THESIS RESEARCH PROJECT

Developing a conceptual model on strategies overcoming barriers for the introduction of radical innovations in niches

Jara Schulz

March 2019

TU Delft
INDUSTRIAL ECOLOGY
INNOVATIVE BY NATURE
Universiteit Leiden

Title

Developing a conceptual model on strategies overcoming barriers for the introduction of radical innovations in niches

Author

Name:	Jara Schulz
Student number TU:	s1752073
Student number LU:	4137701
Date:	March 7, 2019
Programme:	Msc. Industrial Ecology
Course code:	4413TRP30Y
University:	University of Technology Delft & Leiden University

Examiners

1st Supervisor: Dr. L.M. (Linda) Kamp
Department of Technology, Policy and Management, TU Delft
Section Energy and Industry

2nd Supervisor: Dr. J.R. (Roland) Ortt
Department of Technology, Policy and Management, TU Delft
Section: Economics of Technology and Innovation

Executive Summary

Radical innovation is widely acknowledged as important for companies aiming to contribute to sustainable development while maintaining and improving their competitive advantage. However, the diffusion and development process of radical innovations is described as complex, uncertain and long-winded due to barriers raised within the socio-technical system. This system is a linked network of technological aspects, actors and institutions in which the process of development and diffusion of the radical innovation evolves. In order to overcome barriers within this system, companies can adopt a niche strategy, which enables the creation of a market despite these barriers. In these niche markets the radical innovation is able to develop until it reaches maturity and can survive in the mainstream market. For example, to overcome the lack of available infrastructure of complementary products and services such as charging stations, production, repair and maintenance facilities (the barrier) that supports the use of electric cars (the radical innovation), hybrid cars were developed (the niche strategy). These hybrid cars contain both an electric motor and a traditional gasoline engine and can thus use both the new required infrastructure and the currently existing infrastructure supporting the traditional gasoline engine. Through the creation of a niche market in which hybrid cars are sold, the infrastructure of complementary products and services of the all-electric car has time to develop, so that later the radical innovation (the all-electric car) can be diffused on a large-scale.

This thesis builds upon the research performed by Ortt & Kamp (2019). They developed a barrier framework that includes seven core factors and seven influential factors representing the components of the social-technical system of a radical innovation. The core factors represent the market characteristics and are necessary for the large-scale diffusion of the radical innovation: The product quality and performance, the product price, the production system, the availability of complementary products and services, the network formation and coordination and the availability of consumers and appropriate institutional aspects. It is assumed that if one of these seven core factors is deficient or absent, the large-scale diffusion process is hindered or completely blocked. The influential factors have an influence on the core factors and describe the underlying cause of the deficiency or absence within these core factors. Examples are the availability of knowledge and awareness of technology, market and application, the availability of the necessary resources, and the availability of appropriate social-cultural aspects. To overcome a barrier, comprised of a core- and influencing factor, that is blocking large-scale diffusion, companies can adopt a niche strategy.

Ortt et al. (2013) described that around 80% of the nowadays-successful radical innovations on the market were first introduced in one or more niche markets before large-scale diffusion started, indicating that niche strategies play a significant role in the diffusion of radical innovations. However, current management and innovation literature on niche strategies is not sufficiently developed to propose the most suitable niche strategies to companies. In this thesis, three main research gaps were identified that lead to this statement. Firstly, the existing literature only proposes a limited amount of niche strategies. Secondly, these proposed niche strategies are not formally linked to barriers that can be experienced during the development and diffusion of radical innovations. Thirdly, the particular company characteristics, which influence the effectiveness of a niche strategy to overcome an experienced barrier, are not included in the existing literature on niche strategies yet. These findings all hinder the identification of an effective niche strategy for companies. Therefore, the objective of this research is to link (new) niche strategies to barriers comprised of one influencing and one core factor as described in the barrier framework developed by Ortt & Kamp (2019), and to develop evaluation criteria that companies can use to define the most suitable niche strategy for their particular situation. Hence, the following research question is posed:

"How can the causal linkage between barriers and niche strategies be captured in a framework so that companies are able to more accurately choose a suitable strategy that enables the diffusion of their radical innovation into a niche market during the market adaptation phase?"

Figure I shows the simplified final framework developed during this thesis research, illustrating the answer to the research question. The main elements that capture the causal linkages in the framework that companies can use to choose a suitable niche strategy are included.

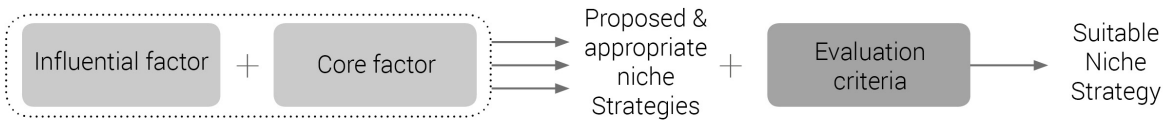


Figure I: Simplified final framework

The conceptual model systematically describes relationships between niche strategies and barriers, which are always a combination of one influential factor (IF) and one core factor (CF) (see figure I). These niche strategies either create a niche market or influence the socio-technical system in favour of the radical innovation so that later a niche market can be created. The evaluation criteria are complementary to the conceptual model and can be used by companies to define the most suitable niche strategy, since the conceptual model proposed multiple niche strategies per barrier.

To come to this model, a multi-method approach was used: Three different methods were applied in three different research steps, in order to refine and improve the results in an iterative way and to obtain diverse and extensive results. In the first research step, a conceptual model and evaluation criteria were proposed by means of logical reasoning using preliminary theoretical insights on radical innovations, niche strategies, the factor framework and barriers. The credibility of the proposed conceptual model and the proposed evaluation criteria was subsequently assessed in the second and third research step. This was done by confirming the proposed relationships by means of a literature review (second research step) and two primary case study interviews (third research step) using pattern matching and cross-case analysis. If confirmed by literature and/or empirical evidence, the relationships were found appropriate.

To obtain the theoretical insights used in the first research step, desk research was performed on relevant literature. Based on these preliminary insights, assumptions and definitions were drawn up, guiding the logical reasoning processes of both the evaluation criteria and the conceptual model. Three ways of overcoming a barrier were assumed:

1) The niche strategy can be a measure or a solution that removes the impact of the deficient core factor on the diffusion of the innovation *[E.g.: Adopting a geographical niche strategy to circumvent missing appropriate institutional aspects (CF)]*
2) The niche strategy can be a measure or solution that solves the deficiency related to the influential factor *[E.g.: Adopting a technological research & develop niche strategy in order to increase the technological knowledge (IF), so that the product performance and quality will increase (CF)].*
3) The niche strategy can be a measure or solution that solves the deficiency within the core factor by removing the influence of the influencing factor, or by adapting the core factor to the state of the influencing factor. *[E.g.: Adopting a redesign niche strategy to adapt to a lack of financial resources (IF) that is affecting the quality and performance of the product (CF)]*

In total, 157 relationships were proposed in this first research step between 28 niche strategies and 30 barriers. These 28 niche strategies can be divided into three categories: 1) 'Increasing knowledge and resources niche strategy', which specifically aims to directly increase the knowledge and resources within the company and indirectly increase the knowledge and resources within the socio-technical system *[E.g.: Pilot research niche strategy, financial resource niche strategy];* 2) 'Influencing

niche strategy', which aims to change the perception, behaviour or opinion of customers, other actors within the network or of institutions that are needed to diffuse the innovation *[E.g.: Education niche strategy, lobbying niche strategy];* and 3) 'Marketing niche strategy', which consists of strategies aiming to commercialise the radical innovation. The latter can be divided into two: 'Strategies that fundamentally change aspects of the product, production system or complementary products and services' *[E.g.: Hybridization niche strategy]* and 'Strategies that change the business model' *[E.g.: Top-end niche strategy]*. In order for companies to define the most successful niche strategy in their situation, the most *suitable* niche strategy (see figure I), 10 criteria are formulated based on logical reasoning that can help companies assess the proposed niche strategies according to their particular characteristics.

The second research step consisted of a desk research that was performed to find external confirmation of the proposed relationships in the conceptual model in order to confirm the credibility of the logic behind the model, and furthermore, to find external support on the list of evaluation criteria. The literature review on relevant literature confirmed 127 relationships of the 157 relationships described in the conceptual model. The confirmations are based on literature covering relevant theories underlining the existence of the linkage between the barrier and niche strategy, and/or on literature giving real-life examples of the proposed linkage between the barrier and strategy based on a case-study research. On the remaining 30 relationships, not enough information could be obtained to either confirm or contradict the proposed relationship. Not one described relationship is explicitly contradicted by the researched literature, which is mainly due to the time limits and scope of the literature search. The desk research on the 10 proposed evaluation criteria aimed to find theoretical support in terms of *aspects* that the criteria cover that is needed for an effective strategy evaluation. It was found that the aspects necessary for an accurate evaluation - consistency, consonance, advantage and feasibility (Rumelt, 1993) - were all covered.

For the third research step, two primary case studies were conducted with two different companies that commercialised their sustainable radical innovation but did not achieve large-scale diffusion yet. Both companies adopted multiple niche strategies in order to diffuse their radical sustainable innovation in the market. Through a cross-case study between the case study results, the conceptual model and the criteria, multiple improvements were defined. The case study interviews confirmed 21 proposed relationships as described in the initial conceptual model. Of these 21 confirmed proposed relationships, 5 were confirmed by both companies. The case studies also added new relationships: First of all, three new relationships between already defined barriers and already defined strategies were found; furthermore, one new niche strategy and three new barriers were discovered. The interviews indicate that the list of 10 evaluation criteria is practically relevant and useful in their particular situations. One company indicated that the current lack of a deliberate decision-making process on the adoption of niche strategies raised new barriers. The difference in ranking (weighting) of the criteria by the two different interviewees confirmed that the company characteristics indeed have a great impact on the choice for a particular strategy, and thus that the suitability of strategies to overcome a strategy will differ per company.

Both the desk research and the empirical research showed, by the number of confirmed relationships, that the logic behind the conceptual model is credible. However, future research is needed to improve both the practical and theoretical usability of the framework. The addition of new barriers resulting from the empirical research shows that for future research it would be beneficial to reduce the ambiguity of barriers since the assumptions regarding the barriers have had a large influence on the conceptual model. Furthermore, it would be interesting to study the relationships between the different niche strategies, in order to find an optimal sequence of niche strategies to overcome one or multiple barriers. To increase the usability of the evaluation criteria in practice, research on the strength of the relationships is required. Lastly, it would be useful to develop a practical tool in which the conceptual model and evaluation criteria are integrated.

The research contributes both practically and theoretically. From a practical perspective, the logic behind the model can help companies to develop a comprehensive decision-making process focused on defining a suitable strategy to overcome the experienced barrier, or the model can be used to define a niche strategy. The evaluation criteria can be used to assess the suitability of strategies in its' particular situation. From a theoretical perspective, the research made a first attempt to link niche strategies formally to the barriers and the barrier framework developed by Ortt & Kamp (2019). Furthermore, the research adds a list of niche strategies that extend the currently described amount of niche strategies in literature, including both the innovation phase and market adaptation phase; it adds a categorisation of the niche strategies, and it adds a list of evaluation criteria.

Acknowledgements

First of all, I would like to thank my supervisors Linda Kamp en Roland Ortt, who have supported me throughout my thesis with their knowledge and enthusiasm on the research topic. The discussions, insightful comments and challenging questions really inspired and motivated me to get the best out of my research.

Secondly, I want to express my gratitude to the companies who I got to interview during my thesis for their enthusiastic response on my research. I am grateful for the inspiration the interviews gave me and for the valuable results it provided for my research.

Last but not least, special thanks to my family and friends for supporting me throughout writing this master thesis and life in general.

Contents

List of figures

List of Tables

1. Introduction

1.1 Background

Technological innovation is important for companies aiming to contribute to sustainable development while maintaining and improving their competitive advantage. (Kennedy et al., 2017) Technological innovation involves the large-scale development, deployment, acceptance and diffusion of new or improved products or processes. (Brooks, 1980; Slocum et al., 2008) The development of new sustainable technological innovations is widely acknowledged as a driver for realizing sustainable development, since these aim to improve environmental and social performance and aim to emerge, transform or replace unsustainable products and markets. (Kennedy et al., 2017)

In general, two types of technological innovations are distinguished: Incremental and radical innovations. The difference is based on both the amount of new technological knowledge integrated into the innovation and the degree of market disruption. (Dewar & Dutton, 1986; Schumpeter, 1942; Slocum et al., 2008) Incremental innovation is usually driven by the demand for lower costs or a better quality, performance or design, which is achieved through upgrading existing technology. These practices are common business in every industry in order to remain competitive. Radical innovation on the other hand, incorporates technology that is totally new and serves in general as foundation for further technological developments. (Slocum et al., 2008) Radical innovations have the ability to develop new markets or completely reform the structure of the market. It embodies a striking development in the price/ performance ratio of a certain industry. (Ortt, 2012; Slocum et al., 2008)

The process of technological innovation does not evolve by itself, but within a linked network of actors and institutions: the sociotechnical- or innovation system. (Diaz Anadon et al., 2016) The difference between radical and incremental innovations is that the latter fits in an existing innovation system, and for a radical innovation a whole new innovation system needs to be formed, or the existing innovation system needs to be adapted. (Negro et al., 2012) The commercialization of radical innovations thus brings along a higher number of uncertainties and risks to companies in comparison with incremental innovations. Barriers within the socio-technical system can hamper or completely block large-scale diffusion of the radical innovations. (Ortt, Shah, et al., 2007). A niche market strategy can be adopted to overcome or circumvent these barriers and to create a market for the radical innovation. Ortt et al. (2013) states that around 80% of the nowadays-successful radical innovations on the market were first introduced in one or more niche markets before large-scale diffusion started. Niche markets form protected spaces in which the radical innovation is able to develop in terms of user needs, financial and technological viability and price/performance ratio, until it reaches maturity and is able to survive in the mainstream market. This is achieved through interactive learning processes of introducing and rejecting applications, and through adaptations in the institutional, management and organizational context. (Geels & Schot, 2007a; Kemp et al., 1998)

1.2 Research Problem

1.2.1 Problem Description and Research Gap

As described in the previous section, niche strategies play a significant role in the introduction of radical innovations into the market. These strategies aim to overcome barriers, raised by lacking or incompetent components within the socio-technical system, which obstruct the large-scale diffusion of the radical innovation. Ortt & Kamp (2019) identified these components, referred to as 'factors', that are involved in the diffusion process of radical innovations, and that thus can, depending on the presence or absence, enable, hamper or even completely block the diffusion process. All these factors should be in place in order to realise large-scale diffusion. Two types of factors can be distinguished (See figure 1.1): Influencing factors (IF) and core factors (CF). (Ortt & Kamp, 2019)

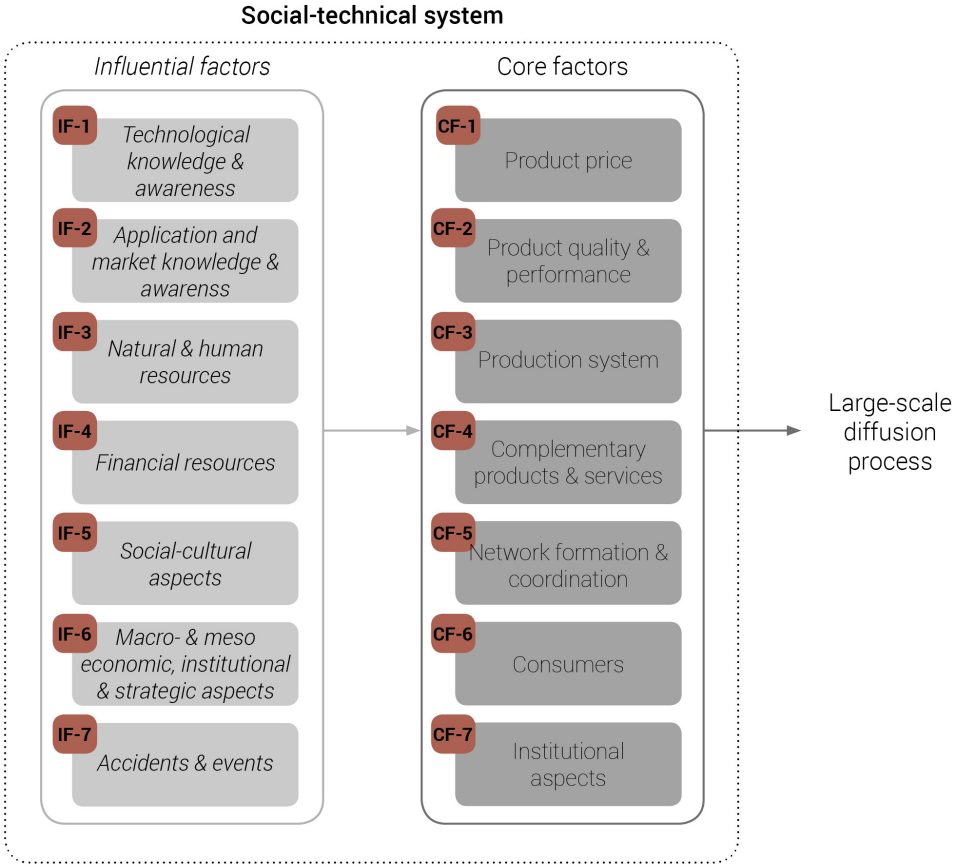


Figure 1.1: The influencing factors (IF) and core factors (CF) and their influence on the large-scale diffusion process (Ortt & kamp, 2019)

The core factors (CF-1 to CF-7, see figure 1.1) represent the market characteristics and have a direct effect on the diffusion process of radical products. If one or more core factors are lacking, or only half in place, large-scale diffusion is not possible and a particular niche strategy should be adopted. The influencing factors (IF-1 to IF-7, see figure 1.1) describe the wider political, economic, cultural, social, technological, legal and environmental factors, which have an indirect effect on the development and diffusion of the radical innovation. These influential factors have a direct effect on the core factors; if one of the influential factors is missing it explains the difficulties occurring in the core factors. Ortt & Kamp (2019) describe that the combination of a missing core- and a missing influencing factor represents a specific market situation, in which a barrier is hampering large-scale diffusion of the radical innovation. A company can remove or circumvent each barrier by adopting a

particular niche strategy. (Ortt et al., 2013; Ortt & Kamp, 2019) Chapter 2 provides a more extensive description of this framework.

This developed framework enables companies to track the socio-technical system evolution, which can be used to define niche strategies that enable market formation (Ortt & Kamp, 2019). However, as also indicated in the article itself, the formulation of specific niche strategies is limited, especially in relation to the barriers raised by lacking or incomplete factors. Up until now, other literature on management and innovation systems only describes two strategies, however not in relation to the factor framework: A niche accumulation strategy and a hybridization strategy (Raven, 2007). A niche accumulation strategy is described as a strategy in which the radical innovation is introduced in multiple niche markets that exists besides the mass market. Through this, direct competition from mature radical innovations is avoided, which enables the radical innovation to develop. The hybridization strategy is described as a strategy in which the new radical innovation is integrated into a new application with an already existing radical innovation. Furthermore, Ortt & Kamp (2019) defined during two case studies two more niche strategies that can be adopted to circumvent or overcome barriers within the socio-technical system: A niche strategy 'to experiment with and demonstrate a radically new technological component', and a niche strategy that introduces the technology in specific niches in which the new technological innovation outperforms the mature technology. However, as also described by the authors, 'many more niche strategies (..) can be derived'.

1.2.2 Problem Definition

Current management and innovation literature on niche strategies is not sufficiently developed to propose the most suitable niche strategies to companies. The number of niche strategies described in the literature do not completely cover all the possible niche strategies that can be adopted by companies to create a niche market and the strategies are not formally linked yet to the factor framework developed by Ortt & Kamp (2019).

Furthermore, the practical application of the framework can be improved by means of evaluation criteria, which will enable companies to more accurately choose the most suitable niche strategy to overcome the experienced barrier. These criteria will complement the existing framework and will help to evaluate the relationships between the niche strategies and barriers according to the specific characteristics of the company.

1.3 Research Objective and Research Questions

1.3.1 Research Objective

The theoretical objective of this research project is to develop a conceptual model that includes new niche strategies that can remove or circumvent barriers raised by missing or incomplete factors as described in the framework by Ortt & Kamp (2019). The niche strategies will cover strategies for commercialisation of radical innovations and strategies aiming to influence the market before introduction of radical innovations. Furthermore, the objective is to research the formal relationship between the barriers and the strategies, and to develop criteria that can be used by companies to evaluate the suitability of the strategies in relation to their specific company characteristics.

The practical objective of this research project is to develop a conceptual model that help companies facing barriers that hinder or block large-scale diffusion of their radical innovation to assess the most suitable strategies. Through this, companies will be able to adopt the most effective strategy in order to successfully introduce their innovation into a niche market.

1.3.2 Research Type and Deliverable

The research that will be performed in this thesis is qualitative and explorative of nature, which requires flexibility of the methods that will be used. The first part of the research, consisting out of the development of evaluation criteria and the development of an initial conceptual model, will be done based on logical reasoning and preliminary theoretical insights. Subsequently, desk research will be performed using relevant literature, aiming to support the proposed niche strategies and linkages in the initial conceptual model and to support the developed evaluation criteria. The conceptual model and the evaluation criteria resulting from this desk research will be refined by means of two primary case studies. This will allow an in-depth perspective on the relationships between barriers and niche strategies as experienced in practice and the future use and usability of the evaluation criteria in practice. The research approach is further elaborated in section 1.4.3. The deliverable of this thesis is the conceptual model and the evaluation criteria that can be used to assess the suitability of the niche strategy to overcome the particular barriers.

1.3.3 Research Question

The research question that will be answered in this thesis is:

"How can the causal linkage between barriers and niche strategies be captured in a framework so that companies are able to more accurately choose a suitable strategy that enables the diffusion of their radical innovation into a niche market during the market adaptation phase?"

In order to answer the main research question, the following two sub-research questions have been defined:

1. *What evaluation criteria are relevant for assessing the suitability of new niche strategies?*
    a. Which evaluation criteria can be defined based on logical reasoning and preliminary knowledge on niche strategies and the factor framework as described by Ortt & Kamp (2019)?
    b. What can related literature and theoretical concepts contribute to the development of the evaluation criteria?
    c. How can empirical research contribute to the development of the evaluation criteria?

2. *What does a conceptual framework of the linkages between niche strategies and barriers look like?*
    a. What new niche strategies can be identified and linked to the factor framework as described by Ortt & Kamp (2019) based on logical reasoning?
    b. What can related literature and theoretical concepts contribute to the development of the linkage of these niche strategies to the barriers?
    c. How can empirical research contribute to the development of the linkage of these niche strategies to the barriers?

1.4 Research Strategy

1.4.1 Research Framework

The research framework can be found in figure 1.2. It shows the research components that are needed to achieve the research objective, and how these components are interrelated with each other. Besides increasing the understanding of the research itself, I used this framework to formulate and refine the research questions. The image consists out of different parts (see Legend): The preliminary theoretical insights; the research perspective; the research objects; and the research objective. The preliminary theoretical insights (blocks on the left) are used to formulate the research perspective. The latter is the leading thread throughout the thesis and serves as guidance during the evaluation of the research questions and objectives. The research objects are the units of analysis, which will be studied in relation to the research perspective. Conclusions of the research will be based on the 'confrontation' of these two (the analysis) The confrontation can be a comparison to find similarities and differences or can be for example an assessment. The analysis of this confrontation will lead to fulfilment of the research objectives. (Verschuren & Doorewaard, 2010)

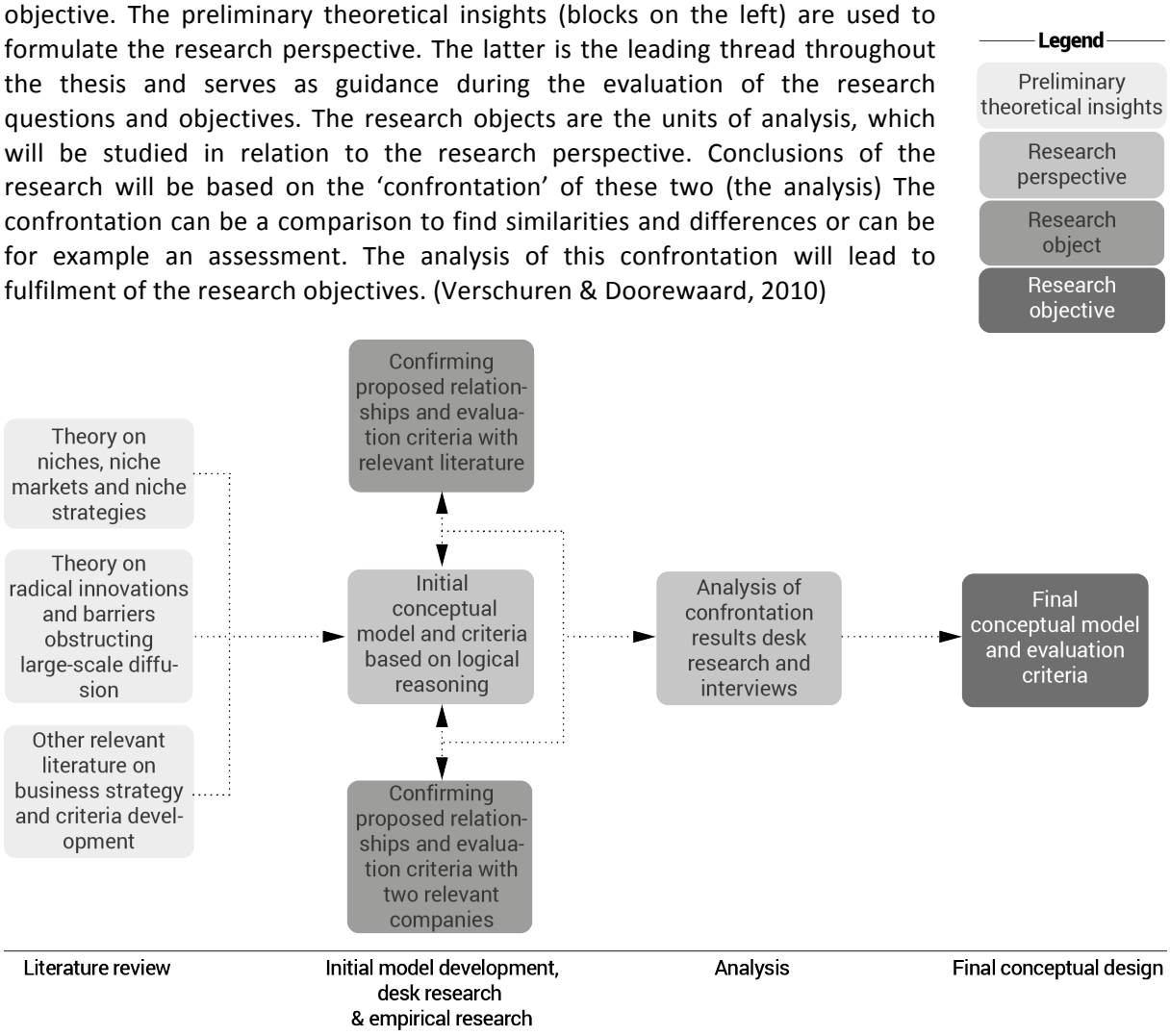


Figure 1.2: The research framework

The research perspective in my research is a conceptual model, a schematic representation of causally linked concepts and a set of evaluation criteria, which will both be refined through a confrontation with the research objects. The model will propose niche strategies that can overcome barriers that are comprised of the factors described in the framework developed by Ortt & Kamp (2019) I will not focus on extending the number of barriers; I assume that the barrier framework as described by Ortt & Kamp (2019) is complete. The first version of the conceptual model and list of criteria will be developed by means of logical reasoning and the preliminary theoretical insights. The preliminary theoretical insights will be described in the literature review in chapter 2. The definitions of 'barriers', 'overcoming barriers' and 'type of strategies' that will be followed in this thesis will be

described in chapter 3 'Setting definitions'. The chapter will also include the development of the evaluation criteria. These criteria and the initial conceptual model (developed in chapter 4) will be refined through desk research on relevant literature and through performing two primary case studies, which both aim to confirm the proposed linkages between these niche strategies and the barriers and the use and usability of the developed evaluation criteria. Both the criteria and the conceptual model will thus be improved in an iterative manner.

1.4.2 Research Design

Figure 1.3 (next page) shows how the iterative process of the development of the conceptual model (as described in the previous section) fits into the complete research design. The blocks resemble the 7 different research stages that will be gone through and describe which research questions will be answered in the particular stages:

1. Research design
The first part of the research design describes the focus of the research and consists out of the research gap and research problem, research objective and research questions. Furthermore, a detailed description of the methods that will be used to gather relevant research material, the reasons why I chose these methods, the type of research material that is needed, how the data will be analysed, and the research objects (units of analysis) that will be studied are described in this part of the research.

2. Development definitions and criteria
Based on the theoretical insights that are described in the research design stage, I will establish assumptions and definitions that will be used as guideline to develop the initial conceptual model. Furthermore, this part will consist out of the development of the evaluation criteria based on the theoretical insights. This part will answer research questions 1A.

3. Initial conceptual model development
In this stage, the initial conceptual model will be developed, based on logical reasoning and insights obtained from a preliminary theory study. This research stage will answer research question 2A.

4. Theoretical support of model and criteria
The proposed relationships described in the conceptual model will be confirmed by means of a literature research, in order to assess the logics behind the model. It will focus on the acknowledgement of the existence of the proposed relationships between niche strategies and barriers according to relevant literature. Furthermore, this stage will perform a literature research on the evaluation criteria in order to find support on the usefulness. This research stage will answer research question 1B and 2B.

5. Empirical research on model and criteria
The conceptual model and the evaluation criteria will be improved and refined by means of two primary case studies. By conducting interviews, it is possible to obtain detailed information about the experience of a company on the adoption of niche strategies in practice. It will focus on confirming the relationships between niche strategies and barriers that are defined in the model and to find points of improvement. The evaluation criteria will be assessed on relevancy and the use in practice will be questioned. A cross-case analysis will be performed between the cases to find patterns between the results. This research stage will answer research questions 1C and 2C.

6. Conclusion
In this stage the main research question will be answered.

7. Finalization

This stage describes the contribution, the discussion and the recommendations of the research.

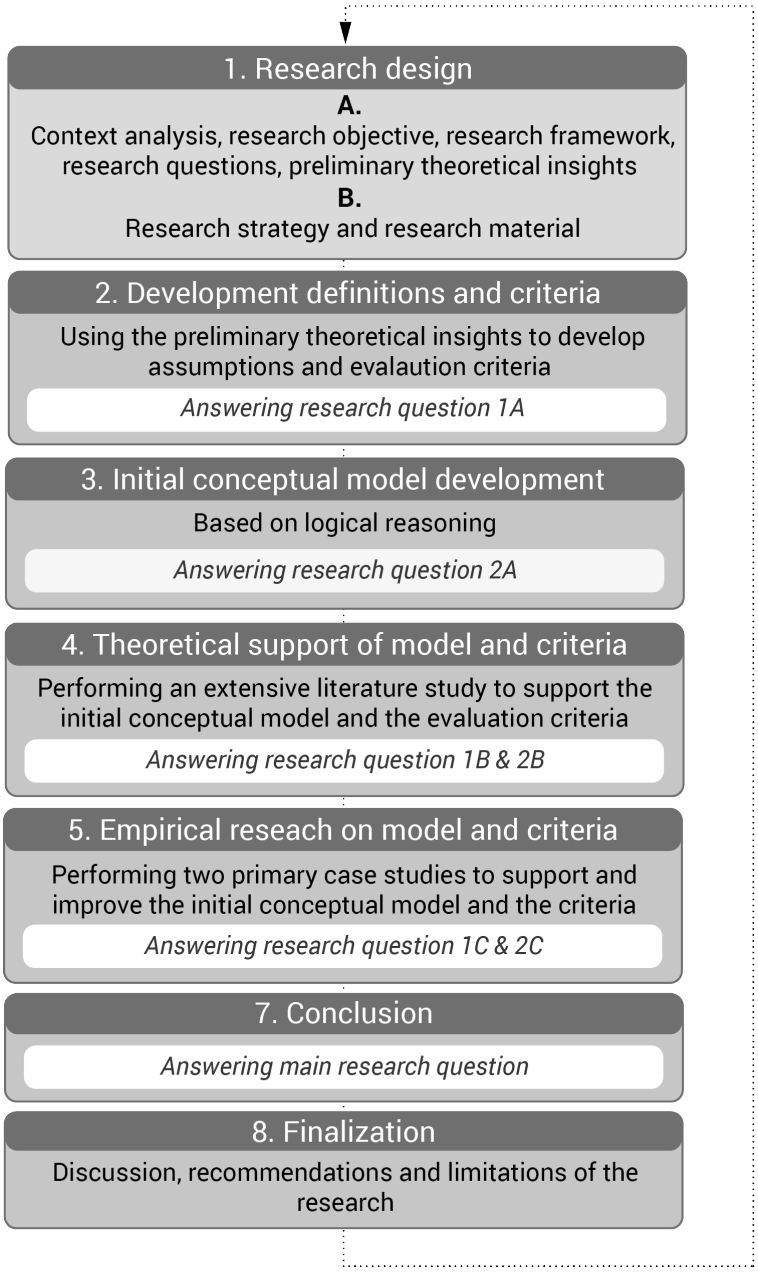


Figure 1.3: Flow of the research

1.4.3 Research approach per sub-question

This section explains the approach that will be taken during the research per sub-question. Section 1.4.4 describes the different approaches in more detail. The methodology of the development of the conceptual model based on logical reasoning can be found in chapter 4; the methodology of the literature research can be found in chapter 5; and the methodology of the primary case studies is described in chapter 6.

1. *What evaluation criteria are relevant for assessing the suitability of new niche strategies?*

The aim of this question is to develop evaluation criteria that can be used to assess and evaluate the suitability of the niche strategies to overcome particular barriers that are defined based on the factor framework by Ortt & Kamp (2019).

   a. *Which evaluation criteria can be defined based on logical reasoning and preliminary knowledge on niche strategies and the factor framework by Ortt & Kamp (2019)?*

Evaluation criteria will be developed by means of logical reasoning using initial theoretical knowledge of niche strategies, barriers, the factor framework and on company characteristics. This knowledge will be gained during a descriptive analysis of relevant literature on these topics.

   b. *What can related literature and theoretical concepts contribute to the development of the evaluation criteria?*

The developed evaluation criteria will be supported by relevant theoretical concepts, in order to achieve an understanding of the use and purpose of the evaluation criteria from other perspectives. Through this, relevancy and usefulness of the developed criteria in 1a will be assessed.

   c. *How can empirical research contribute to the development of the evaluation criteria?*

The use and usefulness of the evaluation criteria will be confirmed during two primary case study interviews with two different companies. This approach allows an in-depth perspective on how companies currently select strategies in order to circumvent or remove an experienced barrier.

2. *What does a conceptual framework of the linkages between niche strategies and barriers look like?*

The aim of this question is to develop a conceptual model including new niche strategies and linkages between these new niche strategies and barriers defined by using the factor framework by Ortt and Kamp (2019).

   a. What new niche strategies can be identified and linked to the factor framework as described by Ortt & Kamp (2019) based on logical reasoning?

The first version will be developed by means of logical reasoning using insights obtained from a preliminary theoretical analysis on relevant literature covering theory on niche strategies, barriers, radical innovations and the factor framework.

   b. *What can related literature and theoretical concepts contribute to the development of the linkages of these niche strategies to the barriers?*

Subsequently, relevant literature concepts will be analysed to support the proposed relationships between the barriers and the niche strategies. This will be done by means of a qualitative desk research using existing papers, reports and journals in relevant research fields. Selection of the proper research material will be done based on the number of citations and on relevancy.

c. *How can empirical research contribute to the development of the linkage of these niche strategies to the barriers?*

A primary case study approach will be taken in order to achieve the aim of this question, which is to gain insight into the proposed relationships between niche strategies and barriers captured in the initial conceptual model in reality. Through this, the proposed relationships between niche strategies and barriers captured in the initial conceptual model can be confirmed, and the initial model can be refined and improved according to the results, on which a cross-case study will be performed.

1.4.4 Reasoning and limitations of the research approach

A multi-method approach will be taken in order to be able to answer the main research question; three different methods will be used. Developing the conceptual model based on logical reasoning will propose relationships that will be (or not be) confirmed, improved and refined during the desk research and the empirical research (see next paragraphs). As described by Verschuren & Doorewaard (2010) a conceptual model has multiple purposes; it is a way to clearly define and scope the research subject and it gives structure to the formulation of the assumed linkages. Some benefits of the three-step approach are the possibility to obtain diverse and extensive results, and that the assumed causal relationships can be refined and improved in an iterative way. (Verschuren & Doorewaard, 2010) Furthermore, multiple methods yielding a comparable outcome 'provides a more certain portrayal of the (..) phenomenon' (Jick, 1979).

Desk research
As described in the previous section, a literature review will be performed in order to answer sub-research questions 1b and 2b. Question 1b aims to find theoretical support on the evaluation criteria developed by means of logical reasoning. This will be done by means of a qualitative desk research using existing papers, reports and journals in relevant research fields. Selection of the proper research material will be done based on the number of citations and on relevancy. Question 2b aims to confirm the proposed relationships between the barriers and niche strategies in the initial model developed based on logical reasoning. There are two possibilities that will be perceived as a confirmation of the linkage: Either the reviewed papers indicate that the theory underlines the existence of the linkage between the barrier and strategy, or authors give an example of the linkage based on research on a real life case. Chapter 5.1.2 will elaborate more on the methodology used for the confirmation of the linkages using literature sources. Using secondary data to refine the initial conceptual model has multiple advantages. As described by E. Smith (2011) and Verschuren & Doorewaard (2010) secondary data sources are easier accessible in comparison to other approaches in which information is collected directly and it requires less time to gather the amount and type of data needed because it enables a quick scan of a large amount of literature in order to find the linkage between niche strategies and barriers in real-life.

Using literature that describes secondary sources allows for the discovering of new relationships, since the data can be interpreted on a different level or way than the original researcher(s) did. (E. Smith, 2011) However, there are also limitations of using this approach. Assessing the data quality, the representativeness of the samples and the relevancy of the data can be difficult. There is a lack of knowledge on the data collection process and the obtained data can be case-specific. The results do not elaborate on the strength of the linkages between niche strategies and barriers and the experiences of other companies in the same situation. Furthermore, the interpretation of the data

can be done wrongly or biased, since the secondary data is gathered with another purpose. Lastly, there is a chance that the data that is needed in order to meet the research objective is not available or cannot be found, which can lead to adjustments in the conceptual research design and thus to a different research focus. (Verschuren & Doorewaard, 2010)

Empirical research

A primary case study approach will be taken in order to obtain an in-depth perspective on the relationships between barriers and niche strategies as experienced by the company (answering question 2c) and on the use and type of evaluation criteria used in practice (answering question 1c). A case study is described by Eisenhardt (1989) as a "research strategy, which focuses on understanding the dynamics present within single settings". (K. M. Eisenhardt, 1989) This approach will be taken in order to improve and refine the conceptual model and the proposed evaluation criteria based on data obtained during interviews with two companies. The case study research also aims to obtain an understanding of the used evaluation criteria in real-life and a confirmation of the relationships that exist in real life cases, including the specific contextual factors involved. Yin (2014) describes that a case study research is a useful method to obtain these aims. This qualitative approach is required since a quantitative approach that tests the validity or reliability of the model is time consuming (Verschuren & Doorewaard, 2010) and cannot be executed within the available time for this thesis. Furthermore, it is both an exploratory and explanatory study, for which the flexibility that a case study research offers is useful. (Verschuren & Doorewaard, 2010) Two case studies will be conducted with two different companies that will be selected based on theoretical considerations. Through using criteria for the selection of cases instead of random selection, the probability that theoretical insights are obtained from the case studies is enhanced (K. Eisenhardt & Graebner, 2007). The interviews will be semi-structured and will contain both open and closed questions. Chapter 6 elaborates in more depth on the primary case study procedure.

Researching two cases instead of one has multiple advantages. As Eisenhardt & Graebner (2007) described, studying multiple cases instead of one case will lead to a "better grounded, more accurate, and more generalizable" outcome and will enhance the robustness of it. Furthermore, it is possible to do a cross-case analysis between the two cases. This entails exploring and analysing relationships, e.g. similarities and differences, between the outcomes of the case studies, which can lead to unsuspected, new insights. (K. Eisenhardt & Graebner, 2007; Yin, 2014) However, performing only two cases has also some disadvantages; it will decrease the internal validity, since results can be biased, and it will decrease the generalizability, since only two perspectives are taken into account.

The quality of the case study research depends on four criteria: Construct validity; internal validity; external validity; and reliability (Yin, 2014). Below, these criteria and the measures that are taken in order to fulfil these criteria are described:

1. *Construct validity*

Construct validity refers to the establishment of accurate operationalization for the concept that is studied. This means that the in order to gather data from the empirical research, variables or attributes need to be clearly defined to avoid subjective judgement. (Yin, 2014) This research increases construct validity by including multiple perspectives into the conceptual model: Besides two case studies, also a literature study will be performed. Both these results will be compared to the initial conceptual model developed based on logical reasoning, which enhances the chain of evidence (Yin, 2014) of this research.

2. *Internal validity*

Internal validity refers to the justification of causal relationships. An increased internal validity can be established by methodological and data source triangulation. (Yin, 2014) This will be accomplished by a cross-case comparison of the two case studies that will be conducted, aiming to find patterns

between the results. Furthermore, the results (e.g. the proposed relationships between strategies and barriers) will be supported by literature, in order to confirm their existence by an external source.

3. *External validity*

External validity refers to the generalizability of the case study results beyond its own boundaries. As Yin (2014) describes, the external validity is an important barrier within case study research. This study will increase the generalizability by conducting two different case studies instead of one.

4. *Reliability*

Reliability refers to the extent the study can be successfully replicated by another researcher using the same data collection procedure and achieving the same outcome. (K. M. Eisenhardt, 1989; Yin, 2014) This can be achieved by developing a case study database and by using a case study protocol. (Yin, 2014) Detailed methodologies will be written for the development of the conceptual model based on logical reasoning, for de literature research and for the primary case study.

1.5 Relevance to Industrial Ecology

This thesis is written in fulfilment of the master program of Industrial Ecology at Leiden University and Delft University of Technology. Industrial Ecology is often referred to as 'the science of sustainability', based on the analogy between non-human, biological ecosystems and industrial systems that is used to understand how to create sustainable industrial systems. The master program integrates technical, environmental and social science perspectives to analyse sustainability problems and to design and implement solutions for these problems. This thesis research project builds, as described before, on the work of Ortt & Kamp (2019). In their article they take a company perspective on the development and diffusion of radical innovations in the market. Their developed framework enables companies to track the socio-technical system evolution, which will be used to define niche strategies that enable market formation. Ortt & Kamp's (2019) approach is 'inspired by theory on socio-technical systems and technology innovation systems and transition' (Ortt & Kamp, 2019), which are all frequently used within the field of industrial ecology. Sustainable radical innovations aim to improve environmental and social performance and aim to emerge, transform or replace unsustainable products and markets. They are seen as essential drivers for realizing sustainable development. (Kennedy et al., 2017) Studying how specific niche strategies can support the market creation of sustainable radical innovations is thus relevant to the field of industrial ecology.

1.6 Thesis Structure

Table 1 indicates the structure of this thesis. It is primarily based on the research steps described in the research design section (1.4.2). This chapter described the research topic, objective, research questions and the strategy that will be followed towards answering these research questions. The second chapter will include an elaboration on relevant theory, and the third chapter will set a definition of the barriers and (niche) strategies that will be followed in this thesis. Chapter three also includes evaluation criteria that can be used to assess the suitability of niche strategies. In the fourth chapter, the conceptual model will be developed. The initial model is based on logical reasoning. This initial model will subsequently, in chapter five, be refined by means of a literature study with the aim of supporting the assumptions in the initial model. Chapter six describes the primary case study protocol that will be followed in chapter seven and eight. Chapter seven includes the two primary case study results and will analyse these results. The outcomes of the two primary case studies will be compared with each other and compared to the initial conceptual model in chapter eight. The

ninth, and last, chapter of this thesis is the conclusion, discussion and reflection on the research described in this thesis.

Table 1.1: Thesis structure

Chapter	Description	Research Question
1.	Introduction of research	
2.	Theoretical background	
3.	Setting definitions	1AB
4	Conceptual model development – Logical reasoning	2A
5	Conceptual model development – Desk research	2B
6.	Primary case study protocol	
7.	Primary case study results and analysis	
8.	Improving and refining criteria and model	1C, 2C
9.	Conclusion, discussion, reflection	Main research question

2. Theoretical Background

This chapter describes the relevant theoretical context of the research. These theoretical insights are used to formulate the knowledge gap, research problem and research questions as described in chapter 1 and will be used during the development of criteria and definitions in chapter 3 and the development of the conceptual model in chapter 4.

2.1 Diffusion of Radical Innovations

2.1.1 Pattern of development and diffusion

The spread of innovations within the market or within a market segment is called diffusion. The speed of diffusion can be described by means of a S-curve, which shows the cumulative percentage of adopters of the innovation over time (see the lightgrey graph in figure 2.1). (Rogers, 1995) The adoption of the innovation starts off slow. After overcoming the first obstacles such as technical, social or economic uncertainties, the early majority starts to adopt the innovation, causing a rapid growth of adoption. The end of the pattern represents the phase in which the innovation is fully accepted in the market. The innovation risks substitution by other technologies, which will cause the adoption to slow down. (Ortt & Schoormans, 2004; Rogers, 1995)

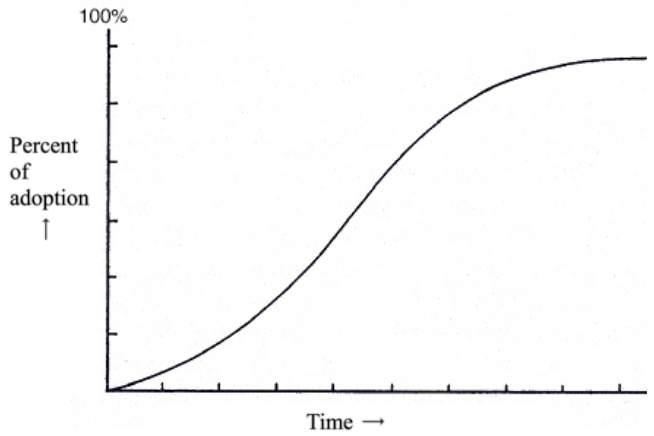


Figure 2.1: The S-curve (Rogers, 1995)

However, Ortt & Schoormans (2004) argue that the S-curve does not completely resemble the pattern of development and diffusion of radical innovations. They noticed that the time between invention of the technology and wide-scale adoption of the technology is usually characterized by the development of multiple, small-scale applications incorporating the technology. This pattern of introduction and rejection of these small-scale applications cannot be seen in the S-curve. According to them, the S-curve thus only represents the last part of the, usually complex, uncertain and long-winded (Slocum et al., 2008), development and diffusion process of radical innovations. (Ortt & Schoormans, 2004) Following these conclusions, the authors propose a new diffusion model, see figure 2.2, to represent the pattern of development and diffusion of radical innovations. (Ortt & Schoormans, 2004)

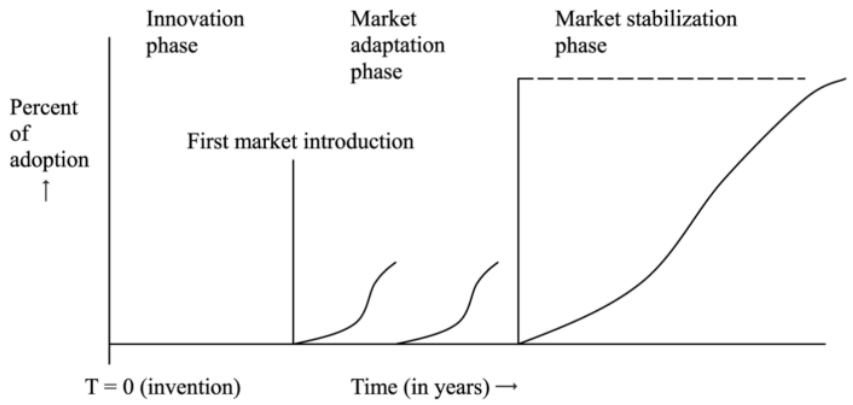


Figure 2.2: The pattern of development and diffusion of radical innovations (Ortt & Schoormans, 2004)

As also can be seen in figure 2.2, Ortt & Schoormans (2004) distinguish three different phases, of which the last phase depicts the S-curve:

1) The innovation phase

This phase begins when the new technology is invented and ends when the technology is introduced to the market for the first time.

2) The market adaptation phase

This phase shows the developments from the first market introduction until the start of the large-scale diffusion process. During the market adaptation phase, the amount of actors is highly volatile and there is a lot of change regarding the applications of the technology and the market segments, making it the most tumultuous phase. (Ortt, Shah, et al., 2007)

3) The market stabilization phase

This phase starts with the large-scale diffusion process and ends when the market is saturated or when the technology is substituted by other technology.
(Ortt & Schoormans, 2004)

2.2 Factors hampering large-scale diffusion

As was mentioned in the introduction of this thesis, Ortt & Kamp (2019) developed a framework including factors that are required for large-scale diffusion process of radical innovations, and that can, depending on the presence or absence, enable, hamper or even completely block this process. Companies aiming to diffuse their radical innovation on a large-scale in the market can use their framework in multiple ways. First of all, it can be used to reveal the reasons behind the, usually long, timeframe between the innovation itself and the start of the large-scale diffusion process. Furthermore, companies can use the framework to monitor their system development over time during market formation, which is useful in order to define the (specific) type, scope and timing of the introduction of the radical innovation (see section 2.3). (Ort & Kamp, 2019)

The framework consists out of two layers (see figure 1.1); the core factors and the influencing factors. These factors are based on the notion of radical innovations being systems consisting out of both social and technical components, called a socio-technical system. (Ort & Kamp, 2019) If one of these components is not developed properly, the diffusion of the radical innovation will be blocked. Ortt & Kamp (2019) formulated seven components that are essential for the formation of a market, see table 2.1, and that have a direct effect on the large-scale diffusion of the radical innovation.

Table 2.1: Factors that facilitate or hamper the system development and large-scale diffusion of radical innovations (Ortt and Kamp, 2019)

No.	Factor	Explanation
CF-1	Product performance and quality	A prerequisite for large-scale diffusion of the product is a good performance and quality of the product, not only absolute, but also in comparison to existing, comparable, products: the product should be a feasible option for customers. A deficient performance and quality of the product or its components, or the presence of undesired side effects can block large-scale diffusion.
CF-2	Product Price	This factor relates to both the financial and non-financial investments involved in the usage and acquirement of the product. If these costs are exorbitant high, also in comparison to existing, comparable products, it can block the large-scale diffusion process.
CF-3	Production System	To enable large scale-diffusion, a production system that is able to produce the products on a large-scale with the desired quality should be in place. Defects or flaws in the production process, or a missing production system, can block large-scale diffusion.
CF-4	Complementary Products and Services	This factor refers to the availability and price of the complementary products and services that are needed over the life-time (all activities from development to end-of-life) of the product. Absence, incompatibility or high prices of complementary products and services, or of parts of these systems, can block large-scale diffusion.
CF-5	Network formation and coordination	Network formation and coordination refers to the presence and coordination of necessary actors in the supply network. Lacking actors or lacking coordination between the actors within the network can block large-scale diffusion of the product.
CF-6	Customers	To enable large-scale diffusion, a customer base is required that should comprehend the product and its use and that are able and wiling to acquire and use the product. A lacking customer base can block the large-scale diffusion process.
CF-7	Specific Institutional Aspects	This factor refers to the way in which institutional aspects (i.e. policies, laws, standards and regulations) influence the involved actors during manufacturing, distribution, acceptance and use of the product and influence the product, production system and complementary products and services. The influence of the institutional aspects can have a negative or positive impact on the large-scale diffusion process.

The influencing factors describe the wider political, economic, cultural, social, technological, legal and environmental contexts that influence the core factors. These 7 factors explain the origin of the difficulties occurring in the core factors. (Ort and Kamp, 2019) Table 2.2 describes these seven influencing factors in more detail.

Table 2.2: Factors that describe the origin of the problems occurring in the core factors (Ortt and Kamp, 2019)

No.	Factor	Explanation
IF-1	Knowledge and awareness of technology	This factor distinguishes to two types of technological knowledge that actors in the technology innovation system should have and should be aware of: 1) Fundamental knowledge, referring to knowledge on the technological principles in the product, the production system and the complementary products and services; 2) Applied technological knowledge, referring to knowledge necessary for the development, the production, the usage, the maintenance and the improvement of the product, the production system and the complementary products and services. If one of these types of knowledge is missing, large-scale diffusion will be hampered.
IF-2	Knowledge and awareness of application and market	Actors on both the supply and consumer side should have knowledge on the type of applications. Consumers should, for example, understand how to use a product and the suppliers should understand the potential applications of the innovation. Furthermore, this factor refers to the knowledge of the market structure and actors active in the market that is necessary. If one of these types

		of knowledge is missing, large-scale diffusion will be hampered.
IF-3	Natural and human resources	Natural resources, human resources and other inputs necessary for the use and production of the product, the complementary products and services and the production system should be available with the required quality. Absence of these inputs hampers large-scale diffusion.
IF-4	Financial resources	Financial resources are essential for the development and large-scale diffusion of the product, the production system and the complementary products and services. Different actors, such as banks, investors and consumers, can provide financial resources. Insufficient financial resources hamper large-scale diffusion.
IF-5	Socio-cultural aspects	The norms and values of the actors that are part of the products' socio-technical system can influence the large-scale diffusion process of the product. The norms and values vary depending on the cultural background and industry, change over time and can change from stimulating to blocking large-scale diffusion.
IF-6	Macro- and meso- economic, institutional and strategic aspects	The economic situation in industries or countries influences the development and large-scale diffusion process. This can be a negative influence (a recession will hamper large-scale diffusion) or a positive influence (economic growth will stimulate large-scale diffusion). Furthermore, strategic and institutional aspects reflect the macro-economic situation of a country, which can hamper or stimulate the large-scale diffusion process.
IF-7	Accidents and events	The presence or risk of external accidents and events such as environmental disasters, war, and political instabilities can stimulate or hinder the large-scale diffusion process of products.

2.3 Strategies for large-scale diffusion

Different categories of introduction strategies can be distinguished that companies, aiming to commercialise their radical innovation, can adopt:

1) Wait-and-see introduction strategy
The wait-and-see introduction strategy is a strategy in which the pioneering company waits with the introduction of the radical innovation; it becomes a follower on purpose. The company observes the performance of the competitors and introduces the radical innovation into the market when it is commercially attractive to do so. (Ortt, Shah, et al., 2007)

2) Mass-market introduction strategy
A mass-market introduction strategy is a strategy that can be adopted if all the factors necessary for large-scale diffusion, as described by Ortt and Kamp (2019), are present. It usually requires a large investment in facilities that enable large-scale production and distribution. This strategy is mainly viable when the pioneering company is able to protect their market (by, for example, means of a patent) or when the innovation becomes more valuable with the increase of users. (Ortt, Shah, et al., 2007)

3) Niche market introduction strategy
The niche market introduction strategy is a strategy in which multiple applications are introduced into the market before one application is successful and adopted in the market. The erratic pattern of development and diffusion resembles this process. (Ortt, Shah et al., 2007) There are 'mature' and 'early' niches; a niche that develops during the market stabilization phase next to the existing market is called a matured niche; an early niche is a small market that develops before large-scale diffusion of the innovation, facilitating the road to the mass market. (Ortt et al., 2013) The term 'niche' in this thesis refers to early niches.

3. Setting Definitions

This chapter sets definitions and formulates assumptions needed to be able to obtain an answer to the research question. The first section sets the definition of a barrier and defines how niche strategies can overcome a barrier. The second section gives a definition of niche strategies and formulates categories in which the niche strategies can be classified. In the third and last section a list of relevant evaluation criteria are developed that companies can use to assess the suitability of niche strategies.

3.1 Barriers obstructing innovations from large-scale diffusion

3.1.1 Definition of a barrier

The definition of a 'barrier' that is used in this thesis is based on the description by Ortt & Kamp (2019) explaining the concept of the relations between influencing and core factors: The combination of a missing core- and a missing influencing factor represents a specific market situation, in which a barrier is hampering large-scale diffusion of the radical innovation. A barrier in this thesis will be defined as (see figure 3.1) *a problem related to a core factor (B)*, which is *raised by an inhibiting influencing factor (A)*, and which is obstructing the large-scale diffusion process (C). The barrier thus consists out of two elements (A and B). The influence (C) is the effect of the barrier. The 'problem related to the core factor' and an 'inhibiting influencing factor' is sometimes also described in this thesis as a 'missing', 'not in place', 'half in place', 'inhibiting' or 'incomplete' factor. Each factor described in the previous chapter is described rather generic, but factors actually exists out of more, smaller, elements that together comprise the factor. For example, the first core factor, CF-1: 'Product performance and quality', is described as the performance and quality of the product, both absolute, and relative to comparable products. However, the product 'quality' is a broad term, which can be further divided into, for example, the eight dimensions of product quality as described by Garvin: Features, reliability, performance, conformance, durability, serviceability, aesthetics and perceived quality (Garvin, 1984). Each core and influencing factor can be similarly divided into smaller elements: If a barrier is raised by an 'incomplete' or 'missing' factor, it refers to these smaller elements that comprise the influencing or core factor that are not properly developed.

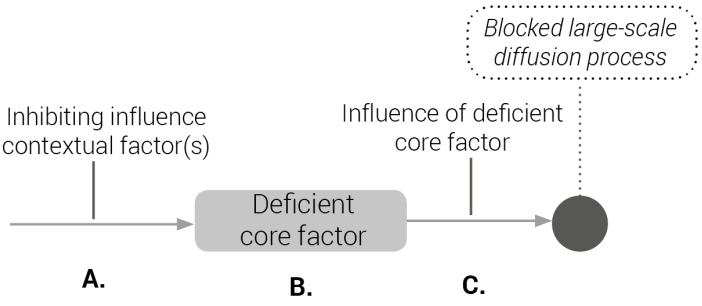


Figure 3.1: The elements of a barrier (AB) and its influence (C) on the large-scale diffusion process

3.1.2 Overcoming a barrier

Previous chapters mentioned that barriers can be either 'circumvented' or 'removed' by adopting a niche strategy. The difference between these two ways of overcoming a barrier is important to note. The images below illustrate the obstruction of a large-scale diffusion of a radical innovation by a barrier. As described in the previous section, a barrier consists out of 2 distinguishable parts and has an effect. Therefore, there will be assumed that the barrier can be overcome in three ways through

the adoption of a particular niche strategy. The main difference between 'circumventing' or 'removing' a barrier is based on the state of the core factor, since the core factor has the main influence on the diffusion process; If the core factor is still incomplete after the adoption of a strategy (see point 1 below), the barrier is circumvented; if the deficiency in the core factor is removed, the barrier is considered solved (see point 2 and 3 below). The three types of strategies are based on which part the niche strategy is applied to. Which is either by aiming to change the influence of the barrier (1), by changing the influencing factor (2), or by changing the core factor (3):

1. The strategy can be a measure or s solution that *removes the impact of the deficient core factor on the diffusion of the innovation* (see figure 3.2). So the barrier still exists, but does not obstruct the diffusion anymore: The barrier is circumvented. [E.g.: Adopting a geographical niche strategy to circumvent missing appropriate institutional aspects (CF-7)]

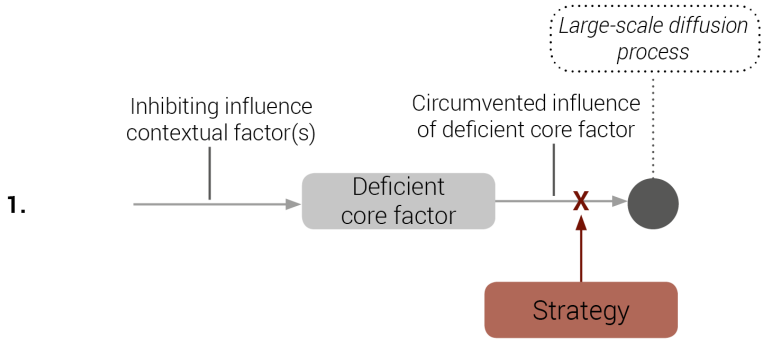


Figure 3.2: Circumventing the barrier by removing the influence of the deficient core factor

2. The strategy can be a measure or s solution that *solves the deficiency related to the influencing factor* (see figure 3.3), which removes the negative influence of this contextual factor on the core factor: The barrier is removed. [E.g.: Adopting a technological research & develop niche strategy in order to increase the technological knowledge (IF-1), so that the product performance and quality will increase (CF-1)].

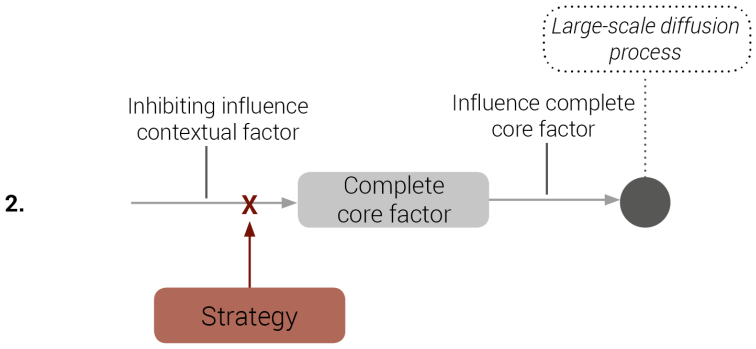


Figure 3.3: Removing the barrier by solving the deficiency related to the influencing factor

3. The strategy can be a measure or s solution that *solves the deficiency within the core factor* (see figure 3.4). This means that the problem related to the influencing factor still exist, but does not obstruct the diffusion anymore, since the deficiency in the core factor will be removed: The barrier is removed. [E.g.: Adopting a redesign niche strategy to adapt to a lack of financial resources (IF-4) that is affecting the quality and performance of the product (CF-1).]

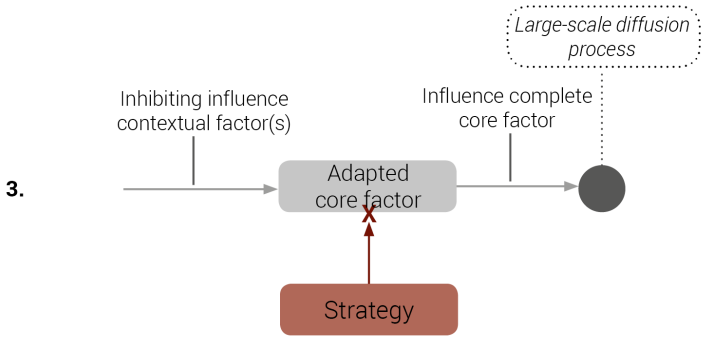


Figure 3.4: Removing the barrier by solving the deficiency within the core factor

3.1.3 Assumptions regarding the strategies overcoming barriers

The following assumptions regarding the relationships between strategies and barriers are defined, which will be used during the initial conceptual model development, the literature analysis, and the primary case study analysis:

1. In the first scenario (type-1 strategy), *'the strategy removes the impact of the deficient core factor on the diffusion of the innovation',* there will be assumed that all barriers related to this core factor – so, independently of the amount and type of influencing factors that form the barrier – can be circumvented with this strategy. The problem related to the core factor will still exist, which means that the barrier will not be removed, but the influence of the barrier on the diffusion process of the radical innovation is removed.
2. In the second scenario (type-2 strategy), *'the strategy solves the deficiency related to the influencing factor',* the strategy is specific to the influencing factor; there can be assumed that all barriers (independent of the type of core factor that is deficient) related to the influencing factor can be removed by implementing this strategy. This can be assumed since the reason that the core factor(s) is/are deficient is the particular inhibiting influencing factor. If the deficiency regarding this inhibiting factor is removed, the deficiency in the core factor(s) can be solved as well.
3. In the third scenario (type-3 strategy), '*the strategy solves the deficiency within the core factor',* the strategy aims to remove the barrier by solving the deficiency related to the core factor. Since the deficiency within the core factor is specific to the type of influencing factor, it will mainly be strategies that are specific to the particular barriers. It is however possible that the strategy can be adopted for multiple barriers related to the core factor, depending on the characteristics of the strategy.

3.1.4 Assumptions regarding the possible experienced barriers

There are 7 core factors and 7 influencing factors that together can form many different barriers. Figure 3.5 shows four different situations in which one or more barriers obstruct the large-scale diffusion of an innovation. Only four influencing factors (IF) and four core factors (CF) are depicted instead of seven of each.

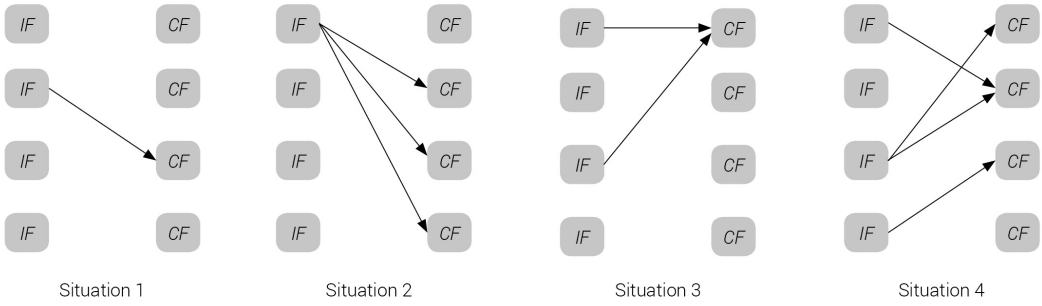


Figure 3.5: Different situations in which a company faces one or more barriers

The first theoretical situation refers solely to barriers consisting out of primary core factors influenced by primary influencing factors as described in the factor framework by Ortt & Kamp (2019). However, as depicted in situation 2, a deficiency within one influencing factor can cause multiple barriers within different core factors, and as depicted in situation 3, different influencing factors can cause a deficiency within one core factor. However, companies will in practice most likely face situation 4; in this situation multiple barriers are raised by different influencing factors each causing one or more deficiencies within multiple core factors. This research will focus on the first situation. There can be argued that situation 3 can be circumvented by the type-1 strategy; situation 2 can be removed by adopting a type-2 strategy; and situation 1 can be removed or circumvented by a type-1, a type-2 or a type-3 strategy (as also described in §3.1.3). However, it is likely that situation 2 and 3 will require a combination or a sequence of different strategies that strengthen each other. This would require an analysis of the interrelationship between different strategies. This would be an interesting addition to the research, but is considered out of scope.

Within the first situation, there are theoretically speaking 7*7=49 barriers possible. However, in reality, not all influencing factors will have an influence on the core factors. Hence, assumptions regarding the influence of these contextual factors on the core factors are listed below. These will be used during the development of the initial conceptual model in the next chapter.

1. The influencing factor ‘knowledge and awareness of technology’ (IF-1) can have an impact on all the core factors.
2. The influencing factor ‘knowledge and awareness of application and market’ (IF-2) has mainly an influence on the factors related to the social components within the socio-technical system: The ‘network formation and coordination’ (CF-4), ‘customers’ (CF-5) and the ‘specific institutional aspects’ (CF-7).
3. The influencing factors ‘natural & human resources’ (IF3) and ‘financial resources’ (IF-4) are related to resources available to the company and thus mainly influence the technological components within the socio-technical system: ‘product performance & quality’ (CF-1), ‘product price’ (CF-2), ‘production system’ (CF-3) and ‘complementary products & services’ (CF-4). However, there are some exceptions:
    a. The influencing factor ‘financial resources’ can influence the core factor ‘customers’. This barrier comprises the lack of financial resources of the customers, affecting their chance or willingness to buy the product;
    b. Furthermore, since barriers raised by deficiencies within the influencing factor natural & human resources will most likely ask for different strategies, this influencing factor is separated within the analysis;
    c. The factor ‘natural resources’ (IF-3b) is assumed to influence the factor ‘product price’ and the factor ‘complementary products and services’ only. Although the barrier can also influence the factor ‘product performance and quality’ and the factor ‘production system’, these barriers are considered to be too overlapping with the other factors;

d. The factor 'human resources' (IF-3a) is assumed to influence the factor 'product performance and quality' and the factor 'production system'. Although the barrier can also influence the factor 'product price' and the factor 'complementary products and services', these barriers are considered to be too overlapping with the other factors.

4. The influencing factors 'socio-cultural aspects' (IF-5), 'accidents or events' (IF-7) and 'macro- & meso-economic, generic, institutional and strategic aspects' (IF-6) mainly influence the social components of the socio-technical system: 'Network formation and coordination' (CF-5), 'customers' (CF-6) and 'specific institutional aspects' (CF-7). There are two exceptions:
   a. 'Macro- & meso-economic, generic, institutional and strategic aspects' can also have an influence on the core factor 'complementary products & services', since the availability of the elements can be influenced by the aspects.
   b. Furthermore, 'socio-cultural aspects' can have an influence on the core factor 'product performance and quality', since the quality has a degree of subjectivity to it (for example, the perceived quality by customers).

Figure 3.6 gives an overview of the assumptions above (grey cells are an assumed barrier)

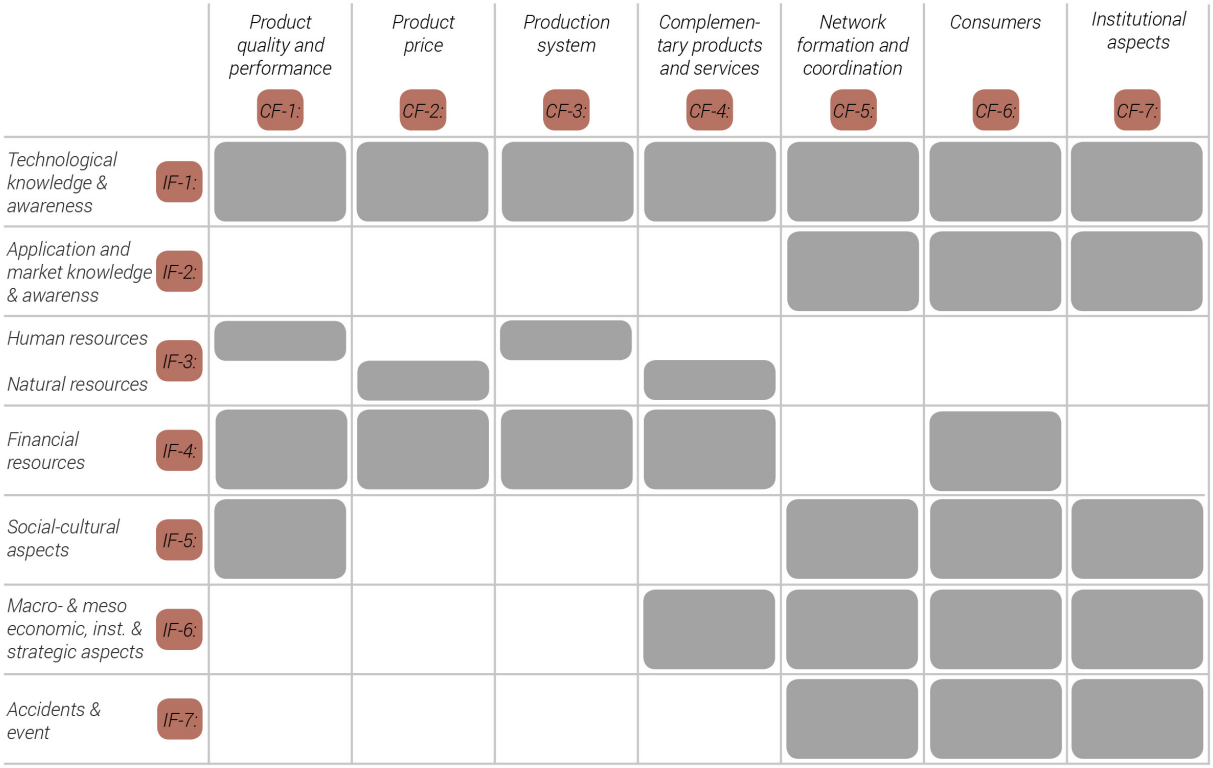


Figure 3.6: Overview of the possible barriers (in grey), following the assumptions

3.2 Strategies for niche market creation

3.2.1 Definition and categories of niche strategies

The niche market introduction strategy focuses on the creation of early niches, which can be achieved by companies through the adoption of a strategy that aims to overcome barriers within the socio-technical system that hinder the large-scale diffusion of the radical innovation. A term that is often mentioned in combination with this definition is a 'niche strategy'. Ortt & Kamp (2019) refer to niche strategies as strategies aiming at 'introducing a specific version of the innovation for a specific,

small, segment of customers', which thus refers to niche strategies that aim to sell the radical innovations. This first definition fits into the description of the pattern of development and diffusion (see §2.1.1), which describes a graph that shows how niche markets are created during the market adaptation phase through the adoption of a niche strategy. However, as Ortt & Kamp (2019) also describe, there are also strategies that 'help shape socio-technical systems during market formation', which is achieved by influencing the market. Comparing this second definition with the description of the pattern of development and diffusion as described in section 2.1.1, it points towards the possibility to adopt a niche strategy within the innovation phase, before the actual market is formed in the market adaptation phase. The definition of a niche strategy that will be used throughout this research is the combination of the two described definitions of a niche strategy; a niche strategy is a strategy that can be adopted by a company to either create a niche market within the market adaptation phase, or to change the socio-technical system in favour of the radical innovation, so that (later) a niche market can be created. The latter can be adopted in both the innovation and the market adaptation phase. Figure 3.7 illustrates this definition.

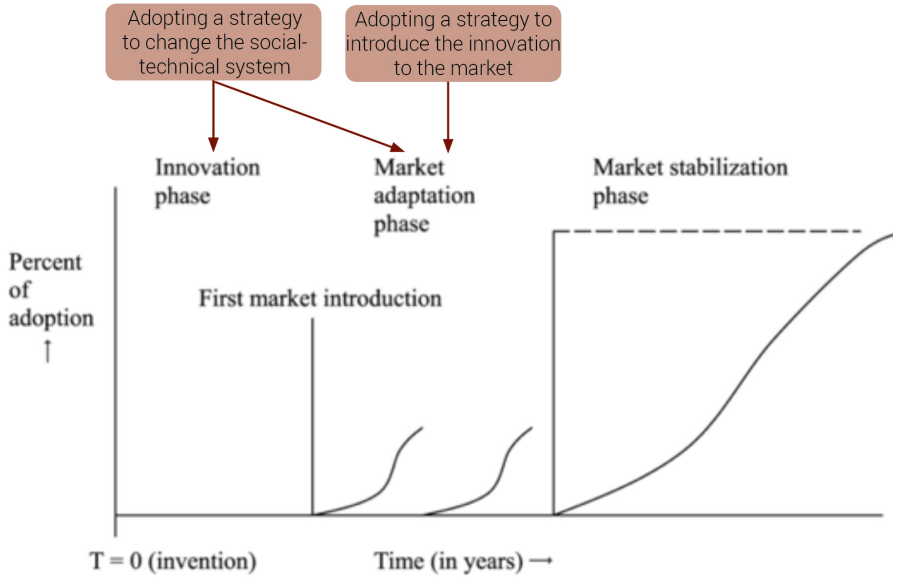


Figure 3.7: Two definitions of niche strategies that together comprise the definition of a niche strategy used in this research

The term 'niche strategy' can thus refer to different categories of niche strategies, which is important to acknowledge, since this thesis aims to develop new strategies that can overcome barriers within the socio-technical system. Not all strategies that will be developed are directly aiming to sell the radical innovation (as de first definition implied). A more specific formulation of different categories of strategies aiming to create a niche market will be described below.

1) The first category of niche strategies can be described as 'increasing knowledge and resources niche strategies'. These strategies specifically aim to directly increase the knowledge and resources within the company and indirectly increase the knowledge and resources within the socio-technical system.
    a. Examples are a 'technological research niche strategy' and a 'financial resource niche strategy'.
2) The second category of niche strategies can be described as strategies aiming to influence the social components of the socio-technical system, and will be referred to as 'influencing niche strategies'. It aims to change the perception, behaviour or opinion of actors within the network, of consumers or of institutions that are needed to diffuse the innovation.
    a. Examples are an 'education niche strategy' and a 'lobbying niche strategy'

3) The third category of niche strategy described in this section, strategies aiming to commercialise the radical innovation, will be referred to as 'marketing niche strategies'. There are two different options within this type of strategy:
    a. Strategies that fundamentally change aspects of the product, production system or complementary products and services: Examples are a 'redesign niche strategy' and a 'hybridization niche strategy'.
    b. Strategies that change the business model: For example a 'top-end niche strategy' and a 'leasing niche strategy'.

Figure 3.8 visualises the different categories as described above. Section 4.3 will show a more detailed scheme, including all the niche strategies that will be described in the conceptual model developed in section 4.2.

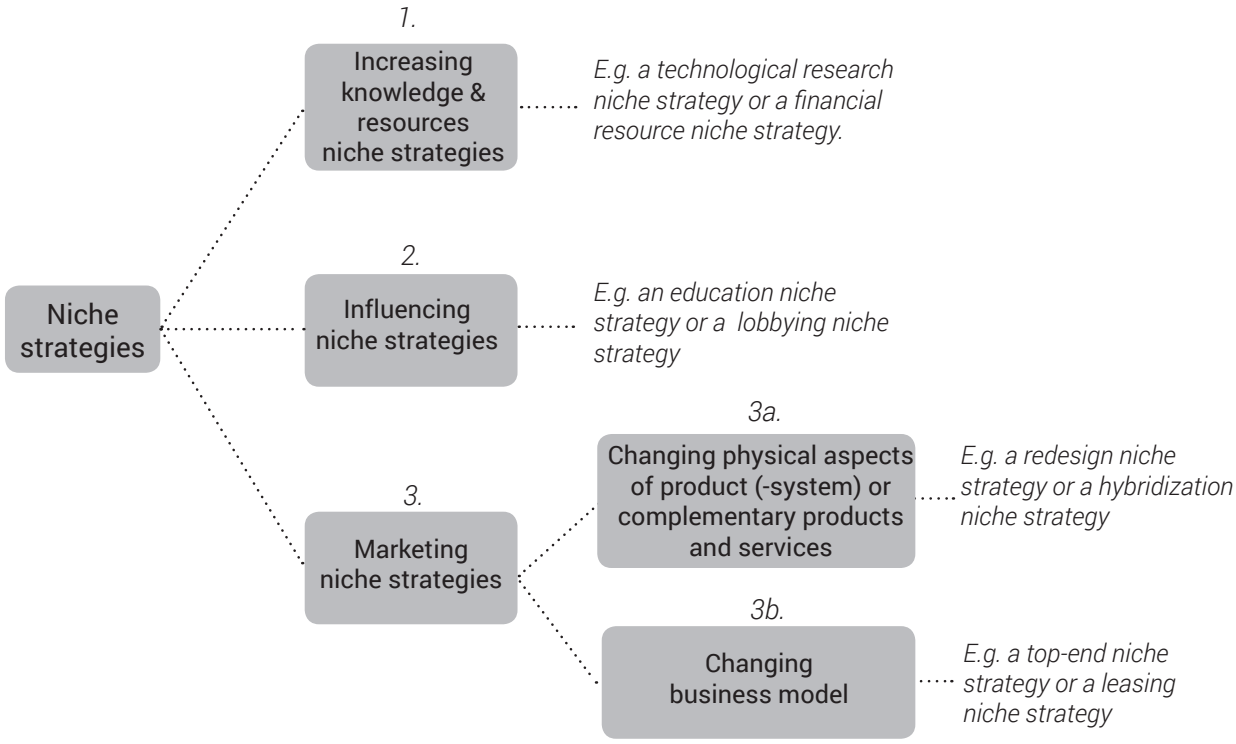


Figure 3.8: Overview of the different niche strategy categories and some examples

3.2.2 Stage of strategies

Furthermore, there is a distinction between the development stages of the niche strategies that will be used throughout this thesis. They indicate to which extent the strategies are confirmed by literature and which strategies will be the most suitable to companies:

1) Proposed strategies

Proposed strategies are strategies of which is assumed that they can be adopted to overcome or circumvent the barriers. The relationship between the barriers and proposed strategies are defined by logical reasoning using preliminary theoretical insights.

2) Appropriate strategies

Appropriate strategies are strategies of which the relationship between the proposed strategies and barriers are confirmed by relevant literature. The proposed strategy is thus able to overcome the barrier to which it is linked to in the initial conceptual model.

3) Suitable strategies

Suitable strategies are the strategies that companies should adopt to have the most successful outcome of removing or circumventing the experienced barrier. It depends per company which appropriate strategy fits the best in their case. The next section describes evaluation criteria that can be used by companies to assess the suitability of the strategies.

3.3 Defining Evaluation criteria

3.3.1 Introduction and methodology

In this section, evaluation criteria will be developed that can be used by companies to assess and evaluate the suitability of the niche strategies to overcome particular barriers that are defined based on the factor framework by Ortt & Kamp (2019). As described in §1.3.1, the evaluation criteria should assess the suitability of the strategies in relation to the specific characteristics of the company. This section first describes the development of evaluation criteria based on logical reasoning. Secondly, the developed evaluation criteria will be supported by a relevant theoretical concept. The aim of the confirmation is to find out if all the aspects that are needed to effectively evaluate a strategy are included in the list of evaluation criteria. In chapter 7, two primary case studies are described that will confirm the relevancy and usefulness of the evaluation criteria in practice.

BusinessDictionary.com defines an evaluation criteria as a "benchmark, standard, or yardstick against which accomplishments, conformance, performance and suitability of an individual, alternative, activity, product, or plan, as well as of risk-reward ratio is measured". In this thesis, the evaluation criteria will aim to determine the suitability of different alternatives, the strategies, as solution to circumvent or remove the experienced barriers. As described in the previous paragraph, the aim of the criteria is to evaluate strategies in terms of suitability for companies to overcome experienced barriers. The following three, general criteria are used as guideline during the development of the evaluation criteria:

- *The evaluation criteria take the perspective of the company adopting the strategy*

This criterion relates to the formulation of the evaluation criteria; the company that will use the evaluation criteria should be able to assess the strategy based on their specific characteristics. Taking their perspective will contribute to the usability and usefulness of the evaluation criteria. This perspective is important, since only then it complies with the aim of the research as described in chapter 1.

- *The evaluation criteria should cover the most important characteristics of companies.*

The different aspects of the characteristics of a company are based on the business model components (e.g. the competitive strategy, their vision, their product, their target market and their supply chain management) and their specific company profile (e.g. their human and financial resources, their capital goods and their norms and values within the company). These are defined based on general knowledge on company characteristics.

- *The evaluation criteria must complement the barriers framework*

Some barriers experienced by the company are caused by the particular characteristics of the company (e.g. 'lack of financial resources affects the product quality and performance). Redundancy of these aspects should be avoided.

3.3.2 Development of evaluation criteria based on logical reasoning

The following 10 evaluation criteria are developed based on the criteria established above. The envisioned use of the evaluation criteria is by means of a multi-criteria analysis. Each niche strategy should be relative or absolute scored on the criteria. The company then ranks the criteria from most

important, to least important. The combination of the score and ranking than indicates the most suitable strategy.

1. *The niche strategy is understandable to everyone and not overly difficult or complex to interpret;*

This evaluation criterion refers to the interpretation of the niche strategy as described in the conceptual model by the company; how they rewrite the aims of the strategy to fit within their business practices and how they communicate it to the rest of the company. Not everyone within the company (this, however, depends on the size of the company) will be involved during the decision-making process on which strategy to adopt. It thus refers to the ability of the company to make the particular niche strategy their 'own'.

2. *The niche strategy is agreeable to those who must implement the niche strategy;*
3. *The strategy is consistent between the organizational objectives and the values of the management; it does not evoke opposing interests.*

These two criteria refer to the vision of the company. Some niche strategy can for example (physically) change the innovation itself or can change the way of practice of the company (e.g. the business model). If this does not comply with the vision and practices of the company, the company can decide to adopt a different niche strategy that does comply with their vision, norms and values.

4. *The niche strategy has a high estimated chance of success over time with a degree of reliability, consistency and effectiveness;*

The aim of the niche strategy is to overcome a barrier; it depends on the company however, if the strategy should be effective on the short term or on the long term. This evaluation criterion thus refers to the time frame in which the strategy should be reliable, consistent and effective.

5. *The strategy is adaptable to future trends within the industry;*

As described before, niche strategies can (physically) change the innovation itself or can change the way of practice of the company (e.g. the business model). If the industry in which the company is active changes fast, this criterion can be important.

6. *There are no major negative side effects/down sides on (the company's) environment of adopting the niche strategy in terms of economic, environmental and/or social impact.*

This criterion refers to the negative impact of the strategy on the environment of the company and is particularly important for companies aiming to have a sustainable impact.

7. *The strategy can be realized within the company's financial resources;*
8. *The strategy can be realized within the company's human resources;*
9. *The strategy can be realized within the company's capital goods;*

The three evaluation criteria above refer to the resources and goods available within the company to bring the niche strategy into practice. Although a lack of, for example, human resources (=influencing factor) can raise deficiencies within core factors, the human resources mentioned in evaluation criterion 9 does not refer to human resources that are available to be able *to diffuse the product*, but refer to the ability of the human resources to *bring the niche strategy into practice.* The same counts for the financial resources and the capital goods.

10. *The niche strategy has a potential good cost/benefit ratio;*

A niche strategy can require a high financial input (see criterion 7), but can still have a high benefit. This cost/benefit ratio can be more important than the absolute amount of financial resources that are needed. The costs do however not only refer to financial resources but also for example to the negative side effects (see criterion 6). The importance of this ratio depends per company and is thus important to take into account.

3.3.3 Literature confirmation

The evaluation of a strategy is described in literature as a fundamental step in guiding the business practices. However, it is unrealistic to expect that the evaluation will always lead to the perfect strategy. The aim is thus not to create a complete list of evaluation criteria based on literature; the aim is, as also described in the introduction of this section, to confirm the completeness of the established 10 evaluation criteria in terms of *aspects* that the criteria cover, needed to evaluate a particular strategy. Rumelt (1993) describes four broad guidelines that are widely used by companies to test strategies: Consistency; consonance; advantage; and feasibility (Rumelt, 1993). These four guidelines are used to subdivide the evaluation criteria developed in the previous section. (The numbers in front of the evaluation criteria do not correspondent to the numbers used in the previous section.)

A. "**Consistency**: The strategy must not present mutually inconsistent goals and policies." (Rumelt, 1993)
    1. The niche strategy is understandable to everyone and not overly difficult or complex to interpret;
    2. The strategy is consistent between the organizational objectives and the values of the management group; it does not evoke opposing interests;
    3. The niche strategy is agreeable to those who must implement the niche strategy.

B. "**Consonance**: The strategy must represent an adaptive response to the external environment and to the critical changes occurring with it." (Rumelt, 1993)
    4. The niche strategy has a high estimated chance of success over time with a degree of reliability, consistency and effectiveness.

C. "**Advantage**: The strategy must provide for the creation and/or maintenance of a competitive advantage in the selected area of activity." (Rumelt, 1993)
    5. The strategy is adaptable to future trends within the industry.

D. "**Feasibility**: The strategy must neither overtax available resources nor create unsolvable sub problems." (Rumelt, 1993)
    6. The niche strategy has a potential good cost/benefit ratio;
    7. The strategy can be realized within the company's financial resources;
    8. The strategy can be realized within the company's human resources;
    9. The strategy can be realized within the company's capital goods;
    10. There are no major negative side effects/down sides on (the company's) environment of adopting the niche strategy in terms of economic, environmental and/or social impact.

3.3.4 Conclusion

It can be concluded that the developed evaluation criteria cover the aspects that are needed to evaluate a strategy, since all four guidelines as described by Rumelt (1993) are covered by the developed evaluation criteria. Although the guidelines 'consonance' and 'advantage' both only include one criterion, the criteria do cover the aim of both the guidelines. Through ranking the evaluation criteria, the company is able to indicate which aspects are important for the company. For example, the amount of resources a strategy should need, the impact a strategy can have on the company and its surroundings and to which degree the strategy should comply to their vision, objectives and available capabilities and resources. The primary case study in chapter 7 will aim to confirm the relevancy of the criteria and the potential use of these criteria in practice.

4. Conceptual model development – Logical reasoning

The first part of this chapter, 4.1, elaborates on the methodology that is followed during the development of the conceptual model based on logical reasoning. In 4.2, the initial conceptual framework is developed based on logical reasoning. Section 4.3 closes the chapter with a conclusion, which includes an elaboration on the developed framework.

4.1 Methodology of logical reasoning

This section describes the development of the conceptual model in more detail. The process that will be followed can be described in multiple steps, as can be seen in the figure below, and is based on the research questions and research framework as described in chapter 1.

As can be seen in the image, the first version of the framework (step 1 and 2 together) proposes relationships between niche strategies and barriers. These niche strategies are assumed to be effective to remove or circumvent the identified barriers based on logical reasoning. The steps are described in more detail below the image.

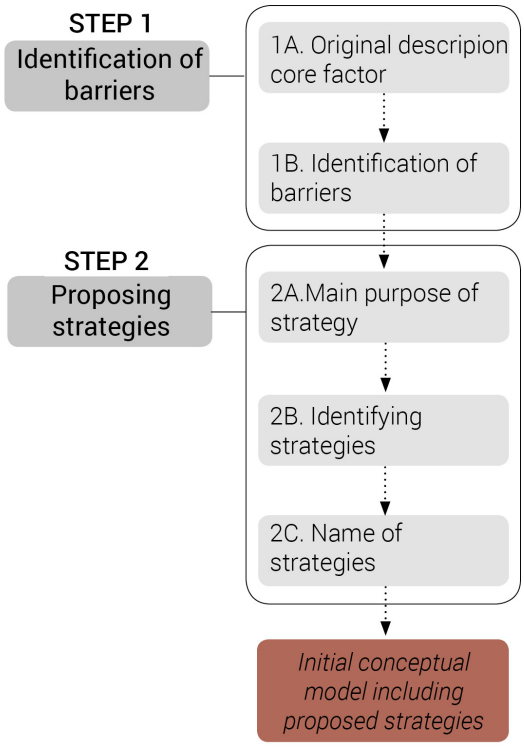


Figure 4.1: Steps taken during the conceptual model development based on logical reasoning

Step 1: Identification of barriers

The first step aims to identify barriers that companies can experience during the market adaptation phase and will consist out of three different consecutive parts:

***1A** – Original description of core factor*

The original description of the core factor as described by Ortt & Kamp (2019) will be used as starting point for the barrier identification. To be able to formulate potential barriers raised by deficiencies in core factors, a more elaborated understanding of some of the core factors is given. This will increase the comprehension of the possible relationship between influencing and core factors and hereby

steer the line of reasoning towards the formulation of niche strategies as solution for the raised barriers.

1B – *Identification of barriers*

The relevant barriers that can hinder large-scale diffusion of a radical innovation are identified based on the assumption described in 3.1.4 'Assumptions regarding the possible experienced barriers'. These assumptions are defined by rationalising the potential influence of the influencing factors on the core factors.

Step 2: Proposing strategies

The second step aims to propose niche and business strategies that can circumvent or remove the barriers that are described during step 1B, and is developed based on logical reasoning. This step consists out of three different steps, of which the two first steps explain the rationale behind the formulation of strategies:

2A *– Main purpose of strategy*

To circumvent or remove a barrier, companies can adopt different types of strategies. These three types of strategies are described in section 3.2.1 'Overcoming a barrier'. To guide the generating process and to make the conceptual framework as complete as possible, it is assumed that each barrier can be overcome in three different ways. This section will thus describe the main goal of the strategy. Thus, this step does not elaborate on concrete measures (strategies) yet; the aim is to give a broad direction, which helps by generating the strategies in the next step and, furthermore, it is also a useful way to be able to cluster the strategies and keep a clear overview throughout the generation process.

An example of a direction is 'increasing the technological knowledge to remove the inhibiting influence of the contextual factor'. This falls in the second type of niche strategies as described in section 3.2.1. This overarching direction provides room for different strategies that can be adopted by companies to overcome the barrier. There will be assumed that within each strategy type, multiple niche strategies will exist.

2B – Identifying strategies

This step identifies the different niche strategies that companies can adopt to overcome the barriers, and are based on the directions developed in step 2A. The strategies are explained by giving concrete measures that companies can take. The identification is based on logical reasoning, and if indicated, based on literature findings.

For example, if the first direction as described in step 2A is 'increasing the technological knowledge', this step will give measures to achieve this increase. This can, for example, be 'conducting research in a research environment'. There will be assumed that for each type of niche strategy, at least two niche strategies exist. However, when I could not come up with a strategy, this row is left empty to indicate that most likely another strategy exists.

2C *– Name of strategy*

In this final part, the strategy as described in the previous step (2B) will be given a name. Some descriptions of strategies in 2B will be merged into the same strategy name, in order to reduce the amount of niche strategies and to avoid redundancy.

Conclusion

In this section a conclusion will be drawn based on the outcome of the first two steps (the red cell in figure 4.1). An overview of the strategies will be given and there will be elaborate on the relations between the strategies. This conclusion part will also serve as input for the answer on research question 2A, which can be found in the conclusion chapter.

In the next chapter, Chapter 5, a desk research will be conducted in order to find external support on the relationships between the defined niche strategies and barriers. This chapter (Chapter 4) includes these confirmations by means of a reference. Literature contributes in two different ways in the conceptual model described in this chapter:

1. If literature **supports** the assumed relationship between the barrier and the defined strategy, the section in which this support is described is mentioned in the last column of the table 'Literature support'. Furthermore, the tables will indicate to what extent the found literature contributes to the confirmation of the proposed relationships. There are three possibilities:
    a. '*Yes*': The proposed relationship is confirmed by the literature sources; the relationship can be seen as appropriate.
    b. *'No'*: The proposed relationship is contradicted by the literature sources; the relationship should be removed or revised according to the findings. Most likely, the reasoning behind the proposed relationship is incorrect.
    c. 'Not found': The reviewed literature sources do not provide enough information to either confirm or contradict the proposed relationships in the conceptual model.
2. If the strategy described in the tables in 'B. Strategy' and 'C. Strategy name' are **directly derived** from literature, it will be mentioned with a source reference in those particular cells.

4.2 Step 1 & 2: Proposing niche strategies

4.2.1 Core factor 1: Product performance and quality

Step 1A: Original description of core factor

A prerequisite for large-scale diffusion of the product is a good performance and quality of the product, not only absolute, but also in comparison to existing, comparable, products: the product should be a feasible option for customers. A deficient performance and quality of the product or its components or the presence of undesired side effects can block large-scale diffusion. (Ortt & Kamp, 2019)

Step 1B: Barrier Identification

Five barriers have been identified, caused by five different influencing factors that all have a direct influence on the core factor 'product performance and quality':

IF1: Knowledge and awareness of technology

Barrier 1.1.1: *"A lack of knowledge and awareness on technological principles affects the product performance and quality."*

IF2: Knowledge and awareness of application and market

This influencing factor is assumed to be too external to have a direct influence on the core factor product performance and quality.

IF3: Natural and human resources

Barrier 1.3.1: *"Human resources with appropriate knowledge and competences are lacking, affecting the product performance and quality."*

IF4: Financial resources

Barrier 1.4.1: *"A lack of financial resources affects the quality and performance of the product."*

IF5: Socio-cultural aspects

Barrier 1.5.1: *"Socio-cultural aspects influence the quality of the product."*

IF6: Macro- and meso-economic, institutional and strategic aspects

This influencing factor is assumed to be too external to have a direct influence on the core factor product performance and quality.

IF7: Accidents and events

This influencing factor is assumed to be too external to have a direct influence on the core factor product performance and quality.

Step 2: Proposing Strategies

Tables 4.1 – 4.4 show the strategies that are proposed and/or found appropriate to be able to overcome the indicated barrier. 'A. Main purpose of strategy' describes the overall goal of the strategy; 'B. Proposed strategy' describes the strategy in detail by listing the actions that aim to realize the goal. These are based on logical reasoning, or, if a source is indicated, directly derived from literature. 'C. Name of proposed strategy' proposes a name that covers the content described in B. The last column 'Literature Support' indicates if the proposed relationship is confirmed by literature ('Yes'/'no'/'not found') and indicates the section in which the strategy and confirmation is elaborated.

Table 4.1: Proposing strategies to overcome barrier 1.1.1

IF1. Knowledge and awareness of technology			
1.1.1) "A lack of knowledge and awareness on technological principles affects the product performance and quality"			
A. Main purpose of strategy	**B. Proposed strategy**	**C. Name of proposed strategy**	*Literature support*
Type 1: *Eliminating the influence of the barrier on the diffusion of the innovation* - by integrating the technology into a different application.	Adopting a strategy in which the technology is integrated into a different application. The barrier will thus still exist, but it gives the company time to optimise the performance and quality of the concerning application.	Different application strategy	Not found §5.2.25
Type 2: *Solving the barrier by removing the lack of knowledge and awareness of the company on technological principles* – by developing new technological knowledge so that the influencing factor does not negatively influence the performance and quality of the product	A strategy can be adopted in which technological knowledge will be developed by means of technological research.	Technological research & Develop strategy	Yes §5.2.1
	Adopting a strategy in which a pilot research will be performed can reveal technological issues in practice, since consumers and other stakeholders involved are able to deliver feedback.	Pilot research & develop Strategy	Yes §5.2.2
Type 2: *Solving the barrier by removing the lack of knowledge and awareness of the company on technological principles* – by increasing the internal technological knowledge, the knowledge and awareness of existing technological principles will be increased, so that the influencing factor does not negatively influence the performance and quality of the product	A strategy in which new employees and/or interns are hired can increase the internal knowledge on technological principles the company was not aware of yet.	Human resource management strategy	Yes §5.2.4
	A strategy in which trade exhibitions and conferences are visited can increase the knowledge on the latest trends and innovations regarding the technology. Furthermore, these can be visited to get familiar with the practices of the competitors in the industry. Because of this, the company is able to discover the main performance and quality differences in comparison with the competitors, in order to be able to reduce these differences.	Market research strategy	Not found §5.2.3
Type 3: *Adapting to a lack of technological knowledge and awareness* - Sharing the available internal technological knowledge within the company increases the capacity of the company to find new solutions to problems with the existing knowledge	A strategy in which internal training, courses and brainstorm sessions are performed in order to increasing the overall level of technological knowledge of the employees and to increase the applicability of the existing knowledge in favour of the product performance and quality.	Internal knowledge sharing strategy	Yes §5.2.6

	Type 3: *Adapting to a lack of technological knowledge and awareness* – Increasing the quality and performance using the available technological knowledge	A strategy in which the application will be redesigned with a focus on increasing the quality and performance with the available technological knowledge and awareness.	Redesign strategy	Yes §5.2.12

Table 4.2: Proposing strategies to overcome barrier 1.3.1

IF3. Natural and human resources			
1.3.1) "Human resources with appropriate knowledge and competences are lacking, affecting the product performance and quality"			
A. Main purpose of strategy	**B. Proposed strategy**	**C. Name of proposed strategy**	*Literature support*
Type 1: *Eliminating the influence of the barrier on the diffusion of the innovation* - by integrating the technology into a different application.	Adopting a strategy in which the technology is integrated into a different application. The barrier will thus still exist, but it gives the company the time to optimise the performance and quality of the concerning application.	Different application strategy	Not found §5.2.25
Type 2: *Solving the problem related to the influencing factor* - Increasing the amount of human resources with appropriate knowledge and competences, or increasing the competences of the human resources	A strategy can be adopted in which new employees and/or interns are hired with the aim to increase the knowledge and competences, so that the product performance and quality can increase.	Human resource management strategy	Yes §5.2.4
	A strategy in which internal training, courses and brainstorm sessions are performed. Sharing the available internal knowledge within the company increases the capacity of the company to find new solutions to problems with the existing knowledge and it will increase the competences of the human resources.	Internal knowledge sharing strategy	Yes §5.2.6
Type 3: *Adapting to a lack of human resources within the company* - increasing the product performance and quality with the help of external resources	Circumventing the lack of available human resources with appropriate knowledge and competences by starting a partnership, or by acquiring the knowledge, in which the appropriate knowledge and competences are available to increase the product performance and quality.	Partnership strategy	Not found §5.2.24

Table 4.3: Proposing strategies to overcome barrier 1.4.1

IF4. Financial resources			
1.4.1) "A lack of financial resources affects the quality and performance of the product".			
A. Main purpose of strategy	**B. Proposed strategy**	**C. Name of proposed strategy**	*Literature support*
Type 1: *Eliminating the influence of the barrier on the diffusion of the innovation* - by integrating the technology into a different application.	Adopting a strategy in which the technology is integrated into a different application. The barrier will thus still exist, but it gives the company the time to optimise the product performance and quality of the concerning application.	Different application strategy	Not found §5.2.25

	Type 2 - *Solving the problem related to the influencing factor by increasing financial resources* – this will remove the lack of financial resources that negatively influences the core factor	A strategy that aims to increase the financial resources by participating in competitions in order to win money; starting a crowd funding campaign; applying for a bank loan; or by getting involved in an incubator program.	Finance sourcing strategy	Yes §5.2.9
		A strategy that aims to increase the financial resources by applying for subsidies. *(Ortt et al., 2013)*	Subsidies(A) strategy	Yes §5.2.10
	Type 3 - *Adapting to a lack of financial resources* – Increasing the quality and performance with the available financial resources.	A strategy in which the application will be redesigned with a focus on increasing the quality and performance focusing on reducing the costs	Redesign strategy	Yes §5.2.12

Table 4.4: Proposing strategies to overcome barrier 1.5.1

IF5. Socio-Cultural Aspects				
1.5.1) "Social-cultural aspects influence the quality of the product"				
A. Main purpose of strategy		**B. Proposed strategy**	**C. Name of proposed strategy**	*Literature support*
	Type 1: *Eliminating the influence of the barrier on the diffusion of the innovation* - by integrating the technology into a different application.	Adopting a strategy in which the technology is integrated into a different application. The barrier will thus still exist, but it gives the company the time to optimise the product performance and quality of the concerning application.	Different application strategy	Not found §5.2.25
	Type 2: *Changing the aspects in favour of the innovation* – in order to decrease the negative influence on the quality of the product	Adopting a strategy that aims to change the behaviour of the actors. For example, an influencer (Company/person acting as an example) can be used to gradually change the methods, habits, norms and values among the actors in the (desired) network.	Changing behaviour strategy	Not found §5.2.11
		Adopting a strategy that aims to directly influence the institutions that create laws that can force people to change their norms and values.	Direct lobbying	Yes §5.2.17
		A strategy in which NGO's, the public or media is used to raise awareness on the negative influence of the existing norms and values and that emphasize on the importance of different norms and values.	Indirect lobbying	Yes §5.2.17
	Type 3 – *Adapting to the social-cultural aspects that are present* - Since not all dimensions of product quality and performance are objective (e.g. serviceability, aesthetics, perceived quality, conformance, amount of features), the product can be adapted to the social-cultural environment by changing the dimensions that comprises the quality and performance.	A strategy in which the product will be redesigned with a focus on adapting the quality dimensions so that it fits the socio-cultural environment.	Redesign strategy	Yes §5.2.12
		A strategy in which together with an lead-user the product is further developed so that the quality of the product will comply to the needs and wishes of the market. *(Ortt et al., 2013)*	Lead-user strategy	Yes §5.2.7
		A strategy in which the public is used to generate ideas in order to help develop the application further to be able to adapt the quality of the product to the social-cultural aspects	Crowd sourcing strategy	Yes §5.2.8

Overview results core factor 1

Figure 4.2 below shows a summary of the tables above. The colours correspond to the colours used in the tables, indicating the different type of strategies (purple type-2; orange type-3; blue type-1). The top of the image represents the barrier obstructing diffusion of the product. The first arrow represents the deficient influencing factor; since a deficiency within the core factor can have different origins, the influencing factors are individually indicated at the left of the figure. Per influencing factor, the strategies that can be adopted by companies for the particular core factor are shown. Since the type-2 (purple) strategies aim to remove the influencing factor, these are pointed towards the first arrow 'deficient influencing factor'. Because of this, the deficiency within the core factor will be removed and the barrier will thus be solved. The type-3 (orange) strategies aim to solve the deficiency within the core factor and are specific to the influencing factor; these strategies thus point towards the core factor. The type-1 (blue) strategies aim to circumvent the barrier and are specific to the core factor; that is why these point towards the last arrow and why these 'overrule' the different influencing factors that form deficiencies within the core factor; they can be adopted independent from which influencing factor caused the barrier. The empty boxes represent strategies that could not be reasoned yet. They are included empty based on the assumption that at least two different strategies per barrier and per type will exist.

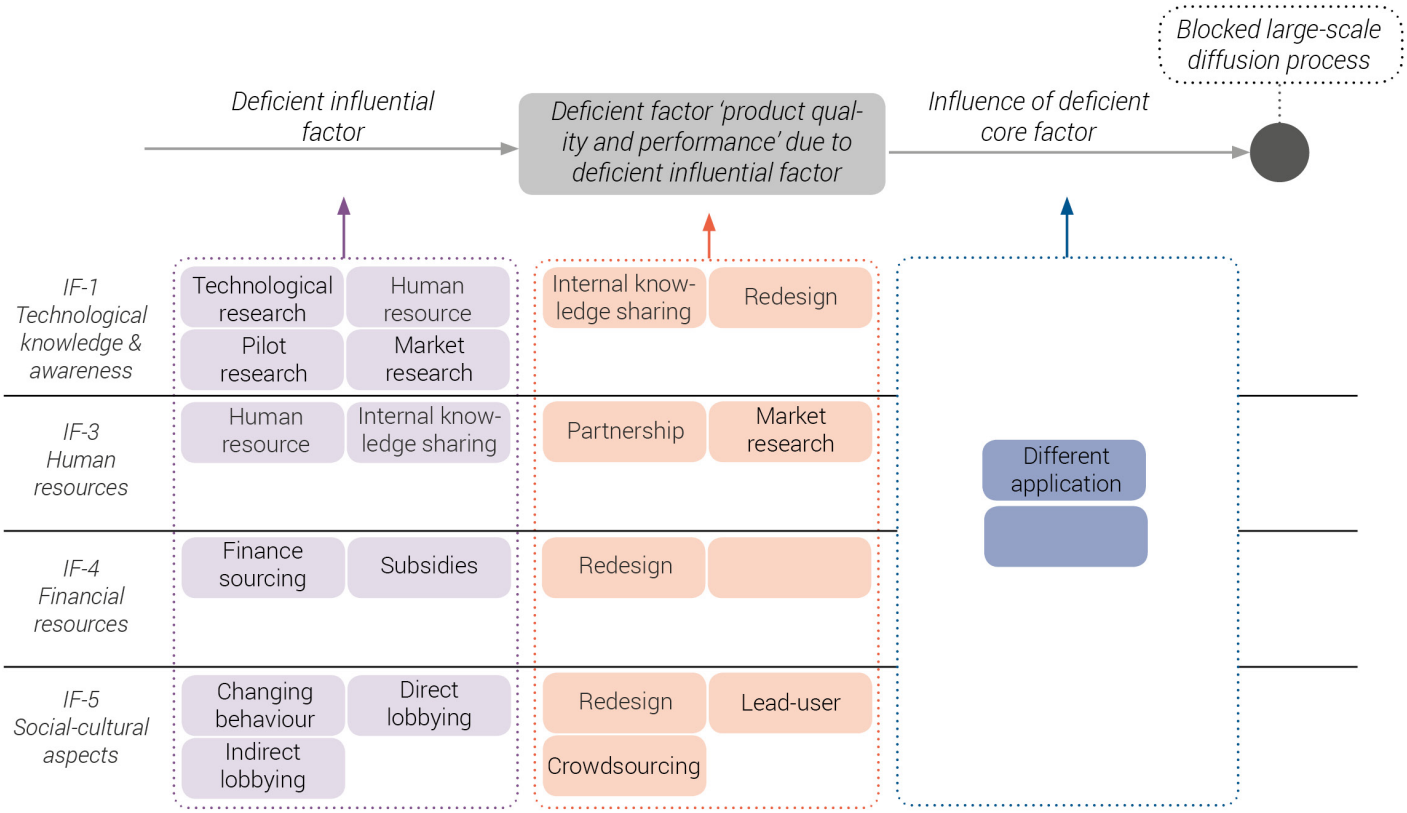


Figure 4.2: Overview of the strategies removing or circumventing the barriers related to core factor 1

4.2.2 Core factor 2: Product price

Step 1A: Original description of core factor

This factor relates to both the financial and non-financial investments involved in the usage and acquirement of the product. If these costs are exorbitant high, also in comparison to existing, comparable products, it can block the large-scale diffusion process. (Ortt & Kamp, 2019)

Step 1B: Barrier Identification

Four barriers have been identified, caused by four different influencing factors that all have a direct influence on the core factor 'product price':

IF1: Knowledge and awareness of technology

Barrier 2.1.1: *"A lack of knowledge and awareness of technology causes a high product price (in comparison to other comparable products."*

IF2: Knowledge and awareness of application and market

This influencing factor is assumed to be too external to have a direct influence on the core factor product price.

IF3: Natural and human resources

Barrier 2.3.1*: "Natural resources are lacking or expensive, causing a high product price (in comparison to other comparable products."*

IF4: Financial resources

Barrier 2.4.1: *"Financial resources are lacking, causing a high product price (in comparison to other comparable products."*

IF5: Socio-cultural aspects

This influencing factor is assumed to be too external to have a direct influence on the core factor product price.

IF6: Macro- and meso-economic, institutional and strategic aspects

This influencing factor is assumed to be too external to have a direct influence on the core factor product price.

IF7: Accidents and events

This influencing factor is assumed to be too external to have a direct influence on the core factor product price.

Step 2: Proposing Strategies

Tables 4.5 – 4.7 show the strategies that are proposed and/or found appropriate to be able to overcome the indicated barrier. 'A. Main purpose of strategy' describes the overall goal of the strategy; 'B. Proposed strategy' describes the strategy in detail by listing the actions that aim to realize the goal. These are based on logical reasoning, or, if a source is indicated, directly derived from literature. 'C. Name of proposed strategy' proposes a name that covers the content described in B. The last column 'Literature Support' indicates if the proposed relationship is confirmed by literature ('Yes'/'no'/'not found') and indicates the section in which the strategy and confirmation is elaborated.

Table 4.5: Proposing strategies to overcome barrier 2.1.1

IF1. Knowledge and awareness of technology			
2.1.1) "A lack of knowledge and awareness of technology causes a high product price (in comparison to other comparable products"			
A. Main purpose of strategy	**B. Proposed strategy**	**C. Name of proposed strategy**	*Literature support*
Type 1: *Eliminating the influence of the barrier on the diffusion of the innovation by changing the business model* – When the price of the product is high due to a lack of knowledge of the technology, a different business model can be adopted that aims to sell /lease the product for the high price	A strategy that entails selling the product to a niche market that has a higher financial status and can afford more.	Top-end strategy	Yes §5.2.23
	A strategy in which the product will be leased, so that the high costs will be spread over a certain time period.	Leasing strategy	Yes §5.2.19
	A strategy in which a sharing platform will be developed, which gives multiple users access to the same product. Users only use the product when they need to.	Sharing platform strategy	Yes §5.2.20

	anyway. Because of this, the barrier that will cause fewer customers to acquire it will be circumvented.	A strategy in which is applied for subsidies in the form of tax benefits for consumers. Because of this, the product has indirectly a lower price. *(Ortt et al., 2013)*	Subsidy[(B)] strategy	Yes §5.2.10
	Type 2: *Solving the problem related to the influencing factor by increasing the technological knowledge of the company* - by developing new technological knowledge so that the influencing factor does not negatively influence the price of the product.	A strategy can be adopted in which knowledge will be developed by technological research with a focus on improving engineering productivity, improving the efficiency of the production process or discovering possible savings on outsourced parts.	Technological research & develop strategy	Yes §5.2.1
		Adopting a strategy in which a pilot research will be performed can reveal technological issues in practice, since consumers and other stakeholders involved are able to deliver feedback.	Pilot research & develop Strategy	Yes §5.2.2
	Type 2: *Solving the barrier by removing the lack of knowledge and awareness of the company on technological principles* – by increasing the internal technological knowledge, the knowledge and awareness of existing technological principles will be increased, so that the influencing factor does not negatively influence the price of the product	A strategy in which new employees and/or interns are hired can increase the internal knowledge on technological principles the company was not aware of yet.	Human resource management strategy	Yes §5.2.4
		A strategy in which trade exhibitions and conferences are visited can increase the knowledge on the latest trends and innovations regarding the innovation. Furthermore, these can be visited to get familiar with the practices of the competitors in the industry. Because of this, the company is able to discover the main unfavourable differences in comparison with the competitors, in order to be able to reduce these differences.	Market research strategy	Not found §5.2.3
	Type 3 – *Solving the barrier by circumventing the influencing factor: Reducing the product price with the existing knowledge* – By doing so, the issues concerning the lack of technological knowledge can be circumvented	A strategy in which the product will be redesigned with a focus on producing a simpler and cheaper version of the application with the existing knowledge.	Redesign niche strategy	Yes §5.2.12

Table 4.6: Proposing strategies to overcome barrier 2.3.1

IF3. Natural and human resources			
2.3.1) "Natural resources are lacking or expensive, causing a high product price (in comparison to other comparable products"			
A. Main purpose of strategy	**B. Proposed strategy**	**C. Name of proposed strategy**	*Literature support*
Type 1: *Eliminating the influence of the barrier on the diffusion of the innovation by changing the business model* –a different business model can be adopted that aims to sell /lease the product for the high price anyway, circumventing the barrier that will cause less customers to acquire it.	A strategy that entails selling the product to a niche market that has a higher financial status and can afford more. *(Ortt et al., 2013)*	Top-end strategy	Yes §5.2.23
	A strategy in which the product will be leased, so that the high costs will be spread over a certain time period.	Leasing strategy	Yes §5.2.19
	A strategy in which a sharing platform will be developed, which gives multiple users access to the same product. Users only use the product when they need to.	Sharing platform strategy	Yes §5.2.20
	A strategy in which is applied for subsidies in the form	Subsidy[(B)] strategy	Yes

		of tax benefits for consumers. Because of this, the product has indirectly a lower price. *(Ortt et al., 2013)*		§5.2.10
	Type 2: *Solving the problem related to the influencing factor* - To solve the problem of lacking natural resources, there can be moved to another geographical location, and to overcome a high price of natural resources, the company can start an alliance to be able to acquire the resources in bulk.	A strategy that involves moving to another geographical location where the needed resources are available or where the natural resources are less expensive. *(Ortt et al., 2013)*	Geographical strategy	Yes §5.2.22
		A strategy in which together with another company natural resources can be acquired in bulk, making it less expensive to for the company.	Partnership strategy	Yes §5.2.24
	Type 3: *Adapting to the lack of natural resources - by u*sing different or less natural resources.	A strategy in which the product will be redesigned with cheaper or less natural resources so that the product can be sold cheaper.	Redesign strategy	Yes §5.2.12

Table 4.7: Proposing strategies to overcome barrier 2.4.1

IF4. Financial Resources			
2.4.1) "Financial resources are lacking, causing a high product price (in comparison to other comparable products"			
A. Main purpose of strategy	**B. Proposed strategy**	**C. Name of proposed strategy**	*Literature support*
Type 1 *Eliminating the influence of the barrier on the diffusion of the innovation by changing the business model* –a different business model can be adopted that aims to sell /lease the product for the high price anyway, circumventing the barrier that will cause less customers to acquire it.	A strategy that entails selling the product to a niche market that has a higher financial status and can afford more. *(Ortt et al., 2013)*	Top-end strategy	Yes §5.2.23
	A strategy in which the product will be leased, so that the high costs will be spread over a certain time period.	Leasing strategy	Yes §5.2.19
	A strategy in which a sharing platform will be developed, which gives multiple users access to the same product. Users only use the product when they need to.	Sharing platform strategy	Yes §5.2.20
	A strategy in which is applied for subsidies in the form of tax benefits for consumers. Because of this, the product has indirectly a lower price. *(Ortt et al., 2013)*	Subsidy(B) strategy	Yes §5.2.10
Type 2 - *Solving the problem related to the influencing factor by increasing financial resources* – this will remove the lack of financial resources that negatively influences the core factor	A strategy that aims to increase the financial resources by participating in competitions in order to win money; starting a crowd funding campaign; applying for a bank loan; or by getting involved in an incubator program.	Finance sourcing strategy	Yes §5.2.9
	A strategy that aims to increase the financial resources by applying for subsidies. *(Ortt et al., 2013)*	Subsidies(A) strategy	Yes §5.2.10
Type 3: *Reducing the product price with the existing financial resources* – By doing so, the lack of financial resources can be circumvented	A strategy in which the product will be redesigned with the aim to produce a simpler and cheaper version.	Redesign strategy	Yes §5.2.12

Overview results core factor 2

Figure 4.3 shows a summary of the tables 4.5 – 4.7. The colours correspond to the colours used in the tables, indicating the different type of strategies (purple type-2; orange type-3; blue type-1). The top of the image represents the barrier obstructing diffusion of the product. The first arrow represents the deficient influencing factor; since a deficiency within the core factor can have different origins, the influencing factors are individually indicated at the left of the figure. Per influencing factor, the strategies that can be adopted by companies for the particular core factor are shown. Since the type-2 (purple) strategies aim to remove the influencing factor, these are pointed towards the first arrow 'deficient influencing factor'. Because of this, the deficiency within the core factor will be removed and the barrier will thus be solved. The type-3 (orange) strategies aim to solve the deficiency within the core factor and are specific to the influencing factor; these strategies thus point towards the core factor. The type-1 (blue) strategies aim to circumvent the barrier and are specific to the core factor; that is why these point towards the last arrow and why these 'overrule' the different influencing factors that form deficiencies within the core factor; they can be adopted independent from which influencing factor caused the barrier. The empty boxes represent strategies that could not be reasoned yet. They are included empty based on the assumption that at least two different strategies per barrier and per type will exist.

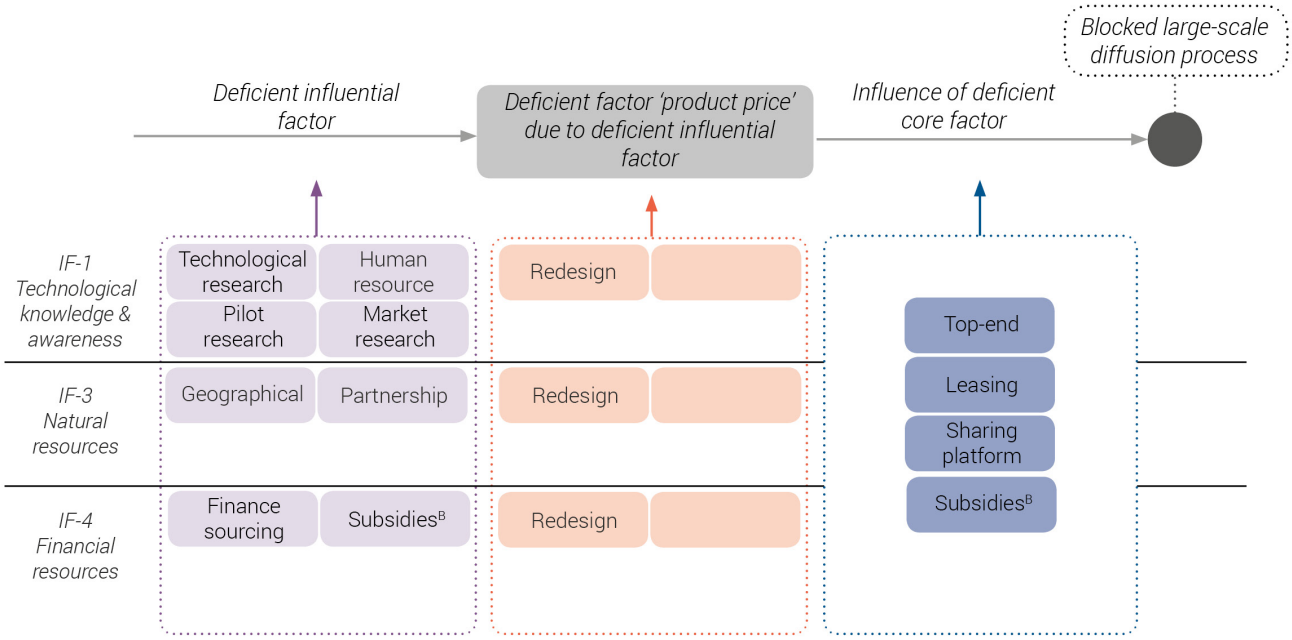


Figure 4.3: Overview of the strategies removing or circumventing the barriers related to core factor 2

4.2.3 Core factor 3: Production system

Step 1A: Original description of core factor

To enable large scale-diffusion, a production system that is able to produce the products on a large-scale with the desired quality should be in place. Defects or flaws in the production process or a missing production system can block large-scale diffusion. (Ortt & Kamp, 2019)

Step 1B: Barrier Identification

Three barriers have been identified, caused by three different influencing factors that all have a direct influence on the core factor 'production system'.

IF1: Knowledge and awareness of technology

Barrier 3.1.1*: "Knowledge and awareness of technology is lacking, influencing the availability of a production system that can produce large quantities of the products with a sufficiently good performance and quality."*

IF2: Knowledge and awareness of application and market

This factor has not a direct influence on the core factor production system.

IF3: Natural and human resources

Barrier 3.3.1*: "Human resources are lacking, influencing the availability of a production system that can produce can produce large quantities of the products with a sufficiently good performance and quality."*

IF4: Financial resources

Barrier 3.4.1: *"Financial resources are lacking, influencing the availability of a production system that can produce can produce large quantities of the products with a sufficiently good performance and quality."*

IF5: Socio-cultural aspects

This influencing factor is assumed to be too external to have a direct influence on the core factor production system.

IF6: Macro- and meso-economic, institutional and strategic aspects

This influencing factor is assumed to be too external to have a direct influence on the core factor production system.

IF7: Accidents and events

This influencing factor is assumed to be too external to have a direct influence on the core factor production system.

Step 2: Proposing Strategies

Tables 4.8 – 4.10 show the strategies that are proposed and/or found appropriate to be able to overcome the indicated barrier. 'A. Main purpose of strategy' describes the overall goal of the strategy; 'B. Proposed strategy' describes the strategy in detail by listing the actions that aim to realize the goal. These are based on logical reasoning, or, if a source is indicated, directly derived from literature. 'C. Name of proposed strategy' proposes a name that covers the content described in B. The last column 'Literature Support' indicates if the proposed relationship is confirmed by literature ('Yes'/'no'/'not found') and indicates the section in which the strategy and confirmation is elaborated.

Table 4.8: Proposing strategies to overcome barrier 3.1.1

IF1. Knowledge and awareness of technology				
3.1.1) "Knowledge and awareness of technology is lacking, influencing the availability of a production system that can produce large quantities of the products with a sufficiently good performance and quality"				
	A. Main purpose of strategy	**B. Proposed strategy**	**C. Name of proposed strategy**	*Literature support*
	Type 1: *Eliminating the influence of the barrier on the diffusion of the innovation* - by integrating the technology into a different application.	Adopting a strategy in which the technology is integrated into a different application. The barrier will thus still exist, but it gives the company time to optimise the production system of the concerning application.	Different application strategy	Yes §5.2.25
	Type 2: *Solving the barrier by removing the lack of knowledge and awareness of the company on technological principles* – by developing new technological	A strategy can be adopted in which technological knowledge will be developed by technological research so that the aspects of the production process that are not sufficiently developed can be improved.	Technological research & develop strategy	Yes §5.2.1
		Adopting a strategy in which a pilot research will be	Pilot research &	Yes

	knowledge so that the influencing factor does not negatively influence the production system of the product	performed can reveal technological issues in practice, since consumers and other stakeholders involved are able to deliver feedback.	develop Strategy	§5.2.2
	Type 2: *Solving the barrier by removing the lack of knowledge and awareness of the company on technological principles* – by increasing the internal technological knowledge, the knowledge and awareness of existing technological principles will be increased, so that the influencing factor does not negatively influence the production system of the product	A strategy in which new employees and/or interns are hired can increase the internal knowledge on technological principles the company was not aware of yet.	Human resource management strategy	Yes §5.2.4
		A strategy in which trade exhibitions and conferences are visited can increase the knowledge on the latest trends and innovations regarding the technology. Furthermore, they can be visited to get familiar with the practices of the competitors in the industry. Because of this, the company is able to discover the main unfavourable differences in comparison with the competitors, in order to be able to reduce these differences.	Market research strategy	Not found §5.2.3
	Type 3: Solving the barrier by changing the production process with the available knowledge – to circumvent the lack of technological knowledge but still produce a product with a sufficiently good performance and quality.	A strategy in which the product will be redesigned with the aim on producing a simpler and/or cheaper version of the application that can be produced with the existing knowledge of technology.	Redesign strategy	Yes §5.2.12
		A strategy that entails producing the same product but on a smaller scale for a higher price (which can be for example be producing it by hand, in order to guarantee a high product performance and quality), and selling the product to a niche market that has a higher financial status and can afford more. By producing on a smaller scale, the company can get more experienced with the technology, so that at a later stage the production can be up scaled. *(Ortt et al., 2013)*	Top-end strategy	Yes §5.2.23

Table 4.9: Proposing strategies to overcome barrier 3.3.1

IF3. Natural and human Resources				
3.3.1) "Human resources are lacking, influencing the availability of a production system that can produce large quantities of the products with a sufficiently good performance and quality"				
A. Main purpose of strategy		**B. Proposed strategy**	**C. Name of proposed strategy**	*Literature support*
	Type 1: *Eliminating the influence of the barrier on the diffusion of the innovation* - by integrating the technology into a different application.	Adopting a strategy in which the technology is integrated into a different application. The barrier will thus still exist, but it gives the company time to optimise the production system of the concerning application.	Different application strategy	Yes §5.2.25
	Type 2: *Solving the problem related to the influencing factor* - Increasing the amount of human resources with appropriate knowledge and competences, or increasing the competences of the human resources	A strategy can be adopted in which new employees and/or interns are hired with the aim to increase the knowledge and competences, so that the product performance and quality can increase.	Human resource management strategy	Yes §5.2.4
		A strategy in which internal training, courses and brainstorm sessions are performed. Sharing the available internal knowledge within the company increases the capacity of the company to find new solutions to problems with the existing knowledge and increases the competences of the human resources.	Internal knowledge sharing strategy	Yes §5.2.6

	Type 3: *Adapting to a lack of human resources with appropriate knowledge and competences* - increasing the quality or availability of a production system with the help of external resources.	Circumventing the lack of available human resources with appropriate knowledge and competences by starting a partnership, or by acquiring the knowledge, so that appropriate knowledge and competences are made available to increase the quality or availability of a production system.	Partnership strategy	Not found §5.2.24

Table 4.10: Proposing strategies to overcome barrier 3.4.1

IF4. Financial Resources				
3.4.1) "Financial resources are lacking, influencing the availability of a production system that can produce large quantities of the products with a sufficiently good performance and quality"				
A. Main purpose of strategy		**B. Proposed strategy**	**C. Name of proposed strategy**	*Literature support*
	Type 1: *Eliminating the influence of the barrier on the diffusion of the innovation* - by integrating the technology into a different application.	Adopting a strategy in which the technology is integrated into a different application. The barrier will thus still exist, but it gives the company time to optimise the production system of the concerning application.	Different application strategy	Yes §5.2.25
	Type 2 - *Solving the problem related to the influencing factor by increasing financial resources* – this will remove the lack of financial resources that negatively influences the core factor	A strategy that aims to increase the financial resources by participating in competitions in order to win money; starting a crowd funding campaign; applying for a bank loan; or by getting involved in an incubator program.	Finance sourcing strategy	Yes §5.2.9
		A strategy that aims to increase the financial resources by applying for subsidies. *(Ortt et al., 2013)*	Subsidies[(A)] strategy	Yes §5.2.10
	Type 3: Solving the barrier by changing the production process with the available knowledge – to circumvent the lack of financial resources but still produce a product with a sufficiently good performance and quality.	A strategy in which the product will be redesigned with the aim on producing a simpler and/or cheaper version of the application that can be produced with the existing financial resources.	Redesign strategy	Yes §5.2.12
		A strategy that entails producing the same product but on a smaller scale for a higher price (which can be for example be producing it by hand, in order to guarantee a high product performance and quality), and selling the product to a niche market that has a higher financial status and can afford more. *(Ortt et al., 2013)*	Top-end strategy	Yes §5.2.23

Overview results core factor 3

Figure 4.4 shows a summary of the tables 4.8 – 4.10. The colours correspond to the colours used in the tables, indicating the different type of strategies (purple type-2; orange type-3; blue type-1). The top of the image represents the barrier obstructing diffusion of the product. The first arrow represents the deficient influencing factor; since a deficiency within the core factor can have different origins, the influencing factors are individually indicated at the left of the figure. Per influencing factor, the strategies that can be adopted by companies for the particular core factor are shown. Since the type-2 (purple) strategies aim to remove the influencing factor, these are pointed towards the first arrow 'deficient influencing factor'. Because of this, the deficiency within the core factor will be removed and the barrier will thus be solved. The type-3 (orange) strategies aim to solve the deficiency within the core factor and are specific to the influencing factor; these strategies thus point towards the core factor. The type-1 (blue) strategies aim to circumvent the barrier and are

specific to the core factor; that is why these point towards the last arrow and why these 'overrule' the different influencing factors that form deficiencies within the core factor; they can be adopted independent from which influencing factor caused the barrier. The empty boxes represent strategies that could not be reasoned yet. They are included empty based on the assumption that at least two different strategies per barrier and per type will exist.

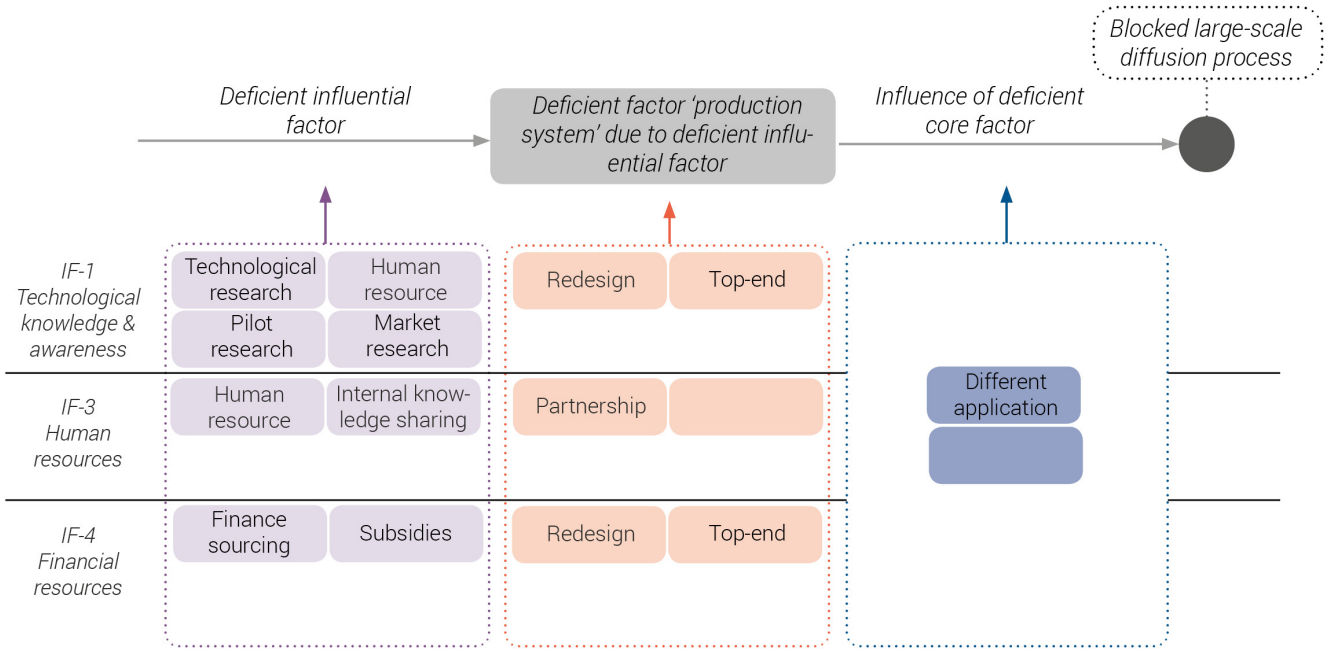


Figure 4.4: Overview of the strategies removing or circumventing the barriers related to core factor 3

4.2.4 Core factor 4: Complementary products and services

Step 1A: Original description of core factor

This factor refers to the availability and price of the complementary products and services that are needed over the life-time (all activities from development to end-of-life) of the product. Absence, incompatibility or high prices of complementary products and services or of parts of these systems can block large-scale diffusion. (Ortt & Kamp, 2019)

Step 1B: Barrier Identification

Four barriers have been identified, caused by four different influencing factors that all have a direct influence on the core factor 'complementary products and services.

IF1: Knowledge and awareness of technology

Barrier 4.1.1: *"Knowledge and awareness of technology is lacking, affecting the availability and quality of the complementary products and services."*

IF2: Knowledge and awareness of application and market

This influencing factor is assumed to not have a direct influence on the core factor complementary products and services.

IF3: Natural and human resources

Barrier 4.3.1: *"Natural resources are lacking, affecting the availability and quality of the complementary products and services."*

IF4: Financial resources

Barrier 4.4.1*: "Financial resources are lacking, affecting the availability and quality of the complementary products and services."*

IF5: Socio-cultural aspects

This influencing factor is assumed to be too external to have a direct influence on the core factor complementary products and services

IF6: Macro- and meso-economic, institutional and strategic aspects

Barrier 4.6.1: *"Macro- and meso-economic, institutional and strategic aspects are unfavourable, affecting the availability and quality of the complementary products and services."*

IF7: Accidents and events

This influencing factor is assumed to be too external to have a direct influence on the core factor complementary products and services.

Step 2: Proposing Strategies

Tables 4.11 – 4.14 show the strategies that are proposed and/or found appropriate to be able to overcome the indicated barrier. 'A. Main purpose of strategy' describes the overall goal of the strategy; 'B. Proposed strategy' describes the strategy in detail by listing the actions that aim to realize the goal. These are based on logical reasoning, or, if a source is indicated, directly derived from literature. 'C. Name of proposed strategy' proposes a name that covers the content described in B. The last column 'Literature Support' indicates if the proposed relationship is confirmed by literature ('Yes'/'no'/'not found') and indicates the section in which the strategy and confirmation is elaborated.

Table 4.11: Proposing strategies to overcome barrier 4.1.1

IF1. Knowledge and awareness of technology			
4.1.1) "Knowledge and awareness of technology is lacking, affecting the availability and quality of the complementary products and services"			
A. Main purpose of strategy	**B. Proposed strategy**	**C. Name of proposed strategy**	*Literature support*
Type 1: *Eliminating the influence of the barrier on the diffusion of the innovation* – by circumventing the use of a new external system of complementary products and service	A strategy in which the product is combined with an existing product, so that the system of complementary products and services of that product can be used until the system of complementary products and systems required for the new product is available. *(Ortt et al., 2013)*	Hybridization strategy	Yes §5.2.15
	A strategy in which an adaptor is designed, which makes the product compatible with an existing system of complementary products and services. *(Ortt et al., 2013)*	Adaptor strategy	Yes §5.2.16
Type 2: *Solving the barrier by removing the lack of knowledge and awareness of the company on technological principles* – by developing new technological knowledge so that the influencing factor does not negatively influence the core factor	A strategy can be adopted in which technological knowledge will be developed by technological research so that the aspects of complementary products and services that are not sufficiently developed or that are not available can be improved or be made available.	Technological research & Develop strategy	Yes §5.2.1
	Adopting a strategy in which a pilot research will be performed can reveal technological issues in practice, since consumers and other stakeholders involved are able to deliver feedback.	Pilot Research & Develop Strategy	Yes §5.2.2
Type 2: *Solving the barrier by removing the lack of knowledge and awareness of the company on technological principles* – by increasing the internal technological knowledge, the knowledge and awareness of existing technological principles will be increased, so that the influencing factor does not	A strategy in which new employees and/or interns are hired can increase the internal knowledge on technological principles the company was not aware of yet.	Human resource management strategy	Yes §5.2.4
	A strategy in which trade exhibitions and conferences are visited can increase the knowledge on the latest trends and innovations regarding the technology. Furthermore, they can be visited to get familiar with the practices of the competitors in the industry. Because of this, the company can discover the main unfavourable	Market research strategy	Not found §5.2.3

	negatively influence the core factor	differences in comparison with the competitors, in order to be able to reduce these differences.		
	<u>*Type 3:*</u> *Solving the deficiency within the core factor by adapting to the influencing factor* – Redesigning the product or the infrastructure of complementary products and services so that it adapts to the influencing factor	A strategy in which a stand-alone version of the product is developed so that the core factor, a lacking infrastructure of complementary products and services, is solved, because it is not required anymore. *(Ortt et al., 2013)*	Stand-alone strategy	Yes §5.2.13
		A strategy in which a new, separate system of complementary products and services is designed with the existing technological knowledge. *(Ortt et al., 2013)*	Dedicated strategy	Yes §5.2.14

Table 4.12: Proposing strategies to overcome barrier 4.3.1

IF3. Natural and human resources			
4.3.1) "Natural resources are lacking or very expensive, affecting the availability and quality of the complementary products and services"			
A. Main purpose of strategy	**B. Proposed strategy**	**C. Name of proposed strategy**	*Literature support*
<u>Type 1:</u> *Eliminating the influence of the barrier on the diffusion of the innovation* – by circumventing the use of a new external system of complementary products and service	A strategy in which the product is combined with an existing product, so that the system of complementary products and services of that product can be used until the system of complementary products and systems required for the new product is available. *(Ortt et al., 2013)*	Hybridization strategy	Yes §5.2.15
	A strategy in which an adaptor is designed, which makes the product compatible with an existing system of complementary products and services. *(Ortt et al., 2013)*	Adaptor strategy	Yes §5.2.16
<u>Type 2:</u> *Solving the problem related to the influencing factor* - To solve the problem of lacking natural resources, there can be moved to another geographical location, and to overcome a high price of natural resources, the company can start an alliance to be able to acquire the resources in bulk.	A strategy that involves moving to another geographical location where the needed resources are available or where the natural resources are less expensive. *(Ortt et al., 2013)*	Geographical strategy	Yes §5.2.23
	A strategy in which together with another company natural resources can be acquired in bulk, making it less expensive to for the company.	Partnership strategy	Yes §5.2.24
<u>*Type 3:*</u> *Solving the deficiency within the core factor by adapting to the influencing factor* – Redesigning the product or the infrastructure of complementary products and services so that it adapts to the influencing factor	A strategy in which a stand-alone version of the product is developed so that the core factor, a lacking infrastructure of complementary products and services, is solved, because it is not required anymore. *(Ortt et al., 2013)*	Stand-alone strategy	Not found §5.2.13
	Decreasing use of natural resources by adopting a strategy in which a new, separate system of complementary products and services is designed with the available (or different) natural resources.	Dedicated strategy	Not found §5.2.14

Table 4.13: Proposing strategies to overcome barrier 4.4.1

IF4. Financial Resources			
4.4.1) "Financial resources are lacking, affecting the availability and quality of the complementary products and services"			
A. Main purpose of strategy	**B. Proposed strategy**	**C. Name of proposed strategy**	*Literature support*
Type 1: *Eliminating the influence of the barrier on the diffusion of the innovation* – by circumventing the use of a new external system of complementary products and service	A strategy in which the product is combined with an existing product, so that the system of complementary products and services of that product can be used until the system of complementary products and systems required for the new product is available. *(Ortt et al., 2013)*	Hybridization strategy	Yes §5.2.15
	A strategy in which an adaptor is designed, which makes the product compatible with an existing system of complementary products and services. *(Ortt et al., 2013)*	Adaptor strategy	Yes §5.2.16
Type 2 - *Solving the problem related to the influencing factor by increasing financial resources* – this will remove the lack of financial resources that negatively influences the core factor	A strategy that aims to increase the financial resources by participating in competitions in order to win money; starting a crowd funding campaign; applying for a bank loan; or by getting involved in an incubator program.	Finance sourcing strategy	Yes §5.2.9
	A strategy that aims to increase the financial resources by applying for subsidies. *(Ortt et al., 2013)*	Subsidies[(A)] strategy	Yes §5.2.10
Type 3: Solving the deficiency within the core factor by adapting to the influencing factor – Redesigning the product or the infrastructure of complementary products and services so that it adapts to the influencing factor	A strategy in which a stand-alone version of the product is developed so that an external system of complementary products and services is not required, which decreases the need of financial resources. *(Ortt et al., 2013)*	Stand-alone strategy	Not found §5.2.13
	Adopting a strategy in which a new, separate system of complementary products and services is designed within the amount of financial resources available. *(Ortt et al., 2013)*	Dedicated strategy	Not found §5.2.14

Table 4.14: Proposing strategies to overcome barrier 4.6.1

IF6. Macro- and meso-economic, institutional and strategic aspects			
4.6.1) "Macro- and meso- economic, institutional and strategic aspects affect the availability and quality of the complementary products and services"			
A. Main purpose of strategy	**B. Proposed strategy**	**C. Name of proposed strategy**	*Literature support*
Type 1: *Eliminating the influence of the barrier on the diffusion of the innovation* – by circumventing the use of a new external system of complementary products and service	A strategy in which the product is combined with an existing product, so that the system of complementary products and services of that product can be used until the system of complementary products and systems required for the new product is available. *(Ortt et al., 2013)*	Hybridization strategy	Yes §5.2.15
	A strategy in which an adaptor is designed, which makes the product compatible with an existing system of complementary products and services. *(Ortt et al., 2013)*	Adaptor strategy	Yes §5.2.16

	Type 2: *Changing the aspects in favour of the innovation* – in order to decrease the negative influence on the availability of network formation and coordination	Adopting a strategy that aims to directly influence the institutions in order to raise awareness on the unfavourable aspects and on the inhibiting influence of these aspects on the diffusion of the innovation.	Direct lobbying strategy	Yes §5.2.17
		Adopting a strategy that aims to change the behaviour of the actors. For example, an influencer (Company/person acting as an example) can be used to gradually change the methods, habits, norms and values among the actors in the (desired) network.	Changing behaviour strategy	Not found §5.2.11
	Type 3: Avoiding or decreasing the use of a new external system of complementary products and services – circumventing the barrier by reducing the dependency on complementary products or services.	A strategy in which a stand-alone version of the product is developed so that an external system of complementary products and services is not required, which decreases the importance of the influence of the unfavourable aspects. *(Ortt et al., 2013)*	Stand-alone strategy	Not found §5.2.13
		Adopting a strategy in which a new, separate system of complementary products and services is designed within the amount of financial resources. *(Ortt et al., 2013)*	Dedicated strategy	Not found §5.2.14

Overview results core factor 4

Figure 4.5 shows a summary of the tables 4.11 – 4.14 above. The colours correspond to the colours used in the tables, indicating the different type of strategies (purple type-2; orange type-3; blue type-1). The top of the image represents the barrier obstructing diffusion of the product. The first arrow represents the deficient influencing factor; since a deficiency within the core factor can have different origins, the influencing factors are individually indicated at the left of the figure. Per influencing factor, the strategies that can be adopted by companies for the particular core factor are shown. Since the type-2 (purple) strategies aim to remove the influencing factor, these are pointed towards the first arrow 'deficient influencing factor'. Because of this, the deficiency within the core factor will be removed and the barrier will thus be solved. (Text continues after figure 4.5)

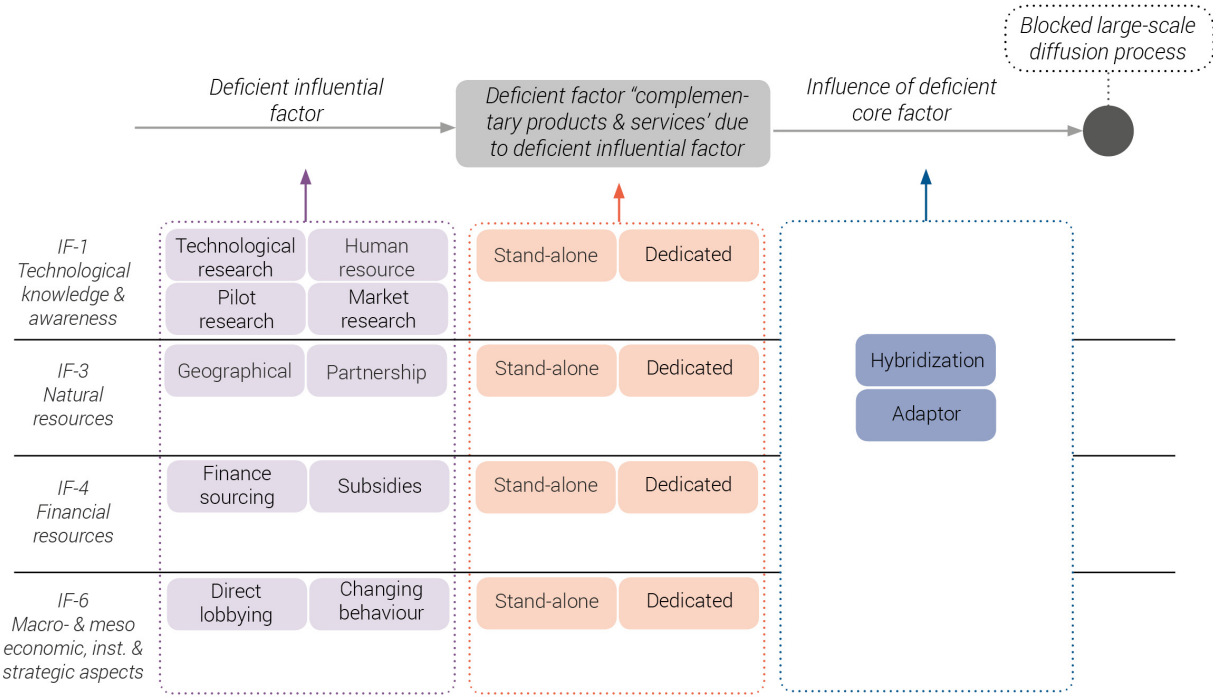


Figure 4.5: Overview of the strategies removing or circumventing the barriers related to core factor 4

The type-3 (orange) strategies aim to solve the deficiency within the core factor and are specific to the influencing factor; these strategies thus point towards the core factor. The type-1 (blue) strategies aim to circumvent the barrier and are specific to the core factor; that is why these point towards the last arrow and why these 'overrule' the different influencing factors that form deficiencies within the core factor; they can be adopted independent from which influencing factor caused the barrier. The empty boxes represent strategies that could not be reasoned yet. They are included empty based on the assumption that at least two different strategies per barrier and per type will exist.

4.2.5 Core factor 5: Network formation and coordination

Step 1A: Original description of core factor
Network formation and coordination refers to the presence and coordination of necessary actors in the supply network. Lacking actors or lacking coordination between the actors within the network can block large-scale diffusion of the product. (Ortt & Kamp, 2019)

Step 1B: Barrier Identification
Five barriers have been identified, caused by five different influencing factors that all have a direct influence on the core factor 'network formation and coordination.

IF1: Knowledge and awareness of technology

Barrier 5.1.1: *"Knowledge and awareness of technology is missing, affecting the network formation and coordination."*

IF2: Knowledge and awareness of application and market

Barrier 5.2.1: *"Knowledge and awareness of application and market is missing, affecting the network formation and coordination."*

IF3: Natural and human resources

This influencing factor is assumed not to have a direct influence on the core factor network formation and coordination

IF4: Financial resources

This influencing factor is assumed not to have a direct influence on the core factor network formation and coordination

IF5: Socio-cultural aspects

Barrier 5.5.1: *"Socio-cultural aspects affect the availability of network formation and coordination."*

IF6: Macro- and meso-economic, institutional and strategic aspects

Barrier 5.6.1: *"Macro- and meso-economic, institutional and strategic aspects affect network formation and coordination."*

IF7: Accidents and events

Barrier 5.7.1: *"The presence of or risks on accidents and events can hamper the availability of network formation and coordination."*

Step 2: Proposing Strategies
Tables 4.15 – 4.19 show the strategies that are proposed and/or found appropriate to be able to overcome the indicated barrier. 'A. Main purpose of strategy' describes the overall goal of the strategy; 'B. Proposed strategy' describes the strategy in detail by listing the actions that aim to realize the goal. These are based on logical reasoning, or, if a source is indicated, directly derived from literature. 'C. Name of proposed strategy' proposes a name that covers the content described in B. The last column 'Literature Support' indicates if the proposed relationship is confirmed by literature ('Yes'/'no'/'not found') and indicates the section in which the strategy and confirmation is elaborated.

Table 4.15: Proposing strategies to overcome barrier 5.1.1

IF1. Knowledge and awareness of technology			
5.1.1) "Knowledge and awareness of technology is missing, affecting the network formation and coordination"			
A. Main purpose of strategy	**B. Proposed strategy**	**C. Name of proposed strategy**	*Literature support*
Type 1: *Eliminating the influence of the barrier on the diffusion of the innovation* – The barrier will still exist, but the strategy will make a network available by means of different measures.	A strategy that involves moving to another industry or to other geographical location where network formation and coordination are not affected by the missing knowledge and awareness. *(Ortt et al., 2013)*	Geographical strategy	Yes §5.2.22
	Adopting a strategy in which a partnership is established with another company that has access to a well-developed network of actors, which can be used until a more appropriate network is formed.	Partnership strategy	Not found §5.2.24
Type 2: *Solving the barrier by removing the lack of knowledge and awareness of the company on technological principles* – by developing new technological knowledge so that the influencing factor does not negatively influence the core factor	A strategy can be adopted in which technological knowledge will be developed by technological research so that it won't affect the network formation and coordination.	Technological research & develop strategy	Yes §5.2.1
	Adopting a strategy in which a pilot research will be performed can reveal technological issues in practice, since consumers and other stakeholders involved are able to deliver feedback.	Pilot research & develop Strategy	Yes §5.2.2
Type 2: *Solving the barrier by removing the lack of knowledge and awareness of the company on technological principles* – by increasing the internal technological knowledge, the knowledge and awareness of existing technological principles will be increased, so that the influencing factor does not negatively influence the core factor	A strategy in which new employees and/or interns are hired can increase the internal knowledge on technological principles the company was not aware of yet.	Human resource management strategy	Yes §5.2.4
	A strategy in which trade exhibitions and conferences are visited can increase the knowledge on the latest trends and innovations regarding the technology. Furthermore, these can be visited to get familiar with the practices of the competitors in the industry. Because of this, the company is able to discover the main unfavourable differences in comparison with the competitors, in order to be able to reduce these differences.	Market research strategy	Not found §5.2.3
Type 3: Solving the deficiency within the core factor by adapting to the influencing factor – Sharing the available knowledge on the technology within the network of stakeholders will increase their knowledge and awareness of technology. The barrier will be removed.	Adopting a strategy in which knowledge is shared by means of workshops, networking and brokering events, presentations, reports, debates and round tables. *(Ortt et al., 2013)*	Education strategy	Yes §5.2.5
	A strategy in which the product will be redesigned with the aim of improving the use cues of the product so that actors in the network will understand the use and purpose of the product more easily.	Redesign strategy	Yes §5.2.12

Table 4.16: Proposing strategies to overcome barrier 5.2.1

IF2. Knowledge and awareness of application and market				
5.2.1) "Knowledge and awareness of application and market is missing, affecting the network formation and coordination"				
	A. Main purpose of strategy	**B. Proposed strategy**	**C. Name of proposed strategy**	*Literature support*
	Type 1: *Eliminating the influence of the barrier on the diffusion of the innovation* – The barrier will still exist, but the strategy will make a network available by means of different measures.	A strategy that involves moving to another industry or to other geographical location where network formation and coordination are not affected by the missing knowledge and awareness. *(Ortt et al., 2013)*	Geographical strategy	Yes §5.2.22
		Adopting a strategy in which a partnership is established with another company that has access to a well-developed network of actors, which can be used until a more appropriate network is formed.	Partnership strategy	Not found §5.2.24
	Type 2: Solving the barrier by removing the lack of knowledge and awareness of the company on the market and the application - By increasing the company's knowledge on market and application, the deficiency in the influencing factor is solved.	A strategy in which together with an lead-user the product is further developed so that it will comply to the needs and wishes of the market. *(Ortt et al., 2013)*	Lead-user strategy	Yes §5.2.7
		A strategy in which the public is used to generate ideas in order to help develop the innovation further and the knowledge and awareness of application and market is increased.	Crowd sourcing strategy	Yes §5.2.8
		A strategy in which research is performed in order to increase the market knowledge of the company. The strategy aims to, for example, determine the most promising market segments, to determine the most promising network actors, the competitors etc.	Market research strategy	Yes §5.2.3
		A strategy in which the product is tested by means of a pilot research will show the company how customers and other actors use the product. It will reveal the user and other actors their preferences for the product.	Pilot research & develop strategy	Yes §5.2.2
	Type 3: Solving the deficiency within the core factor by adapting to the influencing factor – Sharing the available knowledge on the market and application within the network of stakeholders will increase their knowledge and awareness. Furthermore it is possible to raise their awareness by using an influencer. The barrier will be removed.	Adopting a strategy in which knowledge is shared by means of workshops, networking and brokering events, presentations, reports, debates and round tables. *(Ortt et al., 2013)*	Education strategy	Yes §5.2.5
		Adopting a strategy in which a pilot research will be performed in order to show potential stakeholders the benefits and use of the product.	Pilot project strategy	Yes §5.2.2
		Adopting a strategy that aims to change the behaviour of the actors. For example, an influencer (Company/person acting as an example) can be used to gradually change the methods, habits, norms and values among the actors in the (desired) network.	Changing behaviour strategy	Yes §5.2.11

Table 4.17: Proposing strategies to overcome barrier 5.5.1

IF5. Socio-cultural aspects			
5.5.1) "Socio-cultural aspects affect the availability of network formation and coordination"			
A. Main purpose of strategy	**B. Proposed strategy**	**C. Name of proposed strategy**	*Literature support*
Type 1: *Eliminating the influence of the barrier on the diffusion of the innovation* – The barrier will still exist, but the strategy will make a network available by means of different measures.	A strategy that involves moving to another industry or to other geographical location where there are stimulating socio-cultural aspects, and where network formation and coordination are not affected by these aspects. *(Ortt et al., 2013)*	Geographical strategy	Yes §5.2.22
	Adopting a strategy in which a partnership is established with another company that has access to a well-developed network of actors, which can be used until a more appropriate network is formed.	Partnership strategy	Not found §5.2.24
Type 2: *Changing the aspects in favour of the innovation* – in order to decrease the negative influence on the availability of network formation and coordination	Adopting a strategy that aims to change the behaviour of the actors. For example, an influencer (Company/person acting as an example) can be used to gradually change the methods, habits, norms and values among the actors in the (desired) network.	Changing behaviour strategy	Not found §5.2.11
	Adopting a strategy that aims to directly influence the institutions that create laws that can force people to change their norms and values.	Direct lobbying	Yes §5.2.17
	A strategy in which NGO's, the public or media is used to raise awareness on the negative influence of the existing norms and values and that emphasize on the importance of different norms and values.	Indirect lobbying	Yes §5.2.17
Type 3: Solving the deficiency within the core factor by adapting to the influencing factor - By adapting to the socio-cultural aspects, the network formation and coordination will not be hampered	A strategy in which the product will be redesigned with a focus on adapting to the socio-cultural environment.	Redesign strategy	Yes §5.2.12
	A strategy in which together with a lead-user the product is further developed so that it will comply to the needs and wishes of the market. *(Ortt et al., 2013)*	Lead-user strategy	Yes §5.2.7

Table 4.18: Proposing strategies to overcome barrier 5.6.1

IF6. Macro- and meso-economic, institutional and strategic aspects			
5.6.1) "Macro- and meso-economic, institutional and strategic aspects affect the availability of network formation and coordination"			
A. Main purpose of strategy	**B. Proposed strategy**	**C. Name of proposed strategy**	*Literature support*
Type 1: *Eliminating the influence of the barrier on the diffusion of the innovation* – The barrier will still exist, but the strategy will make a network available by means of different measures.	A strategy that involves moving to another industry or to other geographical location where network formation and coordination are not affected by the unfavourable aspects. *(Ortt et al., 2013)*	Geographical strategy	Yes §5.2.22
	Adopting a strategy in which a partnership is established with another company that has access to a well-developed network of actors, which can be used until a more appropriate network is formed.	Partnership strategy	Not found §5.2.24

	Type 2: *Changing the aspects in favour of the innovation* – in order to decrease the negative influence on the availability of network formation and coordination	Adopting a strategy that aims to directly influence the institutions in order to raise awareness on the unfavourable aspects and on the inhibiting influence of these aspects on the diffusion of the innovation.	Direct lobbying strategy	Yes §5.2.17
		Adopting a strategy that aims to change the behaviour of the actors. For example, an influencer (Company/person acting as an example) can be used to gradually change the methods, habits, norms and values among the actors in the (desired) network.	Changing behaviour strategy	Not found §5.2.11
	Type 3: Solving the deficiency within the core factor by adapting to the influencing factor - By adapting to the state of the available aspects, the network formation and coordination will not be hampered	A strategy in which together with a lead-user the product is further developed so that the product and the business practices of the company will comply to the aspects available in the market. *(Ortt et al., 2013)*	Lead-user strategy	Yes §5.2.7

Table 4.19: Proposing strategies to overcome barrier 5.7.1

IF7. Accidents and events				
5.7.1) "The presence of or risks on accidents and events can hamper network formation and coordination"				
A. Main purpose of strategy		**B. Proposed strategy**	**C. Name of proposed strategy**	*Literature support*
	Type 1: *Eliminating the influence of the barrier on the diffusion of the innovation* – The barrier will still exist, but the strategy will make a network available by means of different measures.	A strategy that involves moving to another industry or to other geographical location where the network formation and coordination is not hampered by the presence of or risks on accidents and events. *(Ortt et al., 2013)*	Geographical strategy	Yes §5.2.22
		Adopting a strategy in which a partnership is established with another company that has access to a well-developed network of actors, which can be used until a more appropriate network is formed.	Partnership strategy	Not found §5.2.24
	Type 2: *Solving the barrier by removing the presence of or risks on accidents and events.*	*No strategies could be reasoned within the ability of companies to completely remove the presence or risks on accidents and events; the factor is too external. It is not possible to solve or remove the risk (only to circumvent it)*		
	Type 3: Solving the deficiency within the core factor by adapting to the influencing factor.	*I could not come up with strategies by means of logical reasoning that complies to the aim described.*		

Overview results core factor 5

Figure 4.6 shows a summary of the tables 4.15 – 4.19. The colours correspond to the colours used in the tables, indicating the different type of strategies (purple type-2; orange type-3; blue type-1). The top of the image represents the barrier obstructing diffusion of the product. The first arrow represents the deficient influencing factor; since a deficiency within the core factor can have different origins, the influencing factors are individually indicated at the left of the figure. Per influencing factor, the strategies that can be adopted by companies for the particular core factor are shown. Since the type-2 (purple) strategies aim to remove the influencing factor, these are pointed towards the first arrow 'deficient influencing factor'. Because of this, the deficiency within the core

factor will be removed and the barrier will thus be solved. The type-3 (orange) strategies aim to solve the deficiency within the core factor and are specific to the influencing factor; these strategies thus point towards the core factor. The type-1 (blue) strategies aim to circumvent the barrier and are specific to the core factor; that is why these point towards the last arrow and why these 'overrule' the different influencing factors that form deficiencies within the core factor; they can be adopted independent from which influencing factor caused the barrier. The empty boxes represent strategies that could not be reasoned yet. They are included empty based on the assumption that at least two different strategies per barrier and per type will exist.

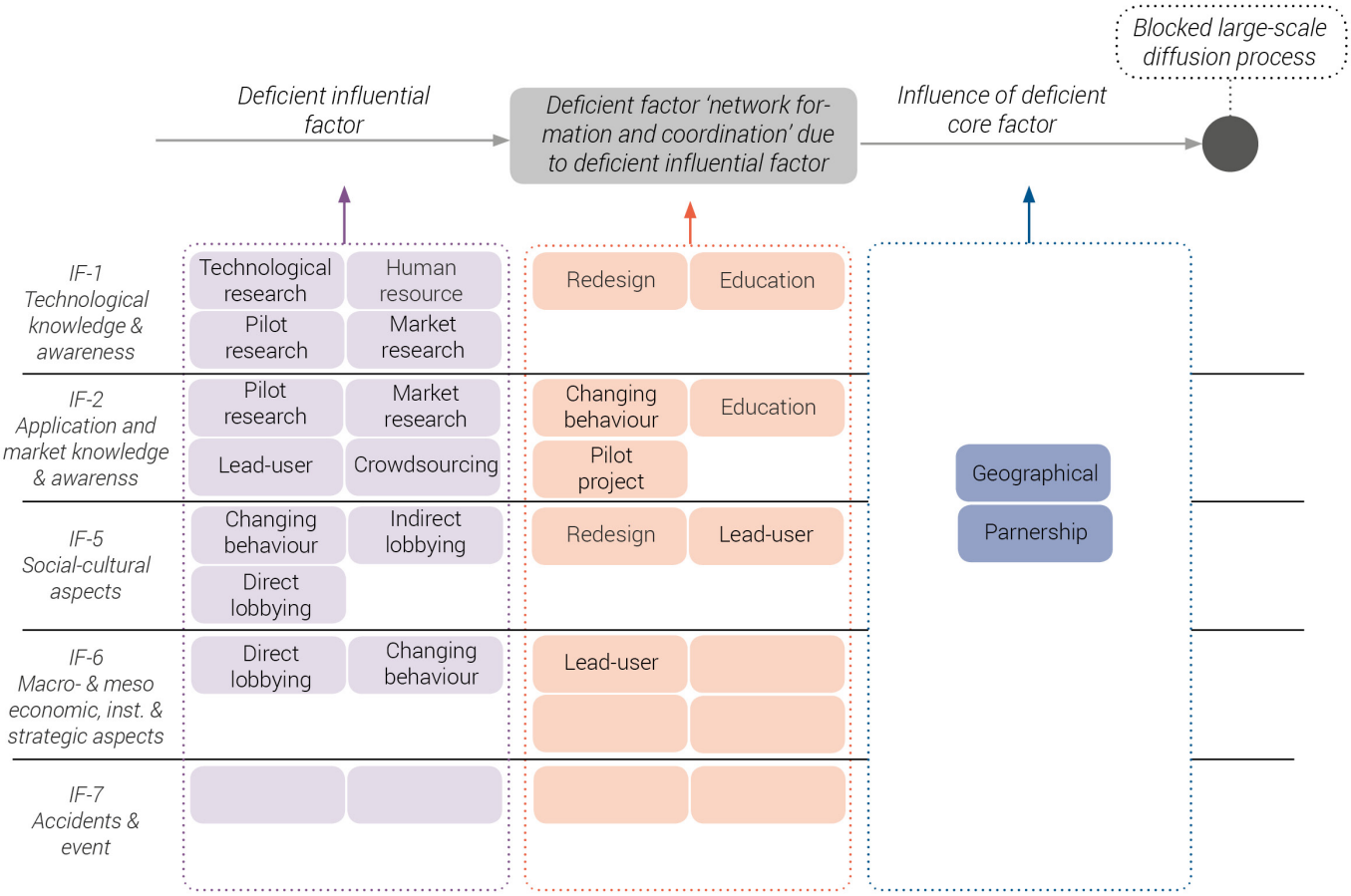


Figure 4.6: Overview of the strategies removing or circumventing the barriers related to core factor 5

4.2.6 Core factor 6: Customers

Step 1A: Original description of core factor

To enable large-scale diffusion, a customer base is required that should comprehend the product and its use and that are able and wiling to acquire and use the product. A lacking customer base can block the large-scale diffusion process. (Ortt & Kamp, 2019)

Step 1B: Barrier Identification

Six barriers have been identified, caused by six different influencing factors that all have a direct influence on the core factor 'customers':

IF1: Knowledge and awareness of technology

Barrier 6.1.1: *"A lack of knowledge and awareness of technology affects the availability of customers."*

IF2: Knowledge and awareness of application and market

Barrier 6.2.1: *"A lack of knowledge and awareness of application and market affects the availability of customers."*

IF3: Natural and human resources

This influencing factor is assumed not to have a direct influence on the core factor customers.

IF4: Financial resources

Barrier 6.4.1: *"A lack of financial resources affects the availability of customers."*

IF5: Socio-cultural aspects

Barrier 6.5.1: *"Socio-cultural aspects affect the availability of customers."*

IF6: Macro- and meso-economic, institutional and strategic aspects

Barrier 6.6.1: *"Macro- and meso-economic, institutional and strategic aspects affect the availability of customers."*

IF7: Accidents and events

Barrier 6.7.1: *"The presence of or risks on accidents and events can hamper the availability of customers."*

Step 2: Proposing Strategies

Tables 4.20 – 4.25 show the strategies that are proposed and/or found appropriate to be able to overcome the indicated barrier. 'A. Main purpose of strategy' describes the overall goal of the strategy; 'B. Proposed strategy' describes the strategy in detail by listing the actions that aim to realize the goal. These are based on logical reasoning, or, if a source is indicated, directly derived from literature. 'C. Name of proposed strategy' proposes a name that covers the content described in B. The last column 'Literature Support' indicates if the proposed relationship is confirmed by literature ('Yes'/'no'/'not found') and indicates the section in which the strategy and confirmation is elaborated.

Table 4.20: Proposing strategies to overcome barrier 6.1.1

IF1. Knowledge and awareness of technology				
6.1.1) "A lack of knowledge and awareness of technology can affect the availability of customers"				
	A. Main purpose of strategy	**B. Proposed strategy**	**C. Name of proposed strategy**	*Literature support*
	Type 1: *Eliminating the influence of the barrier on the diffusion of the innovation– R*emoving the influence of availability of customers.	A strategy that involves moving to another industry or to other geographical location where there are stimulating aspects that do not hamper the availability of customers. *(Ortt et al., 2013)*	Geographical strategy	Yes § 5.2.22
	Type 2: *Solving the barrier by removing the lack of knowledge and awareness of the company on technological principles* – by developing new technological knowledge so that the influencing factor does not negatively influence the core factor	A strategy can be adopted in which technological knowledge will be developed by technological research so that it won't affect the creation of a customer base.	Technological research & develop strategy	Yes §5.2.1
		Adopting a strategy in which a pilot research will be performed can reveal technological issues in practice, since customers and other stakeholders involved are able to deliver feedback.	Pilot research & develop Strategy	Yes §5.2.2
	Type 2: *Solving the barrier by removing the lack of knowledge and awareness of the company on technological principles* – by	A strategy in which new employees and/or interns are hired can increase the internal knowledge on technological principles the company was not aware of yet.	Human resource management strategy	Yes §5.2.4

	increasing the internal technological knowledge, the knowledge and awareness of existing technological principles will be increased, so that the influencing factor does not negatively influence the core factor	A strategy in which trade exhibitions and conferences are visited can increase the knowledge on the latest trends and innovations regarding the technology. Furthermore, they can be visited to get familiar with the practices of the competitors in the industry. Because of this, the company is able to discover the main unfavourable differences in comparison with the competitors, in order to be able to reduce these differences.	Market research strategy	Not found §5.2.3
	<u>*Type 3:*</u> *Solving the deficiency within the core factor by adapting to the influencing factor* – By increasing the technological awareness specifically of the customers.	Adopting a strategy in which available knowledge is shared by means of workshops, networking and brokering events, presentations, reports, debates and round tables. *(Ortt et al., 2013)* Also by developing a straightforward user manual. This will increase the knowledge and awareness of technology of potential customers.	Education strategy	Yes §5.2.5
		A strategy in which the product will be redesigned with the aim of improving the use cues of the product so that customers will understand the use and purpose of the product more easily.	Redesign strategy	Yes §5.2.12
		Adopting a strategy that aims to change the behaviour of the actors. For example, an influencer (Company/person acting as an example) can be used to gradually change the methods, habits, norms and values among the actors in the (desired) network. Furthermore, customers can be informed on the product benefits by showing them the pay-off of the product. Because of this, they will understand the purpose of the product. Furthermore, this strategy aims to increase the user confidence by for example handing out samples and by giving live demonstrations.	Changing behaviour strategy	Yes §5.2.11

Table 4.21: Proposing strategies to overcome barrier 6.2.1

IF2. Knowledge and awareness of application and market			
6.2.1) "Knowledge and awareness of application and market is missing, affecting the availability of customers"			
A. Main purpose of strategy	**B. Proposed strategy**	**C. Name of proposed strategy**	*Literature support*
Type 1: *Eliminating the influence of the barrier on the diffusion of the innovation*	A strategy that involves moving to another industry or to other geographical location where there are stimulating aspects that do not hamper the availability of customers. *(Ortt et al., 2013)*	Geographical strategy	Yes § 5.2.22
<u>*Type 2:*</u> *Solving the barrier by removing the lack of knowledge and awareness of the company on the market and the application* - by increasing the company's knowledge on market and application, the deficiency in the influencing factor is solved.	A strategy in which together with an lead-user the product is further developed so that it will comply to the needs and wishes of the market. *(Ortt et al., 2013)*	Lead-user strategy	Yes §5.2.7
	A strategy in which the public is used to generate ideas in order to help develop the innovation further and the knowledge and awareness of application and market is increased.	Crowd sourcing strategy	Yes §5.2.8

		A strategy in which research is performed in order to increase the market knowledge of the company. The strategy aims to, for example, determine the most promising market segments, to determine the most promising network actors, the competitors etc.	Market research strategy	Yes §5.2.3
		A strategy in which the application is tested by means of a pilot research will show the company how customers and other actors use the application. It will reveal the user and other actors their preferences for the product.	Pilot research & develop strategy	Yes §5.2.2
	Type 3: Solving the deficiency within the core factor by adapting to the influencing factor – Communicating the available knowledge of the application to the customers in order to increase their level of knowledge.	Adopting a strategy in which knowledge of the application is shared with potential customers by means of workshops, networking and brokering events, presentations, reports, debates and round tables. *(Ortt et al., 2013)*	Education strategy	Yes §5.2.5
		Adopting a strategy in which a pilot research will be performed in order to show potential stakeholders the benefits and use of the application.	Pilot project strategy	Yes §5.2.2
		Adopting a strategy that aims to change the behaviour of the actors. For example, an influencer (Company/person acting as an example) can be used to gradually change the methods, habits, norms and values among the actors in the (desired) network. Furthermore, customers can be informed on the product benefits by showing them the pay-off of the product. Because of this, they will understand the purpose of the product. Furthermore, this strategy aims to increase the user confidence by for example handing out samples and by giving live demonstrations.	Changing behaviour strategy	Yes §5.2.11

Table 4.22: Proposing strategies to overcome barrier 6.4.1

IF4. Financial resources				
6.4.1) "A lack of financial resources affect the availability of customers."				
A. Main purpose of strategy		**B. Proposed strategy**	**C. Name of proposed strategy**	*Literature support*
	Type 1: *Eliminating the influence of the barrier on the diffusion of the innovation*	A strategy that involves moving to another industry or to other geographical location where there are stimulating aspects that do not hamper the availability of customers. *(Ortt et al., 2013)*	Geographical strategy	Yes § 5.2.22
	Type 2 - *Solving the deficiency within the influencing factor* - Solving the lack of financial resources of the company so that the product can be sold for a lower price, making customers able to acquire the product regarding their low financial resources.	A strategy that aims to increase the financial resources of the company by participating in competitions in order to win money; starting a crowd funding campaign; applying for a bank loan; or by getting involved in an incubator program. Because of this, the product can be sold for a lower price.	Finance sourcing strategy	Yes §5.2.9
		A strategy that aims to increase the financial resources by applying for subsidies. *(Ortt et al., 2013)* By this, the product can be sold for a lower price, making it easier for customers to acquire.	Subsidies[(A)] strategy	Yes §5.2.10

	<u>Type 3:</u> *Solving the deficiency within the core factor by adapting to the influencing factor* – By changing the perception of the price of the customers or by adapting to the lack of financial resources among potential customers (eg a redesign or a different business model)	A strategy that entails selling the product to a niche market that has a higher financial status and can afford more. The product is thus marketed as a luxury product.	Top-end strategy	Yes §5.2.23
		Redesign with the aim to make the product cheaper A strategy in which the product will be redesigned with the aim on producing a simpler/cheaper version of the application, so that the target group can acquire the product with the financial resources they have.	Redesign strategy	Yes §5.2.12
		A strategy in which the product will be leased, so that the product costs can be spread over a certain time period, which avoids that customers have to spend all the money at once.	Leasing strategy	Yes §5.2.19
		A strategy in which a sharing platform will be developed, which gives multiple users access to the same product. Users only use the product when they need to; and only pay for use of the product, which is less than acquiring the product.	Sharing platform strategy	Yes §5.2.20
		A strategy in which one product is sold to a target market that can afford to buy the product, and at the same time one product is given away for free to a target market that does not have the financial resources to acquire the product.	Buy-one, give-one strategy	Yes § 5.2.21
		A strategy in which the consumers are informed on the product benefits by showing them the pay-off of the product. In order to inform the customers about the purpose of the product so that they will buy it, despite the high price.	Changing behaviour strategy	Yes §5.2.11

Table 4.23: Proposing strategies to overcome barrier 6.5.1

IF5. Socio-cultural aspects			
6.5.1) "Socio-cultural aspects affect the availability of customers"			
A. Main purpose of strategy	**B. Proposed strategy**	**C. Name of proposed strategy**	*Literature support*
<u>Type 1:</u> *Eliminating the influence of the barrier on the diffusion of the innovation*	A strategy that involves moving to another industry or to other geographical location where there are stimulating aspects that do not hamper the availability of customers. *(Ortt et al., 2013)*	Geographical strategy	Yes § 5.2.22
<u>Type 2:</u> *Changing the aspects in favour of the innovation* – in order to decrease the negative influence on the availability of customers.	Adopting a strategy that aims to change the behaviour of the actors. For example, an influencer (Company/person acting as an example) can be used to gradually change the methods, habits, norms and values among the actors in the (desired) network. Furthermore, customers can be informed on the product benefits by showing them the pay-off of the product. Because of this, they will understand the purpose of the product. Furthermore, this strategy aims to increase the user confidence by for example handing out samples and by giving live demonstrations.	Changing behaviour strategy	Not found §5.2.11

		Adopting a strategy that aims to directly influence the institutions that create laws that can force people to change their norms and values.	Direct lobbying	Yes §5.2.17
		A strategy in which NGO's, the public or media is used to raise awareness on the negative influence of the existing norms and values and that emphasize on the importance of different norms and values.	Indirect lobbying	Yes §5.2.17
	<u>Type 3:</u> *Solving the deficiency within the core factor by adapting to the influencing factor* – so that it does not affect the availability of customers.	A strategy in which the product will be redesigned with a focus on adapting to the socio-cultural environment, so that customers are more willingly to buy and use the product.	Redesign strategy	Yes §5.2.12
		Adopting a strategy that aims to co-develop the innovation with a lead-user representing the target group. The lead-user has the opportunity to integrate his needs and desires into the innovation and to test it. *(Ortt et al., 2013)*	Lead-user strategy	Yes §5.2.7
		A strategy in which the public is used to generate ideas in order to help develop the innovation further so that the innovation can adapt to the socio-cultural aspects.	Crowd sourcing strategy	Yes § 5.2.8

Table 4.24: Proposing strategies to overcome barrier 6.6.1

IF6. Macro- and meso-economic, institutional and strategic aspects			
6.6.1) "Macro- and meso-economic, institutional and strategic aspects affect the availability of customers"			
A. Main purpose of strategy	**B. Proposed strategy**	**C. Name of proposed strategy**	*Literature support*
<u>Type 1:</u> *Eliminating the influence of the barrier on the diffusion of the innovation*	A strategy that involves moving to another industry or to other geographical location where there are stimulating aspects that do not hamper the availability of customers. *(Ortt et al., 2013)*	Geographical strategy	Yes § 5.2.22
<u>Type 2:</u> *Changing the aspects in favour of the innovation* – in order to decrease the negative influence on the availability of customers.	Adopting a strategy that aims to directly influence the institutions in order to raise awareness on the unfavourable aspects and on the inhibiting influence of these aspects on the diffusion of the innovation.	Direct lobbying strategy	Yes §5.2.17
	Adopting a strategy that aims to change the behaviour of the actors. For example, an influencer (Company/person acting as an example) can be used to gradually change the methods, habits, norms and values among the actors in the (desired) network.	Changing behaviour strategy	Not found §5.2.11
<u>Type 3:</u> *Solving the deficiency within the core factor by adapting to the influencing factor* – By adapting to the state of the available aspects, solving the deficiency in the core factor.	A strategy in which together with a lead-user the product is further developed so that the product and the business practices of the company will comply to the aspects available in the market. *(Ortt et al., 2013)*	Lead-user strategy	Yes §5.2.7

Table 4.25: Proposing strategies to overcome barrier 6.7.1

IF7. Accidents and events				
6.7.1) "The presence of or risks on accidents and events can hamper the availability of customers"				
	A. Main purpose of strategy	**B. Proposed strategy**	**C. Name of proposed strategy**	*Literature support*
	Type 1: *Eliminating the influence of the barrier on the diffusion of the innovation*	A strategy that involves moving to another industry or to other geographical location where there are stimulating aspects. *(Ortt et al., 2013)*	Geographical strategy	Yes § 5.2.22
	Type 2: *Solving the barrier by removing the presence of or risks on accidents and events.*	*No strategies could be reasoned within the ability of companies to completely remove the presence or risks on accidents and events; the factor is too external. It is not possible to solve or remove the risk (only to circumvent it)*		
	Type 3: Solving the deficiency within the core factor by adapting to the influencing factor.	*I could not come up with strategies by means of logical reasoning that complies to the aim described.*		

Overview results core factor 6

Figure 4.7 shows a summary of the tables 4.20 – 4.25. The colours correspond to the colours used in the tables, indicating the different type of strategies (purple type-2; orange type-3; blue type-1). The top of the image represents the barrier obstructing diffusion of the product. The first arrow represents the deficient influencing factor; since a deficiency within the core factor can have different origins, the influencing factors are individually indicated at the left of the figure. Per influencing factor, the strategies that can be adopted by companies for the particular core factor are shown. Since the type-2 (purple) strategies aim to remove the influencing factor, these are pointed towards the first arrow 'deficient influencing factor'. Because of this, the deficiency within the core factor will be removed and the barrier will thus be solved. The type-3 (orange) strategies aim to solve the deficiency within the core factor and are specific to the influencing factor; these strategies thus point towards the core factor. The type-1 (blue) strategies aim to circumvent the barrier and are specific to the core factor; that is why these point towards the last arrow and why these 'overrule' the different influencing factors that form deficiencies within the core factor; they can be adopted independent from which influencing factor caused the barrier. The empty boxes represent strategies that could not be reasoned yet. They are included empty based on the assumption that at least two different strategies per barrier and per type will exist.

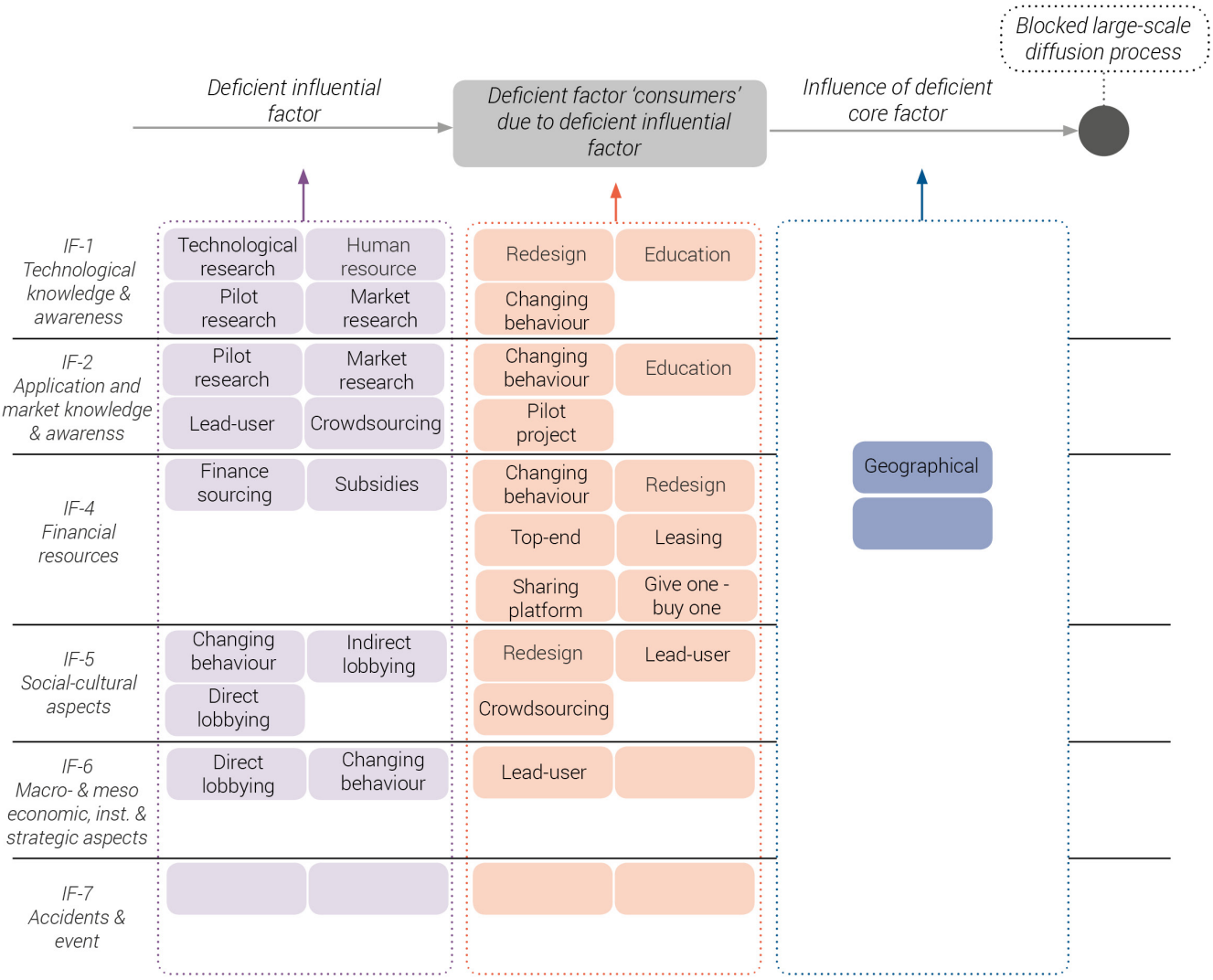


Figure 4.7: Overview of the strategies removing or circumventing the barriers related to core factor 6

4.2.7 Core factor 7: Specific institutional aspects

Step 1A: Original description of core factor

This factor refers to the way in which institutional aspects (i.e. policies, laws, standards and regulations) influence the involved actors during manufacturing, distribution, acceptance and use of the product and influence the product, production system and complementary products and services. The influence of the institutional aspects can have a negative or positive impact on the large-scale diffusion process. (Ortt & Kamp, 2019)

Step 1B: Barrier Identification

Five barriers have been identified, caused by five different influencing factors that all have a direct influence on the core factor 'Specific institutional aspects'.

IF1: Knowledge and awareness of technology

Barrier 7.1.1: *"A lack of knowledge on fundamental and applied technological aspects can affect the availability of appropriate specific institutional aspects."*

IF2: Knowledge and awareness of application and market

Barrier 7.2.1: *"A lack of knowledge and awareness of application and market can affect the availability of appropriate specific institutional aspects."*

IF3: Natural and human resources

This influencing factor is assumed not to have a direct influence on the core factor Specific Institutional Aspects.

IF4: Financial resources

This influencing factor is assumed not to have a direct influence on the core factor Specific Institutional Aspects.

IF5: Socio-cultural aspects

Barrier 7.5.1*: "Social cultural aspects affect the availability of appropriate specific institutional aspects."*

IF6: Macro- and meso-economic, institutional and strategic aspects

Barrier 7.6.1: *"Macro- and meso-economic, institutional and strategic aspects affect the availability of appropriate specific institutional aspects."*

IF7: Accidents and events

Barrier 7.7.1: *"The presence of or risks on accidents and events affect the availability of appropriate specific institutional aspects."*

Step 2: Proposing Strategies

Tables 4.26 – 4.30 show the strategies that are proposed and/or found appropriate to be able to overcome the indicated barrier. 'A. Main purpose of strategy' describes the overall goal of the strategy; 'B. Proposed strategy' describes the strategy in detail by listing the actions that aim to realize the goal. These are based on logical reasoning, or, if a source is indicated, directly derived from literature. 'C. Name of proposed strategy' proposes a name that covers the content described in B. The last column 'Literature Support' indicates if the proposed relationship is confirmed by literature ('Yes'/'no'/'not found') and indicates the section in which the strategy and confirmation is elaborated.

Table 4.26: Proposing strategies to overcome barrier 7.1.1

IF1. Knowledge and awareness of technology				
7.1.1) "A lack of knowledge on fundamental and applied technological aspects can affect the availability of appropriate specific institutional aspects"				
A. Main purpose of strategy		**B. Proposed strategy**	**C. Name of proposed strategy**	*Literature support*
	Type 1: *Eliminating the influence of the barrier on the diffusion of the innovation* – circumventing the influence of the barrier by moving to another location or by adapting to the available specific institutional aspects by redesign of the product.	A strategy that involves moving to another industry or other geographical location where there are more appropriate institutional aspects *(Ortt et al., 2013)*	Geographical strategy	Yes § 5.2.22
		A strategy in which the product will be redesigned with a focus on adapting to the available specific institutional aspects.	Redesign strategy	Not found §5.2.12
	Type 2: *Solving the barrier by removing the lack of knowledge and awareness of the company on technological principles* – by developing new technological knowledge so that the influencing factor does not negatively influence the core factor	A strategy can be adopted in which technological knowledge will be developed by means of technological research so that the knowledge is available.	Technological research & develop strategy	Yes §5.2.1
		Adopting a strategy in which a pilot research will be performed can reveal technological issues in practice, since consumers and other stakeholders involved are able to deliver feedback.	Pilot test & develop Strategy	Yes §5.2.2

	Type 2: *Solving the barrier by removing the lack of knowledge and awareness of the company on technological principles* – by increasing the internal technological knowledge, the knowledge and awareness of existing technological principles will be increased, so that the influencing factor does not negatively influence the core factor	A strategy in which new employees and/or interns are hired can increase the internal knowledge on technological principles the company was not aware of yet.	Human resource management strategy	Yes §5.2.4
		A strategy in which trade exhibitions and conferences are visited can increase the knowledge on the latest trends and innovations regarding the technology. Furthermore, they can be visited to get familiar with the practices of the competitors in the industry. Because of this, the company is able to discover the main unfavourable differences in comparison with the competitors, in order to be able to reduce these differences.	Market research strategy	? §5.2.3
	Type 3: Solving the barrier by removing the deficiency within the core factor by circumventing the influencing factor – By sharing the available technological knowledge to increase the availability of appropriate institutional aspects or by directly changing the institutional aspects.	Adopting a strategy in which available technological knowledge is shared with the institutions formulating the laws, rules and standards by means of workshops, networking and brokering events, presentations, reports, debates and round tables. *(Ortt et al., 2013)*	Education strategy	Yes §5.2.5
		Adopting a strategy with the aim to influence the institutions in an informal, direct way with the responsible party that establish the specific institutional aspects (laws, rules, standards etc) with the aim to change these in favour of the innovation.	Direct lobbying strategy	Yes §5.2.17
		Adopting a strategy in which institutions are influenced by contributing to their campaigns.	Campaign funding	Yes §5.2.18
		Adopting a strategy in which a regulatory agency is joined in order to have a direct influence on the policy making.	Joining a regulatory agency strategy	Yes §5.2.18

Table 4.27: Proposing strategies to overcome barrier 7.2.1

IF2. Knowledge and awareness of application and market			
7.2.1) "A lack of knowledge and awareness of application and market among the institutions can affect the availability of appropriate specific institutional aspects"			
A. Main purpose of strategy	**B. Proposed strategy**	**C. Name of proposed strategy**	*Literature support*
Type 1: *Eliminating the influence of the barrier on the diffusion of the innovation* – circumventing the influence of the barrier by moving to another location or by adapting to the available specific institutional aspects by redesign of the product.	A strategy that involves moving to another industry or other geographical location where there are more appropriate institutional aspects *(Ortt et al., 2013)*	Geographical strategy	Yes § 5.2.22
	A strategy in which the product will be redesigned with a focus on adapting to the available specific institutional aspects.	Redesign strategy	Not found §5.2.12
Type 2: Solving the barrier by removing the lack of knowledge and awareness of the company on the market and the application - by increasing the company's knowledge on market and application, the deficiency in the influencing factor is solved.	A strategy in which together with an lead-user the product is further developed so that it will comply to the needs and wishes of the market. *(Ortt et al., 2013)*	Lead-user strategy	Yes §5.2.7
	A strategy in which the public is used to generate ideas in order to help develop the innovation further and the knowledge and awareness of application and market is increased.	Crowd sourcing strategy	Yes §4.3.8

		A strategy in which research is performed in order to increase the market knowledge of the company. The strategy aims to, for example, determine the most promising market segments, to determine the most promising network actors, the competitors etc.	Market research strategy	Yes §5.2.3
		A strategy in which the application is tested by means of a pilot research will show the company how customers and other actors use the application. It will reveal the user and other actors their preferences for the product.	Pilot research & develop strategy	Yes §5.2.2
	<u>Type 3:</u> *Solving the barrier by removing the deficiency within the core factor by circumventing the influencing factor* – By sharing the available knowledge on the application to the institutions in order to increase the availability of appropriate institutional aspects or by directly changing the institutional aspects.	Adopting a strategy in which knowledge is shared with the institutions formulating the laws, rules and standards by means of workshops, networking and brokering events, presentations, reports, debates and round tables, so that they see the purpose and advantages of the application. *(Ortt et al., 2013)*	Education strategy	Yes §5.2.5
		A strategy in which NGO's, the public or media is used to raise awareness on the application and market among the institutions	Indirect lobbying strategy	Yes §5.2.17
		A strategy in which the institutions are informed in an informal, direct way with the responsible party that establish the specific institutional aspects (laws, rules, standards etc) with the aim to change these in favour of the innovation.	Direct lobbying strategy	Yes §5.2.17
		Adopting a strategy in which institutions are influenced by contributing to their campaigns.	Campaign funding	Yes §5.2.18
		Adopting a strategy in which a regulatory agency is joined in order to have a direct influence on the policy making.	Joining a regulatory agency strategy	Yes §5.2.18

Table 4.28: Proposing strategies to overcome barrier 7.5.1

IF5. Socio-cultural aspects				
7.5.1 "Social cultural aspects affect the availability of appropriate specific institutional aspects"				
A. Main purpose of strategy		**B. Proposed strategy**	**C. Name of proposed strategy**	*Literature support*
	<u>Type 1:</u> *Eliminating the influence of the barrier on the diffusion of the innovation* – circumventing the influence of the barrier by moving to another location or by adapting to the available specific institutional aspects by redesign of the product.	A strategy that involves moving to another industry or other geographical location where there are more appropriate institutional aspects *(Ortt et al., 2013)*	Geographical strategy	Yes § 5.2.22
		A strategy in which the product will be redesigned with a focus on adapting to the available specific institutional aspects.	Redesign strategy	Not found §5.2.12
	<u>Type 2:</u> *Changing the aspects in favour of the innovation* – in order to decrease the negative influence on the availability of appropriate institutional aspects	Adopting a strategy that aims to change the behaviour of the actors. For example, an influencer (Company/person acting as an example) can be used to gradually change the methods, habits, norms and values among the actors.	Changing behaviour strategy	Not found §5.2.11
		Adopting a strategy that aims to directly influence the institutions that create laws in favour of the innovation.	Direct lobbying	Yes §5.2.17

		A strategy in which NGO's, the public or media is used to raise awareness on the negative influence of the existing norms and values and that emphasize on the importance of different norms and values, trying to convince the lawmakers to change the institutional aspects.	Indirect lobbying	Yes §5.2.17
	Type 3: Solving the barrier by solving the deficiency within the core factor – By adapting to the socio-cultural aspects in order to decrease the negative influence of the influencing factor on the availability of appropriate institutional aspects or by directly changing the institutional aspects.	Adopting a strategy that aims to co-develop the innovation with a lead-user representing the target group. The lead-user has the opportunity to integrate his needs and desires into the innovation and to test it. *(Ortt et al., 2013)*	Lead-user strategy	Yes §5.2.7
		A strategy in which the public is used to generate ideas in order to help develop the innovation further so that the innovation can adapt to the socio-cultural aspects.	Crowd sourcing strategy	Yes § 5.2.8
		Adopting a strategy in which institutions are influenced by contributing to their campaigns.	Campaign funding	Yes §5.2.18
		Adopting a strategy in which a regulatory agency is joined in order to have a direct influence on the policy making.	Joining a regulatory agency strategy	Yes §5.2.18

Table 4.29: Proposing strategies to overcome barrier 7.6.1

IF6. Macro and meso economic, institutional and strategic aspects			
7.6.1) "Macro and meso economic, institutional and strategic aspects affect the availability of appropriate specific institutional aspects".			
A. Main purpose of strategy	**B. Proposed strategy**	**C. Name of proposed strategy**	*Literature support*
Type 1: *Eliminating the influence of the barrier on the diffusion of the innovation* – circumventing the influence of the barrier by moving to another location or by adapting to the available specific institutional aspects by redesign of the product.	A strategy that involves moving to another industry or other geographical location where there are more appropriate institutional aspects *(Ortt et al., 2013)*	Geographical strategy	Yes § 5.2.22
	A strategy in which the product will be redesigned with a focus on adapting to the available specific institutional aspects.	Redesign strategy	Not found §5.2.12
Type 2: *Changing the aspects in favour of the innovation* – in order to decrease the negative influence on the availability of appropriate specific institutional aspects.	Adopting a strategy that aims to directly influence the institutions in order to raise awareness on the unfavourable aspects and on the inhibiting influence of these aspects on the diffusion of the innovation.	Direct lobbying strategy	Yes §5.2.17
	Adopting a strategy that aims to change the behaviour of the actors. For example, an influencer (Company/person acting as an example) can be used to gradually change the methods, habits, norms and values among the actors in the (desired) network.	Changing behaviour strategy	Not found §5.2.11
Type 3: Solving the deficiency within the core factor by adapting to the influencing factor – Adapting to the state of the available aspects in order to decrease the negative influence of the influencing factor on the	Adopting a strategy in which institutions are influenced by contributing to their campaigns.	Campaign funding	Yes §5.2.18
	Adopting a strategy in which a regulatory agency is joined in order to have a direct influence on the policy making.	Joining a regulatory agency strategy	Yes §5.2.18

	availability of appropriate institutional aspects or by directly changing the institutional aspects.			

Table 4.30: Proposing strategies to overcome barrier 7.7.1

IF7. Accidents and events			
7.7.1) "The presence of or risks on accidents and events affect the availability of appropriate specific institutional aspects"			
A. Main purpose of strategy	**B. Proposed strategy**	**C. Name of proposed strategy**	*Literature support*
Type 1: *Eliminating the influence of the barrier on the diffusion of the innovation* – circumventing the influence of the barrier by moving to another location or by adapting to the available specific institutional aspects by redesign of the product.	A strategy that involves moving to another industry or other geographical location where there are more appropriate institutional aspects *(Ortt et al., 2013)*	Geographical strategy	Yes § 5.2.22
	A strategy in which the product will be redesigned with a focus on adapting to the available specific institutional aspects.	Redesign strategy	Not found §5.2.12
Type 2: *Solving the barrier by removing the presence of, or risks on accidents and events.*	*No strategies could be reasoned within the ability of companies to completely remove the presence or risks on accidents and events; the factor is too external. It is not possible to solve or remove the risk (only to circumvent it)*		
Type 3: Solving the deficiency within the core factor by adapting to the influencing factor - Adapting to the state (presence or risks) of accidents and events in order to decrease the negative influence of the influencing factor on the availability of appropriate institutional aspects or by directly changing the institutional aspects.	Adopting a strategy in which institutions are influenced by contributing to their campaigns.	Campaign funding	Yes §5.2.18
	Adopting a strategy in which a regulatory agency is joined in order to have a direct influence on the policy making.	Joining a regulatory agency strategy	Yes §5.2.18

Overview results core factor 7:

Figure 4.8 shows a summary of the tables 4.26 – 4.30. The colours correspond to the colours used in the tables, indicating the different type of strategies (purple type-2; orange type-3; blue type-1). The top of the image represents the barrier obstructing diffusion of the product. The first arrow represents the deficient influencing factor; since a deficiency within the core factor can have different origins, the influencing factors are individually indicated at the left of the figure. Per influencing factor, the strategies that can be adopted by companies for the particular core factor are shown. Since the type-2 (purple) strategies aim to remove the influencing factor, these are pointed towards the first arrow 'deficient influencing factor'. Because of this, the deficiency within the core factor will be removed and the barrier will thus be solved. The type-3 (orange) strategies aim to solve the deficiency within the core factor and are specific to the influencing factor; these strategies thus point towards the core factor. The type-1 (blue) strategies aim to circumvent the barrier and are specific to the core factor; that is why these point towards the last arrow and why these 'overrule' the different influencing factors that form deficiencies within the core factor; they can be adopted independent from which influencing factor caused the barrier. The empty boxes represent strategies

that could not be reasoned yet. They are included empty based on the assumption that at least two different strategies per barrier and per type will exist.

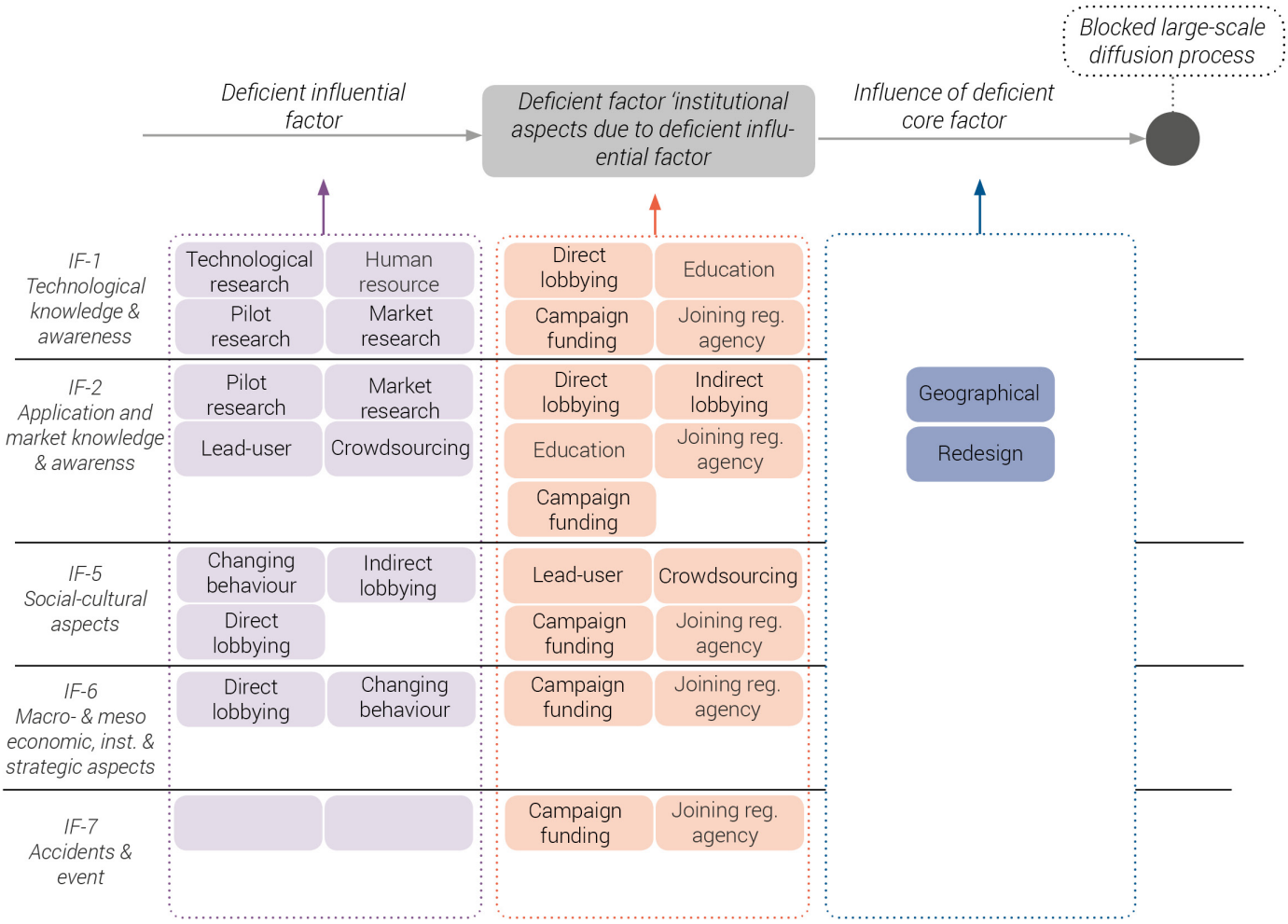


Figure 4.8: Overview of the strategies removing or circumventing the barriers related to core factor 7

4.3 Conclusion

The complete initial conceptual model is comprised out of the 7 different figures (figures 4.2 – 4.8) , a complete overview integrating the seven figures can be found in §4.3.4. First, this section will elaborate on the type-1 strategies (*circumventing the influence of the barriers on the diffusion process)*. Second, the type-2 strategies (*removing the deficiencies within the influencing factors)* will be elaborated and compared. Third, the type-3 strategies (*removing the deficiencies within the core factors)* will be elaborated.

4.3.1 Type-1 strategies

Type-1 strategies aim to circumvent the influence of the deficient core factor on the diffusion process; after the implementation of these strategies, the deficiencies within both the influencing- and core factor still exist. Adopting a type-1 strategy could in theory circumvent multiple deficiencies within a single core factor. Figure 4.9 shows an overview of the type-1 strategies per core factor.

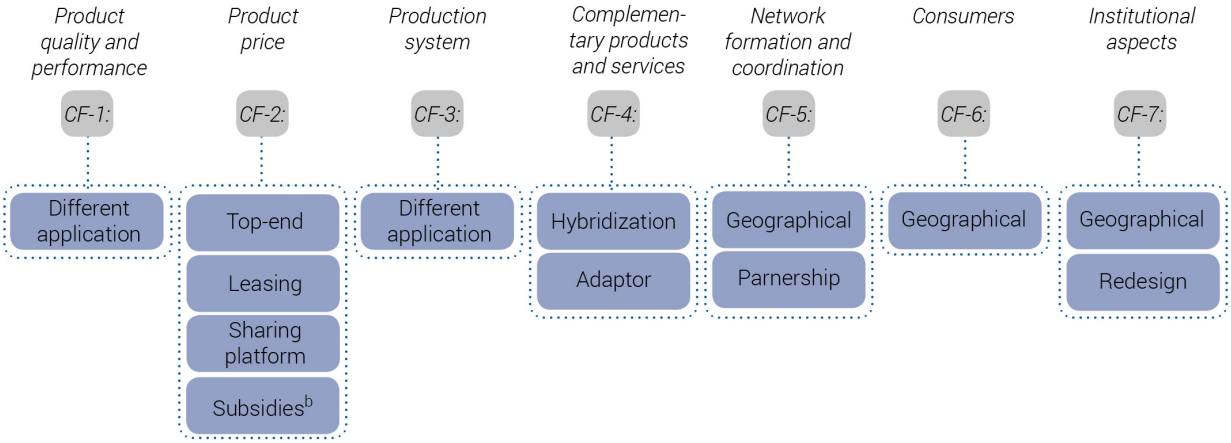


Figure 4.9: Overview of the type-1 strategies per core factor

Companies can adopt the type-1 strategies permanently (e.g. geographical location-, leasing- or sharing platform- or a subsidies[b] niche strategy) but, in order to successfully diffuse the product on a large-scale within the market, these strategies should be adopted in combination with other strategies (type-2 and -3 strategies) so that the barriers that a company is experiencing can be solved instead of only circumvented. These type-1 strategies thus create a niche market that enables companies to gain experience within the market, to learn, and to solve the barriers in the meantime by adopting other strategies. As can be noticed, most of the strategies are marketing strategies; either they are changing physical aspects of the product (-system) or of the complementary products and services, or they change the business model. All of these strategies are quite radical in terms of impact they have on the company, either on the business model, the physical location, or the change regarding the application. The only exception is the Subsidies[b] niche strategy.

For both the factors 'product quality and performance' (CF-1) and 'production system' (CF-3), only one strategy is included; introducing the technology within a different application. This can be perceived as a radical niche strategy, but, as reasoned, it can be an effective strategy that can buy the company time to solve other barriers related to the core factors until the innovation in its current form can be introduced into the market without facing barriers. The question on how to circumvent barriers related to a deficient product quality and performance and a deficient production system is complex, since the performance, quality and production of a product can be perceived as fundamental elements needed to be able to physically create a market for the application in its current form. The same can be noticed for the core factor 'consumers' (CF-6); only the geographical strategy is included in the model. Other effective strategies circumventing the lack of customers could not be reasoned.

4.3.2 Type-2 strategies

Type-2 strategies aim to solve the deficiency within the influencing factor with the aim to remove the deficiency within the core factor. The whole barrier will thus be solved after the successful adoption of a type-2 strategy. Figure 4.10 gives an overview of the type-2 strategy per influencing factor (IF).

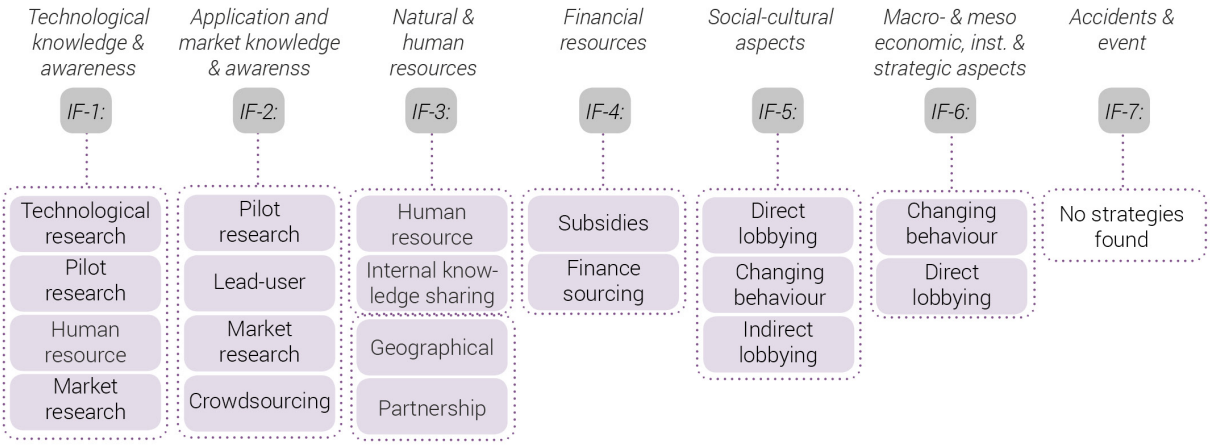


Figure 4.10: Overview of the type-2 strategies per influencing factor

As can be noticed, all the type 2 strategies can be classified as either an 'increasing knowledge & resources niche strategy' or as an 'influencing niche strategy'. The strategies that can be adopted to solve the influencing factors IF-1 to IF-4 are all adopted due to a lack of resources or knowledge within the company itself. If resources and/or knowledge are lacking within the company, there is a high chance that it will cause multiple barriers within different core factors. Adopting a type-2 strategy can thus solve multiple deficiencies within different core factors (see situation 2 in figure 3.5, §3.1.4). The last three influencing factors (IF-5 – IF-7) are aspects that are assumed to be external to the company, by influencing mainly the social components of the social-technical system (the only exception is socio-cultural aspects influencing the –perception of - product quality and performance). The negative impact of these influencing factors can only be removed by influencing the actors by changing their behaviour or by (in)direct lobbying.

Within the type-2 strategies, each strategy could be combined with each other, for example (IF-1); performing technological research by means of a pilot research. It is also possible to adopt two strategies parallel to each other at the same time, for example (IF-6) adopting both the changing behaviour strategy and the direct lobbying strategy. However, this will need more research.

All strategies included in IF-1 and IF-2 could either be executed by the company itself, in partnership with another company or by acquiring the needed knowledge/awareness. A partnership strategy is in this case a facilitating strategy, as opposed to the partnership strategy to overcome the deficiency within the influencing factor 'natural resources' (IF-3), and as included in the type-1 and type-3 overview (see figure 4.9 and 4.11).

The empty cells (IF-7) represent strategies that are assumed will exist but which could not be reasoned yet. Strategies within the ability of companies to completely remove the presence or risks on accidents and events will, because of the external nature of this influencing factor, most likely not exist. However, the barrier can be circumvented (see type-1 strategies), or there can be adapted to the risk or presence (see type 3 strategies).

4.3.3 Type-3 strategies

Figure 4.11 shows the type-3 strategies that can be adopted to remove deficiencies within the core factors. The barriers are presented per core factor (CF): The influencing factors (IF) that can cause a deficiency within the particular core factor are listed vertically. For example, the first column shows

four different barriers. For each barrier, the different niche strategies that can be adopted to overcome these barriers are indicated.

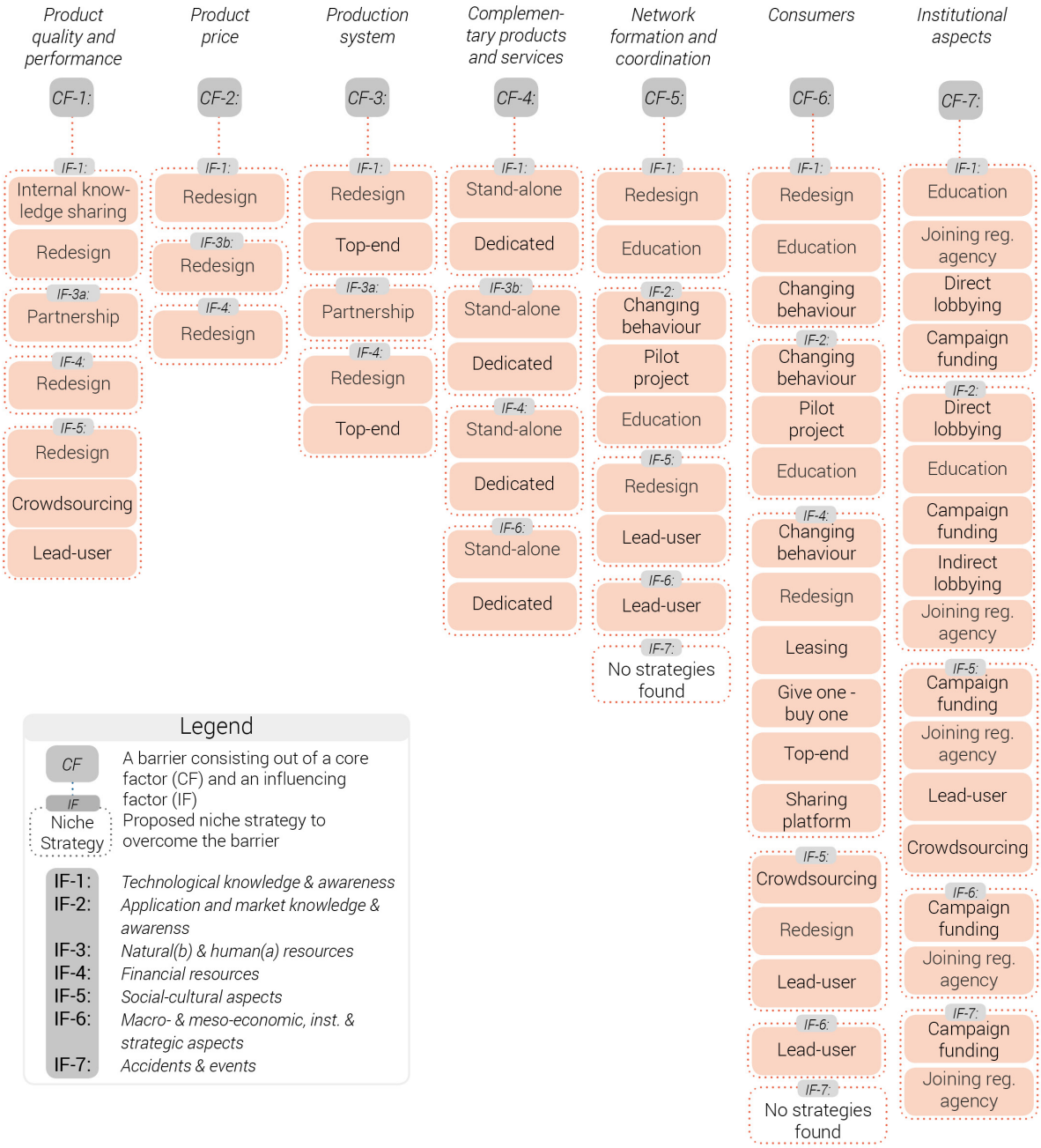


Figure 4.11: Overview of the type-3 strategies per barrier

Most of the type-3 strategies aim to solve the deficiency within the core factor by *adapting* the core factor to the state of the influencing factor, and is therefore specific to the barrier. An example is a redesign strategy, which can be adopted as solution to many experienced barriers. The redesign strategy aims to redesign the product with the available resources and/or knowledge. Because of this, the deficiency within the influencing factor is circumvented and the deficiency within the core factor is removed. Other strategies aim to solve the deficiency within the core factor *directly*. Here, the deficiency within the core factor can be removed independent of which influencing factor is causing the deficiency. Two examples are the strategies 'campaign funding' and 'joining regulatory agency' for deficiencies related to core factor 7 'Institutional aspects'.

All categories of niche strategies (see figure 11, §3.2.1) are included. However, from category 1 ('increasing knowledge and resources niche strategies') only the lead-user and crowdsourcing strategy are included within the type-3 strategy; namely within the core-factors CF-5 (network formation and coordination) and CF-6 (customers). What also can be noticed, is that 'influencing niche strategies' are only overcoming barriers related to the social components of the socio-technical system (e.g. CF-5, CF-6 and CF-7). Furthermore, it is noticeable that the first category within the marketing niche strategies ('changing physical aspects of product (-system) or complementary products and services' can be adopted often (except for all barriers related to IF-2 and all barriers related to CF-7).

Some cells are left empty; for these barriers no type 3 barriers could be reasoned yet. Most of these empty cells are related to influencing factor 7 'risks or presence of accidents and risks'. Only for core factor 7 ' institutional aspects' two strategies were included in the model. This is due to the differences between the characteristics of the core factors.

4.3.4 Complete initial conceptual model

Figure 4.12 (next page) shows an overview of the complete initial conceptual model. Each column can be read separately. The niche strategies are displayed per core factor (CF) / influencing factor (IF) combination. Since the type-1 (blue) strategies are circumventing the influence of the deficient core factors, these are not linked to an influencing factor. Instead, they are connected to the core factors directly. The type-1 and type-2 niche strategies are linked to an influencing factor (the small grey boxes). Since the figure only indicates the numbers of the core and influencing factors, a legend is included presenting the corresponding names.

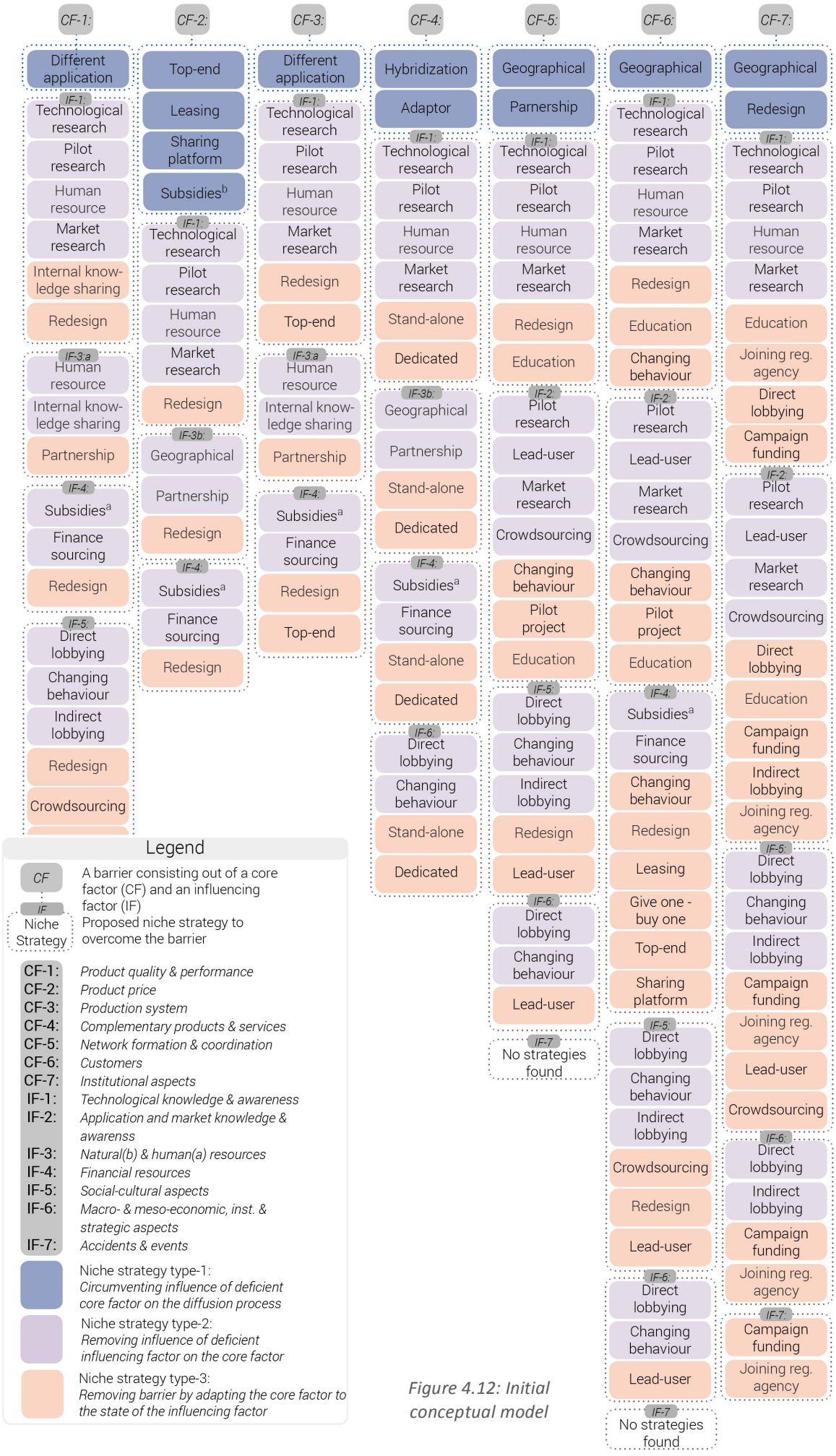


Figure 4.12: Initial conceptual model

4.3.5 Categories of niche strategies

This chapter can also draw a conclusion on the niche strategy categories (see section §3.2.1). The image below (figure 4.12) shows the same image as the mentioned section, but including all the niche strategies included in the developed conceptual model. As can be noticed, some niche strategies can be categorised within two categories (e.g. lead-user, geographical, partnership, hybridization).

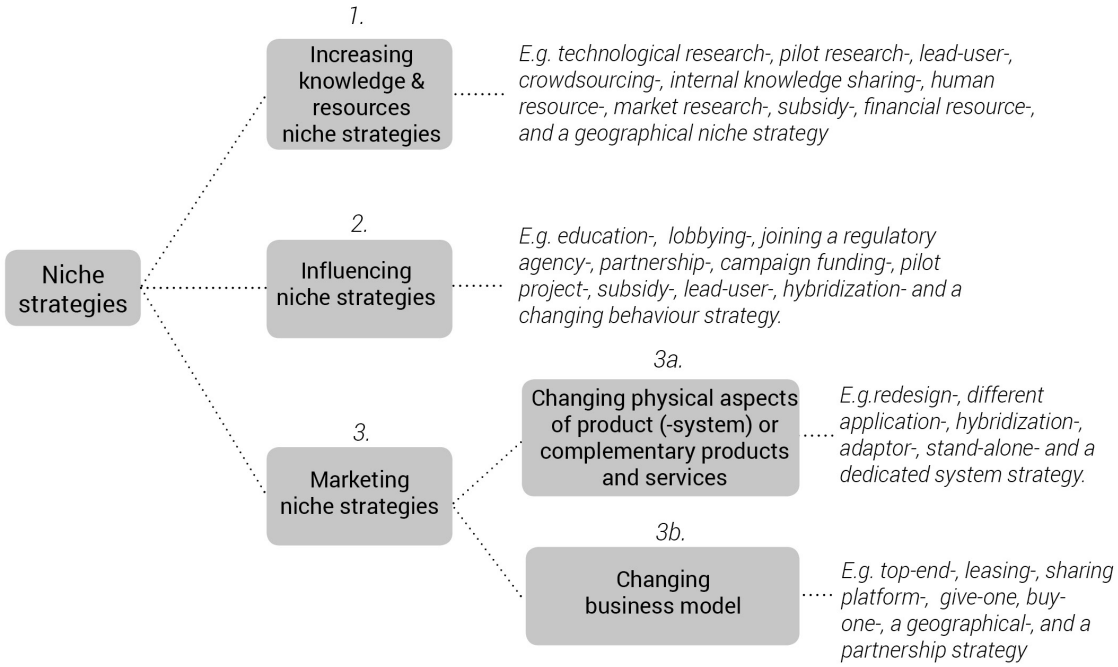


Figure 4.13: Final categorisation of niche strategies

5. Conceptual model development - Literature confirmation

The first part of this chapter, 5.1, elaborates on the methodology that is followed during the confirmation of the relationships described in the initial conceptual model using literature. In section 5.2, the relationships proposed in the initial conceptual model are confirmed or complemented by literature. Section 5.3 draws a conclusion of the steps executed in section 5.2.

5.1 Methodology literature confirmation

5.1.1 Procedure

The aim of the desk research performed in this chapter is to find confirmation of the relationships described in chapter 4. If a confirmation of a relationship is found, it shows that the logical reasoning behind the relationship is credible; the proposed relationships can be perceived as appropriate relationships. However, it does not mean that the confirmation shows the strength of the relationship; the success of the adoption of a particular niche strategy to overcome a barrier will depend on the particular characteristics of the company. Figure 5.1 shows the steps that will be taken in this chapter. As can be seen in the image, step 3 and 4 work towards a conceptual model that is comprised of appropriate and proposed niche strategies. Step 3 will first elaborate on the proposed strategies in the initial conceptual model developed in chapter 4. It will describe the niche strategies in more detail (step 3A) and will define the category in which the niche strategy can be classified (step 3B). Step 4 is a desk research on relevant theoretical concepts and on other literature that can confirm the relationships as defined in the initial conceptual model in chapter 4. First, the niche strategies will be compared to strategies that exist in practice already (step 4A). Second, the aim is to confirm the relationships between the proposed niche strategies and barriers described in the initial conceptual model by means of a literature review (step 4B). The steps are described in more detail below the image.

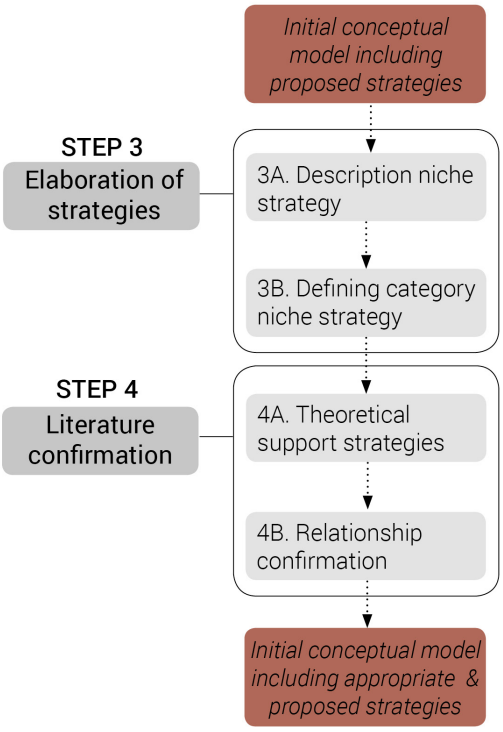


Figure 5.1: Steps taken during the confirmation of the relationships described in the initial conceptual model.

As opposed to the first two steps (chapter 4), where the steps are followed per core factor, the third and fourth step will be performed per niche strategy. This will provide a more comprehensible overview of the generated niche strategies.

Step 3: Elaboration of the strategies
The aim of the third step is to provide a deeper understanding of the proposed niche strategies as included in the initial conceptual model developed in chapter 4.

***3A** – Description of niche strategy*
This part gives a detailed description of the main goal of the particular niche strategy, and how it aims to overcome the barriers as proposed in the initial model.

***3B** – Defining category of niche strategy*
Four types of niche strategies are distinguished (see also §3.2.1): 1) 'Increasing knowledge and resources niche strategy'; 'Influencing niche strategy'; and 'Marketing niche strategies'. The latter is divided into two: 'Changing physical aspects of product (-system) or complementary products and services' and 'Changing the business model'. This step will elaborate on the category in which the niche strategy can be classified.

Step 4: Literature confirmation
The aim of the third step is to find external support on the developed niche strategies and the proposed relationships between the niche strategies and barriers by means of a literature study.

***4A** – Theoretical support of strategies*
This step aims to find a strategy in literature that can be compared with the described strategy. This makes the search for data that can confirm the proposed relationships (next step) easier. The aim is to discover what those comparable strategies entail, in which situations it is applied and what the purpose of those strategies is. Section 5.1.2 elaborates more on the method that will be followed to find a comparable strategy.

***4B** – Relationship confirmation*
This part describes the conclusion that can be drawn from 4A. When a comparable strategy is described in literature in combination with a comparable barrier, it can be interpreted as an acknowledgment of the existence of the relationship between the identified barriers and developed niche strategies in the previous steps. When a proposed relationship is supported, a reference is mentioned in the last column of the tables included in chapter 4, or when the strategies are complemented, it is mentioned in the second column of the tables included in chapter 4. The data collection and analysis method will be described in the next section in more detail.

Conclusion
In this section, a conclusion will be drawn based on the outcome of the third and fourth steps. An overview of the strategies will be given per category of niche strategy and a final image illustrating the conceptual model including the confirmed and not confirmed relationships will be drawn. Furthermore, there will be elaborated on the confirmed relationships and on the relationships that could not be confirmed.

5.1.2 Data collection

As described in section 1.4.4, data will be collected by means of a literature review. There will be searched for relevant papers, reports and journals on article databases 'Scopus', 'Web of science' and 'Google Scholar'. Selection of the proper research material will be done in multiple steps, depending on date, number of citations and how specific they are. The aim is to find articles that are published at least after 2010, if the articles are older they should be cited at least 100 times, otherwise a minimum number of 50 times. However, if articles are very specific or recently published, it is likely that they have fewer citations. The literature search that will be performed is very broad; there will be searched with specific descriptions of strategies and/or barriers. Since there

will be worked with a limited time frame, the aim is to search with at least 5 different combinations of search-strings. If no relevant data is obtained, there will be mentioned that within the limits of this research, no confirmation of the proposed relationship between niche strategies and barriers is found. The search-string will depend per case (the particular niche strategy), but will consist out of the name of the niche strategy or the aim of the strategy as will be described in step 3 in this chapter. If a comparable strategy is found in literature, that name will be used as well.

5.1.3 Data analysis

The confirmation of the proposed relationships between niche strategies and barriers can be done in two ways:

A. Either, the theory mentioned in the research material underlines the existence of the linkage between the barrier and strategy;
B. Or the research material gives a real-life example of the linkage between the barrier and strategy based on a case-study research.

It is preferred to find a confirmation of a proposed relationship nu means of both confirmation types, since it is likely that the statement (being the confirmation) is based on research in practice that showed the existence in multiple cases or showed that it is a common phenomenon in general. The confirmation type B should be a case in which a technological innovation is diffused in the market by the adoption of the particular niche strategy. This type of confirmation however, brings a lot of limitations and uncertainties (see §1.4.4), and only shows the adoption in one particular situation. But it still can be perceived as a confirmation of the possibility to adopt the niche strategy in a situation in which a particular barrier is experienced.

Per niche strategy, the proposed relationships will be indicated in tables. First the barriers that can be overcome (as reasoned during the conceptual model development in chapter 4) will be indicated, and second, how the niche strategy aims to overcome the barrier (being either type-1, type-2 or type-3, see §3.1.2). Subsequently, it will depend on this type what the exact requirements of the confirmation are:

- *Type 1: The niche strategy removes the impact of the deficient core factor on the diffusion of the innovation*

The research material should describe that adoption of the niche strategy will circumvent the deficiency within the core factor. In this case, only the core factor will be mentioned.

- *Type 2: The niche strategy solves the deficiency related to the influencing factor*

The research material should describe that adoption of the niche strategy will solve the deficiency within the influencing factor. In this case, only the influencing factor will be mentioned.

- *Type 3: The niche strategy solves the deficiency within the core factor.*

The research material should describe that adoption of the niche strategy will remove the deficiency within the core factor. In most cases, the strategy is specific to the whole barrier: In these cases, both the core factor and influencing factor should be mentioned by the literature sources. If the strategy directly solves the deficiency within the core factor, independent of which influencing factor caused the deficiency, it will be indicated.

The tables will lastly indicate to what extent the found literature contributes to the confirmation of the proposed relationships. The main question is: 'Does the literature support the proposed relationship?' There are three possibilities:

- If '*Yes'*: The proposed relationship is confirmed by the literature sources; the relationship can be seen as appropriate.
- If '*No*': The proposed relationship is contradicted by the literature sources; the relationship should be removed or revised according to the findings. Most likely, the reasoning behind the proposed relationship is incorrect.

- If '*?*': The reviewed literature sources do not provide enough information to either confirm or contradict the proposed relationships in the conceptual model.

For example: In the initial conceptual model developed in chapter 4, the Technological research & develop niche strategy is only included as a type-2 strategy: it aims to remove the deficiency related to influencing factor 1 'Knowledge and awareness of technology'. Since this influencing factor can raise barriers within all core factors, this strategy is included in the conceptual model 7 times. However, table 5.1 only indicates influencing factor 1, since only this relationship needs confirmation.

Table 5.1: Example of a confirmed relationship

Type-2		
A 'Technological research & develop niche strategy' can remove deficiencies within the following influencing factors:		**Relationship supported by literature?**
IF-1	'Knowledge and awareness of technology'	Yes

5.2 Step 3 & 4: Confirmation of relationships

5.2.1 Technological research & develop niche strategy

Step 3A. Description of niche strategy
This niche strategy aims to increase the technological knowledge of the company on the fundamental and applied technological principles of the production, the production system and the required complementary products and services. This strategy encompasses experimentation in a research environment. The strategy can either be executed within the company, in partnership with another company, or by acquiring the needed knowledge.

Step 3B. Defining category of niche strategy
The Technological research & develop niche strategy can be described as an 'increasing knowledge and resources niche strategy', since it aims to increase the knowledge that is available within the company.

Step 4A. Theoretical support of niche strategy
Many researchers agree that new knowledge creation is key for the success and the continuation of companies aiming to innovate within a dynamic market. (Kogut & Zander, 1992; Nonaka, 1991; K. G. Smith et al., 2005) 'Internal knowledge exploration' involves the creation and acquisition of knowledge inside the company and depends on the skills, knowledge and competences of its employees. (K. G. Smith et al., 2005)

Step 4B. Relationship confirmation
The Technological research & develop niche strategy is an example of an internal knowledge exploration process. It can thus be confirmed (see table 5.2) that this niche strategy can overcome barriers caused by a lack of knowledge and awareness of technology.

Table 5.2: Results of the literature confirmation: Technological research & develop niche strategy

Type-2		
A 'Technological research & develop niche strategy' can remove deficiencies within the following influencing factors:		**Relationship supported by literature?**
IF-1	'Knowledge and awareness of technology'	Yes

5.2.2 Pilot research & develop niche strategy and Pilot project niche strategy

Step 3A. Description of niche strategy
The first indicated niche strategy, a Pilot research & develop niche strategy is a small-scale research project aiming to study and evaluate the usage of the innovation in practice. This can be done with the aim to obtain real-life information on the technology or to obtain knowledge and awareness on the usage of the product in practice. The second indicated niche strategy, the Pilot project niche strategy, is a pilot study with the aim to create public awareness and acceptance. They are two separate niche strategies since they overcome different type of barriers. The first one lacking knowledge and awareness *within* the company and the second one lacking knowledge and awareness *within* the social components of the socio-technical system.

Step 3B. Defining category of niche strategy
The Pilot research & develop niche strategy can be described as an 'Increasing knowledge and resources niche strategy', since it aims to increase the knowledge that is available within the company. The Pilot project niche strategy can be described as an 'influencing niche strategy', since it aims to influence the perception of the social components within the socio-technical system.

Step 4A. Theoretical support of niche strategy
A pilot study is described by the Concise Oxford Thesaurus as an 'experimental, exploratory, test, preliminary, trial or try out investigation. The role of pilot studies within the development and deployment of radical innovations it is mentioned as 'demonstration and trial' projects.
Fevolden et al. (n.d.) argue that 'demonstration projects and trials are consequently a crucial tool for companies to facilitate learning and reduce risk'. Gallagher et al. (2006) describe three ways in which demonstration projects contribute to the development and diffusion of the technological innovation:

(1) The technology can be tested in real-life, in which technical and economic data can be obtained which can be used to improve the technology;
(2) It can help by scaling-up the technology;
(3) It shows the market the feasibility of the application, which increases the confidence within the market.

Demonstration projects and trials are widely used by companies that are introducing new technology into the market as a tool to reduce uncertainties. (Hendry et al., 2010) For example, as described by Hendry et al. (2010) demonstration projects and trials are used to 'overcome innovation uncertainties in renewable energy for electricity supply systems in the US, EU and Japan'.

Step 4B. Relationship confirmation
In the initial conceptual model developed in chapter 3, the pilot research & develop niche strategy is included as a type-2 strategy: it aims to remove the deficiency related to influencing factors 1 'Knowledge and awareness of technology' and 2 'Knowledge and awareness of application and market'. Table 5.3 indicates these two influencing factors. Furthermore, the pilot project research niche strategy is included as a type-3 strategy (see table 5.3).

It can be concluded that the relationship between a lack of knowledge and awareness of technology, application and market can be overcome by adopting the Pilot research & develop niche strategy; It will provide knowledge and insights into the technological problems that can be experienced by users in practice but which are unknown to the company. Furthermore, the strategy can provide the company general knowledge and insights into the market and the application. The last two barriers indicated in table 5.3 are a lack of knowledge and awareness amongst the network and consumers, which can be indeed be increased by a demonstration and trial project.

Table 5.3: Results of the literature confirmation: Pilot research & develop niche strategy and Pilot project niche strategy

Type-2		
A 'Pilot research & develop niche strategy' can remove deficiencies within the following influencing factors:		**Relationship supported by literature?**
IF-1	'Knowledge and awareness of technology'	Yes
IF-2	'Knowledge and awareness of application and market'	Yes
Type-3		
A 'Pilot project niche strategy' can overcome the following can remove the following deficiencies within the core factors:		**Relationship supported by literature?**
IF-2 CF-5	'A lack of knowledge and awareness of application and market affects the network creation and coordination'	Yes
If-2 CF-6	'A lack of knowledge and awareness of application and market affects the availability of customers'	Yes

5.2.3 Market research & develop niche strategy

Step 3A. Description of niche strategy
The Market research & develop niche strategy aims to develop internal knowledge by doing a market research. This includes visiting trade exhibitions and conferences in order to increase the internal technological knowledge and knowledge on the competitors. The latter is important to be able to establish a competitive advantage. On those exhibitions and conferences, the latest trends and innovations in the industry can be discovered. Furthermore, this strategy includes a market analysis on consumers, in order to understand their wants and needs regarding the performance and quality of the products and focus groups, interviews or surveys to increase the knowledge and familiarity of the application among consumers and actors in the supply chain.

Step 3B. Defining category of niche strategy
The Market research & develop niche strategy can be described as an 'increasing resources and knowledge niche strategy', since it aims to increase the knowledge that is available within the company.

Step 4A. Theoretical support of niche strategy
'External knowledge generation' involves the sourcing, acquisition or imitation of knowledge from outside the company (Lane et al., 2006). Market Research & Develop Strategy can be categorised in this type of knowledge generation. Literature also refers to it as 'market orientation'; Kohli & Jaworski (2019) describe that market orientation entails "1) one or more departments engaging in activities geared towards developing an understanding of customers' current and future needs and the factors affecting them, 2) sharing of this understanding across departments and 3) the various departments engaging in activities designed to meet select customer needs".
Furthermore, 'Market intelligence' is a broader used term. It includes also obtaining information on the competition and regulation that is present in the market that influences the (future) needs and preferences of the customers.

Step 4B. Relationship confirmation
It is a common strategy to obtain knowledge of the market by means of a market research, which can be done by different strategies, but all have as goal to obtain information about the needs and preferences of the market. It can thus be confirmed that deficiencies regarding the influencing factor 'knowledge and awareness of application and market' can be overcome by adopting a Market research niche strategy. However, a confirmation of the proposed relationship between deficiencies

related to influencing factor 'knowledge and awareness of technology' and this strategy cannot be done based on the studied literature sources (see table 5.4).

Table 5.4: Results of the literature confirmation: Market research & develop niche strategy

Type-2		
A 'Market research & develop niche strategy' can remove deficiencies within the following influencing factors:		**Relationship supported by literature?**
IF-1	'Knowledge and awareness of technology'	?
IF-2	'Knowledge and awareness of application and market'	Yes

5.2.4 Human resource niche strategy

Step 3A. Description of niche strategy
The aim of the Human resource niche strategy is to increase the internal knowledge, competences and skills by hiring new employees or interns.

Step 3B. Defining category of niche strategy
The Human resource niche strategy can be described as an 'increasing resources and knowledge niche strategy', since it aims to increase the resources and knowledge that is available within the company.

Step 4A. Theoretical support of niche strategy
The Human resource niche strategy is a form of external knowledge generation. The latter involves the sourcing, acquisition or imitation of knowledge from outside the company (Lane et al., 2006). The exchange of knowledge within a company can lead to new knowledge generation, which will be more fruitful if the knowledge of the employees is more diverse. (Cohen and Levinthal, 1990)

Step 4B. Relationship confirmation
It can be concluded that attracting new employees or interns can lead to new knowledge (generation) within the company, since they can bring in new, more diverse, knowledge. It can thus solve the lack of human resources with appropriate knowledge and capabilities, and it can increase the knowledge of technology by hiring employees who have the required knowledge that is missing. (See table 5.5)

Table 5.5: Results of the literature confirmation: Human resource niche strategy

Type-2		
A 'Human resource niche strategy' can remove deficiencies within the following influencing factors:		**Relationship supported by literature?**
IF-1	'Knowledge and awareness of technology'	Yes
IF-3a	'Human resources'	Yes

5.2.5 Education niche strategy

Step 3A. Description of niche strategy
This strategy is derived from Ortt et al. (2013)
The Education niche strategy aims to build understanding around both the fundamental and applied technological aspects involved with the product, production system and complementary products and services, with the aim to educate the suppliers, the customers, or the institutions. Sharing of knowledge can be done by workshops, networking and brokering events, presentations, reports, debates and round tables.

Step 3B. Defining category of niche strategy
The Education niche strategy can be described as an 'influencing niche strategy', since it aims to change the knowledge and the perception of the customers, suppliers and institutions in order to be able to sell the innovation to a niche market.

Step 4A. Theoretical support of niche strategy
Education, as in providing new knowledge and information, is known as a useful tool to, for example, increase the understanding of what people know and to increase the ability of observing and evaluating results. (K. G. Smith et al., 2005)

Step 4B. Relationship confirmation
The education strategy is a proposed strategy for the barriers below. The barriers are all related to missing knowledge on technology or application, either among stakeholders within the network, consumers, or among the institutions. Since the previous step indicates that transferring knowledge is a useful tool to increase the understanding of people, it can be confirmed that the Education niche strategy can overcome the barriers described in table 5.6, since they are all related to a lack of knowledge and awareness.

Table 5.6: Results of the literature confirmation: Education niche strategy

Type-3		
An 'Education niche strategy' can remove the following deficiencies within the core factors:		**Relationship supported by literature?**
IF-1 – CF-5	'A lack of knowledge and awareness of technology affects the network formation and coordination'	Yes
If-1 – CF-6	'A lack of knowledge and awareness of technology affects the availability of customers'	Yes
IF-1 – CF-7	'A lack of knowledge and awareness of technology affects the availability of appropriate institutional aspects'	Yes
IF-2 – CF-3	'A lack of knowledge and awareness of market and application affects the network formation and coordination'	Yes
If-2 – CF-6	'A lack of knowledge and awareness of market and application affects the availability of customers'	Yes
IF-2 – CF-7	'A lack of knowledge and awareness of market and application affects the availability of appropriate institutional aspects'	Yes

5.2.6 Internal knowledge sharing niche strategy

Step 3A. Description of niche strategy
The Internal knowledge sharing niche strategy aims to increase the overall level of technological knowledge, skills and competences among the employees of the company. Internal training, courses and brainstorm sessions can achieve this.

Step 3B. Defining category of niche strategy
The Internal knowledge sharing niche strategy can be described as an 'increasing knowledge and resources niche strategy', since it aims to increase the applicability and use of knowledge that is available within the company.

Step 4A. Theoretical support of niche strategy
The Internal knowledge sharing niche strategy is a common strategy within companies that is described as that it "may nurture interunit cooperation and mutual learning, stir up existing

knowledge repositories, and stimulate new ideas for radical innovation". (Tsai, 2001; Zander & Solvell, 2000; Zhou & Li, 2012)

Step 4B. Relationship confirmation
It can be confirmed that internal knowledge sharing increases the overall capabilities of employees and that it can increase their knowledge. It can furthermore be concluded that internal knowledge sharing can stimulate new ideas for innovation, which can be indirectly beneficial for the product performance and quality. It may not solve the influencing barriers, but internal knowledge sharing can remove the deficiency within the core factor. (See table 5.7)

Table 5.7: Results of the literature confirmation: Internal knowledge sharing niche strategy

Type-2		
A 'Internal knowledge sharing niche strategy' can remove deficiencies within the following influencing factors:		**Relationship supported by literature?**
IF-3a	'Human resources'	Yes
Type-3		
A 'Internal knowledge sharing niche strategy' can remove the following deficiencies within the core factors:		**Relationship supported by literature?**
IF-1 – CF-1	'A lack of knowledge and awareness of technology affects the product performance and quality'	Yes

5.2.7 Lead-user niche strategy

Step 3A. Description of niche strategy
I derived this strategy from Ortt et al.(2013).
This strategy aims to co-develop the innovation with a lead-user (which can be a person, company or institution) representing the target group. The lead-user has the opportunity to integrate his needs and desires into the innovation and to test it.

Step 3B. Defining category of niche strategy
The Lead-user niche strategy can be categorised as an 'increasing knowledge and resources niche strategy', since it aims to increase the knowledge of the company on the market characteristics. Furthermore, it can also be categorised as an 'influencing niche strategy', since the strategy influences the market with the lead-user; The lead-user serves as example for the market.

Step 4A. Theoretical support of niche strategy
A lead user strategy is described in literature as a marketing research tool. Von Hippel (1986), who developed the lead user method, describes that lead users are users that represent the future wants and demands of the market; lead users are on the forefront of future trends. By fulfilling their needs, new innovations can be developed. (Von Hippel, 1986) Multiple articles describe empirical evidence of the effectiveness of the lead user method for companies aiming to develop breakthrough innovations with a high commercial attractiveness (Franke & von Hippel, 2003; Lilien et al., 2002; Lüthje & Herstatt, 2004). Dijk & Yarime (2010) calls the mechanism of imitation of lead-users by both users and actors at the supply side 'Imitation of Use'.

Step 4B. Relationship confirmation
It can be concluded that a lead-user strategy is an appropriate strategy to overcome barriers related to missing knowledge and awareness of the application and the market, since, as described in in the previous step, an important player who is aware of the trends, needs and wishes of the market will contribute to the innovation process. This will bring in new knowledge and ideas about their wishes and demands. Since their ideas also incorporate the socio-cultural aspects that affected the

development of the innovation, it is also confirmed that the strategy can remove barriers related to the social cultural aspects; it adapts the core factors to the social-cultural aspects that are present in the market. It thus not solves the deficiency related to the influencing factor but it does solve the deficiencies related to the core factors. (See table 5.8)

Table 5.8: Results of the literature confirmation: Lead-user niche strategy

Type-2		
A 'lead-user niche strategy' can remove deficiencies within the following influencing factors:		**Relationship supported by literature?**
IF-2	'Knowledge and awareness of application and market'	Yes
Type-3		
A 'lead-user niche strategy' can remove the following deficiencies within the core factors:		**Relationship supported by literature?**
IF-5 – CF-1	'Social cultural aspects affect the product quality and performance'	Yes
IF-5 – CF-5	'Social cultural aspects affect the network formation and coordination'	Yes
IF-6 – CF-5	'Macro- and meso-economic, institutional, and strategic aspects affect the network formation and coordination'.	Yes
If-5 – CF-6	'Social cultural aspects affect the availability of customers'	Yes
IF-6 – CF-6	'Macro- and meso-economic, institutional, and strategic aspects affect the availability of customers'	Yes
IF-5 – CF-7	'Social cultural aspects affect the availability of appropriate institutional aspects'	Yes

5.2.8 Crowdsourcing niche strategy

Step 3A. Description of niche strategy
This strategy aims to co-develop the innovation using crowd-powered information platforms. The company propose users problems they are experiencing concerning the innovation, after which users are able to give solutions (for example a product or service design) to these problems using their own experiences, knowledge and insights.

Step 3B. Defining category of niche strategy
The Crowdsourcing niche strategy can be categorised as an 'Increasing knowledge and resources niche strategy', since it aims to increase the knowledge of the company on the market characteristics.

Step 4A. Theoretical support of niche strategy
Crowdsourcing is first described by Howe (2006) as an "act of a company or institution taking a function once performed by employees and outsourcing it to an undefined (and generally large) network of people in the form of an open call". It is based upon the idea that crowds hold skills, knowledge and ideas that can help the company to innovate. It is a process in which companies open their innovation practices to the broader market. (Djelassi & Decoopman, 2013)

Step 4B. Relationship confirmation
It can be concluded that a crowdsourcing strategy is an appropriate strategy to overcome barriers related to missing knowledge and awareness of the application and the market, since, as described in the previous step, the market itself will contribute to the innovation process. This will bring in new knowledge and ideas about their wishes and demands. Since their ideas also incorporate the socio-cultural aspects that affected the development of the innovation, it is also confirmed that the

strategy can remove barriers related to the social cultural aspects; it adapts the core factors to the social-cultural aspects that are present in the market. It thus not solves the deficiency related to the influencing factor but it does solve the deficiencies related to the core factors. (See table 5.9)

Table 5.9: Results of the literature confirmation: Crowdsourcing niche strategy

Type-2		
A 'Crowdsourcing niche strategy' can remove deficiencies within the following influencing factors:		**Relationship supported by literature?**
IF-2	'Knowledge and awareness of application and market'	Yes
Type-3		
A 'Crowdsourcing niche strategy' can remove the following deficiencies within the core factors:		**Relationship supported by literature?**
IF-5 – CF-1	'Social cultural aspects affects the product quality and performance'	Yes
If-5 – CF-6	'Social cultural aspects affects the availability of customers'	Yes
IF-5 – CF-7	'Social cultural aspects affects the availability of appropriate institutional aspects'	Yes

5.2.9 Finance sourcing niche strategy

Step 3A. Description of niche strategy
The Finance sourcing niche strategy aims to increase the financial resources of the company. This can be achieved by different measures. It is possible to apply for a loan (the lender can be different), to start a crowd funding campaign, to participate in competitions that have financial prizes, or by finding an investor.

Step 3B. Defining category of niche strategy
The Finance sourcing niche strategy can be described as an 'increasing knowledge and resources niche strategy', since it aims to increase the resources that are available within the company.

Step 4A. Theoretical support of niche strategy
Getting a loan to increase the financial resources is referred to in literature as 'debt financing'. The lenders are usually banks; it is shown that start-up capital often consists out of this kind of funding. (Kerr & Nanda, 2015; Robb & Robinson, 2014) As described by Morris et al. (2009) 'debt financing is often seen as more accessible than investment finance and as generally requiring a lower level of accountability'. Furthermore, a loan is described as a method that is usually applied to acquire asset purchases, whereas investment finance is in general used to finance longer-term business development or major purchases. This is due to usually high interests for loans. (Morris et al., 2009)

Crowd funding is a form of financial investment that is nowadays seen as an alternative way to gain external financial resources (Belleflamme et al., 2014). Crowd funding is defined by Ordanini et al. (2011) as "a collective effort by people who network and pool their money together, usually via the internet, in order to invest in and support efforts initiated by other people or organizations". This strategy is usually adopted to gain direct contact to the market and to gain financial resources from a large crowd who are genuinely interested in the innovation. (Ordanini et al., 2011)

Step 4B. Relationship confirmation
It can be concluded that the deficiency related to the influencing factor financial resources could be removed by the adoption of the finance sourcing. The different possibilities regarding the manner in

which the financial resources are obtained have different characteristics but they all overcome the barrier in their own way. (See table 5.10)

Table 5.10: Results of the literature confirmation: Finance sourcing niche strategy

Type-2		
A 'Finance resource niche strategy' can remove deficiencies within the following influencing factor:		**Relationship supported by literature?**
IF-4	'Financial resources'	Yes

5.2.10 Subsidies niche strategy

Step 3A. Description of niche strategy
I derived this strategy from Ortt et al.(2013)
The Subsidies niche strategy aims to decrease the price of the product and/or to increase the financial resources of the company. In the conceptual model, there are 2 types of subsidy strategies described, the first type (A) is subsidy that the company receives from national or international funds, and the second type (B) is a tax subsidy, which is obtained by the customers.

Step 3B. Defining category of niche strategy
The Subsidies niche strategy can be categorised as an 'Increasing knowledge and resources niche strategy' in the case of type A, since it aims to increase the resources that are available within the company. It can be categorised as an 'influencing niche strategy' in the case of type B, since it decreases the product price and by this it influences the customers to buy the product.

Step 4A. Theoretical support of niche strategy
Governments are able to support companies by providing subsidies. An example is offering tax credits: This makes the acquisition or use of the innovation less expensive for consumers. Another examples are grants, which are directly paid to the company. (del Río et al., 2010)

Morris et al. (2009) describes that grants are a good source of finance for new and developing companies. However, it can take a lot of time to obtain a grant, and usually it covers not all costs needed. Nanda et al. (2015) describe that innovative projects in industries in which it takes a lot of time to discover the viability in terms of capital and investment of a project (such as the clean energy industry) are usually not funded without external financial aid from the government. Howell (2015) confirms the important role of these subsidies in the innovation process.

Step 4B. Relationship confirmation
It can be confirmed that the price that consumers pay will be lower by the tax credits; it is confirmed that the barrier related to a high product price can be circumvented by the adoption of the subsidy strategy. Furthermore, It can be concluded that the literature confirms that the barriers related to the influencing factor 'financial resources' can be overcome by the Subsidies niche strategy, since grants will increase the financial resources. (See table 5.11)

Table 5.11: Results of the literature confirmation: Subsidies niche strategy

Type-1		
A 'Subsidies niche strategy (type B)' can circumvent deficiencies in the following core factors:		**Relationship supported by literature?**
CF-2	'Product price'	Yes

Type-2		
A 'Subsidies niche strategy (type A)' can remove deficiencies within the following influencing factor:		**Relationship supported by literature?**
IF-4	'Financial resources'	Yes

5.2.11 Changing behaviour strategy

Step 3A. Description of niche strategy

This strategy aims to create a niche market by changing the behaviour of the actor within the socio-technical system. Different measures can be implemented in order to overcome the barriers, depending on the underlying reason. Consumer confidence can be established by handing out samples, which shows how the product fit into the daily lives of the consumers. By means of advertisements people can get introduced to the new behaviour, which establishes awareness and encourages acceptance of the new behaviour. Demonstrating proof of pay-off of the product can show consumers a possible reward (eg water savings) of the new behaviour, encouraging them to purchase the product. Furthermore, rewarding the right behaviour by for example discounts on next purchases could stimulate consumers as well. Establishing a partnership with an influencer (which can be a person, company, or institution) can also influence consumer behaviour.

Step 3B. Defining category of niche strategy

This Changing behaviour niche strategy can be defined as an 'Influencing Niche Strategy', since it aims to influence the behaviour of actors (network partners, consumers, institutions) and to change their perception of the product.

Step 4A. Theoretical support of niche strategy

"Social marketing" is a marketing strategy aiming to change consumer behaviour. (Kotler & Roberto, 1989) describe the 5 steps towards a strategy to change the consumer behaviour:

1. Analysing the social marketing environment
2. Researching and selecting the target adopter population
3. Designing social marketing strategies
4. Planning social marketing mix programs
5. Organizing, implementing, controlling, and evaluating the social marketing effort

Since personal preferences and benefits highly influences the customers choice at the moment of purchase, the features of the innovation should be communicated carefully. (Visser et al., 2018) Key & Czaplewski (2017) describe that by combining all the possible promotional tools (advertising, direct marketing, sales promotions, public relations, digital/internet marketing and personal selling) the reliability perception of the product or service by customers can be improved.

In practice, companies often try to change the behaviour of actors. For example, 'Recyclebank' offers discounts and deals to people who participate in their green practices. (Clinton & Whisnant, 2014) Furthermore, 'Opower', helps utility partners to promote energy efficiency amongst their clients through "proven behaviour-changing techniques (e.g. social proof, commitments, and fear of loss)". (Clinton & Whisnant, 2014)

Step 4B. Relationship confirmation

It can be concluded that the barriers related to deficiencies within the core factor network formation and coordination and consumers can be overcome, since a lack of knowledge and awareness on technology and application can be solved by the adoption of the strategy e.g. by working with an influencer. Also the (perception of a) lack of financial resources among consumers can be overcome by showing them proof of pay-off. However, it cannot be confirmed yet that the strategy can solve the deficiencies within the influencing factors IF-5 and IF-6. (See table 5.12)

Table 5.12: Results of the literature confirmation: Changing behaviour niche strategy

Type-2		
A 'Changing behaviour niche strategy' can remove deficiencies in the following influencing factor		**Relationship supported by literature?**
IF-5	'Social cultural aspects'	?
IF-6	'Macro- and meso-economic, institutional and strategic aspects'.	?
Type-3		
A 'Changing behaviour niche strategy' can remove the following deficiencies within the core factors:		**Relationship supported by literature?**
IF-2 – CF5	'A lack of knowledge and awareness of market and application affects the network formation and coordination'	Yes
IF-1 – CF-6	'A lack of knowledge and awareness of technology affects the availability of consumers'	Yes
If-2 – CF-6	'A lack of knowledge and awareness of market and application affects the availability of consumers'	Yes
IF-4 – CF-6	'A lack of financial resources affects the availability of consumers'	Yes

5.2.12 Redesign niche strategy

Step 3A. Description of niche strategy
The Redesign niche strategy aims to remove the particular barriers by redesigning the existing application. The redesign can be a simpler and/or cheaper version of the original application, so that it can be produced with the existing knowledge and the available financial and natural resources and with the desired performance and quality. The application can also be redesigned with the aim to adapt it to the socio-cultural environment, or to improved use cues of the product, so that the lack of technological knowledge of consumers can be decreased or removed.

Step 3B. Defining category of niche strategy
The Redesign strategy can be described as a 'Marketing niche strategy', or more specific the 'Changing physical aspects of product (-system) or complementary products and services niche strategy'. It aims to redevelop the product, or to develop the product further, so that it can be commercialised.

Step 4A. Theoretical support of niche strategy
Redesigning products is a common strategy for companies. The reasons for companies to redesign their products could be to increase the performance and quality, to lower the costs; to prolong the product's lifetime; to decrease the environmental impacts; to adapt to changing needs of customers; or to fix the product design flaws. (S. Smith et al., 2012) Desai et al. (2001) describes that the decisions related to the design of the product indeed affects the costs and revenue drivers.

Step 4B. Relationship confirmation
The sources mentioned above confirm that deficiencies related to the factors 'product performance and quality', the 'product price', the 'production system', the 'network formation and coordination' and the 'availability of customers' can indeed be solved by redesign. However, the proposed relationship between barriers related to the institutional aspects by adopting the strategy cannot be confirmed yet. (See table 5.13)

Table 5.13: Results of the literature confirmation: Redesign niche strategy

Type-1		
An 'Redesign niche strategy' can circumvent deficiencies in the following core factors:		**Relationship supported by literature?**
CF-7	'Institutional aspects	?
Type-3		
A 'Redesign niche strategy' can remove the following deficiencies within the core factors:		**Relationship supported by literature?**
IF-1 – CF-1	'A lack of knowledge on technology affects the product performance and quality'	Yes
If-4 – CF-1	'A lack of financial resources affects the product performance and quality'	Yes
IF-5 – CF-1	'Social cultural aspects affects the product performance and quality'	Yes
If-1 – CF-2	'A lack of knowledge on technology affects the product price'	Yes
IF-3b – CF-2	A lack of natural resources affects the product price'	Yes
IF-4 – CF-2	'A lack of financial resources affects the product price'	Yes
IF-1- CF-3	'A lack of knowledge on technology affects the production system'	Yes
IF-4 – CF-3	'A lack of financial resources affects the production system'	Yes
IF-1 – CF-5	'A lack of knowledge on technology affects the network formation and coordination'	Yes
IF-5 – CF-5	'Social cultural aspects affects the network formation and coordination'	Yes
IF-1 – CF-6	'A lack of knowledge on technology affects the availability of customers'	Yes
IF-4 – CF-6	'A lack of financial resources affects the availability of customers'	Yes
IF-5 – CF-6	'Social cultural aspects affects the availability of customers'	Yes

5.2.13 Stand-alone niche strategy

Step 3A. Description of niche strategy
I derived this strategy from Ortt et al.(2013)
The aim of the Stand-alone niche strategy is to adapt the innovation, so that it is operating independently and an infrastructure of complementary products and services is not required.

Step 3B. Defining category of niche strategy
The Stand-alone niche Strategy can be described as a 'Marketing Niche Strategy', more specifically the 'Changing physical aspects of product (-system) or complementary products and services niche strategy'.

Step 4A. Theoretical support of niche strategy
Literature on a comparable strategy is not found. However, Ortt et al. (2013) give an example of the adoption of a stand-alone strategy in practice; telephony was first used for 'intra-company communication', in which the telephones were directly connected with each other in pairs. (Dordick, 1990; Huurdeman, 2003) A system of complementary products and services was lacking due to a lack of knowledge on technology.

Step 4B. Relationship confirmation
As can be read in the conclusion in the previous chapter, the stand-alone niche strategy aims to solve the deficiency of a lacking or expensive system of complementary products and services by removing the dependency on such a system. The literature described in the paragraph above indicated that the strategy is implemented before, by highlighting a case in which a stand-alone version of a technology

was developed when a system of complementary products and services was not available. The case indicates that the strategy was adopted since there was a lack of knowledge and awareness of technology that affected the creation of a system of complementary products and services; the first relationship indicated in table 5.14 can thus be confirmed. However, it can be concluded that this example is not enough in order to confirm the other three relationships proposed.

Table 5.14: Results of the literature confirmation: Stand-alone niche Strategy

Type-3		
A 'Stand-alone niche strategy' can remove the following deficiencies within the core factors:		**Relationship supported by literature?**
IF-1 – CF-4	'A lack of knowledge and awareness of technology aspects affects the availability of complementary products and services'	Yes
If-3b CF-4	'A lack of natural resources affects the availability of complementary products and services'	?
IF-4 – CF-4	'A lack of financial resources affects the availability of complementary products and services'	?
IF-6 – CF-4	'Macro- and meso-economic, institutional, and strategic aspects affects the availability of complementary products and services'	?

5.2.14 Dedicated System Niche Strategy

Step 3A. Description of niche strategy
I derived this strategy from Ortt et al.(2013)
The Dedicated system niche strategy aims to remove the dependence on an external infrastructure of complementary products and services by designing an independent infrastructure of complementary products and services on a smaller scale.

Step 3B. Defining category of niche strategy
The Dedicated System Strategy can be described as a 'Marketing Niche Strategy', more specifically the 'Changing physical aspects of product (-system) or complementary products and services niche strategy'.

Step 4A. Theoretical support of niche strategy
Comparable to the previous strategy, a stand-alone niche strategy, literature on a comparable strategy is not found. However, Ortt et al. (2013) give an example of the adoption of a Dedicated system niche strategy in practice; Due to a lack of technological knowledge there was no system of complementary products and services available for the telephony technology. To overcome this barrier, a dedicated system was designed in which the telephony technology was used as an alarm system. (Dordick, 1990; Huurdeman, 2003)

Step 4B. Relationship confirmation
The dedicated system niche strategy aims to solve the deficiency of a lacking or expensive system of complementary products and services by removing the dependency on such a system. The literature described in the paragraph above indicated that the strategy is implemented before, by highlighting a case in which a dedicated system was developed when a system of complementary products and services was not available. The case indicates that the strategy was adopted since there was a lack of knowledge and awareness of technology that affected the creation of a system of complementary products and services; the first relationship indicated in table 5.15 can thus be confirmed. However, it can be concluded that this example is not enough in order to confirm the other three relationships proposed.

Table 5.15: Results of the literature confirmation: Dedicated system niche strategy

Type-3		
A 'Dedicated system niche strategy' can remove the following deficiencies within the core factors:		**Relationship supported by literature?**
IF-1 – CF-4	'A lack of knowledge and awareness of technology aspects affects the availability of complementary products and services'	Yes
If-3b CF-4	'A lack of natural resources affects the availability of complementary products and services'	?
IF-4 – CF-4	'A lack of financial resources affects the availability of complementary products and services'	?
IF-6 – CF-4	'Macro- and meso-economic, institutional, and strategic affects the availability of complementary products and services'	?

5.2.15 Hybridization niche strategy

Step 3A. Description of niche strategy

I derived this strategy from Ortt et al.(2013)

This niche strategy aims to integrate the innovation with an existing innovation, so that the infrastructure of complementary product and services of the existing innovation can be used.

Step 3B. Defining category of niche strategy

The Hybridization niche strategy is both an 'Influencing market strategy' and a 'Marketing niche strategy' (a Changing physical aspects of product (-system) or complementary products and services niche strategy'). Hybridization with another, existing innovation so that the complementary products and services can be used will lead to the creation of a niche where the innovation can be sold in. However, it can also be perceived as an influencing strategy, since the hybrid innovation can be perceived as an intermediate step towards a new infrastructure of complementary products and services. The market will be able to slowly adapt in terms of, for example, favourable institutional aspects, acceptance or physical infrastructures under influence of the hybrid innovation. Because of this, a new infrastructure of complementary products and services will be slowly shaped to the needs of the new innovation.

Step 4A. Theoretical support of niche strategy

The Hybridization niche strategy aims to improve the technical compatibility of the innovation, which is described as "the innovation's compatibility with existing systems, including hardware and software" (Iyer et al., 2006). Hybridization of technologies is mentioned as necessary for the transition towards new systems, since these are usually characterised by lock-in and stability (Geels & Schot, 2007b; Hekkert & van den Hoed, 2004; Raven, 2007). These hybrids help developing the radical technology in terms of 'producer learning, consumer familiarity and complementary assets'. (Keith, 2012) An example is the existence of hybrid cars, which are developed due to a lacking infrastructure of complementary products and services that are needed for full electric cars (Ortt et al., 2013).

Step 4B. Relationship confirmation

Literature indicates that hybridization can help develop the radical technological in terms of providing a system of complementary products and system when this is lacking for the developed innovation. It can thus be concluded that the core factor indicated in table 5.16 can be circumvented by the adoption of a hybridization niche strategy.

Table 5.16: Results of the literature confirmation: Hybridization niche strategy

Type-1		
An 'hybridization niche strategy' can circumvent deficiencies in the following core factors:		**Relationship supported by literature?**
CF-4	'Complementary products and services'	Yes

5.2.16 Adaptor Niche Strategy

Step 3A. Description of niche strategy
This niche strategy aims to develop a device that makes the innovation adaptable to an existing network of complementary products and services. Because of the possibility to make use of another infrastructure of complementary products and services, the influence of the lack of natural and financial resources and the lack of knowledge and awareness of technology on the availability of such a network is circumvented.

Step 3B. Defining category of niche strategy
The Adaptor niche strategy can be described as a 'Marketing Niche Strategy', more specifically a 'changing physical aspects of product (-system) or complementary products and services niche strategy'.

Step 4A. Theoretical support of niche strategy
The Adaptor niche strategy is a form of standardization, which can be described as properties that an innovation must contain in order to function with an existing system of complementary products and services (also called 'compatibility' or 'interoperability'). (Tassey, 1999) Standardization is used often in product design and manufacturing strategies.

Step 4B. Relationship confirmation
Although it is not explicitly mentioned that the strategy can overcome a barrier in which a system of complementary products and services is lacking, it can be concluded that literature confirms that adapting products to an existing network of complementary products and services is a common strategy. (See table 5.17)

Table 5.17: Results of the literature confirmation: Adaptor niche strategy

Type-1		
An 'Adaptor niche strategy' can circumvent deficiencies in the following core factors:		**Relationship supported by literature?**
CF-4	'Complementary products and services'	Yes

5.2.17 Direct- and Indirect lobbying niche strategy

Step 3A. Description of niche strategy
The direct lobbying niche strategy aims at direct, informal contact (calls, emails, meetings) with the policy makers that have a direct influence on the specific laws, rules and standards that needs to be influenced.
An indirect lobbying niche strategy aims to raise awareness on the application and market among NGO's, the public and the media, who subsequently can influence the policy makers by applying pressure.

Step 3B. Defining category of niche strategy

Both the Direct lobbying niche strategy and Indirect lobbying niche strategy are an 'Influencing Niche Strategy', since they aim to change the market by changing the institutional aspects in favour of the innovation.

Step 4A. Theoretical support of niche strategy

Influencing policies is a recurring topic in literature on political science. Different methods are described; lobbying, campaign contributions, endorsements, media campaigns and grassroots campaigns. (De Figueiredo & Richter, 2014) Lobbying is described as an inherent element of 'democratic decision-making processes at all levels' (Jugo et al., 2015).

Negro et al. (2012) mention that instead of competing with competitors from the beginning, it is more beneficial for companies to 'form coalitions and alliances' and lobby for their innovation together, in order to change institutional aspects, acquire the necessary resources and to create a niche in the market.

Furthermore, it is argued by Bicchieri & Mercier (2014) that laws can change the social norms of people and "can even change a person's own preferences and create guilt, especially when there is a shared norm of obeying the law". (Bicchieri & Mercier, 2014)

Step 4B. Relationship confirmation

Both the niche strategies are seen as appropriate strategies to influence policies; it is confirmed that both the niche strategies can remove deficiencies related to a lack of appropriate institutional aspects. Furthermore, by changing the institutions, it can be confirmed that inappropriate social-cultural aspects can be removed by introducing new laws (for which can be lobbied). However, overcoming deficiencies related to IF-6 cannot be directly confirmed. (See table 5.18 & 5.19)

Table 5.18: Results of the literature confirmation: Direct lobbying niche strategy

Type-2		
A 'Direct lobbying niche strategy' can remove deficiencies within the following influencing factors:		**Relationship supported by literature?**
IF-5	'Social-cultural aspects	Yes
IF-6	'Macro- en meso-economic, institutional and strategic aspects'	?
Type-3		
A 'Direct lobbying niche strategy' can remove the following deficiencies within the core factors:		**Relationship supported by literature?**
IF-1 – CF-7	'A lack of knowledge and awareness of technology affects the availability of appropriate institutional aspects'	Yes
If-2 – CF-7	'A lack of knowledge and awareness on market and application affects the availability of appropriate institutional aspects'	Yes

Table 5.19: Results of the literature confirmation: Indirect lobbying niche strategy

Type-2		
An 'Indirect lobbying niche strategy' can remove deficiencies within the following influencing factors:		**Relationship supported by literature?**
IF-5	'Social-cultural aspects	Yes
Type-3		
An 'indirect lobbying niche strategy' can remove the following deficiencies within the core factors:		**Relationship supported by literature?**
If-2 – CF-7	'A lack of knowledge and awareness on market and application affects the availability of appropriate institutional aspects'	Yes

5.2.18 Campaign funding & Joining regulatory agency niche strategies

Step 3A. Description of niche strategy
The Campaign funding niche strategy aims to lobby via contributions to campaigns, which the goal to influence the policy makers and thus the institutions. A 'joining regulatory agency niche strategy' is a strategy in which a member or representative of the company joins a public or governmental agency in order to influence their activities.

Step 3B. Defining category of niche strategy
Both the Joining regulatory agency niche strategy and the Campaign funding niche strategy are an Influencing Niche Strategy, since they aim to change the market by changing the institutional aspects in favour of the innovation.

Step 4A. Theoretical support of niche strategy
Both the strategies are also a form of lobbying, and are able to change institutional aspects. (See description in §5.2.17 on the Direct- and indirect lobbying niche strategy).

Step 4B. Relationship confirmation
Both the niche strategies can be used to change unfavourable institutional aspects into favourable aspects; the influencing factors are not of importance in this case since the strategies directly solve the core factor institutional aspects. It is thus confirmed that both the niche strategies can remove deficiencies related to a lack of appropriate institutional aspects (see table 5.20).

Table 5.20: Results of the literature confirmation: Campaign funding niche strategy and Joining regulatory agency niche strategy

Type-3		
A 'Campaign funding niche strategy' and a 'Joining regulatory agency niche strategy' can remove the following deficiencies within the core factors:		**Relationship supported by literature?**
IF-1 – CF-7	'A lack of knowledge and awareness of technology affects the availability of appropriate institutional aspects'	Yes
If-2 – CF-7	'A lack of knowledge and awareness on market and application affects the availability of appropriate institutional aspects'	Yes
If-5 – CF-7	'Social-cultural aspects affects the availability of appropriate institutional aspects'	Yes
If-6 – CF-7	'Macro- and meso-economic, institutional and strategic aspects affects the availability of appropriate institutional aspects'	Yes
If-7 – CF-7	'Accidents and events affects the availability of appropriate institutional aspects'	Yes

5.2.19 Leasing niche strategy

Step 3A. Description of niche strategy
The Leasing niche strategy is a strategy in which consumers get access to the product for a fixed price paid in terms. Two types of leasing can be distinguished:
1) In the first type, the consumer owns the product as soon as the leasing contract starts. The company has only juridical ownership over the product during the lease contract.
2) In the second type, the company will keep ownership over the product during and at the end of the lease contract.
The aim of the Leasing niche strategy is two-folded, but both related to the price of the product. First, there is a high product price caused by influencing factors. A Leasing niche strategy gives the opportunity to the company to create a niche market despite the barriers, and could furthermore

buy the company time to work on solving the issues influenced by the contextual factors. Second, when the product price is perceived as high by the customers, or the price is high relatively to their financial position, a Leasing niche strategy offers the opportunity to customers to either make use of the product performance, or to require ownership by dividing the product costs over a certain time period.

Step 3B. Defining category of niche strategy
The Leasing Strategy can be characterized as a 'Marketing niche strategies' ('Changing business model niche strategy') , since it aims to create a niche market and sell the product, by changing the business model.

Step 4A. Theoretical support of niche strategy
The second type ('the company will keep ownership over the product during and at the end of the lease contract) as described in A., is in literature referred to as a type of use oriented Product Service System (PSS). A use oriented Product Service System is a business model in which selling products is not the main focus, but in which the aim is to fulfil the customer's needs. In these models, the ownership of the innovation stays within the company; the user only pays for use. Customers leasing the product have unlimited and individual access to the product. (Tukker, 2004).
This type of leasing is in some literature referred to as "fee for service" payment models. These "fee for service" payment models are mentioned in, for example, articles on bringing renewable energy to rural areas in developing countries. (Pode, 2013; Urmee et al., 2009)

The first type is a strategy in which the customer pays for the product, but owns the product as soon as the leasing contract starts. In economic and financing literature the strategy is referred to as "instalment loans" (Pressman, S., & Scott, 2010) or as a "progressive purchase" (Clinton & Whisnant, 2014). It is a widely used strategy (e.g. with cars and mobile phones) to enable consumers to buy a product, without the requirement of saving beforehand (Pressman, S., & Scott, 2010).

Step 4B. Relationship confirmation
It is confirmed by the sources mentioned above that a Leasing strategy can be adopted circumvent barriers related to a high product price if the high price affects the availability of customers; it has been shown in practice that it is a commonly adopted strategy in this case. It is also confirmed that the strategy can solve the barrier related to the availability of customers that have a lack of financial resources to acquire the product (See table 5.21).

Table 5.21: Results of the literature confirmation: Leasing niche strategy

Type-1		
A 'leasing niche strategy' can circumvent deficiencies in the following core factors:		**Relationship supported by literature?**
CF-2	'Product price'	Yes
Type-3		
A 'leasing niche strategy' can remove the following deficiencies within the core factors:		**Relationship supported by literature?**
IF-4 – CF-6	'A lack of financial resources affect the availability of customers'	Yes

5.2.20 Sharing platform niche strategy

Step 3A. Description of niche strategy
The Sharing platform niche strategy encompasses the creation of a (online) sharing platform, which enables an increased utilization rate of products by enabling or offering shared use, access or ownership. By adopting this niche strategy, the barriers related to a high product price can be removed or circumvented. Furthermore, the Sharing Platform Niche Strategy could buy the company time to work on solving the issues influenced by the contextual factors. (It can circumvent barriers related to the core factor 'product price')

Step 3B. Defining category of niche strategy
The Sharing Platform Strategy can be characterized as a 'Marketing Niche Strategy' ('Changing business model niche strategy'), since it aims to create a niche market and sell the product, by changing the business model.

Step 4A. Theoretical support of niche strategy
A Sharing platform niche strategy is, like the Leasing niche strategy, described in literature as a type of a use oriented Product Service System (PSS). A use oriented Product Service System is a business model in which selling products is not the main focus, but in which the aim is to fulfil the customer's needs. In these models, the ownership of the innovation stays within the company; the user only pays for use. The main difference with the leasing strategy, is that sharing the product offers the same product to different customers consecutive to each other (Tukker, 2004). Some examples of access-based consumption are car-or bike-sharing programs (ZipCar, B-cycle), online borrowing programs for DVD's (Netflix), fashion (Rent the Runway), jewellery (Borrowed Bling), or accomodation (AirBnB). (Eckhardt & Bardhi, 2012; Lawson et al., 2016) Lawson et al. (2016) studied the drivers for consumers to access products instead of owning them, and concluded that one of the drivers was saving money.

Step 4B. Relationship confirmation
It is confirmed by the sources mentioned above that a sharing platform niche strategy can be adopted circumvent barriers related to a high product price if the high price affects the availability of customers. It is also confirmed that an opportunity to share a product is appealing to consumers who lack money to acquire the product. (See table 5.22)

Table 5.22: Results of the literature confirmation: Sharing platform niche strategy

Type-1		
A 'sharing platform niche strategy' can circumvent deficiencies in the following core factors:		**Relationship supported by literature?**
CF-2	'Product price'	Yes
Type-3		
A 'sharing platform niche strategy' can remove the following deficiencies within the core factors:		**Relationship supported by literature?**
IF-4 – CF-6	'A lack of financial resources affect the availability of customers'	Yes

5.2.21 Buy-one, give-one niche strategy

Step 3A. Description of niche strategy
This strategy is mainly applicable in cases in which a company aims to sell their innovation to a poor target market. The strategy encompasses selling of the innovation to a target market that can afford to buy the innovation, and donating the same innovation to a target market that has the need for it, but do not have the financial resources to acquire it themselves.

Step 3B. Defining category of niche strategy
The Buy-one, give-one niche strategy can be characterized as a 'marketing niche strategy', specifically the 'changing business model niche strategy', since it adapts the business model to the existing market in order to sell it.

Step 4A. Theoretical support of niche strategy
The Buy-one, give-one niche strategy describes a business model commonly also referred to as a "buy one, give on" business model, which is nowadays widely adopted by companies (Clinton & Whisnant, 2014). Companies using this model sell a product or service to consumers, and use the profit to donate the product or service to a target group that is less fortunate. The "buy one, give one" business model is described as an effective measure to create social and commercial value. (Marquis & Park, 2014)

Step 4B. Relationship confirmation
These descriptions indicate that it can be assumed that this strategy is appropriate to overcome the barrier indicated in table 5.23.

Table 5.23: Results of the literature confirmation: Buy-one, give-one niche strategy

Type-3		
A 'buy-one, give-one niche strategy' can remove the following barrier:		**Relationship supported by literature?**
IF-4 – CF-4	'A lack of financial resources affect the availability of customers'	Yes

5.2.22 Geographical niche strategy

Step 3A. Description of niche strategy
This strategy is derived from (Ortt et al., 2013)
The Geographical niche strategy aims to circumvent the barrier by focussing on or moving to another geographical area, depending on the particular situation.

Step 3B. Defining category of niche strategy
The Geographical Niche Strategy can be characterized as a 'marketing niche strategy', since it tries to relocate to another, existing market in order to commercialise their product. Furthermore it can be characterized as a 'increasing knowledge and resources niche strategy', when natural resources are sourced from somewhere else.

Step 4A. Theoretical support of niche strategy
Research indicates that in order for companies to be able to develop and commercialise their innovations, the external environment including the choice for the right geographic location, is essential. (Christensen et al., 2010; Johansson & Lööf, 2008; Porter & Stern, 2001)

Porter & Stern (2001) describe that the success of innovation in a particular location depends on the "National Innovative Capacity". This framework consists out of three interrelated elements (Porter & Stern, 2001):

1) *The Common Innovation Infrastructure* – This element describes the infrastructure that is available to support the innovation throughout the economy, for example the available human and financial resources spend on research and the institutions that are present.
2) *Cluster-Specific Environment for Innovation* – This element describes the clusters that are present, which is a concentration of firms and institutions in an industry in a particular location. The competitive position of a company within a cluster can be described by Porter's diamond model, which includes the following 4 factors: Firm strategy, structure and rivalry; related and supporting industries; demand conditions; and factor conditions. (Porter, 1990)
3) *The Quality of Linkages* – The quality of the relationships between the innovation infrastructure and the nation's industrial clusters.

Step 4B. Relationship confirmation

The Geographical niche strategy is included in the conceptual model as a type-1 strategy; it is assumed that it can circumvent barriers related to core factors 5 'network formation and coordination'; 6 'Customers; and 7 'institutional aspects. The first element described by Porter & Stern (2001) indicates that the barriers related to a lack of appropriate specific institutional aspects is highly dependent on the location of the company, which supports that geographical relocation is an appropriate strategy to circumvent the barriers related to this core factor. The barriers related to the availability of consumers (CF-6) and network formation and communication (CF-5) can also be circumvented by relocating to another geographical area, since these are mentioned within the element 'cluster-specific environment for innovation' (See table 5.24). Furthermore, the Geographical niche strategy is included in the conceptual model as a type-2 strategy; it is assumed that it can remove barriers that are caused by a lack of natural resources. It aims to remove the deficiency by sourcing the natural resources somewhere else (or acquiring it somewhere else): a location where the needed resources are available or where the natural resources are less expensive. It is described by Porter & Stern (2001) in the first element.

Table 5.24: Results of the literature confirmation: Geographical niche strategy

Type-1		
A 'Geographical niche strategy' can circumvent deficiencies in the following core factors:		**Relationship supported by literature?**
CF-5	'Network formation and coordination'	Yes
CF-6	'Customers'	Yes
CF-7	'Institutional aspects'	Yes
Type-2		
A 'Geographical niche strategy' can remove deficiencies in the following influencing factor		**Relationship supported by literature?**
IF-3b	'Natural resources'	Yes

5.2.23 Top-end niche strategy

Step 3A. Description of niche strategy

I derived the strategy from (Ortt et al., 2013)

If the availability of a proper production system is lacking, or financial and natural resources are not available, which limits the number of products that can be produced, a high-end strategy can be adopted. The aim is to produce a high quality product on a small scale, using the available resources. The products can be sold to a high market segment, in which consumers have the financial resources

to acquire the product. The product is sold as a luxury; offering a high value and exclusivity is key to the strategy.

Step 3B. Defining category of niche strategy
The Top-end niche strategy can be characterised as a 'Marketing Niche Strategy', ('Changing business model niche strategy'), since it aims to create a niche market and sell the product, by changing the business model.

Step 4A. Theoretical support of niche strategy
Ortt et al. (2013) gives two examples in which technological innovations first were sold in the top-end of the market: Cars and the fiber Dyneema. Large-scale production was for both innovations not possible in the beginning; they were produced on a small scale by hand and introduced to the top-end of the market.

The Top-End Strategy is referred to in literature as a 'high pricing strategy'. A high pricing strategy is only viable if the price complies with the perceived value of the innovation by customers. However, in the luxury industry, a high price is usually a unique selling point and not so much a possible disadvantage. (Dolgui & Proth, 2010)

Step 4B. Relationship confirmation
In the conceptual model the strategy is included as both a type-1 and a type-3 strategy. In the first case, the strategy aims to circumvent the barriers related to a high product price. If, as described by literature, the high price complies with the perceived value of the innovation, the top-end strategy can indeed be adopted. The high price would thus be a unique selling point. The same counts for the barrier IF-4 - CF-6 (see table 5.25): when the customers have in general a lack of financial resources, a 'high pricing strategy' can be applied, in which the product will be sold as a luxury good first.
In the case of barrier IF-1 - CF-3 and IF-4 (see table 5.25), in which the production system is not properly developed to produce on a large-scale, the case-studies underline the possibility to produce hand-made products or produce on a smaller scale, and sell the products for a higher price to a higher segment in the market.

Table 5.25: Results of the literature confirmation: Top-end niche strategy

Type-1		
A 'Top-end niche strategy' can circumvent deficiencies in the following core factors:		**Relationship supported by literature?**
CF-2	'Product price'	Yes
Type-3		
A 'Top-end niche strategy' can remove the following deficiencies within the core factors:		**Relationship supported by literature?**
IF-1 – CF-3	'A lack of knowledge and awareness of technology affects the production system'	Yes
If-4 – CF-3	'A lack of financial resources affects the production system'	Yes
IF-4 – CF-6	'A lack of financial resources affects the availability of customers'	Yes

5.2.24 Partnerships niche strategy

Step 3A. Description of niche strategy

As can be seen in the table below, the Partnership niche strategy comprises different actions. It is not a facilitating strategy, but specific a niche strategy to overcome the mentioned barriers in the table below; the goal is to work together with other partners to remove or circumvent the experienced barriers and by this, create a niche market.

1) Either it is a social-hybridization niche strategy; using the network of the partners to overcome a lack of network formation and coordination.
2) Either it is a partnership in which natural resources are bought in bulk together with other parties that need the same materials, to overcome high prices of natural resources
3) Circumventing the lack of human resources by starting a partnership that can deliver the needed knowledge, or by acquiring the needed knowledge from a partner, to directly solve the deficiencies within the core factors 'product quality and performance' and 'production system'.

Step 3B. Defining category of niche strategy

The partnership niche strategy is in the first case described above a marketing niche strategy, and in the second and third case an 'increasing knowledge and resources niche strategy'. The last case combines most of the previously described niche strategies in this chapter that are also included in the 'increasing knowledge and resources niche strategies', but since the barriers are described differently (it is overlapping in a certain way), the niche strategy is described differently.

Step 4A. Theoretical support of niche strategy

For the first two cases, there are no comparable strategies or cases found in literature. The third case, however, can be supported by literature mentioned before; 'External knowledge generation' involves the sourcing, acquisition or imitation of knowledge from outside the company (Lane et al., 2006).

Step 4B. Relationship confirmation

The first two relationships mentioned in table 5.26 cannot be confirmed yet. The last two, however, can be confirmed. Since the acquisition or sourcing of knowledge outside the company will increase the available knowledge.

Table 5.26: Results of the literature confirmation: Partnership niche strategy

Type-1		
A 'Partnership niche strategy' can circumvent deficiencies in the following core factors:		**Relationship supported by literature?**
CF-5	'Network formation and coordination'	?
Type-2		
A 'Partnership niche strategy' can remove deficiencies within the following influencing factors:		**Relationship supported by literature?**
IF-3b	'Natural resources'	?
Type-3		
A 'Partnership niche strategy' can remove the following deficiencies within the core factors:		**Relationship supported by literature?**
IF-3a CF-1	'A lack of human resources with appropriate knowledge and capabilities affects the product quality and performance'	Yes
If-3a CF-3	'A lack of human resources with appropriate knowledge and capabilities affects the production system'	Yes

5.2.25 Different application niche strategy

Step 3A. Description of niche strategy
The Different application niche strategy is a strategy in which the technology is integrated into a different application than the originally developed application. The barriers that companies face with the originally developed application will be circumvented with this strategy will still exist, but it gives the company time to optimise the product performance and quality and the production system.

Step 3B. Defining category of niche strategy
The Different application niche strategy can be characterised as a 'Marketing Niche Strategy', since it aims to sell the technological innovation in a niche market by integrating the technology in another application.

Step 4A. Theoretical support of niche strategy
A comparable strategy has not been found in literature. However, an example of the adoption of this strategy in practice has been found; the production system that was needed to produce fine Nylon fibres, which would substitute silk in stockings, was not properly developed in the beginning. The producer, Dupont, decided to first produce thinker Nylon fibres and integrated these in toothbrushes, in order to be able to improve the production system. (Gillespie, 1986)(Gillespie, 1986) (Gillespie, 1986).

Step 4B. Relationship confirmation
The mentioned example was the case of a lacking production system. This means that only the relationship between the strategy and the core factor 'production system' has been confirmed (see table 5.27).

Table 5.27: Results of the literature confirmation: Different application niche strategy

Type-1		
A 'Different application niche strategy' can circumvent deficiencies in the following core factors:		**Relationship supported by literature?**
CF-1	'Product quality and performance	?
CF-3	'Production system'	Yes

5.3 Conclusion

This chapter aimed to confirm the proposed relationships in the conceptual model developed in chapter 4 using relevant literature. Figure 5.2 shows the confirmed and not confirmed relationships. Each column can be read separately. The niche strategies are displayed per core factor (CF) / influencing factor (IF) combination. Since the type-1 (blue) strategies are circumventing the influence of the deficient core factors, these are not linked to an influencing factor. Instead, they are connected to the core factors directly. The type-1 and type-2 niche strategies are linked to an influencing factor (the small grey boxes). Since the figure only indicates the numbers of the core and influencing factors, a legend is included presenting the corresponding names.

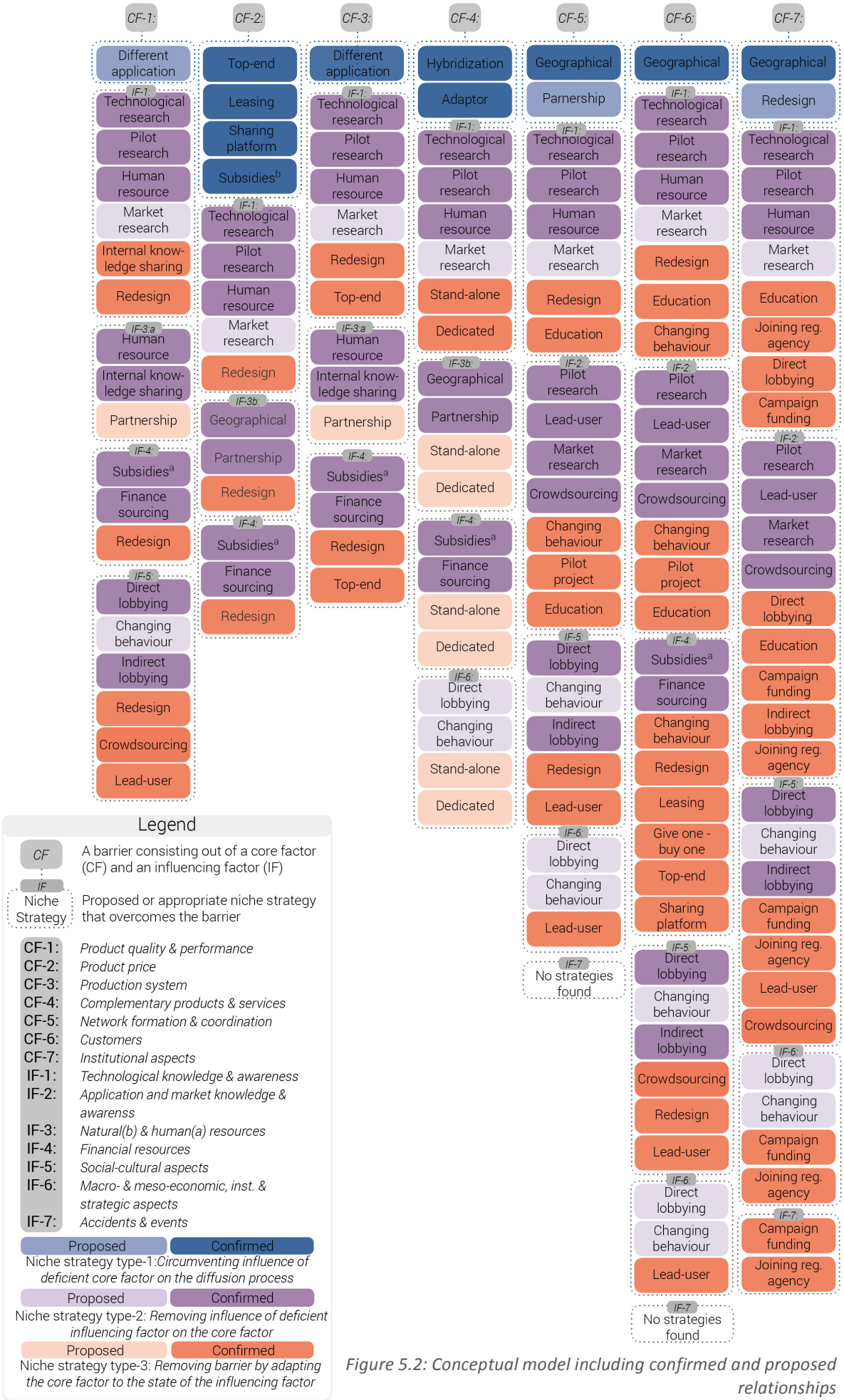


Figure 5.2: Conceptual model including confirmed and proposed relationships

The image indicates that a lot of relationships have been confirmed; of the 157 relationships indicated in the table, only 30 could not be confirmed. These confirmations are, as described in section 5.1, based on two types of confirmations: A) Either, the theory mentioned in the research material underlined the existence of the linkage between the barrier and strategy; Or B) the research material gave a real-life example of the linkage between the barrier and strategy based on a case-study research. Furthermore, there were three possibilities regarding the extent to which a relationship could be confirmed: 1) '*Yes'*: The proposed relationship has been confirmed by the literature sources; the relationship can be seen as appropriate; 2) '*No*': The proposed relationship is contradicted by the literature sources; the relationship should be removed or revised according to the findings. 3) '*?*': The reviewed literature sources do not provide enough information to either confirm or contradict the proposed relationships in the conceptual model.

In the previous section, it is notable that all proposed relationships could either be defined by confirmation type A and/or type B, or that the proposed relationship could neither be confirmed or contradicted (indicated with a *'?'*). In the latter cases, the reviewed literature material did not provide enough information to answer the question 'Does literature support the proposed relationship?' It is apparent that not one proposed relationship was contradicted by the reviewed literature. (See Discussion, chapter 8)

The following table indicates per niche strategy, which type of confirmation of the proposed relationships has been found in literature.

Table 5.28: Overview of confirmation type per niche strategy

Niche strategy	Confirmed – type A	Confirmed – type B
1. Technological research niche strategy	X	
2. Pilot research niche strategy	X	X
3. Pilot project niche strategy	X	X
4. Market research & develop niche strategy	X	
5. Human resources niche strategy	X	
6. Education niche strategy	X	
7. Internal knowledge sharing niche strategy	X	
8. Lead-user niche strategy	X	X
9. Crowdsourcing niche strategy	X	
10. Finance sourcing niche strategy	X	
11. Subsidies niche strategy	X	X
12. Changing behaviour niche strategy	X	X
13. Redesign niche strategy	X	
14. Stand-alone niche strategy		X
15. Dedicated system niche strategy		X
16. Hybridization niche strategy	X	X
17. Adapter niche strategy	X	
18. Direct lobbying niche strategy	X	
19. Indirect lobbying niche strategy	X	
20. Joining regulatory agency niche strategy	X	
21. Campaign funding niche strategy		
22. Leasing niche strategy	X	X
23.Sharing platform niche strategy	X	X
24. Buy-one, give-one niche strategy	X	
25. Geographical niche strategy	X	

26. Top-end niche strategy	X	X
27. Partnership niche strategy	X	
28. Different application niche strategy		X

There was aimed for a confirmation of the proposed relationships by both types of confirmation, however, as the table indicates, this was only achieved for 9 of 28 niche strategies. Since most of the niche strategies were part of multiple proposed relationships (the strategy can overcome multiple barriers), it can be that within those 9 cases, confirmation type A confirmed another proposed relationship than confirmation type B. Furthermore, the table shows that most of the proposed niche strategies can be compared to strategies that are described in literature (type A). Some of these sources mentioned the strategy and the actions related to the strategy as described in the conceptual model literally, and other sources mentioned comparable strategies, in relation to the barriers.

From the number of confirmed relationships found within the restrictions described in the data collection procedure (§5.1.2), it can be concluded that the logical reasoning behind the relationships proposed in the initial conceptual model is credible; a lot of the proposed niche strategies can be perceived as appropriate relationships. However, the confirmation of the proposed relationships, being evidence of the existence of the relationship in practice, should not be confused with the strength of these relationships; the success of the adoption of a particular niche strategy to overcome a barrier will depend on the particular characteristics of the company.

6. Primary case study protocol

The goal of the two primary case studies that will be described in this chapter is to refine and improve the initial conceptual model developed chapter 4 and to improve the evaluation criteria described in chapter 3. The main reason to conduct case studies is that this approach allows obtaining in-depth knowledge on the relationships and evaluation criteria in real life, including the specific contextual setting. (Yin, 2014) Sections 1.4.3 and 1.4.4 elaborate further on the reasoning and consequences of the decision to perform a case study research. This chapter starts with a general description of the case study protocol, after which it will be elaborated per step in the following sections.

6.1 Primary case study process

Figure 6.1 shows the steps that will be taken during the primary case study. It is based upon the case study process described by Yin (2014). The next page describes each step in more detail.

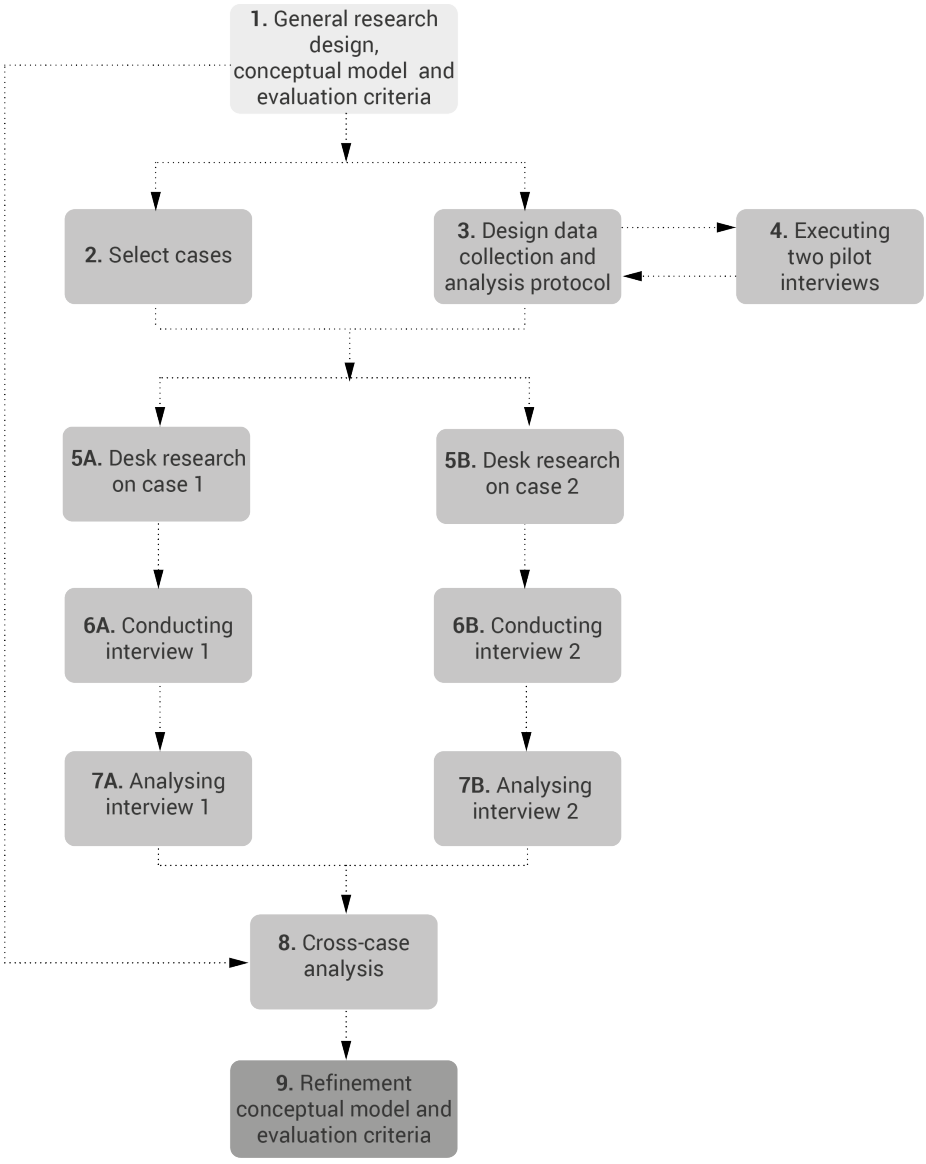


Figure 6.1: The case study process

The first step resembles the previous chapters, in which the research is designed and the evaluation criteria and conceptual model are developed, and serves as starting point of the case study. In the second step, the selection of the cases is done based on criteria. Case study criteria are drawn up in order to be able to select companies that are relevant to the goal of this thesis, and furthermore, to be able to compare the results of the case studies with each other. The third step concerns the development of the case study protocol describing the data collection and analysis methods. The interview developed in this part will be improved by conducting two small pilot studies, which is step four. The fifth step comprises a desk research on the two selected companies, to obtain as much information on the company, the interviewee, the innovation and the market they are active in, on forehand. The sixth step resembles the two interviews with the companies that will be done, which also includes sending summaries of the interviews to the companies in order to avoid inconsistencies or misinterpretations that are drawn from the interview. These interviews be individually analysed in step seven. Step eight resembles the cross-case analysis, in which the similarities or differences between both the interview results itself, and between the interview results and the initial conceptual model (based on logical reasoning and the literature search) and evaluation criteria are analysed. The ninth, and last, step includes drawing conclusions from the analyses and improvement and refinement of the evaluation criteria and the conceptual model.

The next sections describe the case study selection (step two), the data collection and analysis process (step three) and the results of the pilot interviews (step four). The other steps are described in the next chapters.

6.2 Case study selection

6.2.1 Criteria

Five criteria are distinguished that will be used during the case study selection:

1. **Case studies must focus on radical innovations**
As described in section 2.1.1, authors use different terminology to describe a radical innovation and the definition of a 'radical innovation' is rather broad: It can either be a radical new product, system, process or even a material or product component. Radical technologies can stand at the basis of multiple product innovations or can be more applied, which means that the technology is linked to a particular product category. (Ortt, Langley, et al., 2007) For the case studies in this research, I will focus on companies that integrate radical innovations into products that deliver a new functionality to the market.

2. **The radical innovations described in the case studies should be sustainable in nature**
This means that it should contribute to environmental, social and/or economic sustainability. This is criteria is necessary since the thesis will be done as part of the master Industrial Ecology.

3. **The position of the radical innovation on the pattern of development and diffusion should be within or in the end of the market adaptation phase**
The companies must be involved in the diffusion of a radical innovation on a niche level and must have adopted at least one niche strategy in the past, which means that the companies must have already sold products.

4. **The companies must be located in the Netherlands**
Since I will conduct interviews with the companies, it is necessary that they are located in the Netherlands.

5. **The companies should have started as a start-up maximum 10 years ago**
Firstly, it is easier to gain contact with smaller companies (which they most likely are if they only started 10 years ago) and secondly, if companies are smaller they experience different, and probably more, barriers than large, experienced (corporate) companies that already have a big market for their radical innovation or for other products. Furthermore, in order to perform a cross-case analysis, it is useful that they have the same characteristics since they will most likely experience the same type of barriers.

6.2.2 Case study selection

The criteria have lead to the selection of multiple potential companies that developed different type of radical innovations. Two of the selected cases agreed to participate in the research. This section will shortly elaborate on the cases and the reason behind the selection of these two cases using the criteria. Since one of the companies preferred to be included anonymously in the thesis, both the companies will be described anonymously. The first company that participated in the research will be referred to as 'Company A' and the second participating company as 'Company B'. The aim was to interview the founders, or at least an employee who is involved in the company from the start. The interviewee from company A was working at the company since 2016, the interviewee from company B only 8 months. The main disadvantage of interviewing employees that were not involved in the business practices from the beginning and who are not in the board of the company is that they are less familiar with the adopted strategies and experienced barriers of the company over time. However, they might be more critical towards the business practices and reveal more struggles of the company if they are not involved in the board of the company. The particular influence of the employees' position and involvement within the company on the results of the interviews will be elaborated in the discussion chapter.

Company A
The first participating company developed an innovation that increases the capacity of water storage, retention and drainage of roofs. It intercepts all the rainfall, controls the water drainage, delivers real time monitoring about rainfall, storage and drainage and is powered by solar energy. The innovation creates a whole new functionality for roofs, making it comply with the first criteria ('*Case studies must focus on radical innovations')* They aim to improve the urban environment by an improved use of the unutilized roofs: it becomes a place for nature development, recreation, water storage and food-and energy production. This makes the company comply with the second criteria (*'The radical innovations described in the case studies should be sustainable in nature').* They sell their innovation to a niche market, making the company comply to the third criteria ('*The position of the radical innovation on the pattern of development and diffusion should be within or in the end of the market adaptation phase').* The company is located in the Netherlands and separated from its 'original' company (started in 2010) in 2016, making it comply to the last two criteria ('*The companies must be located in the Netherlands' &' The companies should have started as a start-up')*

Company B
The second participating company developed a product that integrates solar cells, which can be placed on the outside of real estate buildings. Integrating solar cells into their product makes the company comply with the first two criteria ('*Case studies must focus on radical innovations' & 'The radical innovations described in the case studies should be sustainable in nature')* The company started in 2013 and since then they have established a market, although this market is rather small. This makes the company comply with the third criteria ('*The position of the radical innovation on the pattern of development and diffusion should be within or in the end of the market adaptation phase'),* since it is within the market adaptation phase. The company is located in the Netherlands and started as a small company in 2013 by a group of Dutch entrepreneurs, making it comply with

the last two criteria (‘*The companies must be located in the Netherlands’ &’ The companies should have started as a start-up’)*

6.3 Data collection

As mentioned in section 1.4.4, data will be collected through performing interviews with two different Dutch companies of which the selection process is described in the previous section. The interviews will be conducted in Dutch and are developed to fit within a 60-minute time frame. The pre-determined questions are semi-structured and contain both open and closed questions. (See Appendix D - Interview protocol) An interview approach is chosen because this method enables to directly steer towards the case study topic, which saves time and gives the company employee the opportunity to reflect on the choices they made. As Yin (2014) describes, conducting interviews delivers perceived causal reasoning, which is very insightful. However, it is important to take into account that the questions should be constructed in an unbiased manner and that the interviewee is only steered until a certain level, to avoid that the interviewee gives an answer that the interviewer expects or wants to hear. (Yin, 2014)

The interview questions focus on refining and improving the evaluation criteria and the conceptual model. These are based on the possible manners of improving and refining the evaluation criteria and the initial conceptual model; the next section (§6.3) describes these manners in more detail, since they will be used during the analysis.

0. Introduction
Since the aim is to record the interview, the first question asks permission regarding the possibility to record the interview. Furthermore, there will be asked if the obtained data has to be integrated anonymously in the final thesis report. After these two questions, an introduction will be given of the research. This introduction is added to the interview protocol after conducting two pilot interviews. The pilot interviewees namely indicated that they did not completely understand the topic of the research, were confused about multiple terms used in the questions, and that they did not understand some of the questions and the type of answers required (see initial interview protocol in Appendix). I concluded that the interview needed more steering from my side, with the main aim to save time during the interviews, since both the pilot interviews took at least 1,5 hour due to the misunderstandings (See Appendix). Giving an introduction at the beginning of the interviews seems to be the most suitable solution to achieve this. This introduction will first elaborate on the concept of socio-technical systems around radical innovations. Secondly, the concept of influencing- and core factors obstructing large-scale diffusion will be explained, by showing a simplified image of the factor framework by Ortt & Kamp (2019) and giving one example of a core and influential factor. Third, the pattern of development and diffusion of radical innovations will be used to explain the concept of niche strategies. Fourth, the aim of the interview will be described, being the confirmation of the proposed relationships between niche strategies and barriers as included in the initial conceptual model, and confirmation of the evaluation criteria. Fifth, the overall lay-out of the interview will be explained, and the interviewees will be asked if they have a question regarding the explained concepts in the previous steps.

1. General information
The first part of the interviews aims to gain a quick insight on the company and the radical innovation itself, and the role of the interviewee within the company. Most of this information will be gathered during a preliminary web-search. I will confirm the findings of this web-search during the start of the interview, and, according to the found information, alter or remove the particular questions.

2. Open questions on barriers, strategies and evaluation criteria
This part of the interview will contain open questions, of which the main aim is to discover the evaluation criteria the companies use to assess the strategies that they adopted after experiencing a barrier. Two or three barriers will be covered, so that multiple viewpoints on the criteria can be taken, without making this part too long or complicated. The aim is to focus on at least two completely different barriers (e.g. combinations of core and influencing factors), in order to make the answers as diverse as possible and thus avoid redundancy of the obtained information.

3. Ranking evaluation criteria
After this second part the interviewees are shown a list with the evaluation criteria developed in chapter 3, and will be asked to rate the criteria, in order to discover the importance and relevancy of the developed criteria. If the company mentioned criteria in the second part of the interview, these will be added to the list (in both the current and next interview), so that it can be ranked as well.

4. List of adopted strategies
This part of the interview will consist out of a form that I fill in together with the interviewee. The interviewee is asked to confirm which strategies on the form (which are all the strategies as described in the initial conceptual model) he adopted so far within the company, which barriers were intended to be circumvented or removed, if it was a successful adoption and in which phase he adopted the strategy. This differs from the initial interview protocol, since the pilot interviews indicated that the initial interview protocol was too complicated. The first interview protocol listed the experienced barriers after which the interviews were asked if they experienced the barrier and if so, which strategy they adopted. Even though the interviewees understood the aim of the questions, still there were minor linkages found. I concluded that understanding and interpreting the barriers was harder than understanding the niche strategies. So, instead of mentioning the barriers, the niche strategies are listed in the final interview protocol. See appendix B for a more extended elaboration on the first interview protocol, on the pilot interview and on the final interview protocol.

5. Adoption of strategies – barriers vs. chances
In the last part, the adoption of strategies by the company in response to experienced barriers or as response to chances will be covered. Additionally, the aim is to reveal the companies' visions of the practical use of the model and criteria within their business practices. The answer to this question can be posed at the end of the interview, but during both the pilot interviews the questions were covered without actually posing the question.

6. Closure
After the interview, a summary will be written of the answers, which will be send to the interviewees. The interviewees have the chance to alter or comment on parts that they do not agree with. After the interviews, one interviewee indicated that they wanted to be included in the research anonymously anyway (during the interview, the interviewee indicated that this was not necessary). Furthermore, both interviewees made no extra comments.

6.4 Data analysis method

6.4.1 Introduction

Data analysis consists out of different steps: Examining, categorising, tabulating, testing, or otherwise recombining results in order to draw conclusions from the primary case study. (Yin, 2014) The analysis will be based on a strategy that aims to support the theoretical propositions as captured in the conceptual model so that the model can be improves and refined according to the case study evidence. Different techniques can be used to analyse the case study evidence: Pattern matching,

explanation building, times-series analysis, logic models and cross-case analysis. (Yin, 2014) In this thesis, pattern matching and cross-case analysis will be performed. As described by Baškarada (2014) pattern matching "involves the comparison of predicted patterns and/or effects with the ones that have been empirically observed, and the identification of any variances or gaps". (Baškarada, 2014) The interview outcome will address the relationships between the experienced barriers and the strategies that were adopted to overcome or circumvent these barriers, and will reveal the used evaluation criteria by the companies. Cross-case analysis entails matching of patterns between the two cases that will be performed.

The primary case studies will be analysed individually, after which the outcome will be compared to each other during the cross-case analysis. The following section (§6.4.2) describes the data analysis procedure of the cross-case analysis. Through first describing the cross-case analysis, individual analysis guidelines for both the independent primary case study analysis can be drawn (§ 6.4.3).

6.4.2 Cross-case analysis data procedure

The aim of the interviews, as described before, is two folded: The first aim is to refine and improve the evaluation criteria and the second aim is to refine and improve the initial conceptual model. The refine- and improvement of both elements, which will be done in the cross-case analysis, can be achieved in different manners, which will be explained in this section. It shows what type of data is needed to come to the conclusion (answer to the sub-research question) of the primary case study research.

Refining and improving the evaluation criteria can be achieved by (see figure 6.2): 1) confirming the relevancy of the developed criteria; 2) by removing and/or changing irrelevant criteria and; 3) by adding new criteria that are indicated as relevant by the companies.

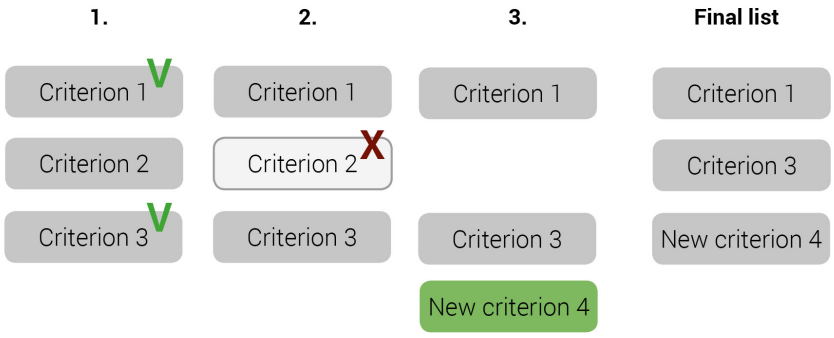


Figure 6.2: Refining and improving the evaluation criteria

Refinement and improvement of the conceptual model can be achieved by (see figure 6.3 for corresponding numbers): 1) confirming the linkages between the strategies and barriers as captured in the initial conceptual model described in chapter 4; by 2) revealing new relationships between already defined barriers and defined strategies; by 3) revealing new relationships between already defined barriers and new discovered strategies; by 4) revealing new relationships between new discovered barriers and already defined strategies and; by 5) revealing new relationships between new discovered barriers and new discovered strategies. A new barrier can either be a new combinations between core and influencing factors as included in the factor framework (Ortt & Kamp, 2019), or can be a combination of new influencing and/or new core factors that are currently not included in the factor framework.

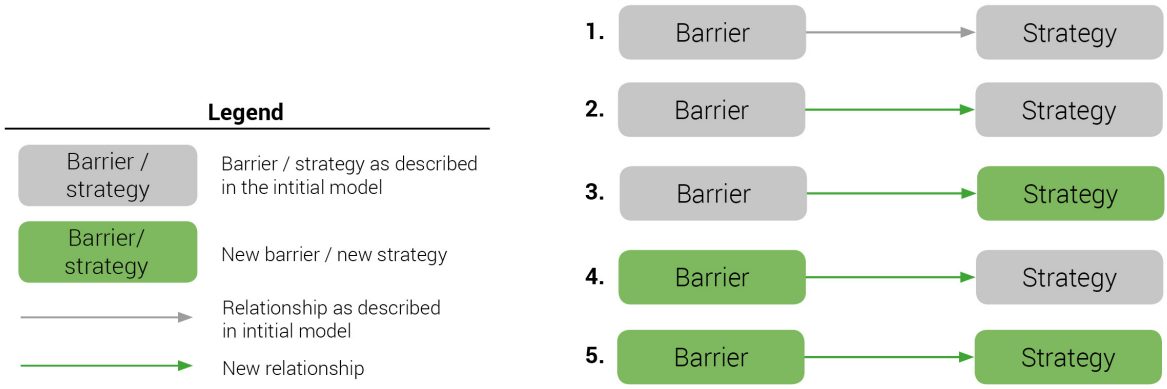


Figure 6.3: Refining and improving the conceptual model

Relationships between barriers and strategies described in the initial model that cannot not be confirmed, by either the desk research and/or the primary case studies, will be included in the conceptual model, but as an assumption based on logical reasoning.

6.4.3 Individual case study data analysis procedure

As described in §6.2, the interview consists out of five parts: 1) General information; 2) Open questions on barriers, strategies and evaluation criteria; 3) Ranking the evaluation criteria; 4) relationships strategies and barriers; 5) Adoption of strategies – barriers vs. chances. The results section of the case studies (§7.2 & §7.3) will follow this order, but the analysis part will be divided into three parts, combining these five different parts: the analysis of the evaluation criteria; the analysis of the relationship between strategies and barriers; and a part for remaining comments. The results of the interviews are anonymously described in an extensive summary, used in the analysis section.

1. Analysis of the evaluation criteria

The analysis of the evaluation criteria will focus on answering the following questions:

A. What does the ranking of the evaluation criteria show?
    a. Which ones are rated as 'decisive'?
    b. Which ones are rated as 'not relevant'?
B. Do they describe additional criteria?
C. What are their thoughts on the usefulness of the developed criteria?
    a. Do they use these evaluation criteria during the assessment of the suitability of a strategy? If yes, is this consciously or unconsciously?
    b. If not, what do they say about the usability in future assessment of the suitability of niche strategies?

2. Analysis of the relationship between strategies and barriers

As described in §6.4.2, the refinement and improvement of the conceptual model consists out of six different elements. The procedure of analysing the interview results is focused on obtaining data for these focus areas: it focuses on the coupling of strategies adopted by the companies, with the barriers as described by the interviewee, using the core- and influencing factors from the factor framework by Ortt & Kamp (2019). The interview results will be systematically analysed in order to be able to perform the cross-case analysis afterwards in a consistent way. The flowchart below depicts the steps that will be gone through per strategy posed to the interviewee in the fourth part of the interview (see section 5.2). Strategies that were mentioned in the other parts of the interview, during the introduction and the part containing open questions on barriers, strategies and evaluation

criteria, will be analysed simultaneously. The flowchart will be used as guidelines during the analysis. If extra strategies were mentioned that were not included in the pre-defined list of strategies (based on the initial conceptual model), these will also be analysed using the flowchart. Each step is further elaborated below the flowchart

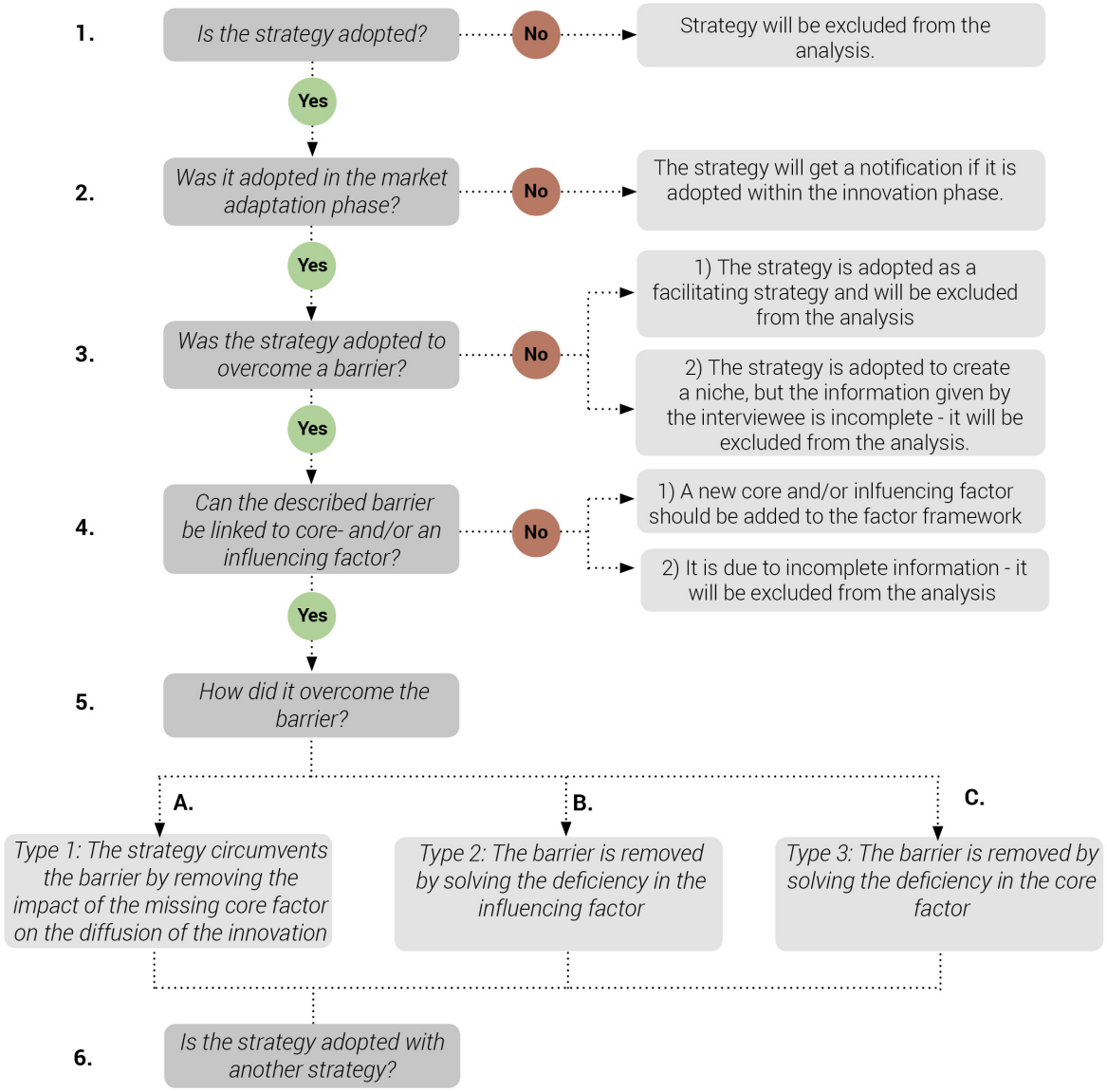


Figure 6.4: Flow of the case study result analysis

Further elaboration of the steps illustrated in figure 6.4:

4. If the company did not adopt the strategy, it will not be included in the analysis;
5. If the company adopted the strategy within the innovation phase, the notion that it is a strategy adopted in the innovation phase will be included in the strategy description of the final conceptual model;
6. If during the interview, the interviewee did not mention that the strategy was adopted to overcome a particular barrier, this can have two underlying reasons: Either the strategy is facilitating another strategy or other business practices, or the data is not gathered carefully enough. Both reasons exclude the strategy form further analysis. This is especially important if the interviewee indicated that they adopted the strategy within the innovation phase; is the strategy adopted to develop the innovation further, or is it adopted to overcome a particular barrier within the socio-technical system that will obstruct the diffusion process?

7. The linkage of the adopted strategies to experienced barriers (a combination of an influencing and core factor) is important, since at a later stage, the relationship found in the case study analysis will be compared to the initial conceptual model. If this relation can be deduced from the interview results, it can be perceived as a confirmation of the existence of this linkage. If it is not possible to link the barrier as described by the interviewee to the factor framework, this can have two reasons: the first reason can be that the factor framework is not complete, the second reason can be that the data is not gathered carefully enough. The first scenario is interesting to elaborate on in the discussion, the second scenario is less useful; the strategy cannot be analysed further.
8. It is useful to analyse how the strategy overcame the barrier, since this will simplify the detection of a relationship between the barriers as described by the interviewee during the interviews and the strategies. The three ways of overcoming a barrier can also be found in section 3.1.2. The assumptions regarding the strategies overcoming barriers (described in 3.1.3) will also be applied during the analysis of the case study results.
9. The last step is analysing the relationship of the strategy with other strategies adopted by the company.

3. Remaining comments

This part analyses the last part of the interview, which is used for the discussion part of the research. Did the company mention the adoption of strategies as a reaction on chances in the market? Are they in general aware of the barriers that are experienced, or do they notice them in hindsight? Did they have an opinion on the usefulness of the conceptual model and the evaluation criteria?

7. Primary case study results

This chapter describes and analyses the primary case study results. Two interviews were conducted with companies that introduced a radical innovation to the market according to the data collection procedure described in the previous chapter. The following sections describe and analyse the results of the interview with Company A (§7.1), and the results of the interview with Company B (§7.2). These sections give a summary of the information obtained during the interview following the structure of the interview protocol (see Appendix). Since one company indicated that they wanted to participate anonymously, this chapter describes the results in such a manner that the information cannot directly lead back to the particular companies. The interviews are summarised briefly, only the details that can be provided according to the wishes of the companies are described. The analysis of the case study results is done according to the case study analysis protocol described in §6.4.

7.1 Results Company A

7.1.1 Introduction: Company and employee

The introduction of the interview comprised information on the interviewee, the market in which the company is active and their vision regarding their innovation. Since it will be described anonymously, this part only contains a brief summary.

The company started officially in 2016, after it separated from its original company, which started in 2010. The interviewee is the engineer within the company and started to work in Company A in 2016, after he finished his graduation internship in Company A. As described in section 5.3.2, Company A developed an innovation that increases the capacity of water storage, retention and drainage of roofs. It intercepts all the rainfall, controls the water drainage, delivers real time monitoring about rainfall, storage and drainage and is powered by solar energy. The company mainly focuses on big roofs, for example for horeca, commercial house rental companies and real estate owners.

The companies' vision in terms of markets they would like to reach is governmental buildings and the market of social rent. The first is hard to reach because there is a lack of financial resources within that market that needs to be reserved in order to acquire the product, and the latter is hard to reach because housing companies are reluctant to acquire the product and integrate it into these social-rent buildings, because it will increase the rent for the tenants (the benefits do not equal the financial costs).

7.1.2 Part 1: Open questions on experienced barriers, adopted strategies and criteria

In this first part of the interview the interviewee was asked to describe two important barriers that obstructed the diffusion of their innovation into the market; which strategies were adopted to circumvent or remove the barriers; and which criteria were used during the decision-making process for the choice of a particular strategy.

The first important barrier that is experienced by Company A according to the interviewee is a technical barrier. In the last 25 years, the market worked hard to construct roofs that ensure fast water run off by integrating a sort of drainage gradient. However, this element is the 'enemy' of the innovation. In order to be able to place Company A's innovation on a building, the integration of a drainage gradient during the construction of new buildings or during the reconstruction of buildings needs to be avoided.

The strategy that Company A adopted in order to overcome this barrier is by convincing the stakeholders that during the construction or reconstruction of the roof, the drainage gradient is not needed. They informed the stakeholders by educating them on the purpose of the innovation and on the advantages that it delivers. This is done for example by showing technical proof and/or by showing proof that it is financial more attractive to integrate a different type of insulation, which can be combined with the innovation, instead of the drainage gradients.
The selection for this strategy was not random or well considered; it arised during the conversations with stakeholders. These stakeholders expressed their complaints, after which Company A tried to contradict their complaints.

The second important barrier that obstructed the diffusion of the innovation according to the interviewee was the creation of a market. The innovation delivers new functions, but can be compared with traditional solutions in terms of placement of the product. Customers did not see the added value of the new innovation.

Company A adopted multiple strategies in order to overcome the barrier and to create a market for their innovation. The interviewee indicated that they explored multiple ways of obtaining and, subsequently, showing the added benefits to the customers and to the environment in order to change their mind about the product. However, they did not use particular evaluation criteria to evaluate the following strategies before adopting them.
They performed multiple pilot projects. Together with the waterboard and municipality of Amsterdam, they realised an important pilot project that showed the benefits of a certain part of the product, which users in general did not want to integrate in the product. Through this, the benefits could be communicated to the market, and the customers saw the benefits of this particular element of the product. They also did other pilots in which both the municipality and the user paid for the product (instead of only the user), since the benefits are for both the user and the municipality.
Another strategy they adopted to create a market is that Company A set requirements towards the user: they only wanted to install the product if they integrated the particular element users usually did not want to integrate. They argued that they could only guarantee the functioning and quality of the product if this element was included in the product.

7.1.3 Part 2: Evaluation criteria form

The interviewee was asked to rank the ten previously developed evaluation criteria (chapter 3) based on its importance during the decision making process on the adoption of a particular niche strategy to overcome or circumvent a barrier, see table 7.1. The interviewee added no additional evaluation criteria.

Table 7.1: The ranked evaluation criteria by Company A

#	Evaluation criteria	0. Not relevant	1. Not important	2. Slightly important	3. Important	4. Essential	5. Decisive
1.	The strategy is understandable to everyone and not overly difficult or complex to interpret			**X**			
2.	The strategy is consistent between the organizational objectives and the values of the management group						**X**

3.	The strategy is agreeable to those who must implement the niche strategy						**X**
4.	The strategy has a high estimated chance of success over time with a degree of reliability, consistency and effectiveness				**X**		
5.	The strategy is adaptable to future trends within the industry	**X**					
6.	The strategy has a potential good cost/benefit ratio			**X**			
7.	The strategy can be realized within the company's financial resources						**X**
8.	The strategy can be realized within the company's human resources					**X**	
9.	The strategy can be realized within the capital goods			**X**			
10.	There are no major negative side effects/down sides on (the company's) environment of adopting the strategy in terms of economic, environmental and/or social impact					**X**	
11.	Other:	**None**					

7.1.4 Part 3: Strategies overcoming or circumventing experienced barriers

In this third part, the strategies as described in the initial conceptual model were proposed to the interviewee. He was asked to indicate 1) whether the company had adopted the strategy, 2) which barriers were aimed to be circumvented or removed, 3) if the adoption was successful or not and 4) in which stage of the development and diffusion curve the strategy was adopted (either the innovation phase or market adaptation phase). Below, the answers are indicated per strategy.

1) Subsidy strategy

As described by the interviewee, the subsidy strategy is continuously adopted. They are for example member of a valorisation programme that supports them with the acquiring of subsidies, but they also apply to subsidies themselves. The main aim of the subsidy strategy is to facilitate the company's growth, since finding investors is hard for them within the Netherlands. Furthermore, the interviewee indicates that the subsidies are a way for them to create new markets, because they apply to subsidies with various partners that have access to these new markets. The strategy is adopted in both the innovation phase and market adaptation phase and it is has been a success so far in terms that they were and are able to grow the company using the subsidies and to create new markets.

2) Technological research & develop strategy

Company A adopted the technological research & development strategy in the market adaptation phase; at this moment the research is still being performed. The research is performed with different parties, such as a university and a project initiated by the Dutch government, which furthermore involves many other companies and stakeholders.

Besides this, they perform research themselves to obtain data related to the use and impact of the product. The reason the interviewee gave, lying also behind the adoption of the strategy, is the aim to create an integral product, so that customers will be more interested in buying the product – the more functions the better. Furthermore, the interviewee indicated that they quantify the benefits of the product, to convince customers that the product actually delivers the benefits.
Up to now, the technological research & development strategy has been successful, but the interviewee indicates that it takes a lot of time (he would like it to go faster) and that it is still in progress.

3) Pilot research & develop strategy

This strategy – and the barriers that were circumvented or removed by adopting it, were mentioned in §7.1.2. The extra information the interviewee gave, was that the technological research performed in partnership with the university is also a pilot research project, and they are going to start three pilots abroad (New York, Washington and Italy). The strategy was so far adopted successfully. The strategy is adopted multiple times, in both the innovation- and market adaptation phase.

4) Market research & develop strategy

The market research strategy is successfully adopted in both the innovation- and market adaptation phase. The interviewee describes that they analyse their competitors once every while in order to find out what their practices are and how they communicate these practices. They performed a stakeholder analysis in the beginning (innovation phase). The reason to perform a competitor analysis was to find out the speed of their development and to compare their strategy to the strategy of Company A. The interviewee described that it was not adopted to overcome a particular barrier.
They also performed a market research on finding potential customer segments, but this was before they introduced the product into the market.

5) Human resource strategy

Company A adopted this strategy by hiring interns, because they deliver valuable work for a low price. They hired the interns because they need the extra hands, the knowledge and the new insights they deliver on the context of the product and the practices within the company.

6) Education strategy

This strategy – and the barriers that were circumvented or removed by adopting it, were mentioned in §7.1.2. Furthermore, they present their opinion in advisory groups and workgroups in order to educate the municipalities and polder boards, with the aim to influence the decision-making process on institutional aspects.

7) Internal training strategy

According to the interviewee, the company has not adopted this strategy so far.

8) Lead-user strategy

The interviewee indicated that Waternet (the 'water board' and municipality of Amsterdam) a lead-user is (together they form 'Waternet'). They see the product as a solution for their problems. They facilitate the development, facilitate pilots and help with acquiring subsidies. They present their vision to the company, which is taken into account by the Company, in order to improve the product. These were all successful until now, Company A still works together in the development of the product. They started working together within the innovation phase, but now, in the market adaptation phase, they still work together.

9) Partnership strategy

The company has multiple partnerships; examples are partnerships with a university and a 'water board'. As described by the interviewee, these partners mainly facilitate development of the product,

by for example performing research and cooperating with pilot projects. Furthermore, they work with the partners because they are rather known within the industry and the Netherlands, which is used for generating familiarity and reputation within networks and consumer markets where there is a lacking familiarity.

10) Crowdsourcing strategy

According to the interviewee, the company has not adopted this strategy so far.

11) Financial resources strategy

Company A successfully adopted this strategy within the market adaptation phase. They had an investment when the company separated from the other company. The main reason they needed the investment was to develop the company further. They also participated in a small pitch competition; the main reason was however not for increasing the financial resources but to gain new contacts within the industry. However, the participation in the competition was not very successful, it cost a lot of time and it did not have a direct effect.

12) Changing customer behaviour strategy

Company A successfully adopted this strategy within the market adaptation phase. This strategy – and the barriers that were circumvented or removed by adopting it, were also mentioned in §7.1.2.
Furthermore, they also had a roundtable with customers and the 'water board' to negotiate about the water retention by the product on the roof. This is because the user has the power to control the amount of water that is stored, and when he looses the water. However, this can have an impact on the environment if too much water is dropped or too little water is dropped. The product has thus opposing interests for different parties. In order to deliver the proper function of the product, these negotiations are sometimes needed in order to change the users' behaviour.

13) Redesign strategy

Company A continuously adopts the redesign strategy, because they work with a design philosophy based on iterations. Every iteration is commercially implemented; this means that almost every customer has a 'new' product. They perceive each new customer as facilitating testers of the new iteration. The barriers that are removed with the strategy are barriers related to the instalment process, production processes, reliability of the product and the lack of functions of the product.
The strategy is implemented successfully and both during the innovation phase and market adaptation phase.

14) Stand-alone strategy

According to the interviewee, the company has not adopted this strategy so far.

15) Independent system strategy

According to the interviewee, the company has not adopted this strategy so far.

16) Hybridization strategy

According to the interviewee, the company has not adopted this strategy so far.

17) Adaptor strategy

According to the interviewee, the company has not adopted this strategy so far.

18) Lobbying strategy

Company A adopted this strategy within the market adaptation phase in two different ways, as explained by the interviewee. The first lobbying activity was to influence municipalities regarding the decisions on the required water storage for the sewage system. They influenced the municipalities successfully. The main barrier that the company overcame with this strategy was that the product

was not made to fit the former required amount of water storage space. To inform the municipalities about their product and the requirements, they were able to change the inhibiting laws.

19) Leasing strategy

According to the interviewee, the company has not adopted this strategy so far. However, they would like to adopt the leasing strategy in the future in order to increase the financial attractiveness for customers to acquire the product. The reason it has not been adopted yet is due to a lack of stimulating institutional aspects such as regulations and laws.

20) Sharing platform strategy

According to the interviewee, the company has not adopted this strategy so far.

21) Geographical strategy

Company A successfully adopted this strategy within the market adaptation phase. The interviewee describes that in Holland they particularly focus on certain areas like Amsterdam, The Hague and Leiden. They also focus on particular cities in other countries, such as New York and Washington DC.
In Rotterdam for example, there are not stimulating institutional aspects yet, so it is very hard to get projects for Company A in that area. However, they do focus on Amsterdam, The Hague and Leiden because there are stimulating institutional aspects regarding tenders.
They are going to start a project in New York, because they have an environmental problem within the city regarding their out-dated sewage system. Because of this particular problem within the city, there are stimulating regulations and laws for real estate owners and constructers to implement innovations that try to solve this problem, such as the innovation from Company A.

22) Top-end strategy

Company A successfully adopted this strategy within the market adaptation phase. They adopted this strategy by selling the product to the top-end of the market. The company offers multiple types of the innovation (ranging in price), but aim to sell the more expensive ones because these deliver more benefits to the users, the owner and the environment. The reason they focused on the top-end of the market is because this segment has more financial resources to acquire the more expensive version of the product.

23) Robin Hood strategy

According to the interviewee, the company has not adopted this strategy so far.

24) Multiple application strategy

According to the interviewee, the company has not adopted this strategy so far.

7.1.5 Additional strategies and perception of strategies

Another strategy they mentioned but which is not included in this list: Company A split off from the former company, because the collaboration with some actors (potential stakeholders) was obstructed. This company offers solutions for the whole roof, which made some stakeholders think, when Company A was still part of it, they were competitors as well. This made the actors not want to work together, although Company A as part of the former company delivered a different type of product and thus were not a competitor with this product. The company decided to split off this part of the company; now they are not seen as a competitor anymore, which makes the communication towards these actors much easier.

Company A adopts strategy partly because they react to chances that occur, and partly because as solution to problems they encounter. As described by the interviewee, sometimes opportunities pass by, and usually fast decision-making is required to make the most of this opportunity. An example

the interviewee gave was the subsidies they adopted. Sometimes a subsidy opportunity is encountered, and they only have a month to apply for it. The reason they adopt the subsidy strategy is then not to overcome a barrier, but because there is a chance to obtain more financial resources.

The interviewee also describes that the adoption of a strategy is based on gut feeling at the moment, they do not use criteria. He says that there is a lot of room for a more structural decision process. Mainly the relevance of a strategy in a certain situation would be useful to discover: How can all the different possibilities be compared e.g. all the advantages and disadvantages of the strategies – so that the most effective strategy for a specific situation easily can be defined.

7.1.6 Analysis and conclusion of results Company A

7.1.6.1 Evaluation criteria

The ranking of the criteria show that the criteria 'The strategy can be realized within the company's financial resources'; 'the strategy is agreeable to those who must implement the niche strategy'; and 'the strategy is consistent between the organizational objectives and the values of the management' are ranked as 'decisive'. It is a small company with a strong vision, so this outcome is as expected. The criteria 'the strategy is adaptable to future trends within the industry' is ranked as not relevant by the interviewee. They perhaps aim for short-term success in regards to overcoming the barriers, so they do not overthink the future trends at the moment. The rest of the proposed evaluation criteria are ranked from 'slightly important to 'essential' and no additional criteria were listed.

As described by the interviewee, they do not consciously used evaluation criteria to assess the suitability of the strategies they adopted. However, he is interested in the concept of these criteria. He adds that it would be useful to have a structural decision-making process; one which is focused on the possibility of the strategy to overcome the barrier.

Conclusion

- Although the company does not consciously use criteria to assess strategies, the concept of evaluation criteria has been confirmed as something that would be useful within their business practices.
- The ranking of the evaluation criteria by the interviewee can be explained based on the characteristics of the company.
- One primary case interview cannot conclude on the removal of certain criteria, but, since the interviewee did not add extra criteria, it can be assumed that from the point of view of the interviewee, the list can be considered complete.
- The interviewee points out that the use of scoring of the strategies (relative to each other) would be useful.

7.1.6.2 Relationships between strategies and experienced barriers

Table 7.2 shows the strategies that Company A adopted (in green) as described by the interviewee. The strategies that were not adopted or unsuccessfully adopted (in red) are left out of the analysis. The table also indicates in which part of the interview the niche strategy was mentioned.

Table 7.2: Overview of the (not) adopted niche strategies by Company A

Niche Strategies	Mentioned in list of strategies (§6.2.4)	Mentioned in other questions
1. Subsidy	Yes	§7.1.2 §7.1.5
2. Technological research & develop	Yes	§7.1.2
3. Pilot research & develop	Yes	§7.1.2
4. Market research & develop	Yes	No
5. Human resource	Yes	No
6. Education	Yes	§7.1.2
7. Internal training	No	No
8. Lead-user	Yes	§7.1.2
9. Partnership	Yes	§7.1.2
10. Crowdsourcing	No	No
11. Financial resources	Yes	No
12. Changing behaviour	Yes	§7.1.2
13. Redesign	Yes	No
14. Stand-alone	No	No
15. Independent system	No	No
16. Hybridization	No	No
17. Adaptor	No	No
18. Lobbying	Yes	No
19. Leasing	No	No
20. Sharing platform	No	No
21. Geographical	Yes	No
22. Top-end	Yes	No
23. Robin-Hood	No	No
24. Multiple application	No	No
25. *New:* Restructuring business	No	§7.1.5

1) Subsidy strategy

The interviewee indicated that the main reason they adopt the subsidy strategy is to facilitate the companies' growth. From this, there can be concluded that they mainly adopt this strategy as a facilitating strategy, since it is not adopted to circumvent or remove a particular barrier. However, the interviewee also indicated that the strategy is used to create markets: they reached the social housing market using the subsidy strategy (see §7.1.2). They could/can not reach this market by themselves (which they want to), because the social housing companies are reluctant to acquire the product and integrate it into these social-rent buildings, because it will increase the rent for the tenants. Company A thus overcomes the barrier of lacking customers in this particular market (*CF-6*) influenced by macro & meso-economic, generic, institutional and strategic aspects (*IF-5*). What can also be noticed from the results is that the subsidy strategy is adopted by Company A together with other parties or with the help of other parties: One party, the validation program, acquires the subsidies for Company A, multiple other parties are acquiring the subsidies together with Company A. These are different type of partnerships.

Conclusion

- The subsidy strategy is used as a facilitating strategy in both the innovation phase and the market adaptation phase.
- The subsidy strategy is adopted in combination with the partnership strategy.
- The subsidy strategy is adopted to overcome the barrier combination IF6 – CF6 (*Inhibiting macro & meso-economic, generic, institutional and strategic aspects affects the availability of customers*). **(Type 3 strategy)**
- From the context there can be concluded that they experienced this barrier within the market adaptation phase.

2) Technological research & develop strategy

Although the strategy is still in progress, the company already used the outcomes successfully. They do perform most technological research themselves. As indicated by the interviewee (see §7.1.4), the technological research & development strategy is adopted in order to increase the product functions and thereby the performance and quality (CF-1) through increasing the knowledge and awareness of the technology (IF-1). The functions are integrated through redesign of the product.

A part of the description in the result section on the technological research & develop strategy in the will be included in the analysis on the 'pilot research strategy' (next paragraph), since it fits the definition of a pilot research strategy instead of the technological research & develop strategy.

Conclusion

- The technological research & development strategy is adopted to overcome the barrier combination IF1 – CF1 (*A lack of knowledge and awareness of technology affects the product performance and quality*) **(Type 2 strategy)**
- It is adopted as a 'increasing knowledge and resources niche strategy'.
- They use the outcomes to increase the application of the technology through redesigning the product (integrating more functions); it is used in combination with the redesign strategy.

3) Pilot research & develop strategy

Company A adopted the pilot research strategy in the innovation phase, but they still start pilot projects at the moment, within the market adaptation phase. Company A performs pilots with multiple aims.

The first reason to adopt this strategy for Company A is to be able to quantify the advantages of the innovation in order to convince the market to acquire and integrate the product. This can be both customers (see §7.1.4) and other stakeholders in the market (see §7.1.1) that are for example needed to place the innovation. The barrier they thus overcame in this situation is lacking customers (CF-6) and lacking network formation (CF-5), caused by a lack of knowledge and awareness of application (IF-2). However, communicating the obtained information is done through educating them (see §6.2.1). It is thus a sequence of different strategies that is used to overcome the barrier.

Usually Company A works together with other parties to realise the pilot project, such as the university and the municipality and water board of Amsterdam.

Conclusion

- The pilot research & development strategy is adopted to overcome the barrier combination IF-2 –CF-6 & C-F5 (*A lack of knowledge and awareness on market and application affects the creation of a customer base and network formation and coordination*) **(Type-2 strategy)**
- The company adopted the pilot research in cooperation with partners – it is thus adopted in combination with the partnership strategy.

- The company communicate the obtained data through education of potential customers and stakeholders. It is thus adopted in combination with the education strategy (see 'Education strategy'
- The strategy is adopted in both the innovation- and market adaptation phase.

4) Market research & develop strategy

The market research & develop strategy is adopted by Company A in the innovation phase in order to find potential customer segments. They also adopted the strategy within the market adaptation phase, but not to overcome a particular barrier. They analyse their competitors every now and then, to compare their practices with each other. In the latter case, the market research & develop strategy is used as a facilitating strategy. They increase the awareness of the market, so influencing factor 2 becomes stimulating, and through this are able to develop the company further.

Conclusion

- The market research & develop strategy is adopted by Company A within the market adaptation phase as a facilitating strategy.

5) Human resource strategy

The human resource strategy is adopted as a facilitating strategy. Company A increased the capabilities of the human resources within the company (IF-3) and trough this, they increased the knowledge and awareness of technology, application and market (If-1;IF-2). These influencing factors become stimulating - through this, the company is able to develop the company further.

Conclusion

- Company A adopts the human resource strategy within the market adaptation phase as a facilitating strategy.

6) Education strategy

The interviewee described they adoption this strategy in two different situations. In the first situation, it was used to educate the stakeholders who usually install the products about the product. Through this, they overcame the lack of network formation and coordination (CF-5) and the creation of a market (CF-6) due to a lack of knowledge on the application (IF-2) (§7.1.2) The second situation they educated municipalities and water boards about the application during workgroups, in order to influence the decision-making process on inhibiting institutional aspects (CF-7).

Conclusion

- The education strategy is adopted to overcome the barrier combination IF-2 – CF-5 & CF-6 (*A lack of knowledge and awareness application affects the network formation and coordination and the creation of a customer base*) **(Type-3 strategy – because it solves the deficiency within the core factor)**
- The barrier they removed was the inhibiting institutional aspects (CF-7) due to a lack of knowledge and awareness of application (IF-2) (*A lack of knowledge and awareness application affects the availability of appropriate institutional aspects)* **(Type-3 strategy – because it solves the deficiency within the core factor)**
- The information obtained during the pilot research was used during the education strategy.
- They adopted the strategy as an influencing strategy

7) Internal training strategy

Since the interviewee indicated that the company did not adopt this strategy so far, it is left out of the analysis.

8) Lead-user strategy

Following the description given by the interviewee of Company A, the lead-user mainly facilitates the development by facilitating pilots and helping with acquiring subsidies. The strategy is thus adopted, as far as can be concluded from the description in the results, as a facilitating strategy.

Conclusion

- Company A adopted the lead-user strategy within the market adaptation phase as a facilitating strategy.

9) Partnership strategy

From the description there can be seen that the partnership strategy plays a facilitating role within Company A. They adopt other niche strategies (e.g. behaviour change niche strategy, pilot research strategy) together with other companies, institutions or municipalities.

Conclusion

- Company A adopted the partnership strategy within the market adaptation phase as a facilitating strategy.

10) Crowdsourcing strategy

Since the interviewee indicated that the company did not adopt this strategy so far, it is left out of the analysis.

11) Financial resources strategy

They adopted the financial resources strategy during the separation of the company in two parts. They had an investment in order to develop the company further, not to overcome a particular barrier. The financial resources strategy is thus adopted as a facilitating strategy

Conclusion

- Company A adopted the financial resources strategy within the market adaptation phase as a facilitating strategy.

12) Changing behaviour strategy

They changed the customer behaviour by setting requirements towards the user; the company argued that they could only guarantee the functioning and quality of the product if this element was included in the product, which they wanted customers to buy. They also tried to change the customer behaviour by showing proof that it is financial more attractive to buy to the product in comparison to other products, and by communicating the added benefits of the product. They adopted the strategy in order to overcome the barrier of the creation of a market (CF-6), due to a lack of knowledge and awareness of the application. (IF-2)

Company A also adopted the strategy through a partnership with influencers (e.g. companies) that have a certain status or are known within the industry (CF-5) or among potential customers (CF-6), in order to gain familiarity through these partnerships which is lacking (IF-2). It can be seen as a form of advertisement.

Conclusion

- The changing behaviour strategy is adopted to overcome the barrier combination IF-2 – CF-6 (*A lack of knowledge and awareness of application affects the creation of a customer base*) **(type-3 strategy)**
- The changing behaviour strategy is adopted to overcome the barrier combination IF-2 – CF-5 (*A lack of knowledge and awareness of application affects the network formation and coordination*) **(type-3 strategy)**

- The strategy is adopted as an 'influencing strategy' within the market adaptation phase.

13) Redesign strategy

Company A adopts this strategy continuously from the beginning of the development of the innovation. As described in the results section (6.2.4), the barriers that are removed are barriers that are experienced in relation to the instalment process, reliability of the product and the lack of functions of the product (all related to CF-1). The interviewee mentioned that these redesigns are implemented after performing the technological research, which is done at the same time. So it is assumed that the influencing factor within the barrier is a lack of knowledge and awareness of technology (IF-1). It is possible that there are others, but these were not mentioned during the interview.

Conclusion

- The redesign strategy is adopted to overcome the barrier combination IF1 – CF1 (*A lack of knowledge and awareness of technology affects the product performance and quality*) **(Type-3 strategy)**
- The company continuously adopts this strategy to improve the product further. This points towards the conclusion that they are in the beginning of the market adaptation phase and did not diffuse their product widespread yet. Otherwise this would not be possible.

14) Stand-alone strategy

Since the interviewee indicated that the company did not adopt this strategy so far, it is left out of the analysis.

15) Independent system strategy

Since the interviewee indicated that the company did not adopt this strategy so far, it is left out of the analysis.

16) Hybridization strategy

Since the interviewee indicated that the company did not adopt this strategy so far, it is left out of the analysis.

17) Adaptor strategy

Since the interviewee indicated that the company did not adopt this strategy so far, it is left out of the analysis.

18) Lobbying strategy

The company adopted the lobbying strategy to influence municipalities during decisions that had to be made regarding requirements that are set within municipalities regarding the water retention. This blocked the diffusion of the product, because it did not comply with these regulations. The particular barrier they removed was inhibiting institutional aspects (CF-7) due to a lack of knowledge and awareness of application (IF-2).

Conclusion

- The lobbying strategy was adopted to remove the barriers obstructing the diffusion of the radical innovation related to CF7 - IF-2 *(inhibiting institutional aspects due to a lack of knowledge and awareness of application)* **(type-3 strategy)**
- Adopted in the market adaptation phase as a influencing niche strategy

19) Leasing strategy

Since the interviewee indicated that the company did not adopt this strategy so far, it is left out of the analysis.

20) Sharing platform strategy

Since the interviewee indicated that the company did not adopt this strategy so far, it is left out of the analysis.

21) Geographical strategy

Company A successfully adopted the geographical strategy. The main barrier that they wanted to overcome is related to the specific institutional aspects that are available within specific regions in the Netherlands. In some geographic areas these aspects form a barrier; the company cannot create a market in those areas yet. As described by the interviewee, they searched for geographical areas where these barriers were not present and could create a market, and found those geographic locations. It is a type 3 strategy: it removes the impact of the missing core factor (inhibiting institutional aspects in this case, CF-7) on the diffusion of the innovation. Which influencing factor forms the barrier with this core factor is not of importance, since the influence of the whole barrier is removed.

Conclusion

- The geographical strategy was adopted to circumvent the barriers obstructing the diffusion of the radical innovation related to CF-7: *A lack of appropriate specific institutional aspects* **(Type-1 strategy)**
- Adopted in the market adaptation phase as a marketing niche strategy

22) Top-end strategy

The main problem that can be derived from the explanation of the interviewee was that the product price was high in comparison to their other products, and they were looking for a market that was able to pay this price. Company adopted successfully this strategy to circumvent the barrier of a high price (CF-2). It is thus a type 1 strategy – it removes the influence of the inhibiting core factor on the diffusion of the product. This means that it circumvents all the barriers related to CF-2 -the type of influencing factor is not of importance, since the barrier does not aim to solve the barriers (e.g. lower the price).

Conclusion

- The Top-end strategy is adopted to circumvent the barriers related to CF-2: 'New high-tech product price'. **(Type-1 strategy)**
- Adopted in the market adaptation phase as an marketing strategy (changing business model)

23) Give-one, buy-one strategy

Since the interviewee indicated that the company did not adopt this strategy so far, it is left out of the analysis.

24) Multiple application strategy

Since the interviewee indicated that the company did not adopt this strategy so far, it is left out of the analysis.

Extra strategy (§6.5.2)

The extra strategy that was mentioned by the interviewee that circumvented a barrier was the restructuring of the business, by separating the company into two different companies. The main barrier they gave was that potential stakeholders thought they were competitors and did not want to

work together with them. So there were inhibiting strategic aspects (IF-5) that affected the network formation (CF-5).

Conclusion

- A strategy in which the company was restructured was adopted in order to overcome the barrier IF-6 – CF-5: ' *Inhibiting macro & meso economic, generic institutional and strategic aspects affect the network formation and coordination'*. **(Type-3 strategy)**
- It was adopted in the market adaptation phase and can be classified as an 'influencing niche strategy'. This is assumed since it influences the perception of these actors within the network.

7.2 Results Company B

7.2.1 Introduction: Company and employee

The introduction of the interview comprised information on the interviewee, the market in which the company is active and their vision regarding their innovation. Since it will be described anonymously, this part only contains a brief summary.

The interviewee is working as sales manager within the company and started eights months ago. The company is initiated by a group of Dutch entrepreneurs in 2013. As described in §6.2.2, Company B developed a product that integrates solar cells into a product which can be integrated on the outside of real estate buildings. They started the company because they were convinced that in order for sustainable products to become a success, they should also be beautiful. Besides five employees working at the office, they have around 20 more employees working in the field and on the production. The envisioned business activities of the company are the production of the product and the establishment of distributers that can sell the product. These distributers should create a market for the product themselves. The company has already have distributers not only in the Netherlands but also in Sweden, Israel, South-Africa, Germany and Denmark. However, due to barriers the company experienced (see next sections), at the moment they are also focusing on creating a market themselves, and needed to start placing the product themselves. Their main market is the privately owned real-estate buildings. Eventually they want to integrate their product on every building in the Netherlands and abroad

7.2.2 Part 1: Open questions on experienced barriers, adopted strategies and criteria

In this first part of the interview the interviewee was asked to describe two important barriers that obstructed the diffusion of their innovation into the market; which strategies were adopted to circumvent or remove the barriers; and which criteria were used during the decision-making process for the choice of a particular strategy.

The first important barrier that was experienced by Company B according to the interviewee was the mentality of the board members. They did not actively work on the creation of a market or a network; the main issue was that there was a lack of a focused business plan. All the distributors they worked with approached the company themselves. Furthermore, they never performed any marketing activities as well.

The strategy that Company A adopted in order to overcome this barrier was by hiring two new employees who's main job is to support the board members. They structured the implementation of new business activities and strategies. It worked well; they delivered a lot of useful input. The

company did not use criteria to evaluate the strategy of hiring new employees, it was a natural decision, since new knowledge was necessary about the development of strategies and delivering new input on the business activities.

The second important barrier that obstructed the diffusion of the innovation according to the interviewee was related to the installation of the product. Customers that wanted to integrate the product into their building were required to find an installer themselves. However, the installers discouraged the customers to integrate the product and instead, install the ordinary version of the product. This was due to a lack of familiarity with the product by the installers. The only aspects they noticed was the increased amount of time it would take to install it.

Company A adopted multiple strategies to overcome this second barrier. However, not all of them are working so far, or very slow. For example, they try to increase the trust of the installers and customers by indicating the past project in which the products were installed, including the benefits that the product delivered. This strategy is working, but not fast enough. They are thinking of giving provision to the installer, but this strategy is not adopted yet. The best strategy Company B came up with is to start installing the product themselves, and thus exclude the installers from the process. They did not use criteria to assess the latter strategy; they only looked at the effectives of the strategy on the short term.

7.2.3 Part 2: Evaluation criteria form

The interviewee was asked to rank the ten previously developed evaluation criteria (chapter 3) based on its importance during the decision making process on the adoption of a particular niche strategy to overcome or circumvent a barrier, see table 7.3. The interviewee added no additional evaluation criteria.

Table 7.3: The ranked evaluation criteria by Company B

#	Evaluation criteria	0. Not relevant	1. Not important	2. Slightly important	3. Important	4. Essential	5. Decisive
1.	The strategy is understandable to everyone and not overly difficult or complex to interpret				X		
2.	The strategy is consistent between the organizational objectives and the values of the management group						X
3.	The strategy is agreeable to those who must implement the niche strategy				X		
4.	The strategy has a high estimated chance of success over time with a degree of reliability, consistency and effectiveness						X
5.	The strategy is adaptable to future trends within the industry						X
6.	The strategy has a potential good cost/benefit ratio				X		

7.	The strategy can be realized within the company's financial resources						X
8.	The strategy can be realized within the company's human resources				X		
9.	The strategy can be realized within the capital goods					X	
10.	There are no major negative side effects/down sides on (the company's) environment of adopting the strategy in terms of economic, environmental and/or social impact						X
11.	Other:	**None**					

7.2.4 Part 3: Strategies overcoming or circumventing experienced barriers

In this third part, the strategies as described in the initial conceptual model were proposed to the interviewee. He was asked to indicate 1) whether the company had adopted the strategy, 2) which barriers were aimed to be circumvented or removed, 3) if the adoption was successful or not and 4) in which stage of the development and diffusion curve the strategy was adopted (either the innovation phase or market adaptation phase). Below, the answers are indicated per strategy.

1) Subsidy strategy

The interviewee described that the company not get any subsidies in terms of for example subsidies used for the development of the innovation. They do receive some form of subsidy; since the product integrates solar cells it is possible for customers to get a sales tax refund. However, in comparison with common products integrating solar cells it is not 100%, but only 33%. This makes it less attractive for customers to integrate Company B's product. They are currently working on getting the full 100% tax refund. Even though it is not 100% yet, and they have a disadvantage, it is still cheaper for customers to acquire the product than without the refund, so the strategy is successful in that sense.

2) Technological research & develop strategy

According to the interviewee they adopted this strategy during the market phase once, however, not successful so far. The company was research the possibility to develop a hybrid system. The main goal was to provide the product with a new function, in order to be able to cover the complete energy need of customers. However, due to a bug in the part of the system offered by a third party the new product was never brought to the market.

3) Pilot research & develop strategy

According to the interviewee, the company has not adopted this strategy so far.

4) Market research & develop strategy

According to the interviewee, the company has not adopted this strategy so far.

5) Human resource strategy

The company adopted this strategy successfully within the market adaptation phase. This strategy – and the barriers that were circumvented or removed by adopting it, were mentioned in §7.2.2.
Besides these employees, they hired an ambassador, who has has many contacts within the market that the company uses to establish more familiarity of the application within the market.

6) Education strategy

The company adopted this strategy successfully within the market adaptation phase. This strategy – and the barriers that were circumvented or removed by adopting it, were mentioned in §7.2.2. Besides the indicated barriers mentioned in §7.2.2, they also adopt this strategy through going to fairs on solar cell technology (for example 'Intersolar' in Munich), to be able to make potential customers information about the product and to create a market. Furthermore, they give distributors technical information about the product, and inform them about potential markets and about how to sell the product, also in order to be able to create a market.

7) Internal training strategy

According to the interviewee, the company has not adopted this strategy so far, although they aim to start internal trainings to increase the knowledge of the employees.

8) Lead-user strategy

According to the interviewee, the company has not adopted this strategy so far.

9) Partnership strategy

According to the interviewee, the company has not adopted this strategy so far.

10) Crowdsourcing strategy

According to the interviewee, the company has not adopted this strategy so far.

11) Financial resources strategy

The company adopted this strategy successfully within the market adaptation phase. There has been a loan and there has been a successful crowd funding action. The latter was an action where individuals were able to invest in the company, after which they would earn interest over the invested amount of money. The barrier they aimed to circumvent was the lack of financial resources to acquire stock and to hire extra employees in order to suffice to the market demand.

12) Changing customer behaviour strategy

The company adopted this strategy successfully within the market adaptation phase. They showcase the benefits of the product on the site. They aimed to increase the potential customers' confidence in the product. A lot of people are afraid for teething pains regarding the product, and through the showcase on the website we show them that the product has already been implemented before and that it works as envisioned.

13) Redesign strategy

The company adopted this strategy successfully within the market adaptation phase. They developed different versions of the product after the introduction of the first version of the product. The difference between the products is the price (ranging from high to low), the colours and the material. The barrier they tried to circumvent is that some customers thought the price was too high, and the barrier that they though the aesthetics of the product did not fit the outlook of their house. The company introduced the different versions step-by-step.

14) Stand-alone strategy

According to the interviewee, the company has not adopted this strategy so far.

15) Independent system strategy

According to the interviewee, the company has not adopted this strategy so far.

16) Hybridization strategy

According to the interviewee, the company has not adopted this strategy so far. However, as described by 2) 'technological research & develop', they were developing a hybrid system (within the market adaptation phase); they tried to integrate another technological innovation. The main goal was to provide the product with a new function, in order to be able to cover the complete energy need of customers. However, they did not introduce the hybrid product to the market yet, due to a bug in the part of the system offered by a third party.

17) Adaptor strategy

This strategy is adopted within the innovation phase. The system is designed with an invertor so that it can be connected to the electricity network within the house. This is needed since otherwise users would not be able to use the energy for all the applications within the house and, if there is an abundance of energy, deliver the surplus back into the common electricity network.

18) Lobbying strategy

As described before, we hired an ambassador whose main activity is lobbying. Sometimes we ask the customers if they have contacts within the municipality when the latter is not giving permission. We then contact them and educate them about the product in order to change their mind. The main barrier is to overcome the lack of knowledge on the application among the municipalities.

19) Leasing strategy

According to the interviewee, the company has not adopted this strategy so far.

20) Sharing platform strategy

According to the interviewee, the company has not adopted this strategy so far.

21) Geographical strategy

The company adopted this strategy successfully within the market adaptation phase. They bring it into practice by only advertising in certain geographical areas, because they focus on the top-end (see next strategy description) of the market, which is usually characterised by certain neighbourhoods within cities or even whole areas (e.g 't Gooi) within the country. They also focus on cities (e.g. Vienna and Bruges) with monuments, since the product is very suitable to be integrated into buildings where there are strict rules regarding the aesthetics.

Furthermore, they also focus on certain geographical areas since some municipalities do not approve the integration of the product into the buildings. Then it is needed to focus on municipalities where the products can be integrated with less hassle.

22) Top-end strategy

The company adopted this strategy successfully within the market adaptation phase. As the employee described, the company focuses on the top-end of the market. They achieve this by increasing the threshold of the price quote, which potential customers have to fill in to get in contact with the company. The barrier they overcome by adopting this strategy is the high price of the product. The price is 2.5 times the price of the common products of the competitors. The reason of the high price is the low production capacity, due to a lack of enough customers. The interview states that the company notices this issue as a negative spiral – the product price can decrease when they reach more customers, which is at the moment not possible since they can only target the top-end of the market.

23) Robin Hood strategy

According to the interviewee, the company has not adopted this strategy so far.

24) Multiple application strategy

According to the interviewee, the company has not adopted this strategy so far.

7.2.5 Additional strategies and perception of strategies

The interviewee could not come up with additional strategies that the company could have adopted in the past.

The company reacts constantly on experienced barriers. The barriers mainly existed due to a lacking vision and business plan. Most of the strategies adopted where strategies that needed to be effective on the short term in order to overcome these barriers. The strategies were not analysed, but, as the interviewee argues, this should be done. According to him, criteria to analyse the strategies are essential. The newly hired employees are, amongst others, working on a business plan and on structuring the adoption process.

7.2.6 Analysis and conclusion of results Company B

7.2.6.1 Evaluation criteria

The ranking of the criteria show that the criteria 'The strategy is consistent between the organizational objectives and the vales of the management group'; 'The strategy has a high estimated chance of success over time with a degree of reliability, consistency and effectiveness'; 'the strategy is adaptable to future trends within the industry'; 'the strategy can be realized within the company's financial resources' and 'there are no major side effects/down sides on the company's environment of adopting the strategy in terms of economic, environmental and/or social impact' are ranked as 'decisive'. The company is at the beginning of the market adaptation phase; they have little time to decide which strategy to adopt and primarily act on intuition instead of objectively assessing the strategy. It is important for them that the strategy is effective and does not require a high amount of financial resources.

The rest of the proposed evaluation criteria are ranked from 'important' to 'essential'; none of the listed criteria were ranked as 'not relevant', 'not important' or as 'slightly important', and no additional criteria were mentioned.

As described by the interviewee, the company did not use criteria to evaluate strategies, which caused other barriers to rise. That is why the interviewee argues that analysing the strategies is essential. They hired new employees to make the decision-process more structured, but they are still at an early stage within this process. At the moment they still react constantly on barriers that arise through adopting strategies that are effective on the short term.

<u>Conclusion</u>

- The use of evaluation criteria is confirmed to be useful for the company, since new barriers rose because of a lacking structured decision-making process.
- A conclusion based on the ranking cannot be done based on a single primary case interview. The interviewee did not add extra criteria; it can be assumed that from the point of view of the interviewee, the list can be considered complete.
- The ranking of the evaluation criteria by the interviewee can be explained based on the characteristics of the company.

7.2.6.2 Relationships between strategies and experienced barriers

Table 7.2 shows the strategies that Company B adopted (in green) as described by the interviewee. The strategies that were not adopted or unsuccessfully adopted (in red) are left out of the analysis. The table also indicates in which part of the interview the niche strategy was mentioned.

Table 7.4: Overview of the (not) adopted niche strategies by Company B

Niche strategies	Mentioned in list of strategies (§6.3.4)	Mentioned in other questions
Subsidy	Yes	No
Technological research & develop	Yes but unsuccessful	No
Pilot research & develop	No	No
Market research & develop	No	No
Human resource	Yes	§7.2.2
Education	Yes	§7.2.2
Internal training	No	No
Lead-user	No	No
Partnership	No	No
Crowdsourcing	No	No
Financial resources	Yes	No
Changing behaviour	Yes	No
Redesign	Yes	No
Stand-alone	No	No
Independent system	No	No
Hybridization	Yes but unsuccessful	No
Adaptor	Yes	No
Lobbying	Yes	No
Leasing	No	No
Sharing platform	No	No
Geographical	Yes	No
Top-end	Yes	No
Robin-Hood	No	No
Multiple application	No	No
Extra mentioned barriers - None		

1) Subsidy strategy

The company adopted the strategy successfully within the innovation phase. At the moment (market adaptation phase) they are trying to get the complete amount (100% instead of 33% tax refund). The barrier the company overcame by this strategy, although it is not 100% yet, is a high product price in comparison with competitive products (CF-3) due to a lack of financial resources (IF-4). There can be noticed that they adopted the strategy as an 'Influencing niche strategy', since the subsidy makes it more attractive for customers to buy the product.

Conclusion:

- The subsidy strategy is adopted to overcome the barrier combination IF-4 & CF-2 (*A lack of financial resources affects the product price).* ***(Type-3* strategy *– because it solves the deficiency within the core-factor, e.g. the high product price becomes lower)***
- The strategy is adopted within the innovation phase
- The strategy is adopted as an influencing niche strategy

2) Technological research & develop strategy

The interviewee indicated that the company adopted this strategy, but that the adoption was unsuccessful. The strategy will be excluded from the analysis

3) Pilot research & develop strategy

Since the interviewee indicated that the company did not adopt this strategy so far, it is left out of the analysis.

4) Market research & develop strategy

Since the interviewee indicated that the company did not adopt this strategy so far, it is left out of the analysis.

5) Human resource strategy

The interviewee described that the characteristics of the board members influenced the formation of a network and the availability of customers in a negative way. There was no business plan and vision. Through hiring new employees they overcame this barrier. There can thus be concluded that the strategy of hiring new employees was successful. They also hired an ambassador who has the ability to lobby within the market, which the company did not do before that raised barriers.

Furthermore, as described in §6.3.2, the interviewee indicated that when the barrier rose of external installers discouraging customers to install Company's B innovation, the company decided to exclude the installers and instead install the product themselves again. The factor that affected the installers was a lack of knowledge on the application. They strategy was thus the hiring of new employees that substituted the unavailable network. The unavailability was caused through actors that did were not willing to cooperate.

Conclusion:

- The human resource strategy is adopted to overcome the barrier combination IF-3 – CF-5&CF-6&CF-7 *(A lack of human resources with appropriate knowledge and competences affects the network formation and coordination, the availability of customers and the availability of appropriate institutional aspects*) **(type-2 strategy)**
- The human resource strategy is adopted to overcome the barrier combination IF-2 – CF-5 *(A lack of knowledge on application and market affects the network formation and coordination.)* **(Type-1 strategy - because it circumvents the barrier)**
- This strategy is adopted in both situations as 'increasing knowledge and resources niche strategies'.

6) Education strategy

The interviewee described they adopted this strategy in different situations. In the first situation they educate the distributors within their network to increase their technological knowledge (IF-1) and market and application knowledge (IF-2) in order for them to create a market. The lacking knowledge made it hard for the company to find distributors (Cf-5). With the strategy the company thus established a more coordinated network. In the second situation they adopted the strategy by going to fairs, to raise the knowledge of the application within the market (CF-6), since the unfamiliarity of potential customers influences the absence of a consumer base.

Conclusion:

- The education strategy is adopted to overcome the barrier combination IF-1&If-2 – CF-5 (*A lack of knowledge and awareness of technology and application affects the network formation and coordination* **(Type 3 – because it solves the deficiency within the core factor)**

- The education strategy is adopted to overcome the barrier combination IF-2 –CF-6 (*A lack of knowledge and awareness of application affects the creation of a customer base*) **(Type-3 strategy – because it solves the deficiency within the core factor)**
- They adopted it within the market adaptation phase as an 'influencing' niche strategy

7) Internal training strategy

Since the interviewee indicated that the company did not adopt this strategy so far, it is left out of the analysis.

8) Lead-user strategy

Since the interviewee indicated that the company did not adopt this strategy so far, it is left out of the analysis.

9) Partnership strategy

Since the interviewee indicated that the company did not adopt this strategy so far, it is left out of the analysis.

10) Crowdsourcing strategy

Since the interviewee indicated that the company did not adopt this strategy so far, it is left out of the analysis.

11) Financial resources strategy

Company B adopted this strategy, through starting a crowdfunding action and by getting a loan, in order to acquire materials needed for the production of the product. The main barrier was that could not produce large enough quantities to fulfil the needs of the market at that moment.

Conclusion:

- The financial resources strategy is adopted to overcome the barrier combination IF-4 – CF-3 (*A lack of financial resources affects the availability of a production system that can produce large quantities of the products with a sufficiently good performance and quality.)* **(Type-2 strategy)**
- The strategy is adopted within the market adaptation phase

12) Changing behaviour strategy

Company B adopted this strategy to overcome the barrier of lacking knowledge and awareness on the application (IF-2) that affects the confidence of the customers and thus obstructs the creation of a customer base (CF-6). They did this by indicating the benefits, such as the pay-off of the product on their website.

Conclusion:

- The changing behaviour strategy is adopted to overcome the barrier combination IF-2 – CF-6 (*A lack of knowledge and awareness of application affects the creation of a customer base*) **(type-3 strategy)**
- The strategy is adopted as an 'influencing strategy' within the market adaptation phase.

13) Redesign strategy

The company adopted the redesign strategy because they encountered two different barriers. The first barrier was raised by customers (CF-5) that lacked the financial resources (IF-5) to buy the product, which was due to the high product price. Redesigning the products so that there were multiple types with different prices made it possible to reach these customers anyway. The second barrier was raised by social-cultural aspects (of customers) that affected their perception of the

product quality and performance (CF-1); the aesthetics of the product did not fit the norms of the customers.

Conclusion:

- The redesign strategy is adopted to overcome the barrier combination IF-4 – CF-6 (*A lack of financial resources affects the creation of a customer base*) **(Type 3)**
- The redesign strategy is adopted to overcome the barrier combination IF-5 – CF-1 (*social-cultural aspects affects product quality and performance*) **(Type 3)**

14) Stand-alone strategy

Since the interviewee indicated that the company did not adopt this strategy so far, it is left out of the analysis.

15) Independent system strategy

Since the interviewee indicated that the company did not adopt this strategy so far, it is left out of the analysis.

16) Hybridization strategy

The interviewee indicated that the company adopted this strategy, but that the adoption was unsuccessful. The strategy will be excluded from the analysis

17) Adaptor strategy

It is a common strategy of companies designing products integrating solar panels to design an invertor that makes it possible to use the generated energy throughout the whole house. Company B also adopted it during the innovation phase. The barrier the company tried to overcome was a lack of complementary products and services. The influencing factor was not mentioned, but it is not important because it was adopted to circumvent the core factor, independent of the influencing factor.

Conclusion:

- The strategy is adopted within the innovation phase as a market niche strategy.
- The adaptor strategy was adopted to circumvent the barriers obstructing the diffusion of the radical innovation related to CF-4: *Missing complementary products and services*

18) Lobbying strategy

It appears that the lobbying strategy is hard to distinguish from the education strategy, since the 'ambassador' is lobbying through education of the employees of the municipality. However, since the aim is to directly change the institutional aspects, it is considered lobbying. The ambassador informs the municipality about the application and stimulates them to change the institutional aspects so that the innovation can be integrated within the municipality.

Conclusion:

- The adaptor strategy was adopted to circumvent the barriers obstructing the diffusion of the radical innovation related to IF-2CF-7: *A lack of knowledge and awareness on application and market affects the availability of appropriate institutional aspects.* **(type 3)**
- Adopted in the market adaptation phase as a influencing niche strategy
- They combined it with the human resource strategy

19) Leasing strategy

Since the interviewee indicated that the company did not adopt this strategy so far, it is left out of the analysis.

20) Sharing platform strategy

Since the interviewee indicated that the company did not adopt this strategy so far, it is left out of the analysis.

21) Geographical strategy

The geographical strategy is applied for two different barriers. The first barrier is an obstruction of the diffusion because of institutional aspects – the municipality who do not want to give permission due to rules within the municipality regarding the aesthetics of neighbourhood. The influencing factors are not of importance in the sense that it aims to circumvent the deficiency of the core factor 'institutional aspects'. The second barrier is to target the top-end of the market (see also next strategy description). The customers in the top-end of the market are targeted because of the lack of financial resources (IF-4) influencing the lack of customers (CF-6).

Conclusion:

- The geographical strategy was adopted to circumvent the barriers obstructing the diffusion of the radical innovation related to CF-7: *A lack of appropriate specific institutional aspects*
- The geographical strategy was adopted to circumvent the barriers obstructing the diffusion of the radical innovation related to IF-4 – CF-6 (*A lack of financial resources affects the availability of customers)*
- Adopted in the market adaptation phase as a marketing niche strategy
- Combined with the top-end strategy

22) Top-end strategy

The reason Company B adopted the top-end strategy is the lack of financial resources (IF-4). Since the production capacity is still too low (CF-3) to be able to offer the products for a lower price (CF-2), they needed to focus on a higher market segment in order to be able to create a market anyway (CF-6). The top-end strategy is thus adopted to remove three barriers, which are all related to each other and can be seen as a negative spiral

Conclusion:

- The top-end strategy is adopted to remove the barriers IF-4 – CF-2/CF-3/CF-6 (*A lack of financial resources affects the product price, the availability of a production system and the availability of customers)*
- It is circumventing the barrier CF-2 (high product price) **– so a type 1 strategy**
- It is solving the barrier of a lacking market (Cf-6) and a lacking production system (Cf-3) – **so a type 3 strategy**
- Adopted in the market adaptation phase as an marketing strategy (changing business model)
- Combined with the geographical strategy

23) Give-one, buy-one strategy

Since the interviewee indicated that the company did not adopt this strategy so far, it is left out of the analysis.

24) Multiple application strategy

Since the interviewee indicated that the company did not adopt this strategy so far, it is left out of the analysis.

8. Refining conceptual model and evaluation criteria

This chapter will refine and improve the initial conceptual model and the initial evaluation criteria as developed in chapter 3 and chapter 4 by applying the primary case study results described in the previous chapter. In the first section, the cross-case analysis will be described, in which the results of the two primary case studies and the results of the literature research are compared to each other. The second section will present the final evaluation criteria and the final conceptual model.

8.1 Evaluation criteria

This section will refine and improve the developed evaluation criteria (see chapter 3) following the analysis guidelines in chapter 6 (§6.4.2 & §6.4.3). The literature research (see chapter 3) confirmed the completeness of the established 10 evaluation criteria in terms of *aspects* that the criteria cover, which is needed to make companies able to evaluate the most suitable strategies. The two primary case study interviews in chapter 6 aimed, individually, to confirm the relevancy and potential use of these criteria in practice. These two interview outcomes will be compared to each other in the first part of this section, in order to explore and analyse patterns between the results that can give new insights on the evaluation criteria; the second part of this section will draw a final conclusion of the cross-case analysis; the third part will present the final evaluation criteria.

8.1.1 Cross-case analysis

During the primary case study interviews, the interviewees were asked to rank the 10 evaluation criteria developed in chapter 3 from 'Not relevant' and 'Not important' to 'Decisive'. The aim of this list was to find out whether all the evaluation criteria as developed based on logical reasoning were considered relevant by the interviewees. The following table includes the results of both companies as ranked by the interviewees. The following colours are used for the two companies: Company A and Company B

Table 8.1: Comparison of the ranked evaluation criteria

#	Evaluation criteria	0. Not relevant	1. Not important	2. Slightly important	3. Important	4. Essential	5. Decisive
1.	The strategy is understandable to everyone and not overly difficult or complex to interpret			X	X		
2.	The strategy is consistent between the organizational objectives and the values of the management group						X X
3.	The strategy is agreeable to those who must implement the niche strategy				X		X
4.	The strategy has a high estimated chance of success over time with a degree of reliability, consistency and effectiveness				X		X
5.	The strategy is adaptable to future trends within the industry	X					X
6.	The strategy has a potential good cost/benefit ratio			X	X		
7.	The strategy can be realized within the company's financial resources						X X

8.	The strategy can be realized within the company's human resources				X	X	
9.	The strategy can be realized within the capital goods				X	X	
10.	There are no major negative side effects/down sides on (the company's) environment of adopting the strategy in terms of economic, environmental and/or social impact					X	X
11.	Other:	None None					

As can be seen, the only similar rankings are: 2 '*The strategy is consistent between the organizational objectives and the values of the management*'; and 7 '*The strategy can be realized within the company's financial resources*'. They both rated the second criterion as decisive, which is not strange, since both are small companies that developed a radical innovation and both have a strong opinion and vision regarding their product. Financial resources are needed to sustain the company. It is thus explainable that both interviewees rated these criteria as decisive. Another similarity is that both the interviewees did not add another criteria to the list. The largest difference in ranking is within 5 '*The strategy is adaptable to future trends within the industry*' - for which company A indicated that it is 'not relevant' and company B indicated that it is 'decisive'. All the other criteria are ranked from 'Slightly important' to 'Essential'. It canbe noticed by the many differences in ranking that the assessment of the strategies is highly dependent on the particular characteristics of the company.

Both companies indicated that they do not consciously assess the strategies they adopt. The interviewee of Company A argued that the concept of evaluation criteria would, however, be useful within their business practices. The interviewee of Company B supported this statement and described how the lack of a proper decision-making process raised new barriers and obstructed the development of the company. The interviewee of Company A added that in order to be able to evaluate the strategies, they need information on the relative scoring of the niche strategies.

8.1.2 Improving and refining the evaluation criteria

The aim of the cross-case analysis was to find and analyse patterns between the individual primary case study results, in order to gain new insights on the evaluation criteria. Section § 6.4.2 describes how the evaluation criteria can be refined and improved by means of three different steps: 1) confirming the relevancy of the developed criteria; 2) by removing and/or changing irrelevant criteria and; 3) by adding new criteria that are indicated as relevant by the companies. This part will follow this three-step approach to improve and refine the evaluation criteria, also by including the results of the literature confirmation.

1) Confirming the relevancy of the developed criteria;
A confirmation of the relevance per developed criterion is not possible, due to the highly subjective nature of the criteria, which they are, as shown by the differences between the ratings. It depends on the characteristics of the particular company applying the evaluation criteria, which criteria are rated as relevant or important and which are rated as irrelevant or less important.

Regarding the relevancy of the evaluation criteria in general, the primary case study results indicated that the evaluation criteria are seen as a useful tool to assess the suitability of the strategies. Furthermore, from the notice that that the differences between the ratings indicate that the assessment of the strategies indeed depend on the particular characteristics of the company, it can be concluded that evaluation criteria are a useful addition to the practical application of the

conceptual framework. Companies should be able to give weight to the different evaluation criteria, since each company will perceive the criteria differently in the light of their characteristics. Furthermore, in order to be able to use the criteria, the companies need the absolute and/or relative score (depending on the particular evaluation criteria) of the niche strategies.

2) Removing and/or changing irrelevant criteria
None of the developed evaluation criteria will be removed and/or changed. Although one company rated one criterion as 'not relevant', the other company rated this particular criterion as 'decisive'; this situation indicates the subjectivity of the rating. Besides this, all the evaluation criteria are rated from 'slightly important' to 'decisive', from which can be assumed that all criteria should be included, since it depends on the characteristics of the company which are relevant and important and which are not.

3) Adding new criteria that are indicated as relevant by the companies.
Both interviewees did not add extra criteria. According to this result, it can be assumed that the list of evaluation criteria is as complete as possible; the most important aspects, as also shown in the literature confirmation are included.

8.1.3 Final evaluation criteria

The final list of evaluation criteria:

1. The niche strategy is understandable to everyone and not overly difficult or complex to interpret;
2. The strategy is consistent between the organizational objectives and the values of the management group; it does not evoke opposing interests.
3. The niche strategy is agreeable to those who must implement the niche strategy;
11. The niche strategy has a high estimated chance of success over time with a degree of reliability, consistency and effectiveness;
12. The strategy is adaptable to future trends within the industry;
13. The niche strategy has a potential good cost/benefit ratio;
14. The strategy can be realized within the company's financial resources;
15. The strategy can be realized within the company's human resources;
16. The strategy can be realized within the company's capital goods;
17. There are no major negative side effects/down sides on (the company's) environment of adopting the niche strategy in terms of economic, environmental and/or social impact.

8.2 Conceptual model

This section will refine and improve the initial conceptual model (see chapter 3) following the analysis guidelines in chapter 6 (§6.4.2 & §6.4.3). The literature research (see chapter 4) confirmed the relationships between strategies and barriers as reasoned in the initial conceptual model. The two primary case study interviews in chapter 6 aimed, individually, to confirm the relationships, to find new relationships, new barriers or new strategies. These two interview outcomes will be compared to each other in the first part of this section in order to explore and analyse patterns between the results; the second part of this section will draw a final conclusion of the cross-case analysis; the third part will present the final conceptual model based on the cross-case analysis.

8.2.1 Cross-case analysis

Below, the results from each case study interview will be compared per strategy.

1) Subsidy niche strategy

Table 8.2 compares the results of Company A and Company B. The main difference that can be noticed is that both adopted the subsidy strategy, but since they experienced different barriers, they adopted a different type of subsidy strategy. Company A adopted the subsidy strategy in order to obtain financial resources for the company itself and, additionally, reach a new market with the help of the other companies who are involved in the project related to the subsidy. The subsidy that Company B obtains is indirect to their company; it is a tax benefit that the consumers obtain. The latter will make it more attractive for customers to buy. However, the barrier experienced was related to the high product price in comparison to competing products. The high price was due to low financial resources, since they did not sell (a lot of) products yet. This explains also the differences in phase. Company A adopted the strategy within the end of the innovation phase - the tax-benefit is related to the specific characteristics of the product, e.g. the integrated solar cells; Company A adopted the strategy within the market adaptation phase - the subsidy programs in which Company A is involved are based on their activities and plans with the product, which they can finance by using the gained subsidy.

Table 8.2: Comparison of the case study interview results: Subsidy strategy

Company:	**A**	**B**
Adopted:	Yes	Yes
Barrier:	IF6 – CF6 (*Inhibiting macro & meso-economic, generic, institutional and strategic aspects affects the availability of customers*)	IF-4 - CF2 (*A lack of financial resources affects the product price)*
Phase:	Market adaptation phase	Innovation phase
Type:	Type 3	Type 3
Category:	Increasing knowledge & resources niche strategy	Influencing niche strategy
Combined?	With a partnership strategy (is a facilitating strategy)	-

2) Technological research & develop niche strategy

Table 8.3 compares the results of Company A and Company B. Company B adopted the strategy within the market adaptation phase, but it was unsuccessful. They performed technological research during the innovation phase, but there it was adopted as a facilitating strategy; it was part of the development process of the product and not adopted as a niche strategy. Company A did adopt the strategy as a niche strategy within the market adaptation phase. Their product faced barriers related to the technological knowledge on the product, for which technological research was needed in order to overcome the barrier and diffuse the product.

Table 8.3: Comparison of the case study interview results: Technological research & develop

Company:	**A**	**B**
Adopted:	Yes	Yes, but unsuccessful
Barrier:	IF1 – CF1 (*A lack of knowledge and awareness of application affects the product performance and quality*)	-
Phase:	Market adaptation phase	-
Type:	Type 2	-
Category:	Increasing knowledge & resources niche strategy	-
Combined?	With the Redesign niche strategy	-

3) Pilot research & develop niche strategy

Table 8.4 compares the results of Company A and Company B. Company B did not adopt this strategy according to the interviewee. Company A did adopt the strategy within both the innovation and market adaptation phase. The adopted it to quantify the advantages of the product. They performed multiple pilots with different aims. Some were overlapping between the innovation and market adaptation phase.

Table 8.4: Comparison of the case study interview results: Pilot research & develop niche strategy

Company:	**A**	**B**
Adopted:	Yes	No
Barrier:	IF-2 –CF-6 & C-F5 (*A lack of knowledge and awareness on market and application affects the creation of a customer base and network formation and coordination*)	-
Phase:	Innovation & market adaptation phase	-
Type:	Type 2	-
Category:	Increasing knowledge & resources niche strategy	-
Combined?	With the 'Education' niche strategy and the 'partnership' strategy. The latter is a facilitating strategy.	-

4) Market research & develop niche strategy

Table 8.5 compares the results of Company A and Company B. Company B did not adopt this strategy. Company A did adopt the strategy, however, they adopted it as a facilitating strategy and not to overcome a specific experienced barrier.

Table 8.5: Comparison of the case study interview results: Market research & develop niche strategy

Company:	**A**	**B**
Adopted:	Yes, but as facilitating strategy	No
Barrier:	-	-
Phase:	-	-
Type:	-	-
Category:	-	-
Combined?	-	-

5) Human resource niche strategy

Table 8.6 compares the results of Company A and Company B. As opposed to Company B, Company A adopted this strategy as a facilitating strategy; the strategy is adopted to develop the company further, not to overcome a specific experienced barrier. Company B, however, did adopt the human resource strategy as a niche strategy in order to overcome different barriers. Their lack of human resources with appropriate knowledge and competences did create specific barriers for which new human resources were required. In order to circumvent the lack of network formation and coordination they also adopted the human resources successfully. However, this strategy is adopted to circumvent the barrier in an effective way on a short term, it did not solve the barrier – it is thus a type 1 strategy.

Table 8.6: Comparison of the case study interview results: Human resource niche strategy

Company:	**A**	**B**
Adopted:	Yes, but as facilitating strategy	Yes
Barrier:	-	IF-3 – CF-5&CF-6&CF-7 *(A lack of human resources with appropriate knowledge and competences affects the network formation and coordination, the availability of consumers and the availability of appropriate institutional aspects)* IF-2 – CF-5 *(A lack of knowledge on application and market affects the network formation and coordination.)*
Phase:	-	Market adaptation phase
Type:	-	1st barrier: type 2 2nd barrier: type 1
Category:	-	Both: Increasing knowledge and resources niche strategy
Combined?	-	-

6) Education niche strategy

Table 8.7 compares the results of Company A and Company B. Both companies adopted the education strategy in order to solve the same deficiency: A lack of knowledge and awareness of application within the social core factors. They both successfully increased the technological and application knowledge of the customers and actors within the network by educating them. However, Company B adopted the strategy also through educating about the application on fairs. Company A specifically obtained the information they use for education through the pilot research niche strategy.

Table 8.7: Comparison of the case study interview results: Education niche strategy

Company:	**A**	**B**
Adopted:	Yes	Yes
Barrier:	IF-2 – CF-5 & CF-6 & CF-7 (*A lack of knowledge and awareness of application affects the network formation and coordination, the availability of customers and the availability of appropriate institutional aspects*)	IF-1&If-2 – CF-5 (*A lack of knowledge and awareness of technology and application affects the network formation and coordination)* IF-2 –CF-6 (*A lack of knowledge and awareness of application affects the creation of a customer base*)
Phase:	Market adaptation phase	Market adaptation phase
Type:	All type 3	Type 3
Category:	Influencing strategy	Influencing strategy
Combined?	With the pilot research niche strategy	-

7) Internal training strategy

According to the interviewees, both companies have not adopted this strategy so far.

8) Lead-user niche strategy

Table 8.8 compares the results of Company A and Company B.Company B did not adopt this strategy. Company A did adopt the strategy, however, they adopted it as a facilitating strategy and not to overcome a specific experienced barrier.

Table 8.8: Comparison of the case study interview results: Lead-user niche strategy

Company:	**A**	**B**
Adopted:	Yes, but as a facilitating strategy	No
Barrier:	-	-
Phase:	-	-
Type:	-	-
Category:	-	-
Combined?	-	-

9) Partnership niche strategies

Table 8.9 compares the results of Company A and Company B. Company B did not adopt this strategy. Company A did adopt the strategy, however, they adopted it as a facilitating strategy and not to overcome a specific experienced barrier.

Table 8.9: Comparison of the case study interview results: Partnership niche strategy

Company:	**A**	**B**
Adopted:	Yes but as facilitating strategy	No
Barrier:	-	-
Phase:	-	-
Type:	-	-
Category:	-	-
Combined?	-	-

10) Crowdsourcing niche strategy

According to the interviewees, both companies have not adopted this strategy so far.

11) Financial resources niche strategy

Table 8.10 compares the results of Company A and Company B. Company A adopted the strategy, however, they adopted it as a facilitating strategy and not to overcome a specific experienced barrier. Company B did adopt the strategy in order to overcome a specific barrier. The strategy solved the deficiency within the influencing factor (lack of financial resources).

Table 8.10: Comparison of the case study interview results: Financial resources niche strategy

Company:	**A**	**B**
Adopted:	Yes, but as a facilitating strategy	Yes
Barrier:	-	IF-4 – CF-3 (*A lack of financial resources affects the availability of a production system that can produce large quantities of the products with a sufficiently good performance and quality.)*
Phase:	-	Market adaptation phase
Type:	-	Type 2
Category:	-	Increasing knowledge and resources niche strategy
Combined?	-	-

12) Changing customer behaviour niche strategy

Table 8.11 compares the results of Company A and Company B. What can be noticed is that both companies adopted the strategy to overcome the same barrier within the market adaptation phase. They both informed the potential customer base the advantages of the product in order to change their behaviour. Company A adopted the strategy by starting a partnership with influencers (e.g. companies) that have a certain status or are known within the industry or among potential customers, in order to gain more familiarity. It can be seen as a form of advertisement.

Table 8.11: Comparison of the case study interview results: Changing customer behaviour niche strategy

Company:	**A**	**B**
Adopted:	Yes	Yes
Barrier:	IF-2 – CF-6 (*A lack of knowledge and awareness of application affects the creation of a customer base*) IF-2 – CF-5 *(A lack of knowledge and awareness of application affects the network formation and coordination)*	IF-2 – CF-6 (*A lack of knowledge and awareness of application affects the creation of a customer base*)
Phase:	Market adaptation phase	Market adaptation phase
Type:	Type 3	Type 3
Category:	Influencing strategy	Influencing strategy
Combined?	-	-

13) Redesign niche strategy

Table 8.12 compares the results of Company A and Company B. Both companies adopted this strategy to overcome a deficiency related to the product quality and performance. However, for Company A, this deficiency was due to a lack of knowledge within the company and for Company B, this deficiency was due to external factors (social-cultural aspects). Company B also adopted the strategy to overcome the lack of financial resources within a market segment, which obstructed consumers to buy the product (so, also external factors).

Table 8.12: Comparison of the case study interview results: Redesign niche strategy

Company:	**A**	**B**
Adopted:	Yes	Yes
Barrier:	IF-1 – CF-1 (*A lack of knowledge and awareness of technology affects the product performance and quality*)	IF-4 – CF-6 (*A lack of financial resources affects the creation of a customer base*) IF-5 – CF-1 (*Social-cultural aspects affects product quality and performance*)
Phase:	Market adaptation phase	Market adaptation phase
Type:	Type 3	Type 3
Category:	Marketing niche strategy	Marketing niche strategy
Combined?	-	-

14) Stand-alone niche strategy

According to the interviewees, both companies have not adopted this strategy so far.

15) Independent system niche strategy

According to the interviewees, both companies have not adopted this strategy so far.

16) Hybridization niche strategy

According to the interviewee, Company A did not adopt this strategy so far. Company B adopted this strategy, but did not continue it due to failures within components. The strategy is thus excluded from the analysis.

17) Adaptor niche strategy

Table 8.13 compares the results of Company A and Company B. As can be seen, only company B adopted this strategy within the innovation phase in order to gain access to a system of complementary products and services.

Table 8.13: Comparison of the case study interview results: Adaptor niche strategy

Company:	**A**	**B**
Adopted:	-	Yes
Barrier:	-	CF-4 Lack of availability of complementary products and services
Phase:	-	Innovation phase
Type:	-	Type 1
Category:	-	Market niche strategy
Combined?	-	-

18) Lobbying niche strategy

Table 8.14 compares the results of Company A and Company B. Both companies adopted the strategy to overcome the same barrier related to lacking knowledge, affecting the availability of appropriate institutional aspects. Company B adopted it together with the human resource strategy – they hired a new employee with the knowledge and competences needed to lobby.

Table 8.14: Comparison of the case study interview results: Lobbying niche strategy

Company:	**A**	**B**
Adopted:	Yes	Yes
Barrier:	IF-2 - CF-7 *(A lack of knowledge and awareness of application affects the availability of appropriate institutional aspects)*	IF-2 - CF-7 (*A lack of knowledge and awareness on application and market affects the availability of appropriate institutional aspects)*
Phase:	Market adaptation phase	Market adaptation phase
Type:	Type 3	Type 3
Category:	Influencing niche strategy	Influencing niche strategy
Combined?	-	Human resource niche strategy

19) Leasing niche strategy

According to the interviewees, both companies have not adopted this strategy so far.

20) Sharing platform niche strategy

According to the interviewees, both companies have not adopted this strategy so far.

21) Geographical niche strategy

Table 8.15 compares the results of Company A and Company B. They both successfully adopted the strategy to circumvent the barrier related to inappropriate specific institutional aspects. Besides this, Company B also adopted the strategy as a type 3 strategy – they target the top-end of the market by focusing on specific geographical areas.

Table 8.15: Comparison of the case study interview results: Geographical niche strategy

Company:	**A**	**B**
Adopted:	Yes	Yes
Barrier:	CF-7 (*A lack of appropriate specific institutional aspects)*	CF-7 (*A lack of appropriate specific institutional aspects)* IF-4 – CF-6 (*A lack of financial resources affects the availability of customers)*
Phase:	Market adaptation phase	Market adaptation phase
Type:	Type 1	1st barrier: Type 1 2nd barrier: Type 1
Category:	Marketing strategy	Marketing strategy
Combined?	-	Top-end niche strategy

22) Top-end niche strategy

Table 8.16 compares the results of Company A and Company B. They both adopted the strategy to circumvent the barrier related to CF-2 (high product price). However, Company B is stuck in a negative spiral: They have a lack of financial resources (IF-4). The production capacity is low, which makes the product price higher, which obstructs the market to acquire the product (the price is too high for them (IF-4), which makes that the company has problems with their financial resources (IF-4 again).

Table 8.16: Comparison of the case study interview results: Top-end niche strategy

Company:	**A**	**B**
Adopted:	Yes	Yes
Barrier:	CF-2 High product price	IF-4 – CF-2/CF-3/CF-6 (*A lack of financial resources affects the product price, the availability of a production system and the availability of customers)*
Phase:	Market adaptation phase	Market adaptation phase
Type:	Type 1	Type 3
Category:	Marketing strategy	Marketing strategy
Combined?	-	Geographical

23) Give-one, buy-one niche strategy

According to the interviewees, both companies have not adopted this strategy so far.

24) Multiple application niche strategy

According to the interviewees, both companies have not adopted this strategy so far.

25) Restructuring business niche strategy – New strategy

Table 8.17 compares the results of Company A and Company B. As can be seen, only Company A adopted this strategy.

Table 8.17: Comparison of the case study interview results: Restructuring business niche strategy

Company:	**A**	**B**
Adopted:	Yes	No
Barrier:	IF-6 – CF-5 (*Inhibiting macro & meso economic, generic institutional and strategic aspects affect the network formation and coordination)*	-
Phase:	Market adaptation phase	-
Type:	Type 3	-
Category:	It is adopted as an influencing strategy	-
Combined?	-	-

8.2.2 Synthesis cross-case study

Only the strategies that were adopted to overcome barriers will be included in the further analysis; strategies adopted as facilitating strategy (in the case of Company A four times) or strategies with an unsuccessful adoption (in the case of Company B two times) are excluded. Figure 8.1 (next page) shows the overview of all the adopted strategies per company. Purple is Company A, blue is Company B (see legend). The interviewee of Company A indicated that they adopted 10 different strategies; the interviewee of Company B indicated that they also adopted 10 different strategies. Some strategies were adopted to overcome multiple barriers, and some strategies were adopted to remove the same barrier. The circumventing strategies (the type-1 strategies) can be seen in the image in the second row; these are independent of the influencing strategies. The type-2 and type-3 strategies are connected to the particular barriers (a combination of an influencing and core factor). The image is further elaborated below the image.

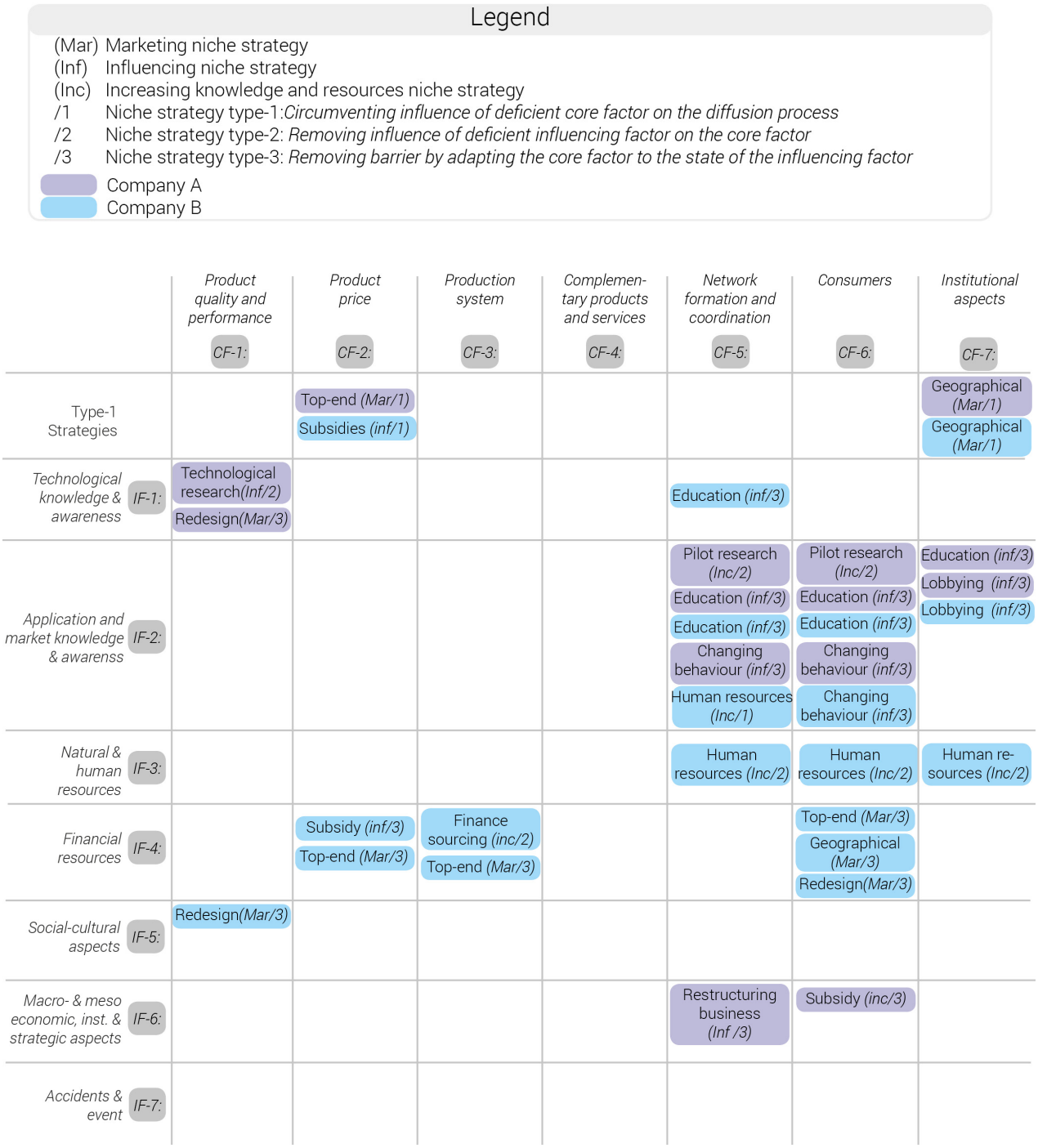


Figure 8.1: Overview of the adopted niche strategies by Company A & B

What can be noticed is that company A adopted the Top-end niche strategy; Company B adopted the Subsidies niche strategy; and both companies adopted the geographical niche strategy as a type-1 strategy in order to circumvent the deficiencies in the same core factors: The Top-end strategy and Subsidies strategy were adopted to circumvent the barrier related to a high product price. The geographical strategy niche strategy was adopted to circumvent the barrier related to inappropriate institutional aspects. Company B also adopted the top-end niche strategy to circumvent the core factor product price, but it was specifically mentioned in combination with an influencing factor, so it cannot be assumed that it can circumvent all the barriers. It is still a type-1 strategy since it aims to circumvent the barrier. The same count for the human resources strategy (IF-4 – CF-5); it was adopted to circumvent a barrier (so it is a type-1 strategy), but it was specifically mentioned in

combination with an influencing factor, so it cannot be assumed that it can be adopted to circumvent all barriers related to the core-factor.
Another similarity is that both companies experienced relatively a lot of barriers in which the core factors 'network formation and coordination' and 'consumers' were deficient. Company A adopted a lot of strategies that removed a lack of knowledge on market and application within the network or among the customers. As can be noticed, Company B adopted multiple strategies to overcome the lack of customers, either because the customers lacked the financial resources to acquire the product, or they lacked the awareness of the application.

Company A adopted more strategies that aimed to increase their internal knowledge on technology and market (e.g. a pilot research and a technological research niche strategy) Company B adopted no strategies to increase the internal knowledge on technology or market. However, Company B experienced barriers due to a lack of human resources with appropriate capabilities and because of a lack of financial resources within the company. Company A experienced no barriers related to these influencing factors; this can be explained by the adoption of multiple strategies as facilitating strategies (as described in the tables in the beginning of this section). Because of this, they avoided these barriers.

8.2.3 Refining the conceptual model

In this section, the niche strategies as included in figure 8.1 will be compared to the conceptual framework as developed in chapter 3. As described in §5.3.2, the cross case analysis between the primary case studies and the conceptual model exists out of 5 steps, which will be followed in this section:

1. Confirming the linkages between the strategies and barriers as captured in the initial conceptual model described in chapter 4
2. Revealing new relationships between already defined barriers and defined strategies;
3. Revealing new relationships between already defined barriers and new discovered strategies
4. Revealing new relationships between new discovered barriers and already defined strategies
5. Revealing new relationships between new discovered barriers and new discovered strategies

Figure 8.2 depicts the same image as shown in the previous section, but this time, the relationships between the barriers and niche strategies as observed during the primary case studies are compared to the conceptual model. The legend describes the colours of the comparative image. Company A and B are still purple (A) and blue (B), but only the outline of the niche strategies. The colour inside the cell corresponds with the steps above. Two examples: A white cell with a blue outline is a niche strategy adopted by company B, which confirms the proposed relationship in the conceptual model; an orange cell with an purple outline is a niche strategy adopted by company A, which reveals a new relationship between a new discovered barrier and an already proposed strategy (step 4).

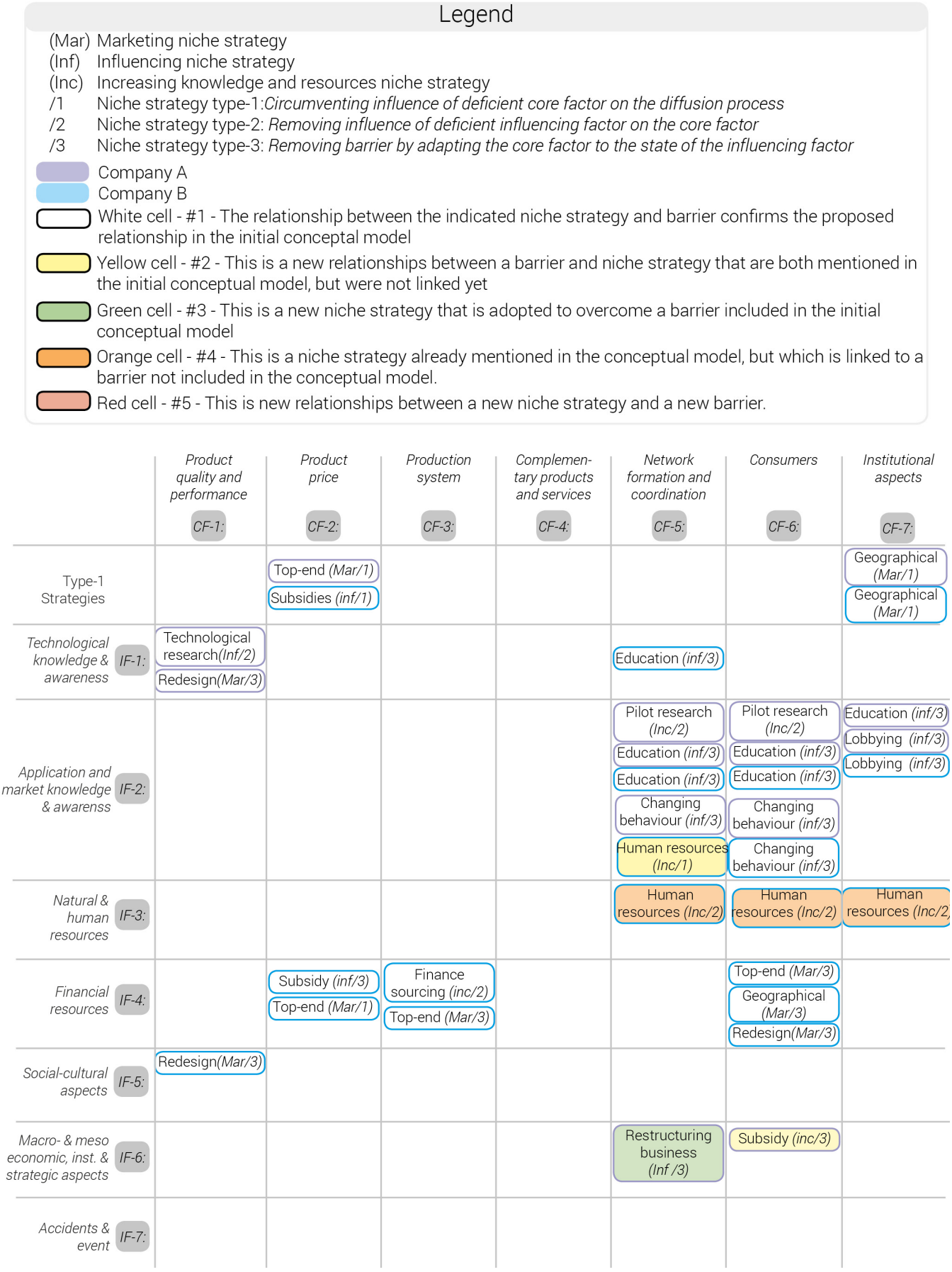


Figure 8.2: Comparison of the adopted niche strategies by Company A & B and the conceptual model

Per previously mentioned step, the conclusions of this part will be described:

1. Confirming the linkages between the strategies and barriers as captured in the initial conceptual model described in chapter 4.

The figure shows 22 confirmed proposed relationships as described in the conceptual model in chapter 3. Of these 22 confirmed proposed relationships, 5 are both confirmed by Company A and Company B. Both the Top-end strategy (If-4 – CF-2) and the geographical strategy (IF-4 – CF-6) are described during the results analysis of the primary case studies as type-3 strategies, since Company B specifically mentioned the influencing factor. Within the conceptual model, these are both described as a type-1 strategy; they are assumed to circumvent the barriers related to the core-factors. The relationship as described in the initial conceptual model can thus only partly be confirmed, since it is not observed that it circumvents all barriers related to the particular core factors.

2. Revealing new relationships between already defined barriers and defined strategies.

Three new relationships between already defined barriers and defined strategies were found during the primary case studies:

- Company A: Changing behaviour strategy to overcome IF1-CF5 '*A lack of knowledge and awareness of technology affects the network formation and coordination'*

This strategy is a type 3 strategy, since it aims to solve the lacking knowledge and awareness within the network; it is thus removing the deficiency within the core factor. As reasoned, the strategy could indeed solve the barrier of lacking knowledge and awareness of technology within the core factor network formation and coordination by trying to change the behaviour of the actors within the network. Furthermore, it would make sense to add this relationship to the conceptual model, since it is already included in the conceptual model to overcome a comparable barrier: '*A lack of knowledge and awareness of technology affects the availability customers'.*

- Company A: Subsidies strategy to overcome IF6-CF6 '*Inhibiting macro & meso-economic, generic, institutional and strategic aspects affects the availability of customers*'

The subsidy strategy can be broader than assumed during the development of the initial conceptual model. Since, in the case of company A, the subsidy strategy is adopted in combination with a partnership strategy, the barrier could be overcome. It thus can be included in the conceptual model. It is a type 3 strategy, since it aims to overcome the specific combination of influencing and core factor.

- Company B: Human resources strategy to overcome IF2-CF5 '*(A lack of knowledge on application and market affects the network formation and coordination.*

By hiring new employees, company B tried to circumvent the lack of knowledge on application and market within the network. After the adoption of the strategy, the particular actors that lacked the knowledge were not needed anymore, since the new employees took over their practices (instalment of the products). It can be reasoned that the strategy can circumvent all barriers related to the network formation and coordination, and that it is a type 1 strategy. The company indicated that it was the only effective short-term strategy. They adopted it temporary – they are aiming for another solution to the barrier.

Conclusion:

All three new relationships will be included in the conceptual model, since the niche strategies overcame the particular barriers successfully.

3. Revealing new relationships between already defined barriers and new discovered strategies

One new relationships between an already defined barrier and a new strategy was found during the primary case studies:

- Company A: Restructuring business niche strategy to overcome IF6-CF-5 '*Inhibiting macro & meso economic, generic institutional and strategic aspects affect the network formation and coordination*".

Company A adopted this strategy because they experienced a barrier during the network formation; potential actors did not want to be part of their network because they perceived the company as competitors. By separating the business into two, these actors changed their vision and became part of the network. It is a strategic strategy, which has a large impact on the structure of the company. It is a new strategy that is not covered by the other niche strategies included in the initial conceptual model developed in chapter 3.

Conclusion:
The new relationships will be added to the conceptual model, since the niche strategy overcame the barrier successfully.

4. Revealing new relationships between new discovered barriers and already defined strategies
Three new relationships between new barriers and already defined strategies are defined:
- Company B: Human resources strategy to overcome IF3-CF5 '*A lack of human resources with appropriate knowledge and competences affects the network formation and coordination'*
- Company B: Human resources strategy to overcome IF3-CF6 '*A lack of human resources with appropriate knowledge and competences affects the e availability of consumers'*
- Company B: Human resources strategy to overcome IF3-CF7 '*A lack of human resources with appropriate knowledge and competences affects the availability of consumers and the availability of appropriate institutional aspects*'

The combination between influencing and core factors (the barriers) are new, since the assumption in chapter three regarding the human resources was that this influencing factor could only influence CF-1 'product price and performance' and CF-3 'production system'. However, the interview with company B revealed that the lack of human resources with appropriate knowledge and capabilities can have a much broader impact; the boards' lack of knowledge and competences of running a company, described by the interviewee as a 'wrong mentality', affected the network formation and coordination, the availability of customers and the lack of appropriate institutional aspects (they were not able to lobby themselves). They hired new employees to remove the barriers.

Conclusion:
The new relationships will be added to the conceptual model, since the niche strategies overcame the barriers successfully.

5. Revealing new relationships between new discovered barriers and new discovered strategies
During the primary case studies there were no new relationships between new discovered barriers and new discovered strategies defined.

8.2.4 Refined conceptual model

Figure 8.3 integrates the findings described above in the initial conceptual model. Each column can be read separately. The niche strategies are displayed per core factor (CF) / influencing factor (IF) combination. Since the type-1 (blue) strategies are circumventing the influence of the deficient core factors, these are not linked to an influencing factor. Instead, they are connected to the core factors directly. The type-1 and type-2 niche strategies are linked to an influencing factor (the small grey boxes). Since the figure only indicates the numbers of the core and influencing factors, a legend is included presenting the corresponding names. The legend also includes information on the colours used within the figure. The description continues below the figure.

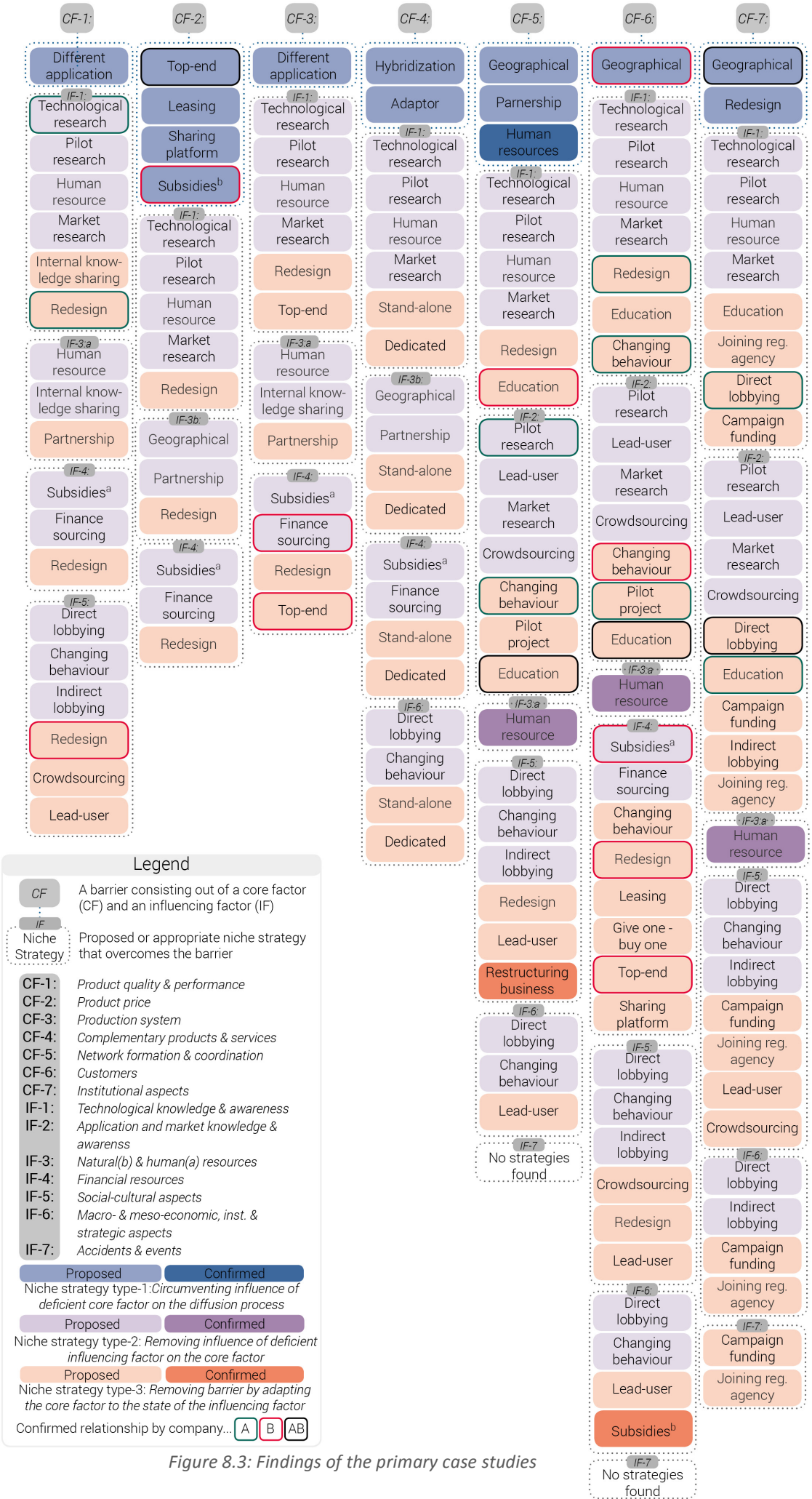


Figure 8.3: Findings of the primary case studies

It should be noted that the human resources strategy is included as a type 1 strategy (CF-5) although it was mentioned in combination with an influencing factor. Company B told however, that the strategy was adopted as a temporary solution to circumvent the lack of network. Furthermore, the top-end strategy type-1 (CF-2) is only half confirmed by company B – since it was also mentioned in combination with an influencing factor. 3 new barriers were added (a lack of human resources affecting the network formation and coordination, the availability of customers and the availability of appropriate institutional aspects), and one new niche strategy.

As can be seen, most of the relationships that were discovered during the primary case studies were already mentioned in the conceptual model. This can indicate that the logic behind the initial conceptual model can be considered legit.

9. Conclusion, discussion and further research

This chapter contains the research conclusions and discussion. The latter includes both the practical and theoretical contributions of the research, a discussion on the quality and limitations of the research and recommendations for further research.

9.1 Conclusions

The objective of the research was (see §1.3.1) to develop a conceptual model that includes new niche strategies, that can remove or circumvent barriers raised by missing or incomplete factors as described in the framework by Ortt & Kamp (2019) and to research the relationship between the barriers and the strategies. Furthermore, the aim was to develop criteria that can be used by companies to evaluate these linkages in order to be able to assess the suitability of the strategies in relation to their specific company characteristics. This section will answer the research questions that were based on this objective. Before answering the main research question "How can the causal linkage between barriers and niche strategies be captured in a framework so that companies are able to more accurately choose a suitable strategy that enables the diffusion of their radical innovation into a niche market during the market adaptation phase?", first, the sub-research questions will be answered.

9.1.1 Sub-research question 1

Sub-research question 1, '*What evaluation criteria are relevant for assessing the suitability of new niche strategies?',* contained three different questions that will guide towards the answer of this question. Before drawing the conclusion that answers sub-research question 1, these three questions will be answered first.

1. **'Which evaluation criteria can be defined based on logical reasoning and preliminary knowledge on niche strategies and the factor framework as described by Ortt & Kamp (2019)?'**

As described in §3.2.2, there is a distinction between the development stages of the strategies within this report, indicating to which extent the strategies are confirmed by literature and to which extent strategies will be the most suitable to companies. Suitable strategies are the strategies that companies should adopt to have the most successful outcome of overcoming or circumventing the experienced barrier. It depends per company which appropriate strategy fits the best in their case.

In order for companies to be able to assess the suitability of niche strategies, 10 criteria were formulated in chapter 3. The evaluation criteria were developed based on three general criteria: 1) *The evaluation criteria take the perspective of the company adopting the strategy; 2) The evaluation criteria should cover the most important characteristics of companies; 3) The evaluation criteria must complement the barriers framework*. The following criteria were listed:

A. The niche strategy is understandable to everyone and not overly difficult or complex to interpret;
B. The strategy is consistent between the organizational objectives and the values of the management group; it does not evoke opposing interests.
C. The niche strategy is agreeable to those who must implement the niche strategy;
D. The niche strategy has a high estimated chance of success over time with a degree of reliability, consistency and effectiveness;
E. The strategy is adaptable to future trends within the industry;
F. The niche strategy has a potential good cost/benefit ratio;

G. The strategy can be realized within the company's financial resources;
H. The strategy can be realized within the company's human resources;
I. The strategy can be realized within the company's capital goods;
J. There are no major negative side effects/down sides on (the company's) environment of adopting the niche strategy in terms of economic, environmental and/or social impact.

The evaluation criteria can be used by means of a multi-criteria analysis to assess the most suitable strategy to overcome or circumvent a barrier. Each niche strategy should be relative or absolute scored on the criteria. The company then ranks the criteria from most important, to least important. The combination of the score and ranking than indicates the most suitable strategy.

2. 'What can related literature and theoretical concepts contribute to the development of the evaluation criteria?'

Since it is unrealistic to expect that the evaluation will always lead to the perfect strategy, the aim of the literature research was not to create a complete list of evaluation criteria; The aim was to confirm the completeness of the established 10 evaluation criteria in terms of aspects that the criteria cover that are needed for an effective strategy evaluation. The four guidelines by Rumelt (1993) were used to confirm the completeness in terms of aspects. These four broad guidelines are widely used by companies to test strategies:

C. "**Consistency**: The strategy must not present mutually inconsistent goals and policies." (Rumelt, 1993)
D. "**Consonance**: The strategy must represent an adaptive response to the external environment and to the critical changes occurring with it." (Rumelt, 1993)
E. "**Advantage**: The strategy must provide for the creation and/or maintenance of a competitive advantage in the selected area of activity." (Rumelt, 1993)
F. "**Feasibility**: The strategy must neither overtax available resources nor create unsolvable sub problems" (Rumelt, 1993)

These four guidelines were used to subdivide the evaluation criteria that were developed based on logical reasoning. All the aspects were covered: 3 evaluation criteria could be listed under 'consistency', 1 evaluation criterion under 'Consonace'; 1 evaluation criterion under 'Advantage'; and 5 evaluation criteria under 'feasibility'.

3. 'How can empirical research contribute to the development of the evaluation criteria?'

Two primary case studies were conducted in which two employees of two different companies that introduced radical innovations into the market were interviewed. The aim was to discover their opinion on the relevancy of the developed list of evaluation criteria, their current use of criteria and their potential use of the evaluation criteria. The empirical research contributed to the development of the evaluation criteria in multiple ways:

- The interviewees indicated that they currently do not use evaluation criteria. They confirmed that the use of evaluation criteria during the assessment of strategies would be useful;
- Furthermore, the results indicate the importance of using evaluation criteria; the lack of a structured evaluation process raised new barriers within Company B.
- No extra evaluation criteria were added to the list, after which there could be assumed that the list was as complete as possible;
- The difference in ranking (weighting) of the criteria by the two different interviewees confirmed that the company characteristics indeed have a great impact on the choice for a particular strategy, and thus that the suitability of strategies to overcome a strategy will differ per company.

- The interviewees indirectly confirmed that the use of the criteria by means of a multiple criteria analysis would be useful.

These points indicate that the goal of the empirical research is fulfilled; the list of evaluation criteria has been identified as relevant; it will be useful since the current lack of use of evaluation criteria raised new barriers; and the companies directly confirmed that the criteria would help them with structuring the decision-making process.

Answer sub-research question 1:
'What evaluation criteria are relevant for assessing the suitability of new niche strategies?'

It can be concluded that the list of evaluation criteria described in answer 1A includes relevant evaluation criteria for assessing the suitability of niche strategies. According to literature it includes all relevant aspects that should be taken into account during the assessment of strategies and empirical research confirmed the usefulness of the evaluation criteria in practice as addition to the conceptual model.

9.1.2 Sub-research question 2

Sub-research question 2, '*What does a conceptual framework of the linkages between niche strategies and barriers look like?*' contained three different questions that will guide towards the answer of this question. Before drawing the conclusion that answers sub-research question 2, these three questions will be answered first.

A. 'What new niche strategies can be identified and linked to the factor framework as described by Ortt & Kamp (2019) based on logical reasoning?'

To be able to define new niche strategies based on the factor framework, a background research on relevant theory is performed in chapter 2 to understand the concept of niche markets, niche strategies and the factor framework of Ortt & Kamp (2019).

The development and diffusion of radical innovations in the market can be characterised as a complex, uncertain and long-winded process (Slocum et al., 2008). Barriers within the socio-technical system can hamper or completely block large-scale diffusion of the radical innovations. (Ortt, Shah, et al., 2007). Ortt and Kamp (2019) identified components, 'factors', that form these barriers. These factors are involved in the diffusion process of radical innovations, and that can, depending on the presence or absence, enable, hamper or even completely block the diffusion process. The factor framework describes two types of factors: Influencing factors (IF) and core factors (CF), which together form the social-technical system of the radical innovation. The seven core factors represent the market characteristics, and have a direct effect on the diffusion process of radical products. The influencing factors (IF-1 to IF-7) describe the wider political, economic, cultural, social, technological, legal and environmental factors, which have a direct effect on the core factors, and an indirect effect on the development and diffusion of the radical innovation. (Ortt & kamp, 2019) (See figure 1.1) A barrier, the combination of a core and influencing factor, can be either 'circumvented' or 'removed' by the adoption of a niche strategy. A niche strategy is a strategy that can be adopted by a company to either create a niche market, or to change the socio-technical system in favour of the radical innovation, so that (later) a niche market can be created. A niche market forms a protected space in which the radical innovation is able to develop in terms of user needs, financial and technological viability and price/performance ratio, until it reaches maturity and is able to survive in the mainstream market. (Ortt, 2013)

I have developed a conceptual model in which the linkages between the niche strategies and barriers are rationalised. Companies can use this model to understand the logic behind the relationships and

to define niche strategies that can overcome the experienced barriers. A total of 28 niche strategies have been identified to overcome barriers that companies can experience during the development and diffusion of their radical innovation into the market, which can be divided in four different categories:

1. 'Increasing knowledge and resources niche strategies', which specifically aim to directly increase the knowledge and resources within the company and indirectly increase the knowledge and resources within the socio-technical system. The niche strategies that fall into this category are: Technological research niche strategy; pilot research niche strategy; lead-user niche strategy; crowdsourcing niche strategy; internal knowledge sharing niche strategy; human resource niche strategy; market research niche strategy; subsidy niche strategy; financial resources niche strategy; and a geographical niche strategy.
2. 'Influencing niche strategies', which aim to change the perception, behaviour or opinion of actors within the network, of customers, or of institutions, that are needed to diffuse the innovation. The knowledge obtained within the first category is applied to the market within this category. The niche strategies that fall into this category are: Education niche strategy; (In)direct lobbying niche strategy; joining a regulatory agency niche strategy; partnership niche strategy; campaign funding niche strategy; pilot project niche strategy; subsidy niche strategy; lead-user niche strategy; hybridization niche strategy; and a changing behaviour niche strategy.
3. 'Marketing niche strategies', which are strategies aiming to commercialise the radical innovation. The latter can be divided into two:
    a. Strategies that fundamentally change aspects of the product, production system or complementary products and services. The niche strategies that fall into this category are: Redesign niche strategy; different application niche strategy; hybridization niche strategy; adaptor niche strategy; stand-alone niche strategy; and a dedicated system niche strategy.
    b. Strategies that change the business model. The niche strategies that fall into this category are: Top-end niche strategy; leasing niche strategy; sharing platform niche strategy; give-one, buy-one niche strategy; geographical niche strategy; partnership niche strategy.

As can be noticed, some niche strategies fall into two different categories; this is due to the nature of the niche strategies. An overview of the strategies is provided in chapter 5.

B. 'What can related literature and theoretical concepts contribute to the development of the linkage of these niche strategies to the barriers?'

The conceptual model, as described in the conclusion of 2A, contains the linkages between niche strategies and barriers based on logical reasoning. A desk research on the confirmation of these relationships is performed in chapter 5. Following the data collection method (§5.1.2), of the 157 relationships described in the conceptual model, only 30 relationships could not be obtained enough information to either confirm or contradict the proposed relationship. Not one described relationship was explicitly contradicted by the researched literature.

There were two possibilities perceived as a confirmation of the linkage: Either the reviewed papers indicated that the theory underlines the existence of the linkage between the barrier and strategy, or the authors gave an example of the linkage based on research on a real life case. The latter is thus a confirmation based on a secondary case study. There was aimed for a confirmation of the proposed relationships by both types of confirmation, however, this was only achieved for 8 of 25 niche strategies. This was mainly due to a combination of time constraints and the barrier descriptions; to find support in literature on detailed barrier descriptions in combination with the strategies could in some cases not be achieved within the limits described in the data collection method.

The confirmation of the many proposed relationships indicatd that the logical reasoning behind the conceptual model is credible; in these cases, the proposed niche strategies can be perceived as appropriate relationships. However, the confirmation of the proposed relationships, being evidence

of the existence of the relationship in practice, does not say anything about the strength of these relationships; the success of the adoption of a particular niche strategy to overcome a barrier will depend on the particular characteristics of the company.

C. 'How can empirical research contribute to the development of the linkage of these niche strategies to the barriers?'

Two primary case study interviews were conducted with two companies that developed a radical product, which were analysed in chapter 7 and compared in a cross-case analysis in chapter 8. Both companies are in the beginning of the market adaptation phase with their product. The case study results showed that both firms adopted various niche strategies to overcome experienced barriers obstructing diffusion of their product in the market; Company A adopted 10 different niche strategies and Company B also adopted 10 different niche strategies. Some strategies were adopted to overcome multiple barriers, and some strategies were adopted to remove the same barrier.

The empirical research indicated that the logic behind the conceptual model can be considered legitimate; in total, 21 proposed relationships as described in the initial conceptual model could be confirmed by the primary case studies. Of these 21 confirmed proposed relationships, 5 are both confirmed by Company A and Company B.

According to the number of confirmed relationships in comparison to the new relationships, it can be said that the initial conceptual model already included almost all the relationships between the strategies and barriers that the interviews revealed. However, the case studies indicated that the initial conceptual model was not complete and that, most likely, it will never be complete, since new cases will always add new additions. The following improvements of the conceptual model indicate this:

- Three *new* relationships between already defined barriers and *already defined* strategies were found during the primary case studies.
- One new niche strategy could be defined for an already proposed barrier; a restructuring business strategy. Company A adopted this strategy to overcome the barrier 'Inhibiting macro & meso economic, generic institutional and strategic aspects affect the network formation and coordination''.
- Three new relationships were discovered between *new* barriers and *already defined* strategies; In chapter 3 there was assumed that the factor human resources could only affect the technological components of the socio-technical system, but company B revealed that the lack of human resources with appropriate knowledge and capabilities can have a much broader impact. Their lack of customers and network was due to the 'wrong mentality', of the board members, which is perceived as a lack of knowledge and competences of running a company. Furthermore, they lacked the skills to influence the institutional aspects, for which they hired a new employee. No new relationships between new discovered barriers and new discovered strategies were found.

The logic behind the conceptual model is perceived as interesting by the interviewees; it can help the companies to structure their decision-making process by helping them to define the exact barrier and to find out which niche strategies are seen as appropriate to overcome the particular barrier and why they are seen as appropriate.

Answer research question 2:

'What does a conceptual framework of the linkages between niche strategies and barriers look like?'

Figure 9.1 shows the final conceptual model in which barriers and niche strategies are linked to each other. There will be elaborated on the figure on the next page.

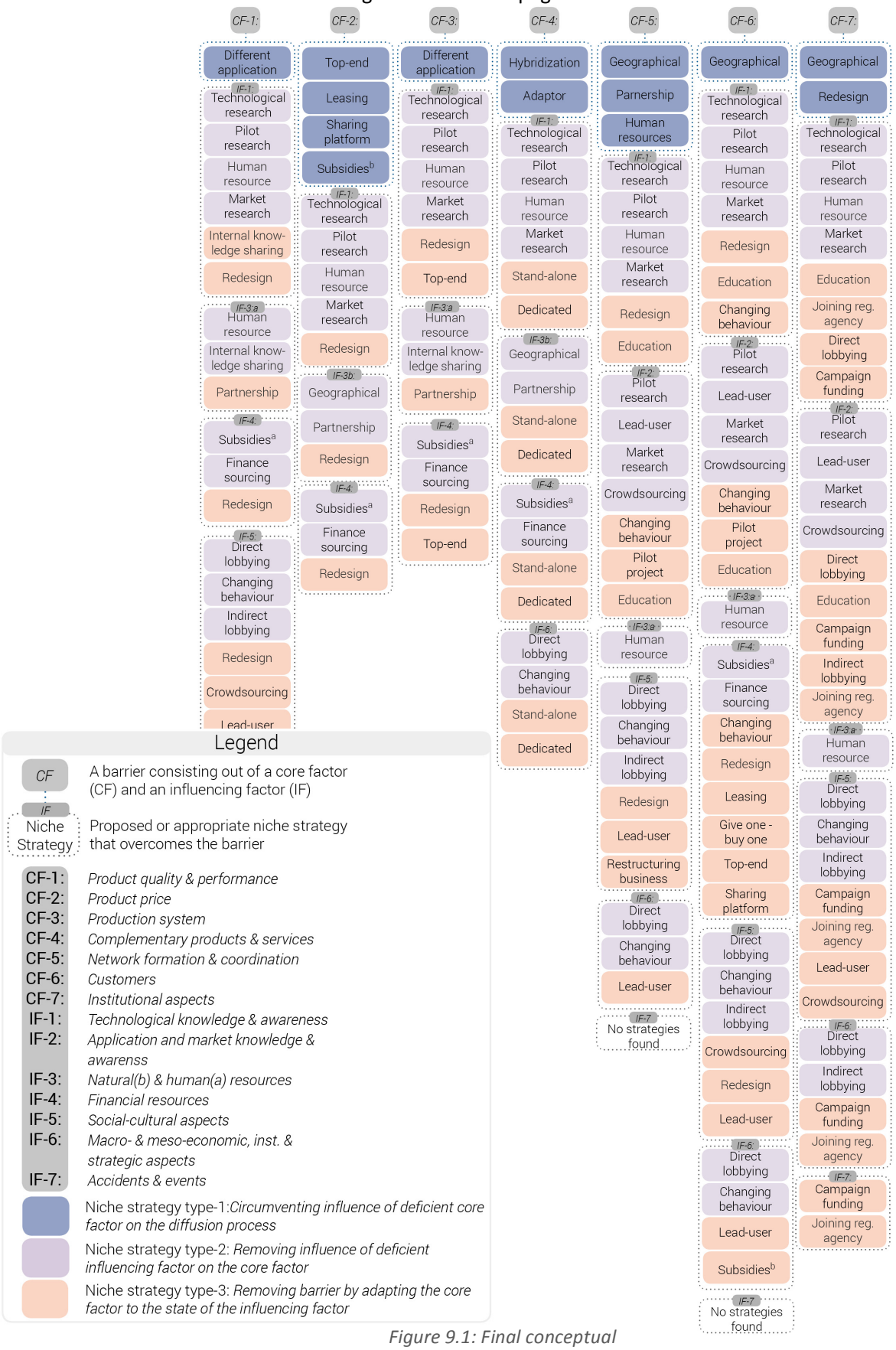


Figure 9.1: Final conceptual model

Each column of figure 9.1 can be read separately. The niche strategies are displayed per core factor (CF) / influencing factor (IF) combination. Since the type-1 (blue) strategies are circumventing the influence of the deficient core factors, these are not linked to an influencing factor. Instead, they are connected to the core factors directly. The type-1 and type-2 niche strategies are linked to an influencing factor (the small grey boxes). Since the figure only indicates the numbers of the core and influencing factors, a legend is included presenting the corresponding names. The legend also includes information on the colours used within the figure.

9.1.3 Main research question

"How can the causal linkage between barriers and niche strategies be captured in a framework so that companies are able to more accurately choose a suitable strategy that enables the diffusion of their radical innovation into a niche market during the market adaptation phase?"

In this research it is demonstrated that a framework can be developed that includes a model linking different niche strategies to barriers that companies can experience during the development and diffusion of their radical innovation. It also includes evaluation criteria that complement this model, which companies can use to assess the suitability of the niche strategies. The following figure (figure 9.2) illustrates the simplified framework. The letters below the simplified framework represent all the elements (and the interaction between these elements) needed to be able to capture the causal linkages.

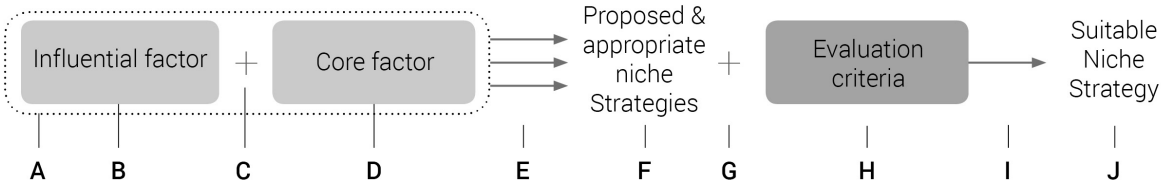


Figure 9.2: Simplified model of the conceptual model and evaluation criteria

The model is based on the factor framework of Ortt & Kamp (2019), which includes 7 influencing factors (B) and 7 core factors (D), which together form the socio-technical system of a radical innovation. The core factors represent the market characteristics, which, if they are not developed properly, can obstruct the large-scale diffusion process of the radical innovation. A deficiency within a core factor is caused by a deficiency within an influencing factor; the relationship between these two types of factors is called a barrier (A). Since in reality not all influencing factors will have an influence on the core factors, and to avoid overlap between the barriers, multiple assumptions regarding the possible barriers that companies can experience were set (C), see §3.1.4. Before the generation of niche strategies that could overcome these barriers, three types of niche strategies were defined (E), based on how they overcome a barrier: A type-1 strategy circumvents the influence of the barrier on the diffusion process, a type-2 strategy removes the deficiency within the influencing factor; a type-3 strategy removes the deficiency within the core factor. These niche strategies either create a niche market, or change the socio-technical system in favour of the radical innovation, so that (later) a niche market can be created. The conceptual model describes a total of 28 niche strategies (F), of which some can only be applied as one type to overcome a barrier, but most can overcome different barriers in different ways (so to overcome one particular barrier it is applied as a type-2 strategy, for another barrier it is applied as a type-3 strategy).

Companies can use the first part of the framework as a tool to define a suitable niche strategy and/or to use the logic behind the model to develop a comprehensive decision-making process focused on defining a suitable strategy to overcome the experienced barrier. However, the linkages between the niche strategies and barriers within the first part of the framework indicate merely the existence of the relationship in practice (most of the linkages were confirmed during the literature research

and/or empirical research), which should not be confused with the strength of these relationships; the success of the adoption of a particular niche strategy to overcome a barrier will depend on the particular characteristics of the company.

In order for companies to be able to accurately choose a suitable strategy, the proposed and appropriate strategies included in the conceptual model thus need to be assessed according to the specific company characteristics, since the most suitable strategy (j) that will overcome an experienced barrier will differ per company. This research made a first attempt to develop evaluation criteria (H) that can assess the proposed niche strategies. These evaluation criteria can be used by means of a multiple criteria assessment (i). Ten evaluation criteria were developed based on 3 criteria (G): *The evaluation criteria take the perspective of the company adopting the strategy; The evaluation criteria should cover the most important characteristics of companies; The evaluation criteria must complement the barriers framework*. Literature and empirical research underlined the completeness of the set of ten criteria in terms of aspects that they cover needed to effectively evaluate a strategy, and it underlined the importance of these criteria in practice. The conceptual model and the evaluation criteria together form a framework that companies can use to assess the most suitable niche strategy.

9.2 Contribution

9.2.1 Practical contribution

From a practical perspective, the deliverables of this thesis are relevant for companies aiming to diffuse a radical innovation and that are at the start or within the market adaptation phase. The conceptual model and evaluation criteria can contribute to companies in multiple ways:

- Firstly, the theory developed in this thesis (see next section) can give companies an understanding of the interrelatedness between barriers and niche strategies; the conceptual model shows a step-by-step logic on how niche strategies can contribute to overcoming particular experienced barriers. These insights can be valuable for companies that want to develop a comprehensive decision-making process focused on defining a suitable strategy to overcome the experienced barrier;
- Secondly, the conceptual model can help companies by defining a niche strategy. After the company defined a barrier, the conceptual model can be used to find a strategy that can overcome this barrier. Companies can use the proposed niche strategies and the described mechanism between the strategies and barriers as inspiration to determine (another) niche strategy that can overcome their particular barrier.
- Thirdly, they can use the developed evaluation criteria to assess the suitability of the determined niche strategy for their particular situation. These criteria complement the conceptual model and thus help the company to evaluate the proposed niche strategies according to the specific characteristics of the company.

9.2.2 Theoretical contribution

From a theoretical perspective, the deliverables of this thesis contributes to the current literature in multiple ways:

- The conceptual model follows a structured logical reasoning, making the first attempt to link niche strategies formally to the barriers and the factor framework developed by Ortt & Kamp (2019). The niche strategies are divided into three types, which cover the possible manners of overcoming a barrier. The described linkages between the proposed strategies and the barriers are partly confirmed by literature, underlining the credibility of the reasoning behind the conceptual model.

- Furthermore, The list of niche strategies extends the currently described number of niche strategies in literature. The conceptual model includes proposed and appropriate niches strategies that can be adopted by companies experiencing barriers within their socio-technical system during the market adaptation phase. However, companies also indicated that they adopted multiple strategies within the innovation phase.
- A categorisation of the niche strategies is added to the theory. Niche strategies can be categorised in three different categories, which depends on the aim of the niche strategies. They are either an 'influencing niche strategy', an 'increasing knowledge and resources niche strategy' or a 'marketing niche strategy'. There are patterns between these categories of niche strategies and the three types of strategies (how they remove or circumvent a barrier).
- The research also adds a list of evaluation criteria to assess the suitability of the proposed niche strategies. These are based on the reasoning that the most suitable niche strategy depends on the particular characteristics of a company experiencing a barrier.

9.3 Discussion of research

The discussion of the research will mainly follow figure 9.2, which explains the different elements of the framework, the interaction between these elements, and which assumptions lay at the base of the framework.

1) Barriers
As described before, assumptions regarding the possible barriers (being a combination of an influencing factor and core factor) that can be experience were made. These were made since in reality not all influencing factors will have an influence on the core factors, and in order to avoid overlap between the barriers. These assumptions influenced the development of the conceptual model in multiple ways.

- Completeness of barriers
Not all seven influencing factors influence all the core factors. One of the assumptions related to the barriers (which influencing factor could influence which core factor §3.1.4) was defined as invalid: There was assumed that the human resources could only influence the factors related to the technical components of the socio-technical system. However, the interview with company B revealed that the lack of human resources with appropriate knowledge and competences could have a much broader impact; the boards' lack of knowledge and competences of running a company, described by the interviewee as a 'wrong mentality', affected the network formation and coordination, the availability of customers and the lack of appropriate institutional aspects (they were not able to lobby themselves). Although all the other assumptions regarding the barriers were defined as appropriate, this indicates that most likely more combinations between influencing and core factors are possible.

- Interpretation of barriers
There were two distinguishable difficulties related to the interpretation of the barriers during the research. This was mainly due to the ambiguity of the barriers.

The first difficulty occurred during the linkage of niche strategies to the barriers defined according to the assumptions made. Since one barrier could be perceived in multiple ways, completely different niche strategies could be linked to one particular barrier. The reason behind the ambiguity is that both the influencing- and core factors described in the factor framework by Ortt & Kamp (2019) consisted out of many aspects. An example is IF-3 'natural and human resources'. A deficiency within this core factor can mean a lack of natural resources, expensive natural resources, a lack of human resources with the appropriate knowledge or a lack of human resources with appropriate

capabilities. These aspects can all have a different impact on a particular core factor, for example on core factor CF-3 'production system', however, it would comprise one barrier within the conceptual model.

The second difficulty occurred during the analysis of the primary case study, for which the experienced barriers by the companies needed to be linked to the barriers in the conceptual model. The latter were defined using the factor framework of Ortt & Kamp (2019) (an influencing factor influencing a core factor which causes a barrier to large-scale diffusion). Since, as described, both the influencing- and core factors described in the factor framework by Ortt & Kamp (2019) consisted out of many aspects, one experienced barrier could be grouped within multiple combinations of influencing and core factors. For example, Company B explained that they adopted the redesign niche strategy in which they developed multiple variations on their product. They adopted it to comply to the demands of the customers, who wanted the aesthetics of the product to comply to their needs, since the product has impact on the outlook of their house. My interpretation was that the barrier raised by social-cultural aspects (If-5) (of customers) that affected their perception of the product quality and performance (CF-1). However, it could also have been interpreted as a lack of knowledge and awareness on market (IF-2) (of the company), which affected the availability of consumers (CF-5). This issue stresses the importance of a clearer barrier definition. This Section 9.2.4 will elaborate more on how this can be solved by further research.

2) Niche strategies

- *Number of niche strategies*

Comparing the number of niche strategies included in the conceptual model -28- to the number of niche strategies mentioned in the article of Ortt et al. (2013) -10-, reveals that there is a large difference between these numbers. The main reason for this is that I stretched the definition of a niche strategy. Where Ortt et al. (2013) only listed niche strategies that aim to introduce the radical innovation into the market (within the market adaptation phase), I also included niche strategies that change the socio-technical system in favour of the radical innovation, so that (later) a niche market can be created (see figure 3.7). I thus assume that niche strategies are not only adopted within the market adaptation phase, but also within the innovation phase. However, within the boundaries of this research, it was not possible to study which particular niche strategies are adopted within each different phase, and which strategies can be combined or can be adopted consecutively. In the next section (future research) some insights regarding these topics are drawn based on the research performed in this thesis.

- *Categorisation of niche strategies*

This thesis divided the niche strategies into three different categories: 'Increasing knowledge and resources niche strategies'; 'Influencing niche strategies'; and 'market niche strategies', in which the latter can be divided into strategies that fundamentally change aspects of the product, production system or complementary products and service and strategies that change the business model. These categories are taking a company perspective; they are classified based on the *actions* that the company should take to overcome the particular barrier that are part of the niche strategy. However, different classifications are possible. An example would be a classification based on the *impact* of the niche strategy on the creation of a niche market. A categorisation could be for example, niche strategies that aim to commercialise the product and thus *directly* create a market and niche strategies that *indirectly* create a market by for example influencing actors, customers or institutions.

3) Conceptual model

- Completeness of conceptual model

The conceptual model is not complete in terms of number of niche strategies that can be adopted to overcome the barriers defined using the factor framework by Ortt & Kamp (2019). Since it was a first attempt to link the strategies to barriers that can be experienced by companies, the main aim was to develop the logic behind the conceptual model and the logic behind the refinement and improvements, not to develop as much niche strategies as possible. Furthermore, a conceptual model containing 200 or more niche strategies will become, from a practical perspective, useless. Companies can use the model to understand the logic, use the niche strategies directly or to use the niche strategies as inspiration to develop a niche strategy more suitable to their particular situation. However, the assumption was made that for each of the three types of niche strategies, at least two niche strategies could be linked to the barrier. As can be seen in the initial conceptual model, this is not achieved for each barrier and type of strategy combination. The primary case study also indicated that more niche strategies exist and that more barriers could be included in the model.

- Method of confirming the linkages

It is apparent that not one proposed relationship was contradicted by the reviewed literature. This can be explained by highlighting the data collection method described in section 5.1; Firstly, for each niche strategy, only a limited amount of time was available to search for research material. This restricted the depth of the outcome. Second, there was specifically searched for confirmations. Multiple articles that confirmed the existence of the relationships (eg overcoming a barrier by the adoption of the particular strategy) also elaborated on the strength and usefulness in particular cases. However, since the aim was to research the existence and not the strength and possible disadvantages/side-effects that could happen, these were not included in the analysis so far.

Furthermore, it should be noticed that although the data collection method was systematically described, the data collection method has been different for each linkage between a niche strategy and a barrier (see also §5.1.2 & 5.1.3). This was due to the broad range of niche strategies described in the conceptual model, in terms of both novelty and nature of the particular strategies.

4) Evaluation criteria

One of the aims of the thesis research was to develop criteria that can be used by companies to evaluate the linkages between niche strategies and barriers, in order to be able to determine the most suitable niche strategy. Ten evaluation criteria were developed based on logical reasoning and on preliminary insights on company characteristics. Additionally, relevant literature was used to back up the assumption that the ten criteria covered all the aspects of company characteristics needed to effectively assess a certain niche strategy. During the primary case study, the evaluation criteria were confirmed as useful for evaluating strategies.

- *Importance of the perception of experienced barriers by companies*

It can be reasoned that a particular niche strategy can be adopted based on different processes:

1. The adoption of a niche strategy as a well-considered response to the experience of a particular barrier. In this case, evaluation criteria are used to assess the suitability of a niche strategy.
2. The adoption of a niche strategy as a reaction on an experienced barrier.
3. The adoption of a niche strategy based on a chance that appeared in the market.

The primary case study results indicated that the two companies currently do not use evaluation criteria to assess the suitability of niche strategies. Sometimes a strategy was adopted based on a chance that appeared in the market, but most of these strategies were defined as facilitating strategies during the analysis of the results. An example is the subsidy strategy in the case of

Company A. The second situation was the most occurring; strategies were adopted as reaction on a situation. It could be noticed that all of the strategies defined as 'increasing knowledge and resources niche strategies' that were adopted by the companies were adopted after they determined a barrier. These strategies were adopted with the specific aim to generate knowledge or resources that were lacking and caused a barrier, and were well thought-through. However, no evaluation criteria were used. Most of the strategies defined as 'influencing niche strategies' and 'marketing niche strategies' (except for the redesign niche strategy) were in general intuitively adopted. It was also noticed that most of the strategies must be effective on the short-term. Especially in the case of Company B, this attitude towards the adoption of strategies also raised new barriers. This indicates the importance of the perception of barriers and the assessment of the relationships between niche strategies and barriers.

- *Future use of evaluation criteria in practice*
In order to evaluate the proposed and appropriate niche strategies as a solution to overcome barriers, the interviewees indicated that the companies would need more detailed information on these relationships, since with the provided information they are not able to determine the impact of the niche strategy themselves. For example, the criteria that evaluate if the niche strategy can be adopted within the financial resources available within the company requires an indication of the financial resources needed to adopt the niche strategy successfully. A description as included in the conceptual model on how the niche strategy overcomes the barrier is thus not sufficient enough; the niche strategy description should cover the absolute and/or relative scores on the evaluation criteria.

Although the 10 developed evaluation criteria are part of one list, the nature of the criteria differs, which is not taken into account yet. Some criteria are wishes, others are requirements, and others are not relevant at all. This can also be noticed from the results of the primary case study interviews: the ratings differed a lot per company. The section on future research will elaborate more on this topic.

5) Quality of research
As described in chapter 1, the quality of the case study research depends on four criteria: Construct validity; internal validity; external validity; and reliability (Yin, 2014). Below, these criteria are followed, in order to assess the quality of the research conducted in this thesis.

Construct validity - Construct validity refers to the establishment of accurate operationalization for the concept that is studied. This means that the in order to gather data from the empirical research, variables or attributes need to be clearly defined to avoid subjective judgement. (Yin, 2014) To achieve construct validity of the research, multiple perspectives were included in the conceptual model, including two primary case studies and a literature study. Furthermore, the methodology followed during the case studies was elaborated in detail and definitions of, for example, barriers and strategies were defined and used throughout the research. However, as also described before, the interpretation of the experienced barriers during the interviews can be biased, which could have influenced the confirmation of the barriers within the conceptual model. It was avoided as much as possible by further questioning the mentioned barrier.

Internal validity - Internal validity refers to the justification of causal relationships. An increased internal validity can be established by methodological and data source triangulation. (Yin, 2014) It is tried to achieve internal validity by performing a cross-case comparison between the two primary case studies and literature research; both the primary case study results and the literature research confirmed multiple similar relationships. However, since there are many relationships included in the model, not all relationships have been confirmed by multiple sources.

External validity - External validity refers to the generalizability of the case study results beyond its own boundaries. As Yin (2014) describes, the external validity is an important barrier within case study research. This study increased the generalizability by using both secondary cases (as part of the literature confirmations) and primary cases to confirm the relationships described in the conceptual model based on logical reasoning. The confirmed relationships by literature were in most cases based on one or two secondary cases studies or on literature that described the relationships as common phenomena. The aim was to find out if the cause-and-effect relationship in the initial conceptual model could be confirmed by literature. The same counted for the two primary case studies; the relationships were confirmed or not. The cross-case study showed that the existence of multiple relationships in practice could be confirmed by both case studies. The aim of the primary case studies was furthermore to check the usability in practice of both the conceptual model and evaluation criteria and to find additional linkages. The two companies of the primary case-studies were active in only two different industries and both were at the beginning of the market adaptation phase, so the generalizability of their results on this point is limited.

Reliability - Reliability refers to the extent the study can be successfully replicated by another researcher using the same data collection procedure and achieving the same outcome. (K. M. Eisenhardt, 1989; Yin, 2014) The reliability of this research is achieved by describing the methodologies and case study protocols in detail. The only threat to the reliability was, as mentioned earlier, the interpretation of the experienced barriers by the companies.

9.4 Further research

1) Reducing ambiguity of barriers
Further research is necessary to reduce the ambiguity of the barriers described in the conceptual model (following the definition of a barrier as described in chapter 3). In the current framework, one influencing factor and one core factor form one barrier, even thought both the influencing and core factor consists out of multiple aspects which can cause completely different barriers. These different barriers ask for different niche strategies. It would be beneficial to the comprehensiveness of the conceptual framework to define the factors in more detail by, for example, developing indicators per factor that represent only one aspect. An influencing factor that then exists out of five different aspects can cause five different barriers with a core factor consisting out of only one aspect, or 10 different barriers with a core factor consisting out of two different aspects.

Another topic for further research would be to find out which barriers are external, and which barriers are internal to the company. Through this, it can be discovered to which degree companies have an influence on the barriers that are experienced. It can be achieved by analysing the different (aspects of) the influencing and core factors. It would also be interesting to find out which barriers are likely to happen in which phase of the development and diffusion process of the radical innovation. If a pattern can be defined, companies would be able to anticipate.

2) Relationships between type and categories of niche strategies
The relationship between niche strategies has not been researched, but would be an interesting addition. Below, two situations are described on why additional knowledge on the relationships between niche strategies would be beneficial.

- *Overcoming multiple barriers –relationships between niche strategies*
As described in section 3.1.4, four different barrier situations were defined. Figure 9.3 shows the four different situations in which one or more barriers obstruct the large-scale diffusion of an innovation. Only four influencing factors (IF) and four core factors (CF) are depicted instead of seven of each. A barrier is depicted as an arrow connecting an influencing and a core factor.

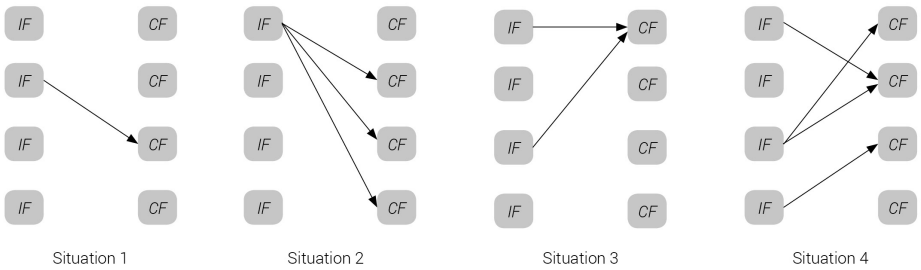


Figure 9.3: Different situations in which a company faces one or more barriers

This thesis only focuses on situation one, since the other three situations will most likely require a combination or a sequence of different strategies in order to overcome the barrier(s) in the most effective way. An analysis of the interrelationship between different strategies was considered out of scope. However, this would be an interesting topic for further research.

In order to find the ideal combination or sequence of niche strategies to overcome multiple barriers, research is needed on the relationships between niche strategies and the barriers itself, e.g. how do the barriers relate to each other – are they separate or do they influence each other? In Company B, a 'loop' of barriers could be determined; they experienced a barrier related to a low production capacity, because the company lacked financial resources. This was due to a lack of customers that perceived the price of the product as high and thus did not acquire the product. There was a high product price due to a low production capacity. This raises the chicken-egg question, which barrier raised which barrier and how can the barriers be overcome by the adoption of one or multiple niche strategies that strengthen each other?

- *Sequences of niche strategies - Innovation phase versus market adaptation phase*

The aim of the research was to develop a conceptual model that companies within the market adaptation phase can use. However, during the research I stretched the definition of a niche strategy. For example, during the primary case studies, the interviewees were asked to indicate whether they adopted the strategy in the innovation phase or the market adaptation phase. Multiple times they indicated that they also adopted a particular strategy to overcome a barrier while they were in the innovation phase. (for example the Adaptor niche strategy or the Pilot research project niche strategy) It would be interesting to find out to what degree the conceptual model could be used by companies in the innovation phase. As described in the discussion, within the boundaries of this research, it was not possible to study which particular niche strategies are adopted within each different phase, and which strategies can be combined or can be adopted consecutively, since this also highly depends on the barriers that are present (or that will arise after the adoption of a particular niche strategy). However, an example can be given: When a company decide to adopt the hybridization niche strategy (as a Marketing niche Strategy) to circumvent a lack of complementary products and services, they can already experience certain barriers within the innovation phase; for example, inappropriate institutional aspects and a lack of network formation and coordination due to a lack of knowledge of application or technology. They could within this phase already adopt the education niche strategy or the lobbying niche strategy, in order to actually diffuse the application into the market using the hybridization niche strategy.

3) Strength of relationship between niche strategies and barriers

Currently, the relationships between niche strategies and barriers are described by the way they overcome the barrier; they are linked together by actions/measures that should be taken (as part of the niche strategy) to either remove or circumvent the barrier. However, as the interviewees indicated during the primary case study interviews, this information is not sufficient for the suitability assessment using the evaluation criteria. The current description does not cover the strength of the relationship between the niche strategy and the barrier, which makes it not possible to compare different strategies with each other. Including the score of each niche strategy on the evaluation

criteria and including the relevance of a strategy in a certain situation would make it possible to assess the niche strategy. The envisioned use of the evaluation criteria, as described in chapter 3 is a multi-criteria analysis, however, at the moment this is not possible with the knowledge on the relationships between the barriers and niche strategies.

Further research could deepen the understanding of the relationship between the niche strategies and barriers as described in the conceptual model. For example by defining the absolute and relative scores on the evaluation criteria. This would make the evaluation criteria more useful in practice. Companies could estimate the relative score of each niche strategy at the moment, but their knowledge on the strength of the relationships between niche strategies and barriers, and the impact of these strategies on the factors is not sufficient enough to accurately determine a suitable niche strategy.

4) Improving quality of research

The research aimed to find confirmation of all the linkages described in the initial conceptual model by means of a literature review (either described linkages in secondary cases or by confirming that the linkage is a common phenomenon) and by means of two primary case studies. However, due to time constraints this could not be achieved; not all linkages were confirmed by either one of the two methods. To increase the internal validity, it would be beneficial to the research if all the relationships could be confirmed by at least one, but preferably two different cases (can be secondary cases described in literature). Although the logic behind the conceptual model was partly confirmed – since multiple sources (eg both literature and primary case studies) confirmed many linkages – this does not necessarily mean that all the linkages included in the model exist in practice.

Furthermore, to increase the generalizability of the findings on both the conceptual model and evaluation criteria and to test the logic behind the model further, it would be recommended to perform additional primary case studies. The two interviewed companies were active in only two different industries and both were at the beginning of the market adaptation phase. It would be interesting to perform around ten more case studies, in which companies are not only at the beginning of the market adaptation phase but also in the end; and with companies from different industries with different technological innovations. These primary case studies could be performed to find or confirm additional linkages that are particular to their position on the patterns of development and diffusion; to find out if patterns can be established between these two; and to find out the function of evaluation criteria within companies that are further in the diffusion process of their technological innovation. Furthermore it would be useful to use these case studies to test the assumptions further, since the primary case studies revealed that one assumption – which core factors the influencing factor 'human resources' could affect - was invalid.

5) Evaluation criteria and developing practical tool

This research made a first attempt to formally link niche strategies to barriers that can be experienced within the socio-technical system and that obstruct large-diffusion of a technological innovation. To increase the usability of the conceptual model and criteria developed in this research it would be beneficial to develop a tool for potential users. This tool could then be used to select the most suitable niche strategy. It would thus combine the conceptual model and the evaluation criteria.

Future research on the evaluation criteria is needed first to be able to create such a tool. A couple of suggestions can be defined from the discussion section. First of all, it should take into account the differences in nature of the 10 evaluation criteria (which are not relevant, which are required, which are a wish. Furthermore, it should provide room for companies to add criteria of which they think are relevant, and it should be possible to weight the different criteria.

10. References

Baškarada, S. (2014). Qualitative Case Study Guidelines. Retrieved from http://ssrn.com/abstract=2559424

Belleflamme, P., Lambert, T., & Schwienbacher, A. (2014). Crowdfunding: Tapping the right crowd. *Journal of Business Venturing*, *29*, 585–609. https://doi.org/10.1016/j.jbusvent.2013.07.003

Bicchieri, C., & Mercier, H. (2014). Norm and Beliefs : How Change Occurs. In *The complexity of social norms* (pp. 37–54). Springer, Cham.

Brooks, H. (1980). Technology, Evolution, and Purpose. *Daedalus*, *109*(1), 65–81.

Christensen, J., Drejer, I., & Christensen, J. L. (2010). The strategic importance of location: Location decisions and the effects of firm location on innovation and knowledge acquisition. *European Planning Studies*, *13*(6), 807–814. https://doi.org/10.1080/09654310500187862org/10.1080/09654310500187862

Clinton, L., & Whisnant, R. (2014). *20 Business Model Innovations for Sustainability*. *Science (New York, N.Y.)* (Vol. 287). https://doi.org/10.1002/yd.20082

De Figueiredo, J. M., & Richter, B. K. (2014). Advancing the Empirical Research on Lobbying. *Annu. Rev. Polit. Sci*, *17*, 163–185. https://doi.org/10.1146/annurev-polisci-100711-135308

del Río, P., Carrillo-Hermosilla, J., & Könnölä, T. (2010). Policy strategies to promote eco-innovation: An integrated framewor. *Journal of Industrial Ecology*, *14*(4), 541–557. https://doi.org/10.1111/j.1530-9290.2010.00259.x

Desai, P., Kekre, S., Radhakrishnan, S., & Srinivasan, K. (2001). Product Differentiation and Commonality in Design : Balancing Revenue and Cost Drivers, *74*(1), 37–51.

Dewar, R. D., & Dutton, J. E. (1986). The Adoption of Radical and Incremental Innovations: An Empirical Analysis. *Management Science*, *32*(11), 1422–1433. https://doi.org/10.1287/mnsc.32.11.1422

Diaz Anadon, L., Chan, G., Harley, A. G., Matus, K., Moon, S., Murthy, S. L., & Clark, W. C. (2016). Making technological innovation work for sustainable development. *Proceedings of the National Academy of Sciences*, *113*(35), 9682–9690. Retrieved from http://www.pnas.org/content/pnas/113/35/9682.full.pdf

Dijk, M., & Yarime, M. (2010). The emergence of hybrid-electric cars: Innovation path creation through co-evolution of supply and demand. *Technological Forecasting & Social Change*, *77*, 1371–1390. https://doi.org/10.1016/j.techfore.2010.05.001

Djelassi, S., & Decoopman, I. (2013). Customers' participation in product development through crowdsourcing: Issues and implications ☆. https://doi.org/10.1016/j.indmarman.2013.05.006

Dolgui, A., & Proth, J.-M. (2010). Pricing strategies and models. *Annual Reviews in Control*, *34*, 101–110. https://doi.org/10.1016/j.arcontrol.2010.02.005

Dordick, H. S. (1990). The origins of universal service. History as a determant of telecommunications policy.

Eckhardt, G. M., & Bardhi, F. (2012). Access-Based Consumption : The Case of Car Sharing. *Journal of Consumer Research*, *39*(4).

Eisenhardt, K., & Graebner, M. (2007). Theory Building from Cases : Opportunities and Challenges. *The Academy of Management Journal*, *50*(1), 25–32.

Eisenhardt, K. M. (1989). Building theories from case study research, *14*(4), 532–550.

Fevolden, A. M., Coenen, L., Hansen, T., & Klitkou, A. (n.d.). The Role of Trials and Demonstration Projects in the Development of a Sustainable Bioeconomy, 1–15. https://doi.org/10.3390/su9030419

Franke, N., & von Hippel, E. (2003). Finding Commercially Attractive User Innovations, *23*(Fall 2004), 301–315. https://doi.org/10.1111/j.1540-5885.2006.00203.x

Gallagher, K. S., Holdren, J. P., & Sagar, A. D. (2006). Energy -Technology Innovation. *Annu. Rev. Environ. Resour.*, *31*, 193–237. https://doi.org/10.1146/annurev.energy.30.050504.144321

Garvin, D. A. (1984). What Does "Product Quality" Really Mean? *Sloan Management Review*, *25*.

Geels, F. W., & Schot, J. (2007a). Typology of sociotechnical transition pathways. *Research Policy*, *36*, 399–417. https://doi.org/10.1016/j.respol.2007.01.003

Geels, F. W., & Schot, J. (2007b). Typology of sociotechnical transition pathways. *Research Policy*, *36*, 399–417. https://doi.org/10.1016/j.respol.2007.01.003

Gillespie, L. (1986). Engineering plastics: The concept that launched an industry. In *High Performance Polymers: Their origin and development* (pp. 9–15). Elsevier Science publishing Co. Inc.

Hekkert, M., & van den Hoed, R. (2004). Competing Technologies and the Struggle towards a New Dominant. *Greener Management International Autumn*, *47*, 29.

Hendry, C., Harborne, P., & Brown, J. (2010). So what do innovating companies really get from publicly funded demonstration projects and trials ? innovation lessons from solar photovoltaics and wind. *Energy Policy*,

38(8), 4507–4519. https://doi.org/10.1016/j.enpol.2010.04.005
Howe, J. (2006). The Rise of Crowdsourcing. *Wired Magazine*, *14*(06), 1–5. https://doi.org/10.1086/599595
Howell, S. T. (2015). *Financing Constraints as Barriers to Innovation : Evidence from R & D Grants to Energy Startups*.
Huurdeman, A. A. (2003). *The worldwide history of telecommunications*. Hoboken, New Jersey: John Wiley & Sons, Inc. All.
Iyer, G. R., Laplaca, P. J., & Sharma, A. (2006). Innovation and new product introductions in emerging markets: Strategic recommendations for the Indian market ☆. https://doi.org/10.1016/j.indmarman.2005.02.007
Jick, T. D. (1979). Mixing Qualitative and Quantitative Methods: Triangulation in Action. *Administrative Science Quarterly*, *24*(4), 602–611.
Johansson, B., & Lööf, H. (2008). Innovation activities explained by firm attributes and location. *Econ. Innov. New Techn*, *17*(6), 533–552. https://doi.org/10.1080/10438590701407349org/10.1080/10438590701407349
Jugo, D., Miholić, D., Žigić, I., & HEP dd, M. (2015). Lobying and public relations: overlapping of two different professions. *Communication Management Forum*, 19–37. Retrieved from http://bib.irb.hr/datoteka/797645.02commforum-jugo-miholic-zigic.pdf
Keith, D. R. (2012). Essays on the Dynamics of Alternative Fuel Vehicle Adoption: Insights from the Market for Hybrid-Electric Vehicles in the United States. *ProQuest Dissertations and Theses*, 1–212. Retrieved from http://ezproxy.nottingham.ac.uk/login?url=http://search.proquest.com/docview/1428851506?accountid=8018%5Cnhttp://sfx.nottingham.ac.uk/sfx_local/?url_ver=Z39.88-2004&rft_val_fmt=info:ofi/fmt:kev:mtx:dissertation&genre=dissertations+&+theses&sid=ProQ:ProQue
Kemp, R., Schot, J., Hoogma, R., Kemp, N. ~, C, J. S., & Remco, T. (1998). Technology Analysis & Strategic Management Regime shifts to sustainability through processes of niche formation: The approach of strategic niche management Regime Shifts to Sustainability Through Processes of Niche Formation: The Approach of Strategic. *Techno Lo^ Anabsis CY Strategic Management*, *10*(2). https://doi.org/10.1080/09537329808524310
Kennedy, S., Whiteman, G., & Ende, J. Van Den. (2017). Radical Innovation for Sustainability : The Power of Strategy and Open Innovation. *Long Range Planning*, *50*(6), 712–725. https://doi.org/10.1016/j.lrp.2016.05.004
Kerr, W. R., & Nanda, R. (2015). Financing Innovation. *Annual Review of Financial Economics*, *7*, 445–462.
Key, T. M., & Czaplewski, A. J. (2017). Upstream social marketing strategy: An integrated marketing communications approach. *Business Horizons*, *60*(3), 325–333. https://doi.org/10.1016/J.BUSHOR.2017.01.006
Kogut, B., & Zander, U. (1992). Knowledge of the Firm, Combinative Capabilities, and the Replication of Technology. *Organization Science*, *3*(3), 383. https://doi.org/10.1287/orsc.3.3.383
Kohli, A. K., & Jaworski, B. J. (2019). Market Orientation: The Construct, Research Propositions, and Managerial Implications. *Journal of Marketing*, *54*(2), 1–18.
Kotler, P., & Roberto, E. L. (1989). *Social marketing. Strategies for changing public behavior.* The Free Press.
Lane, P. J., Koka, B. R., & Pathak, S. (2006). *The Reification of Absorptive Capacity: A Critical Review and Rejuvenation of the*. *Source: The Academy of Management Review* (Vol. 31). Retrieved from https://www.jstor.org/stable/20159255
Lawson, S. J., Gleim, M. R., Perren, R., & Hwang, J. (2016). Freedom from ownership : An exploration of access-based consumption ☆. *Journal of Business Research*, *69*(8), 2615–2623. https://doi.org/10.1016/j.jbusres.2016.04.021
Lilien, G. L., Morrison, P. D., Searls, K., Sonnack, M., Von, E., & Von Hippel, E. (2002). *Performance Assessment of the Lead User Idea-Generation Process for New Product Performance Assessment of the Lead User Idea-Generation Process for New Product Development*. *Hippel Source: Management Science* (Vol. 48). Retrieved from https://www.jstor.org/stable/pdf/822674.pdf
Lüthje, C., & Herstatt, C. (2004). The Lead User method: an outline of empirical findings and issues for future research. *R&D Management*, *34*(5), 553–569.
Marquis, C., & Park, A. (2014). Inside the Buy-One Give-One Model. *Stanford Social Innovation Review*, (Winter 2014), 28–33. Retrieved from www.ssireview.org
Morris, G. D., McKay, S., & Oates, A. (2009). Sources of Finance. In *Finance Director's Handbook* (5th ed.). https://doi.org/10.1016/B978-0-7506-8701-0.00024-2
Nanda, R., Younge, K., & Fleming, L. (2015). Innovation and Entrepreneurship in Renewable Energy Innovation and Entrepreneurship in Renewable Energy. In *The Changing Frontier: Rethinking Science and Innovation Policy* (pp. 199–232).

Negro, S. O., Alkemade, F., & Hekkert, M. P. (2012). Why does renewable energy diffuse so slowly? A review of innovation system problems. *Renewable and Sustainable Energy Reviews*, *16*, 3836–3846. https://doi.org/10.1016/j.rser.2012.03.043

Nonaka, I. (1991). The Knowledge Creating Company. *Harvard Business Review*, *69*, p96-104. https://doi.org/10.1016/0024-6301(96)81509-3

Ordanini, A., Miceli, L., Pizzetti, M., & Parasuraman, A. (2011). Journal of Service Management Crowd-funding: transforming customers into investors through innovative service platforms Article information. *Journal of Service Management*, *22*(4), 443–470. https://doi.org/10.1108/09564231111155079

Ortt, R. (2012). Market Creation for Radically New Technologies : a Literature Review on the Role of Market Niches. *Engineering, Technology and Innovation (ICE) ,2012 18th International ICE Conference On*, 1–16. https://doi.org/10.1109/ICE.2012.6297642

Ortt, R., & Kamp, L. M. (2019). *Introducing radically new innovations during socio-technical system evolution*.

Ortt, R., Langley, D., & Pals, N. (2007). Exploring the market for breakthrough technologies. *Technological Forecasting & Social Change*, *74*, 1788–1804. https://doi.org/10.1016/j.techfore.2007.05.009

Ortt, R., Langley, D., & Pals, N. (2013). Ten niche strategies to commercialize new high-tech products. *IEEE International Technology Management Conference & 19th ICE Conference*, (June). https://doi.org/10.1109/ITMC.2013.7352687

Ortt, R., & Schoormans, J. P. L. (2004). The pattern of development and diffusion of breakthrough communication technologies. *European Journal of Innovation Management*, *7*(4), 292–302. https://doi.org/10.1108/14601060410565047

Ortt, R., Shah, C., & Zegveld, M. (2007). Strategies to Commercialise Breakthrough Technologies. *SSRN Electronic Journal*, 2029–2048. https://doi.org/10.2139

Pode, R. (2013). Financing LED solar home systems in developing countries. *Renewable and Sustainable Energy Reviews*, *25*, 596–629. https://doi.org/10.1016/J.RSER.2013.04.004

Porter, M. E. (1990). *The Competitive Advantage of Nations Harvard Business Review*. Retrieved from http://www.economie.ens.fr/IMG/pdf/porter_1990_-_the_competitive_advantage_of_nations.pdf

Porter, M. E., & Stern, S. (2001). *Innovation: Location Matters*. *MIT Sloan Management Review* (Vol. 42). Retrieved from http://ibr.hi.is/sites/ibr.hi.is/files/out.pdf

Pressman, S., & Scott, R. H. (2010). Consumer debt and poverty measurement. *Focus*, *27*(1), 9–12.

Raven, R. (2007). Niche accumulation and hybridisation strategies in transition processes towards a sustainable energy system: An assessment of differences and pitfalls. *Energy Policy*, *35*, 2390–2400. https://doi.org/10.1016/j.enpol.2006.09.003

Robb, A. M., & Robinson, D. T. (2014). The Society for Financial Studies The Capital Structure Decisions of New Firms Published by : Oxford University Press . *The Review of Financial Studies*, *27*(1), 153–179. https://doi.org/10.1093/rfs/hhs072

Rogers, E. M. (1995). *Diffusion of innovations*. *Macmillian Publishing Co.* https://doi.org/citeulike-article-id:126680

Rumelt, R. P. (1993). Evaluating Business Strategy BT - Strategic Management and Business Policy. In *Strategic Management and Business Policy*. Retrieved from https://pdfs.semanticscholar.org/1abe/519e6129da80a1c97c8f9ee659720c46d871.pdf

Schumpeter, J. A. (1942). *Capitalism, Socialism and Democracy*. New York: New York, Harper & Brothers. Retrieved from http://cnqzu.com/library/Economics/marxian economics/Schumpeter, Joeseph-Capitalism, Socialism and Democracy.pdf

Slocum, A., Rubin, E. S., & Luebke, D. (2008). Understanding Radical Technology Innovation and its Application to CO2 Capture R&D: Interim Report, Volume One—Literature Review. Retrieved from http://repository.cmu.edu/epp

Smith, E. (2011). Using numeric secondary data in education research. Retrieved from https://www.bera.ac.uk/wp-content/uploads/2014/03/Using-numeric.pdf

Smith, K. G., Collins, C. J., & Clark, K. D. (2005). *Existing Knowledge, Knowledge Creation Capability, and the Rate of New Product Introduction in High-Technology Firms*. *Source: The Academy of Management Journal* (Vol. 48). Retrieved from https://www.jstor.org/stable/pdf/20159660.pdf?casa_token=11vMFTegcAAAAAAA:0Mh5sXnmNpxc0_5aY3KoJco68Xdhep8SEHIzHwrf5Np_-9STC11ol0ej_VwWXZhROvOrBbKyiGw1mXqOhkYsYPRvepsauK7xd4Sf5UaN90bjD7c0I_Mb

Smith, S., Smith, G., & Shen, Y.-T. (2012). Redesign for product innovation. *Design Studies*, *33*, 160–184. https://doi.org/10.1016/j.destud.2011.08.003

Tassey, G. (1999). Standardization in Technology-Based Markets. *Research Policy*. Retrieved from

https://www.nist.gov/sites/default/files/documents/2017/05/09/researchpolicypaper.pdf
Tsai, W. (2001). *Knowledge Transfer in Intraorganizational Networks: Effects of Network Position and Absorptive Capacity on Business Unit Innovation and Performance*. *Source: The Academy of Management Journal* (Vol. 44). Retrieved from https://www.jstor.org/stable/3069443
Tukker, A. (2004). Eight types of product-service system: Eight ways to sustainability? Experiences from suspronet. *Business Strategy and the Environment*, *13*(4), 246–260. https://doi.org/10.1002/bse.414
Urmee, T., Harries, D., & Schlapfer, A. (2009). Issues related to rural electrification using renewable energy in developing countries of Asia and Pacific. *Renewable Energy*, *34*(2), 354–357. https://doi.org/10.1016/J.RENENE.2008.05.004
Verschuren, P., & Doorewaard, H. (2010). *Designing a Research Project (Vol. 2)*. The Hague: Eleven International publishing house.
Visser, M., Schoormans, J., & Vogtländer, J. (2018). Consumer buying behaviour of sustainable vacuum cleaners - Consequences for design and marketing. *Journal of Cleaner Production*, *195*, 664–673. https://doi.org/10.1016/J.JCLEPRO.2018.05.114
Von Hippel, E. (1986). *Lead Users: A Source of Novel Product Concepts*. *Management Science* (Vol. 32). Retrieved from https://about.jstor.org/terms
Yin, R. K. (2014). *Case Study Research. Design and Methods* (5th ed.). Thousand Oaks: SAGE Publications Inc.
Zander, I., & Solvell, O. (2000). Cross-border innovation in the multinational corporation : A research agenda Reproduced with permission of the copyright owner . Further reproduction prohibited without permission . *International Studies of Management & Organization*, *30*(2), 44–61.
Zhou, K. Z., & Li, C. B. (2012). How knowledge affects radical innovation: Knowledge base, market knowledge acquisition, and internal knowledge sharing. *Strategic Management Journal*. https://doi.org/10.1002/smj.1959

Appendix A – Initial Interview protocol

This appendix describes the initial interview protocol. This initial interview protocol is used to conduct a pilot in order to make improvements.

Start

I will record the interview, for which I will ask permission of the interviewee first. Furthermore, I will ask if I have to integrate the data anonymously in the final thesis report. Below, the interview is described in detail, including the questions and the aim per question.

"Can the interview be recorded?"

" Do I have to anonymise the interview?"

A) Introduction: 5-7 min

(If this information is found during the preliminary research on the company and the employee, this part only focuses on confirming the found answers)

1. *"When and how did the company start?"*
2. *"What is your (the interviewee) role within in the company?"*
3. *"What is the vision of the company for the future (in relation to the radical innovation)?"*

B) 20 min | Open questions on the company's experience with barriers and strategies

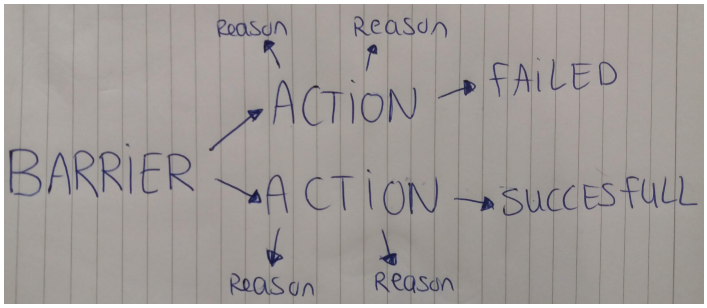
This second part of the interview will contain open questions, of which the main aim is to discover the evaluation criteria the companies use to assess the strategies that they adopted after experiencing a barrier. Two or three barriers will be covered, so that there multiple viewpoints on the criteria can be taken, without making this part too long or complicated. The aim is to focus on at least two completely different barriers (eg combinations of core and influencing factors), in order to make the answers as diverse as possible and thus avoid redundancy of the obtained information.

1. *"Could you list two important barriers that you encountered that obstructed the innovation from diffusion in the market?"*
    a. *"What caused the barrier?"*

Per listed barrier:

2. *"What did the company do to overcome or circumvent the barrier in order to create a market for the innovation anyway?"*
    a. *"Where there actions that the company took that failed?"*
3. *"What were the main reasons that the company decided to adopt these particular actions?"*
    a. If answer not what expected: "*I mean:* Are *there criteria that the company used to assess the viability of these actions?* "

An indication of how the answers of these three questions will create an overview that will steer the line of reasoning of the interview can be found on the image below. It contains the following elements: Barrier → action (=strategy) → reaction (successful or not) and the reasons why they selected the particular action (= the evaluation criteria).



B2) 5-7 min | Ranking the evaluation criteria

After the three first questions, I will show the interviewees a list with the evaluation criteria developed in chapter 3, and will ask them to rate the criteria, in order to discover the importance and relevancy of the developed criteria.

4. *Rank the following evaluation criteria based on the role that they play in the company's decision-making process of selecting a certain strategy/action aiming to remove or circumvent the experienced barrier:*

Evaluation Criteria	Ranking					
	0. *not relevant*	1. *not important*	2. *somewhat important*	3. *important*	4. *essential*	5. *decisive*
1) The niche strategy is understandable to everyone and not overly difficult or complex to interpret	☐	◯	◯	◯	◯	◯
2) The strategy is consistent between the organizational objectives and the values of the management group	☐	◯	◯	◯	◯	◯
3) The niche strategy is agreeable to those who must implement the niche strategy	☐	◯	◯	◯	◯	◯
4) The niche strategy has a high estimated chance of success over time with a degree of reliability, consistency and effectiveness	☐	◯	◯	◯	◯	◯
5) The strategy is adaptable to future trends within the industry	☐	◯	◯	◯	◯	◯
6) The niche strategy has a potential good cost/benefit ratio	☐	◯	◯	◯	◯	◯
7) The strategy can be realized within the company's financial resources	☐	◯	◯	◯	◯	◯
8) The strategy can be realized within the company's human resources	☐	◯	◯	◯	◯	◯
9) The strategy can be realized within the company's capital resources	☐	◯	◯	◯	◯	◯
10) There are no major negative side effects/down sides on (the company's) environment of adopting the niche strategy in terms of economic, environmental and/or social impact	☐	◯	◯	◯	◯	◯

If the company adds criteria to this list, it will be added to the list above so that they can rank it as well, and it will be included in the next interview anyway.

C) 25 min | Questionnaire on experienced barriers and adopted strategies

This part of the interview will consist out of a form that the interviewees have to fill in. They are asked to fill in if they experienced barriers regarding the core factors – there will be 7 tables. If they experienced a certain barrier related to the core factor, they have to indicate which contextual factor influenced the existence of this barrier, and write down the strategy (which actions they took) that they adopted to overcome the barrier.

Below, the form that I will give the interviewees is depicted, only showing the first core factor. The form for the other 6 core factors will look exactly the same.

The company experienced a barrier regarding:

1. Product performance and quality	YES ☐	NO ☐

If yes: By which of the following contextual elements is the deficiency in the core element above influenced? (multiple answers are possible)

Also, describe which strategy the company adopted to overcome the barrier - which is the combination of the contextual element and the core element

◯ A) Knowledge and awareness of technology

Strategy: .....

◯ B) Knowledge and awareness of application and market

Strategy: .....

◯ C) Natural and human resources

Strategy: .....

◯ D) Financial resources

Strategy: .....

◯ E) Socio-cultural aspects

Strategy: .....

◯ F) Macro- and meso-economic, institutional and strategic aspects

Strategy: .....

◯ G) Accidents and events

Strategy: .....

◯ Other:.....

Strategy: .....

◯ Unknown/None of the above

Strategy: .....

D) End

5. *Are there strategies that you adopted that were not based on circumventing or removing a barrier?*
    a. *What was the reason the company adopted this specific strategy?*
    b. *Can you give a couple of examples of strategies adopted through this process?*

Appendix B – Pilot interview results

The goal of the pilot was to gain feedback on the data collection method in order to improve it in favour of the research. The following questions served as guideline during the analysis of the pilot interview:

1. Does the interviewee understand the aim of the interview
2. Does the interviewee understand the questions
3. Does the interviewee give the type of answer I am aiming for
4. Does the interview take the time I intended it to be (60 minutes)
5. Has the interviewee other (general) feedback on the interview

The pilot interviews were conducted with two interviewees. The first interviewee has a start-up (located in Yes Delft) called 'Anything Connected'. They developed a sticker that can be placed on any product or equipment, in order to measure motion, orientation, electric activity, vibrations and temperature. The data collected through these measurements can be used, for example, to predict maintenance. The second interviewee is a fellow student that has a lot of experience with conducting interviews and who is familiar with the development and evolvement of my thesis research from the start. I aimed to conduct the pilot interview with two different types of interviewees (one more technical and the other more general), in order to have different perspectives on the interview protocol.

Below, the main findings of the conducted pilot interviews are listed. Furthermore, there will be indicated how the interview protocol will be improved based on the findings of the pilot interviews:

General:

- Both the pilot interviews took longer than envisioned - between 75 minutes and 90 minutes. This had two causes. The first one was that the interviewees did not understand the interview questions properly and it took a lot of time to explain it. Furthermore, the interviewees described everything in detail, and gave feedback in between the questions since they knew it was a pilot interview. The first reason can be improved by introducing the research shortly before the interview. In the start of the interview I need to cover the main theoretical concepts on which the research focuses. This will entail explaining the concept of niches, (niche) strategies, the socio-technical system in which the technological innovation is embedded, and the concept of barriers that are caused by core factors influenced by contextual factors. This will be done by means of images that illustrate these concepts. One of the pilot interviewees indicated that once I drew the adapted S-curve that showed the market adaptation phase on the innovations he finally understood the concept of niches and the aim of the strategies.
- Furthermore, everything will be translated in Dutch (the pilot interviews were in Dutch, but the questionnaires were still in English) in order to increase the understanding of the questions.

- The interview was too abstract according to the interviewees, which can be improved by re-writing the barriers and factors into sentences, or key words that are easier to understand, and that appeal to the interviewees' imagination.

Open questions and ranking the evaluation criteria

- After explaining the questions and aim of the questions, the interviewees understood them and answered according to plan. The list with evaluation criteria was clear to understand, however, to increase the understanding of the criteria it need to be translated into Dutch.

Questionnaire on experienced barriers and adopted strategies

- The interviewees indicated that they experienced most of the barriers that were indicated on the forms. It was a lot of work to fill in and it was very complex for them to create a barrier out of a combination of a core and influencing factor. They had no idea how to interpret the form. Furthermore, to come up with the strategies related to the experienced barrier was a hard process (this also caused the long interview times) and because their understanding of strategies was narrow or completely different, the results (eg confirmation of the relationships) of the pilot interview were minor. I think the interview can be improved by turning the process around: Starting the questionnaire with the strategies; asking if they adopted the indicated strategy; what the aim was of the strategy (what barrier was intended to be circumvented or removed) and what the impact was of the strategy (was it successful). This way, the focus of the interview will lie on the confirmation of the proposed relationships of the conceptual model; the results will most likely be more useful because it will be easier to answer for the interviewees; more linkages will be established through a better understanding.

Last question – relation between adopted strategy and experienced barrier in practice

- During the first interview (with Anything Connected) this question was already covered during the start of the interview, without explicitly posing the question.

Appendix C – Final interview protocol

0. Start

- *Kan ik het interview opnemen?*
- *Moet ik het interviewen anonimiseren?*
- *[Korte introductie van mijn kant over strategieën, niches, radicale innovaties, sociaal-technische systemen en barrières die diffusie in the markt verhinderen]*

1. Algemene informatie

[Het doel is om de antwoorden voor het interview te verkrijgen d.m.v. een web-search]

- *Wanneer en hoe is het bedrijf gestart?*
- *Wat is uw rol binnen het bedrijf? In hoeverre bent u betrokken bij het bedenken van strategieën?*
- *Wat is de toekomst visie van het bedrijf voor het product?*

2. Open vragen over barrières, strategieën en evaluatie criteria

- Kan u twee belangrijke barrières noemen die u bent tegenkomen met het bedrijf dat de diffusie van de innovatie verhinderde?
    - Wat veroorzaakte de barrière?

- Wat heeft het bedrijf gedaan om de barrière te omzeilen of te elimineren om toch een markt te creëren voor de innovatie?
    - Waren de acties succesvol?
- Wat waren de redenen dat het bedrijf voor deze strategie koos? Wat waren de criteria waaraan de strategie voldeed?

3. Ranken van de evaluatie criteria

- *Beoordeel de volgende evaluatie criteria op de rol die het speelde binnen de besluitvorming over het aannemen van de strategie: (De lijst is vertaald naar het nederlands voor het interview)*

Evaluation Criteria	Ranking					
	0. *not relevant*	1. *not important*	2. *somewhat important*	3. *important*	4. *essential*	5. *decisive*
1) The niche strategy is understandable to everyone and not overly difficult or complex to interpret	☐	◯	◯	◯	◯	◯
2) The strategy is consistent between the organizational objectives and the values of the management group	☐	◯	◯	◯	◯	◯
3) The niche strategy is agreeable to those who must implement the niche strategy	☐	◯	◯	◯	◯	◯
4) The niche strategy has a high estimated chance of success over time with a degree of reliability, consistency and effectiveness	☐	◯	◯	◯	◯	◯
5) The strategy is adaptable to future trends within the industry	☐	◯	◯	◯	◯	◯
6) The niche strategy has a potential good cost/benefit ratio	☐	◯	◯	◯	◯	◯
7) The strategy can be realized within the company's financial resources	☐	◯	◯	◯	◯	◯
8) The strategy can be realized within the company's human resources	☐	◯	◯	◯	◯	◯
9) The strategy can be realized within the company's capital resources	☐	◯	◯	◯	◯	◯
10) There are no major negative side effects/down sides on (the company's) environment of adopting the niche strategy in terms of economic, environmental and/or social impact	☐	◯	◯	◯	◯	◯

4. Vragenlijst over de strategieën.

- *Welke van de volgende strategieën zijn binnen het bedrijf gebruikt om een markt te creëren voor de innovatie?*

[De volgende afbeelding geeft een indicatie aan van hoe deze lijst eruit ziet. Tijdens het interview waren alle strategieën als vermeld in hoofdstuk 3 in deze lijst opgenomen)

1. Subsidie Strategie (Het aanvragen van subsidies)	*YES* ☐	*NO* ☐

A) Welke barrieres werden ermee omzeilt of geelimineerd?

.....

B) Welke impact had de strategie?

◯ *Averechts*

◯ *Geen succes*

◯ *Succesvol*

◯ *Anders :*.....

C) In welk stadium van product ontwikkeling en diffusie is de strategy aangenomen? (een indicatie)

◯ *Innovatie fase*

◯ *Markt adaptatie fase*

◯ *Anders :*.....

- Na de lijst: *'Zijn er nog meer strategieën die jullie hebben toegepast en zo ja, als reactie waarop?*

5) Afsluiting

- *Zijn er strategieën dat het bedrijf heeft aangenomen dat niet een reactie op een barrière waren?*
  - *c. Wat was de reden dat het bedrijf de strategie toepaste?*
  - *d. Kan u een voorbeeld hiervan geven?*