the time when the first working prototype is implemented. After processing the parallel phases two and three, the company arrives at TL which indicated the time when the first launching customer is using the commercial product. Arguments for the parallel transition are that startups want to create the market as soon as possible and do not want to spend too much time on testing. Instead, they test with their customers to determine whether the technology is technical feasible. These findings contribute to both the entrepreneurial as well as the technology management literature stream, by elaborating on the conceptual framework proposed by Suarez. This contribution clearly indicates a difference between the theoretically composed framework that is focused on incumbents and an empirical derived conceptual framework that is applicable for the startup community. I therefore propose a new framework design aimed at the commercial success process for startups (**Figure 5**). This figure shows the sequential differences and completion of the commercial success process of a startup. By combining the original technology life cycle proposed by Suarez (2004), a comparison between the two conceptual models is given, indicating the contribution of this research in a more visual manner.

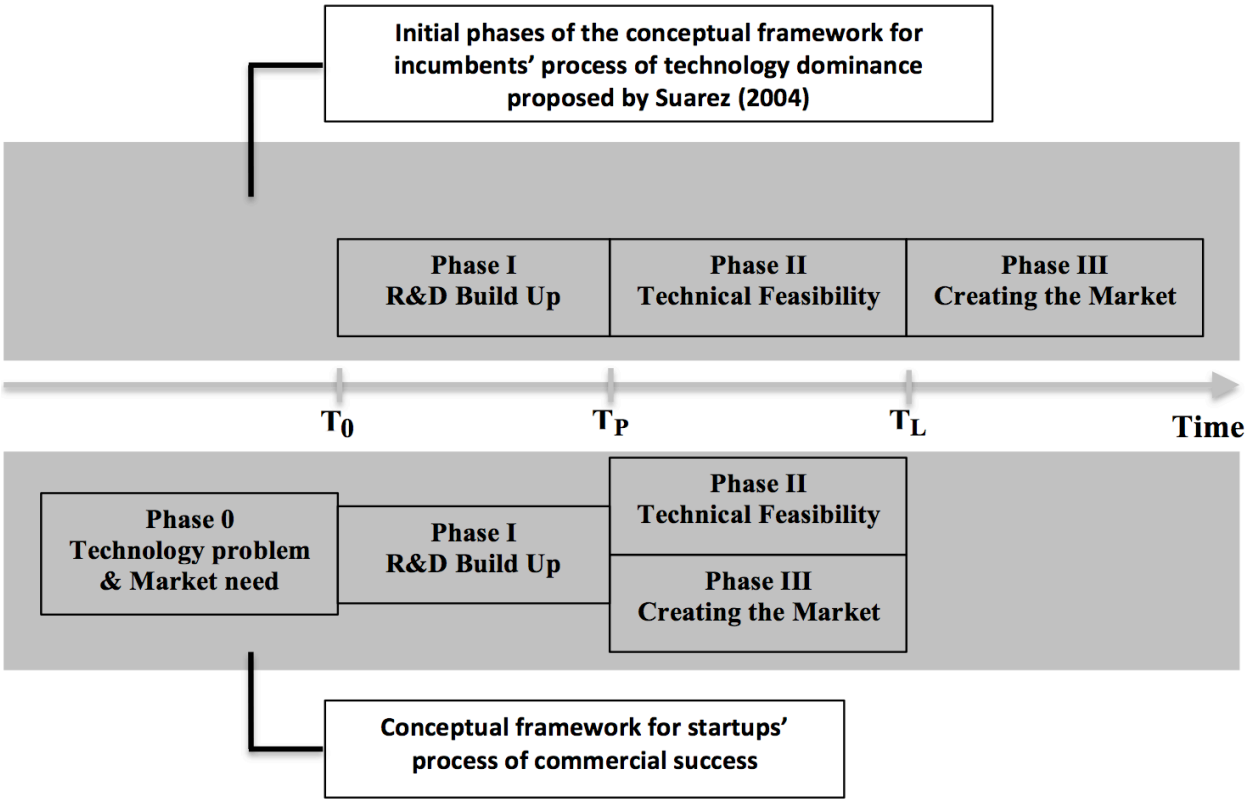

Figure 5 The new conceptual framework for startups (below) and comparison with the incumbents' framework (above)

The second contribution to theory focuses on the actual allocation of commercial success factors in the technology life cycle. Suarez (2004) concludes his research with a table that describes the factors that are important in a particular phase of the process of technological dominance (Annex IV). This clarifies that each phase seems to relate to a different mix of firm and environmental dominance factors. Annex IV shows the factors that have the strongest effect on the particular phase they are situated in. The conclusions of Suarez are based on observations of dominance battles. When comparing the conceptual framework of Suarez containing key factors of success during the first three phases of the technology life cycle with the developed framework resulting from this thesis, both variations and corresponding factors can be found (**Table 15**). The differences can be clarified because Suarez determined the allocation of technology dominance factors based on theoretical assumptions. Additionally, the factor allocation is based on incumbent literature and therefore focused only on the success of incumbents, which also explains the difference in results. Whether firms actually experience these factors in the particular phases of the technology life cycle has not been tested in practice. In recent research however, some scholars have conducted case study research that studies the battle for market dominance in the personal computer industry between the two platform leaders, Apple and IBM (Den Hartigh; Ortt; van de Kaa; Stolwijk, 2016). Again, this research focuses on incumbents. It appears that there is a relation between incumbent dominance factors and startup commercial success factors. Moreover, only two factors from the presented conceptual model of Suarez (2004) are

recurring in the model for startups, being strategic maneuvering, and complementary assets. The strategic maneuvering factor relates to timing of entry, marketing communications and building alliances for startups. Where strategic maneuvering for incumbents is important in the third phase of the technology life cycle, building alliances, marketing communications and timing of entry are respectively spread out over phase one, two and three for startups. The reason for the factor building alliances to be of importance in the first phase instead can be explained by the aim of startups to reduce the uncertainty and increase the chances on success by means of capacity and expertise. Furthermore marketing communications only take place in phase two for startups because most startups lack financial strength to perform these communications. In the second phase their working prototype is used as their marketing communication tool. At last complementary goods also exist in a later phase for startups compared to incumbents. This is due to the lack of knowledge of startups concerning the technological consequences of their technology. During the technical feasibility phase the startups stumble upon problems that are indicated by the users of their products. Based on the feedback of their customers, in-house complementary products will be researched and developed. These insights contribute to the knowledge of the first three phases of the technology life cycle related to commercial success for startups.

Table 15 comparison between technology dominance factors proposed by Suarez and startup commercial success factors

	Phases / Factors	Phase I	Phase II	Phase III
Technology dominance factors proposes by Suarez	Technology superiority		X	
	Credibility /complementary assets	X		
	Strategic manoeuvering			X
	Regulation		X	
	Appropriability regime	X		
	Characteristics of the field	X		
Startup commercial success factors	Brand reputation	X		
	Building Alliances	X		
	Complementary products /services		X	
	Financial strength	X		
	Flexibility	X		
	Goal-driven focus			X
	Launching customer			X
	Iterative learning orientation	X	X	X
	Marketing communications		X	
	Scaling up production			X
	Multidisciplinary team composition	X	X	X
	Timing of entry			X

Managerial implications

Prior to this research some assumptions were be made about the factors that determine commercial success for a startup company based on logical sense. Similarly, whilst entrepreneurship literature acknowledged several important success factors, the context in which commercialization of new technologies and standards emerge is discussed insufficiently. By studying in practice what factors actually contribute to the successful position of a startup firm during the different phases of the technology life cycle, this thesis has generated a contribution to managerial practices. This research is therefore practically important because the results allow managers or entrepreneurs of sustainable energy startups to have an advantage compared to incumbent organizations by increasing their success rate of becoming commercially successful with their technology in an emerging market. This research can be used by new upcoming sustainable energy startups but also for already existing startups to compare whether they value the same factors as important and in what phase of their technology life cycle. Since the evaluated startups have reached commercial success, these factors can be used as an example for new startups aiming for commercial success. The advise towards sustainable energy startups that aim to become commercially successful is to use the two novel insights indicated above as a guiding tool when processing each phase of the technology life cycle. It is recommended to follow the sequential trajectory process through the technology life cycle as proposed and to use the twelve allocated factors in each specific phase as direction to focus on.

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Annex I Job creation

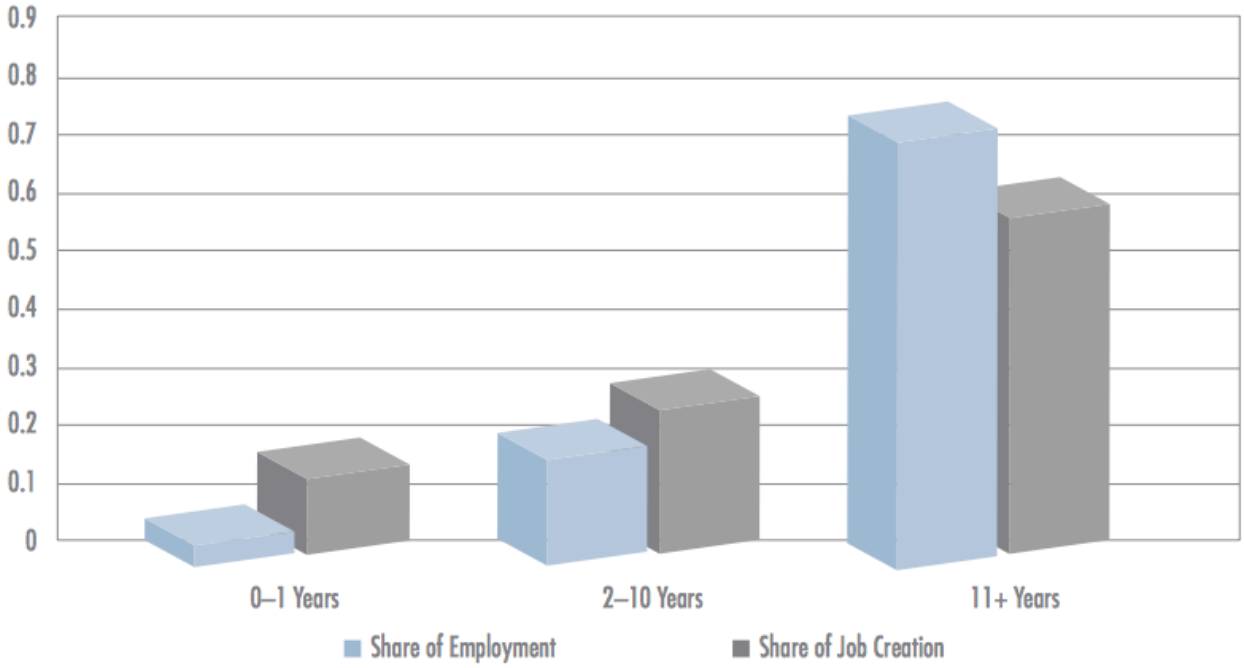

Figure 6 Job Creation by Firm Age, 1998–2011 (Source: U.S. Bureau of the Census)

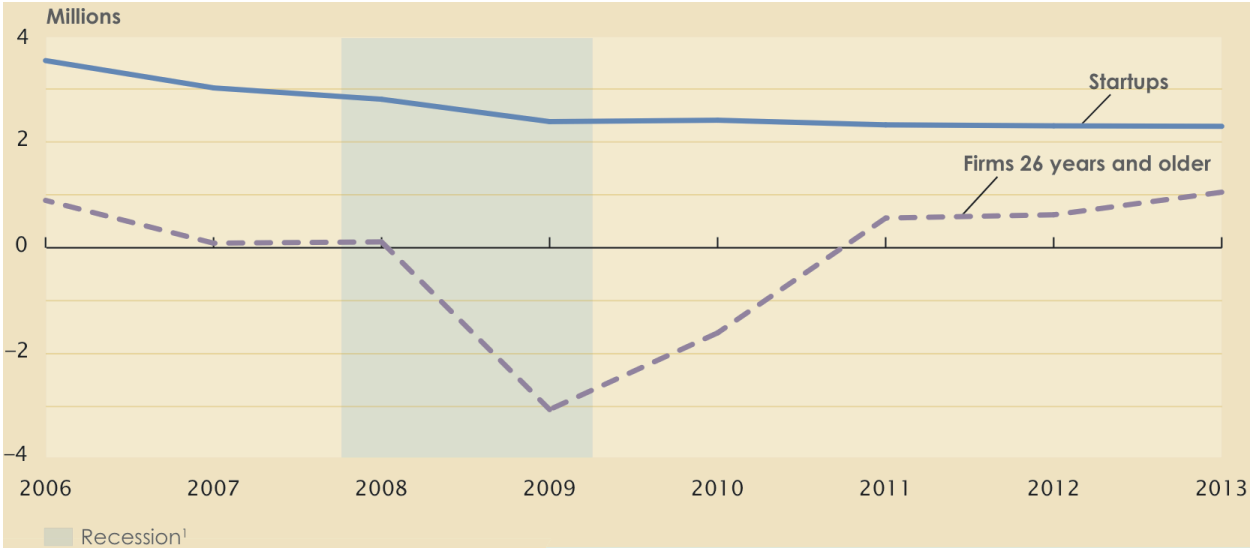

Figure 7 Recovery of net job creation of startups and incumbents (Source: U.S. Bureau of the Census)

Annex II

Potential interesting companies fort his research are in **bold**. These companies have reached any form of success in an emerging market. Companies in *italics* are interesting due to their technological capabilities, but probably have not yet made the introduction into the market.

Table 15 Initial unit of analysis focus group

Yesdelft companies: Energy industry	Start-up	Growth	Alumnus	Product/Service
Bluerise	X			(**Product**) Use ocean resources for cooling
Elemental water makers	X			(**Product**) Create drinking water from solar/wind energy
Flexous	X			(**Product**) mechanical to electric energy convert
Flexsol	X			(**Product**) curved solar panels
Gensos		X		(**Product**) gasification process
Nerdalize	X			(**Product**) uses computer power for heating
PowerWindow	X			(**Product**) window electricity generator
Shifft	X			(**Product/service**) platform for energy usage
Solar Monkey	X			(**Service**) forecasting solar panel output
SolarSwing	X			(**Product**) Solar panels
Solar Works	X			(**Product**) Solar panels
Windchallenge BV		X		(**Product**) portable wind turbines
Eternal Sun			X	(**Product**) testing (simulating) solar systems
Peeeks	X			(**Service**) energy saving methods

Annex III

Table 16 Characteristics of a case study research (Source; Doorewaard, 2010)

1	A small domain, consisting of a small number of research units
2	Generating intensive data
3	Gain more depth than breadth
4	A selective sample
5	An assertion concerning the objective as a whole
6	Observation on site, in an open environment
7	Qualitative data and research methods

Annex IV

Factor Type	Dominance Factor	Phase I	Phase II	Phase III	Phase IV	Phase V
Firm-level	Technological superiority		***			
	Credibility/complementary Assets	***			***	
	Installed base				***	***
	Strategic manoeuvering			***		
Environ-mental level	Regulation		***			
	Network effects and switching costs				***	***
	Regime of Appropriability	***				
	Characteristics of the technological field	***				

Table 17 Success factors in the different phases of the dominance process (Source: (Suarez, 2004))

Annex V Known dominance factors

Factor \ Article	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Technology superiority	X						X		X					X	X													X			X
Credibility	X																														
Flexibility					X																		X	X							
Regulation	X			X				X					X		X			X	X												
Network externalities	X					X		X	X				X				X		X						X						X
Switching costs	X								X				X												X						
Appropriability regimes	X	X							X		X			X	X			X			X				X						X
Financial strength	X																											X			
Brand reputation	X												X		X																
Learning orientation	X		X							X					X	X															
Compatibility							X		X		X																				
Complementary goods/services	X	X			X		X				X		X	X	X		X	X	X	X	X										X
Timing of entry	X								X						X									X	X	X	X				
Pricing strategies	X												X		X							X				X					
Licensing				X				X					X						X			X				X					
Marketing communica-tions	X														X																
Team composition										X																		X	X		
Building alliances	X	X	X	X				X	X	X		X	X			X	X		X	X					X		X	X		X	X
Launching customer				X				X			X		X				X		X												
Installed base	X							X	X				X		X																X
Suppliers/distributors		X		X	X			X		X		X	X	X		X	X		X	X									X		
Bandwagon effect					X																										

Article	Author	Paper
1	Suarez (2004)	Battles for technological dominance: an integrative framework.
2	Garud, Jain and Kumaraswamy, 2002	Institutional entrepreneurship in the sponsorship of common technological standards: the case of sun microsystems and java.
3	Levin & Cross, 2004	The Strength of Weak Ties You Can Trust: The Mediating Role of Trust in Effective Knowledge Transfer.
4	Anderson P., 1990;	Technological Discontinuities and Dominant Designs: a Cyclical Model of Technological Change!
5	Khazam J., 1994	The commercialization of RISC: strategies for the creation of dominant designs.
6	Katz M.L., 1985	Network externalities, competition, and compatibility.
7	David P., 1990	The economics of compatibility standards: an introduction to recent research.
8	Farrell J. and Saloner, 1985	Standardiization compatibility and innovation.
9	Van de Kaa, De Vries, & Van den Ende, 2015	Strategies in network industries: the importance of inter-organizational networks, complementary goods, and commitment.
10	Hansen M. , 1999	The Search-Transfer Problem: The Role of Weak Ties in Sharing Knowledge across Organization Subunits.
11	Funk, 2003	Standards, dominant designs and preferential acquisition of complementary assets through slight information advantages.
12	Utterback, 1994	Mastering the Dynamics of Innovation.
13	Gallagher, 2007	The complementary role of dominant designs and industry standards.
14	Srinivasan, 2006	The Emergence of Dominant Designs.
15	Chilling, 1998	Technological lockout: an integrative model of the economic and strategic factors driving technology success and failure.
16	Henderson, 1990	Architectural Innovation: The reconfiguration of existing product technologies and the failure of established firms.
17	Cusumano, 2002	The Elements of Platform Leadership.
18	Teece, 1986;	Profiting from technological innovation: implications for integration, collaboration, licensing, and public policy.
19	Smit, 1998	Implications of the dominant design in electronic initiation systems in the south african mining industry.
20	Sawhney, 1998	Leveraged high-variety strategies; from portfolio thinking to platform thinking.
21	Baldwin, 2009	"The architecture of platforms; a unified view", in; A. Gawer (Ed.) Platforms, markets and innovation.
22	Economides, 2006	Two-Sided Competition of Proprietary vs. Open Source Technology Platforms and the Implications for the Software Industry.
23	Van den Ende, Van de Kaa, Den Uyl & De Vries, 2012	The paradox of Standard Flexibility: The Effects of Co-evolution between Standard and Interorganizational Network.
24	Den Hartigh, Ortt, Van de Kaa and Stolwijk, 2016).	Platform control during battles for market dominance: The case of Apple versus IBM in the early personal computer industry.
25	Eisenmann, 2011	Platform Envelopment.
26	Rochet, 2003	Platform competition in two-sided markets.
27	Soh, 2010	Network Patterns and Competitive Advantage before the Emergence of a Dominant Design.
28	Kaiser & Muller, 2013	Team Heterogeneity in Startups and its Development over Time.
29	Scholten, Omta, Kemp, & Elfring, 2015	Bridging ties and the role of research and start-up experience on the early growth of Dutch academic spin-offs.
30	Stuart, Hoang and Hybels, 1999	Interorganizational Endorsements and the Performance of Entrepreneurial Ventures.
31	Dao, V. and Zmud, R. 2013	Innovating firms' strategic signaling along the innovation life cycle: The standards war context.

Annex VI Secondary success data startups

Table 18 Secondary success data startups

Success aspects	**Employees (2013)**	**Issued capital (2013)**	**Total assets (2013)**	**Funding / investors**	**Awards**	**Customer base / amount of products**
Bluerise	10 (Magnet.me: Bluerise, 2016)	€44.906 (Company.info: Bluerise B.V., 2016)	€ 90.041 (Company.info: Bluerise B.V., 2016)		The Dutch Climate-KIC Business Competition worth €35.000 (climate-kic.org, 2012) Finalist in Postcode Lottery Green Challenge (Greenchallenge, 2014) Selected in the kairos 50.	If implemented, 2.5 million passengers will use it at Curacao Airport
E-traction	32 in 2013 (company.info: E-traction, 2016)	€14.243	€ 4.7 mln.	2.3 million by the 'Rijksdienst voor Ondernemend Nederland' under the so-called 'innovatiekrediet' (KvK: E-traction Annual Report, 2013)	Third place in the MKB Innovatie Top 100 2014 (mkbinnovatietop100: E-traction, 2014) The Mercedes-Benz BlueEFFICIENCY Award (pvmagazine.nl, 2014). Global Technology Leadership Award (Frost & Sullivan, 2016). For additional achievements: http://www.e-traction.eu	More than 100 busses in 2015. According to Peter de Neef (the new CEO) in 5 years there will be more than 1000 with the technology of E-traction.
Dr. Ten	7	€ 18.000	€ 33.5897		Jan Terlouw Innovatieprijs (Kiemt: Jan Terlouw Innovatieprijs,	According to Dr. Ten in 2020 500.000 households will use the sea salt

					2013). MKB innovatie top 100 (Mkbinnovatie top100: Dr. Ten, 2015).	battery
Easy-path	1	€ 200.000		€ 327.625 for a pilot in the local authority of Ede (Ede, 2016).	Place 35 at the MKB Innovatie Top 100 (MKB Innovatie Top 100: Easypath, 2015).	70 thermopath bicycle path projects ranging from 100 meters to 4 kilometers (Easypath, 2016).
Epyon	28 (in 2010) (Company.info: Epyon, 2010)	€ 296.956 (in 2010) (Company.info: Epyon, 2010)	€ 6,7 mln. (in 2010) (Company.info: Epyon, 2010)	€ 500.000 loan by Rabobank (in 2010) (Company.info: Epyon, 2010) € 7 million (Autoblog.com, 2010)		The demand of the quick charging stations will reach 1.6 million globally in 2015 according to Pike Research (Abb, 2016)
Iungo	4 (company.info: Iungo, 2016)	€ 1.000 (company.info: Iungo, 2016)				500 users (de Waart, 2016)
LG Sonic	7 (Company.info: LG Sonic, 2014)	€ 18.000 (Company.info: LG Sonic, 2014)	€ 2,4 mln. (Company.info: LG Sonic, 2014)		Shell livewire in 2014 (lgsonic.com, 2015) MKB Innovation Top 100 places 19th (MKB Innovatie Top 100, 2015). Aquatech Innovation Award (WSSTP, 2015).	More than 10.000 products in more than 52 countries were implemented (LG Sonic, 2016).
Multi Tool Trac				€ 436.350 by the 'Europees fonds voor regionale ontwikkelingen' (boerenbusiness, 2014; Trekkerweb , 2014).	Place 51 of the MKB Innovatie Top 100 (MKB Innovatie Top 100: Multi Tool Trac, 2015) third place at the Bronzen Sikkel Awards	6 Tractors have been sold out f a series of 10 (Rtlz, 2016).

					(Verum, 2014) third candidate of the Accenture Innovation Award (Accenture, 2014).	
Pathema	2 (Company.info: Pathema, 2014)		€ 180.389 (Company.info: Pathema, 2014)		PIP award with their IVG-C Coolwater technology (Jaarbeurs, 2014) 75th place in the MKB Innovatie Top 100 (MKB Innovatie Top 100, 2015)	A dozen of customers in 2015
THT	10 (in 2014 (Company.info: THT, 2014)	€ 18.000 (Company.info: THT, 2014)	€ 48,5 mln. (in 2014) and € 2,9 mln. profits (in 2014) (Company.info: THT, 2014)		26th place in the MKB Innovatie Top 100 (MKB Innovatie Top 100, 2015) Winner of the Innovaward with their NewCool (Ondernemend Venlo, 2015) Winner of the Trailer Innovation Award (Solarmagazine , 2014)	

Annex VII Interview guide

1. Start of interview

- Do you agree with the proposed framework?
    - Do you agree with the timeline?
    - Do you agree with the 3 type of factors?
    - If not, please rephrase the framework to your experience.

	Phase 1 R&D build up	Phase 2 Technical feasibility	Phase 3 Creating the market	Phase 4 Decisive battle	Phase 5 Post dominance
Inexplicable factors	*Factor 1*		*Factor 2*		
Explicable factors		*Factor 4*			
Entrepreneurial factors	*Factor 3*		*Factor X*		

- In what phase do you consider to be positioned currently?
- What phase do you consider to be most important for you commercial success and why?
- How successful (dominant) do you consider your company to be currently?

2. Inexplicable factors (explain this term and go through all of the phases per type of factor)

- What is the market your business is focused on? (and was it at the start of your business already clear?)
- How is this market characterized? (much/few players or products)
- What organizations are of importance to utilize your success?
- Did you came across dominant players during the process of commercial success?
    - Did you had this at an early or late stage?
    - How did this affected your organization?
- How important are the relationships between you and other networks (i.e. organizations)?
- Was regulatory approval necessary in the process of your success?
- How did the selection of your technology played an important role for your commercial success?
- How did political, organizational and social groups or other socio-political forces influenced the process of your success?
    - For example cooperative actions from suppliers, customers and vendors
    - For example a bad relation between suppliers and customers could have a negative effect on your success.
- What was the role of the market and economy during the process of your success?
- Can you come up with other factors that were inexplicable and uncontrollable for your startup?

3. Explicable factors (explain this term and go through all of the phases per type of factor)

- Did the market introduction played an important role?
- What is the strategy that you have adopted to receive the interest from large organizations?
    - What different types of obstacles/challenges/problems have you encountered during the different phases?
    - What were your solutions/strategies for these problems during these different phases?
    - how did you convince the larger company X that your idea was worthwhile to pursue with?

    - What factors are, according to you, importance for these larger firms to gain trust in your company
    - why do you think the larger companies are willing to support your new product idea
    - How can you, as a small start-up firm, find the access to such a market, which is dominated by large players?
- Does scaling your production, in the sense of staying competitive, play an important role?
    - What pace?
- What other stakeholders (networks) were important for your success?
    - Distributors?
    - Supply chain?
    - Producers?
    - Selling points?
- Can you come up with other explicable factors that led to your success?

4. Entrepreneurial factors (explain this term and go through all of the phases per type of factor)

- Did your organization was cooperative or competitive to other organizations?
    - If competitive: why?
    - If cooperative: why where alliances so important?
- What smaller success opportunities (such as faires/conferences/competitions/exhibitions) have led to your current end success?
    - Did you implement or undergone specific initiatives/projects/campaigns that were required to your success?
- If you have a patent, how do you think this affected the process of your success?
- Did you get in contact with any potential clients and if so, how did they helped you?
    - Why did you choose to do so at this moment in time?
- Did you encounter any challenges during the process of your success?
    - What pain points were you experiencing?
    - What business challenges were you hoping to solve for?
    - How did you solved these challenges? (did you applied any strategies to overcome these challenges?).
- How did you build credibility by showing your buyers/partners that your product had potential to become successful?
- What top events did you want to achieve with your product?
- Can you come up with other entrepreneurial factors that led to your success?

At the end of the interview give the participant the complete list of dominance factors and ask the participant if he/she can find more factors that are important to their success and in what phase.

Annex VIII Comparing the conceptual frameworks

Table 15 comparison between technology dominance factors proposed by Suarez and startup commercial success factors

	Phases / Factors	Phase I	Phase II	Phase III
Technology dominance factors proposes by Suarez	Technology superiority		X	
	Credibility /complementary assets	X		
	Strategic manoeuvering			X
	Regulation		X	
	Appropriability regime	X		
	Characteristics of the field	X		
Startup commercial success factors	Brand reputation	X		
	Building Alliances	X		
	Complementary products /services		X	
	Financial strength	X		
	Flexibility	X		
	Goal-driven focus			X
	Launching customer			X
	Iterative learning orientation	X	X	X
	Marketing communications		X	
	Scaling up production			X
	Multidisciplinary team composition	X	X	X
	Timing of entry			X

Annex IX – XVIII Interview transcripts

The transcripts of the interviews held with ten participating startups are presented in the enclosed conventional appendix.