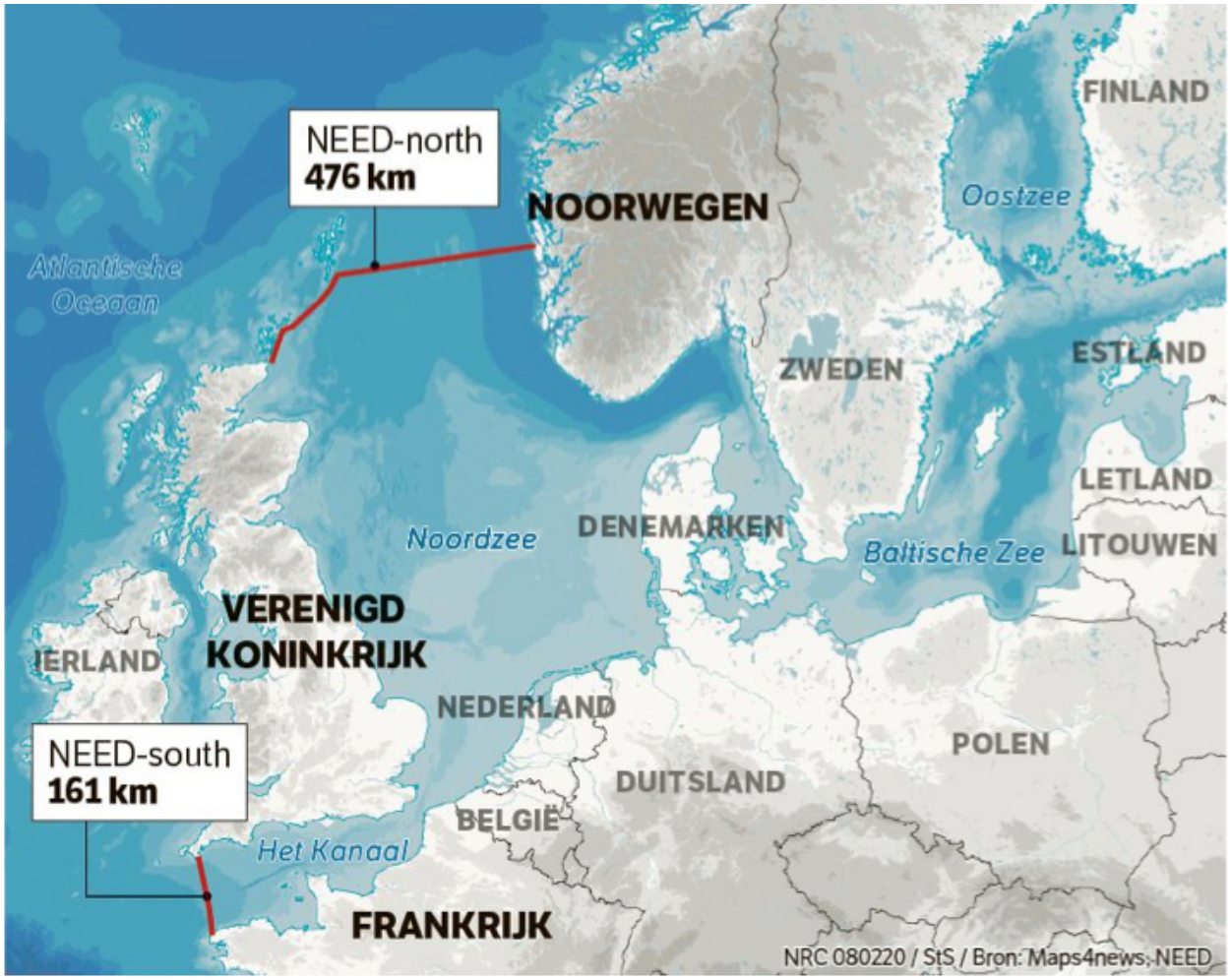
Northern European Enclosure Dam

Success and failure factors for a very radical innovation

Master Thesis - July 2021



Delft University of Technology

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MSc Thesis

Northern European Enclosure Dam

Success and failure factors for a very radical innovation

As partial fulfilment of the requirements for the degree of Master of Science

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Preface

After my study years at the Delft University of Technology, I can certainly say that I have developed myself over time. The story started with my bachelor's degree in mechanical engineering, where my interest in managing innovative projects has only increased. After my bachelor's degree, the choice was made for the master in Management of Technology. Where I have learned a lot in the past two years. Particularly in the field of management, of course, and the other aspects that are involved that are usually not that obvious.

Writing this thesis is the last chapter of my book concerning my study career. I can therefore only say that it was a pleasure to conduct this research. Besides the fact that the subject itself was of interest to me, it also fitted well with my master's degree. It was therefore possible to take the aspects that I have learned in recent years and apply them to my thesis and the research that comes with it. I can only say that I am an experience richer and the approach of this research will support me in my future career.

Before starting my final chapter in my study career, I would like to express my gratitude to my graduate committee. I am certainly aware that I had a committee where cooperation ran smoothly. During the start of my thesis, everyone on the committee was so enthusiastic that everyone was happy to be involved. Besides the fact that it is nice that all thoughts are in the same direction. This also ensured that I could count on everyone on the committee. I would like to thank Bert for taking on the role of chairman, from the start there was clarity in which direction the thesis should go and there was always room for questions where necessary. In addition, I would like to thank Jos for involving me in the Northern European Enclosure Dam innovation group and the connections that were possible to discuss this innovation with others. I would also like to thank Sjoerd, the inventor of this innovation. It was certainly helpful to see other insights into the Northern European Enclosure Dam to support my research. It is was also a great experience to work on the innovation in a group, everyone can learn from each other and work together towards the same goal. Finally, I would also like to express my enormous gratitude to Jan Anne. The time and effort you have put into supervising my thesis have certainly made a significant contribution. The fact that I knew that I could ask you for advice at any time during the research, where the enthusiasm on both sides was noticeable, certainly contributed to this result. I would like to thank you all for the time and effort you have significantly contributed in guiding and supporting this research.

I would also like to express my gratitude to all the experts who participated in conducting the interviews. Obviously, I can't name you as each expert is kept anonymous. However, I would like to thank all seven for your time and effort, and indirectly the contributions you have made to this research. It was very interesting for me to discover everyone's findings, where it has certainly stimulated myself to sometimes look at certain aspects differently.

Finally, I would like to thank my fellow graduates, friends, and family. Not just for the support while writing this research. But also for the support during my entire study career. Where I would like to specifically mention Stephanie, Jorg and Joop for their support over the past few years. Without further ado, I hereby present my final chapter of my study career at the Delft University of Technology.

Summary

Introduction

It is becoming increasingly clear that the current climate policy is not beneficial to our planet. Climate change is having several negative effects on the planetary environment and its health (Rignot et al., 2011). Among these negative effects is the rise of the seawater level (Jevrejeva et al., 2014). Efforts are being made to counter this with various actions, such as the Paris agreement (Levine & Steele, 2021). However, there is a chance that the agreement will turn out differently than planned (Meinshausen, 2016). It is therefore important, and socially most-relevant, to think about what to do if this happens. This means that alternatives are being looked into and examined. A drastic alternative is the Northern European Enclosure Dam (NEED). NEED is a dam that consists of two parts to protect Northern Europe against the rising of the sea level. The idea for this radical innovation, to create a dam consisting of two parts, comes from oceanographer Sjoerd Groeskamp and engineer Joakim Kjellsson and came to life in 2019. The first part is the southern part which runs from France to England, with a length of 161 kilometers. The second part is the northern part which runs from Scotland to Norway, with a length of 476 kilometers (Groeskamp & Kjellsson, 2020).

This radical innovation has many aspects that need to be taken into account. This research specifically looks at the success and failure factors of the radical innovation NEED project compared to a "standard" innovation. The research examined whether there is a difference in the success and failure factors of innovation for extremely large projects in comparison to "standard innovation" projects. To achieve this goal, two research questions have been chosen for this study. The two main research questions are as follows:

RQ1: *What are the success and failure factors of the NEED innovation?*

RQ2: *To what extent do these radical successes and failure factors differ from a "standard" innovation?*

Looking at the conditions of success and failure regarding this research, the factors are aspects that influence the realization of an innovation. A clear picture must be painted regarding the meaning of innovation and the factors for success and failure. Afterwards one can start looking at these factors for NEED itself. This picture can be formed based on innovation theories by linking them to each other with the help of a literature study. Because something such as this project has never been exhibited before, relevant literature will have to be examined. This focuses on comparable-sized projects.

To properly conduct this research, several angles were used to find the answers. The methods that were used to conduct the research can be found in the research methodology chapter. Several research methods were looked into as to which of these were appropriate for this research. Chapter two dives into the research methods that were used and the processes that led to the answers of the research questions. This continues with the experts that were selected for this research and have participated in the semi-structured interviews. The next chapter presents the theoretical framework, which addresses the scientific literature study that highlights different aspects. These key aspects are vital as they render the possibility to investigate which aspects were already known in the theoretical field. These aspects are how to define innovation and the success and failure factors of innovation using innovation theories, what role innovations play in large projects, and what kind of literature is available on innovation for projects that can be compared to the NEED project. The conceptual model emerged from the findings of the literature study which have been used for the interview with the experts. After which a conclusion is formed based on the results. Finally, the last chapter encompasses the discussion and limitations of this research, which is followed by the recommendations.

Research Methodology

To answer the main questions, multiple sub-questions were formed. To answer these sub-questions one or multiple research methods were used. The resources that were used consist of scientific books and articles, coming from databases such as Web of Science and Scopus. Scientific literature is certainly a valuable resource of investigation to this research. However, other research was necessary to support and complement the scientific literary research. As shown later in the literature review, the literature study emphasizes the properties of radical innovation. The gap between standard innovation and innovation of extreme projects is slightly emphasized. Some of the literature revealed what the success and failure factors are when looking at the projects.

The literature study showed that arising failures during the project are mainly solved with applied research. This entails that the problem is solved on the spot. However, up to this point of writing no fundamental research can be found in the literary research which focuses on the success and failure factors of radical innovations in comparison to "standard" innovation. This only emphasizes the value of this research. This gap between extreme wild innovation ideas such as NEED and "standard" innovation, cannot be examined with scientific literature alone. Initially, the Delphi method was preferred. The Delphi method is a combined qualitative analysis, in which a series of open-ended questions are presented to experts. Afterwards a quantitative analysis would be made of the experts' answers. The answers would be summarized and remained anonymous during the survey. The summary with the answers would be presented to the experts again, with feedback. This last process of discussion could take place several rounds, with which a consensus is ultimately sought. This method would have made a better contribution to the validity and reliability of the research. The Delphi method was, however, not feasible for this research, mainly due to the time available for this research and the time the interviewees had for several rounds. Therefore, the semi-structured interview method was chosen. As a result of this the semi-structured interview method was chosen as the research method for this research. A semi-structured interview offers a solution for a qualitative study in which research is conducted into fundamental research. The questions arising from Desk based research were answered using the semi-structured interviews with experts.

The experts vary from innovation expert, civil engineering manager to experts working on large innovative projects. In total seven experts where interviewed, Only their profession is mentioned to guarantee the reliability of the research and the privacy of the experts, the table below shows the experts that were chosen.

Code	Appendix / Page	Profession	Category
E1	B / 72	Innovation strategist	"Standard" innovation theory / Large projects
E2	C / 78	Innovation management prof.	"Standard" Innovation theory expert
E3	D / 83	Hydrogen expert	Large innovative projects
E4	E / 88	Project innovation advisor	Comparable innovative projects
E5	F / 94	Civil maritime engineering tutor	"Standard" innovation / Comparable projects
E6	G / 100	Civil hydraulic consultant	Comparable innovative projects
E7	H / 105	Project manager	Large innovative projects

Table 1: Experts who have been selected for the semi-structured interview method.

The experts participating in the interview were questioned for approximately 30 minutes. This gave a large amount of data that needed to be processed. To do this properly, a content analysis was needed. For this research, the data process consisted of two steps. The first step was to transcribe the interviews. Every word that has been said in the interview was included. The second step was coding. This consists of three phases namely; open, axial, and selective coding. Once the results were processed. These results were then presented to a group of people working on NEED. The response that this focus group regarding NEED gave to the results of this research provided insight into the validation of the research, the groups perspective on the research, but also the points of improvement for this research.

Theoretical Framework

The scientific literature study contributes to find important factors that contribute in answering the research questions. During this research, various sources were examined to find relevant literature on innovation, with a focus on the NEED project. What is innovation? What kind of innovation is the NEED project? What are success and failure factors looking at innovation? What innovation theories could be applicable for the NEED innovation? How has innovation played a role in former, comparable projects? These questions have guided the literary research and formed the scientific literature study.

The literature study showed that a lot of information can be found about types of innovation and what they relate to. The literature provides a clear description of the success and failure factors. However, these success and failure factors are mainly described in a general sense, it cannot be said with certainty whether the success and failure factors and the innovation theories can also be applied to large radical projects such as NEED.

Looking at the size of the innovation and all the different scientific fields that play a role in this project, failures cannot be prevented. The project that leads this thesis, is a project that has never been dealt with before, the current literature will not be sufficient to conclude. Therefore, this thesis does not only dive deep into available literature but also uses the semi-structured interview method to use experts' opinions on success and failure factors for this kind and size of innovation. A conceptual model based on the factors that play a role in innovation based on the scientific literature is shown in the figure 1. The model formed the base for formulating the questions for the semi-structured interview method.

The model consists of three categories, from which factors arise. With these factors, a distinction is made based on the scientific literature study whether these are success or failure factors for an innovation or even both. A distinction is also made whether the factors influence each other. The coherence between these factors indicates the complexity of the research. The factors that can be both a success and a failure factor, were specifically addressed in the semi-structured interview to get clarification on these factors from the experts. In addition to the fact that certain factors cohere with each other. The scientific literature study also shows that certain factors have a greater influence than others. This mainly depends on the project itself and, will also be the case for NEED, where the semi-structured interviews gives clarification on this.

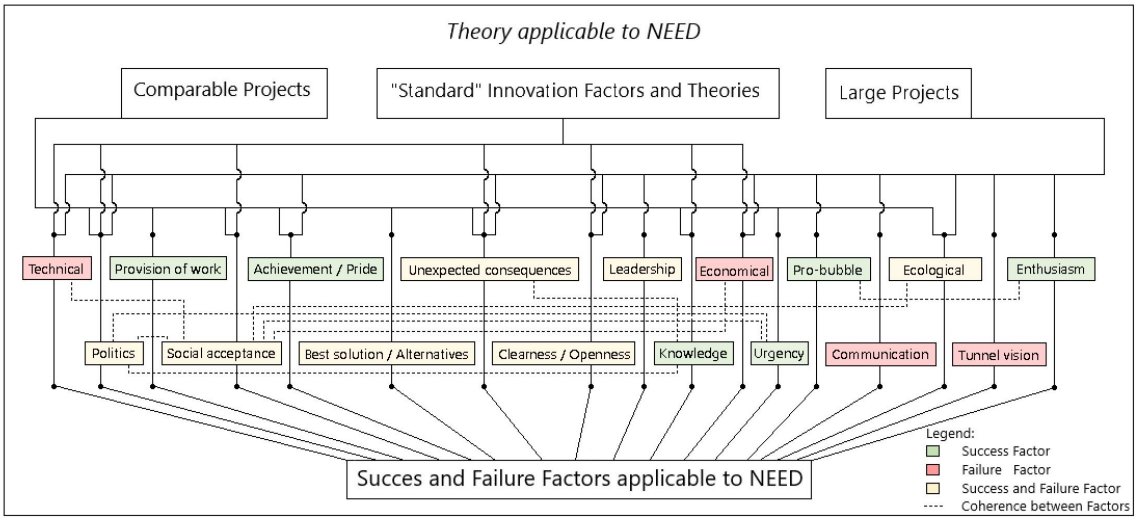

Figure 1: The conceptual model based on the literature study.

Results

The questions posed in the semi-structured interview are divided into two chapters. The first chapter looks at factors applicable to "standard" innovation. The experts were asked what makes an innovation successful, but also its the common failures. The second chapter of the semi-structured interview looks at NEED specifically. The experts were asked what their opinion is about NEED and specific factors that emerged from the scientific literature research. There is not one general response to the NEED innovation when we are comparing the seven experts. However, there are some similarities that the experts point out when they are asked about their stance in this matter. At the start of the interview all the experts acknowledged that there is not just simply one factor that will make this innovation challenging. All of them are pointing out that there are multiple factors that affect the project and also affect each other. The overview below shows the factors and the coherence between them that are applicable to NEED, this is shown in figure 2. This is based on the semi-structured interviews and the scientific literature. Looking at the NEED factors, it seems that there are more success factors than failure factors in general. This needs to be clarified as certain factors were underlined more often during the study and thus appear to play a crucial factor. Four factors stand out that come up repeatedly and seem more crucial.

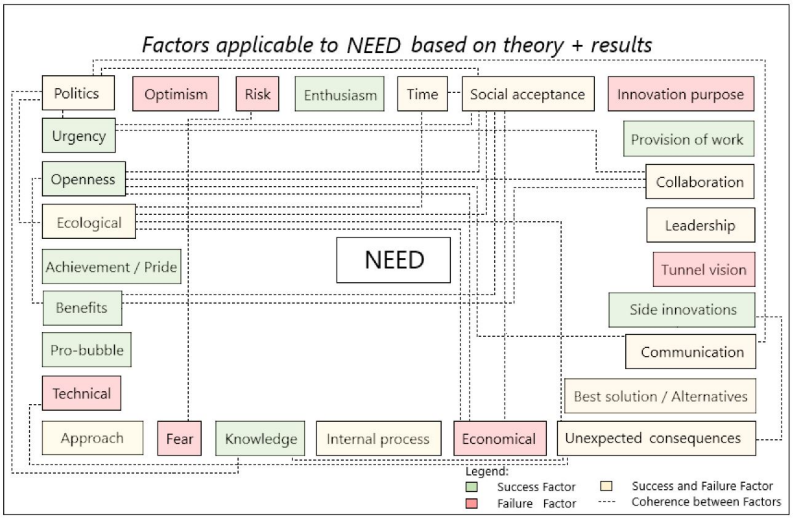

Figure 2: Factors that are applicable to NEED according to the experts and the literature study.

The first crucial factor is politics. The research shows that politics can be both a successful and a failing factor. However, especially from the interviews, it emerges that the politics, looking at NEED, are extremely complex. Where the general impression of the experts on the political factor is seen as a failure factor for NEED. The second factor that stands out at NEED is ecology. This factor is used several times as a failure factor, partly because NEED will have a major impact on the environment. The research shows that this factor is mentioned several times as a negative factor. The factor that will most often be used as a counter-argument for the radical innovation NEED. The third factor is social acceptance. Both the literature and the experts underline this factor. Public opinion can give NEED a positive or negative impulse. This mainly depends on other factors that cohere with this factor. This factor is strongly influenced by the two previously mentioned factors, politics, and ecology. The last crucial factor is urgency. Urgency is strongly stated as a requirement for NEED several times. This is mainly because this factor has a major influence on social acceptance. As soon as the urgency increases due to, for example, a disaster or noticeable negative effects. Then urgency can positively influence the social acceptance factor. So much so that the previously mentioned important factor of ecology is overlooked by society.

With all these previously mentioned results, an end result can be formed regarding the core findings for this research, looking at the difference between NEED and "standard" innovations. There are many different factors that influence NEED. A total of twenty seven factors affect NEED. Nine of these factors form success factors, namely; *urgency, openness, achievement/pride, benefits, pro-*

bubble, knowledge , enthusiasm, provision of work and side innovations. Seven factors form failure factors; *technical, fear, economical, tunnel vision, innovation purpose, risk and optimism.* The last eleven factors can be both a success and a failure factor, these are; *politics, ecological, approach, internal process, unexpected consequences, best solution/alternatives, communication, leadership, collaboration, time and social acceptance.* Finally, the results have shown that certain factors are of greater importance than others and play a more vital role. These factors are; *politics, ecology, social acceptance and urgency.*

Looking at the number of factors in a "standard" innovation is much less than the number of factors related to NEED. In "standard" innovation eighteen factors play a role, at which NEED depends on twenty seven factors. Two of these factors of "standard" innovation are a success factor, namely; *urgency and knowledge.* Six factors are a failure factor; *fear, innovation purpose, risk, collaboration and communication.* The last ten factors can be both a success and a failure factor, these are; *politics, unexpected consequences, leadership, time, openness, technical, rules, kind of innovation, economical and social acceptance.* The previous results have shown that the coherence is more present with the factors applicable to NEED. The four factors that play a bigger role looking at the NEED factors do not play a bigger role looking at the factors of "standard" innovation. These results have been presented to the focus group.

Conclusion

In the conclusion, this paper provides an answer to the two main research questions that were stated in the introduction. The first research question is as follows: *'What are the success and failure factors of the NEED innovation?'.* This question dives into factors that might positively or negatively affect the NEED project. To be able to answer this questions two main methods were used. The scientific literature study already provided several factors that might lead to success and failure factors for innovations in general. However, no research has been done on NEED specifically, and there has also not yet been a scientific study that focused primarily on success and failure factors for radical innovation specifically. Therefore the literature study could not completely provide the answer to the first research question. Semi-structured interviews have been conducted with innovation experts from different fields of work to complete the answer to this question. Both research methods provided several potential success and failure factors. Also, both research methods proved some of these factors to be double sided, as can been seen in figure 18. As they could cause both success and failure to the project. Eventually the research examined four factors as crucial for the NEED project: *politics, ecology, social acceptance* and *urgency.* These factors will play a more important role for the project as all the other factors. For the NEED project to be implemented, these crucial factors will need to receive more attention than the other factors, as they are a prerequisite. Thus, to answer the first research question, there are several success and failure factors applicable to the NEED project as can been seen in figure 18. The factors *politics, ecology, social acceptance* and *urgency* will probably play a crucial role in the development in the further implementation of the project.

The second research question states as follows: *'To what extent do radical successes and failure factors differ from a "standard" innovation?'.* It examines whether there is a difference between success and failure factors for the radical innovation NEED and these factors for "standard" innovation. The outcomes of this research showed that the number of factors that affect a "standard" innovation are much less than the number of factors related to the NEED project. The results showed that the coherence is more present with the factors applicable to the radical innovation NEED. According to the experts this is caused by the complexity of the NEED project. This complexity also reduces the chance of success. The four crucial factors, *politics, ecology, social acceptance* and *urgency*, play a bigger role looking at the NEED project, in comparison to the part they play for "standard" innovation. In conclusion, the research has shown that there is a difference between the factors of radical innovation NEED and "standard" innovation. The difference is in the number of factors as well as the importance of certain specific success and failure factors. In addition, the coherence between the factors related to NEED is greater than the coherence between factors of "standard" innovation.

Discussion

What emerges from this research is that the NEED project is very complex. The coherence appears to be greater with NEED compared to "standard" innovation between factors. Certain factors are crucial for NEED, which require extra attention during the execution of the innovation. However these crucial factors also raise questions. Urgency will only become clear when a treat is clearly present or when a disaster strikes. In addition, the social acceptance of this innovation is not only influenced by urgency, but also by a number of other factors, the large amount of coherence with other factors entails even more complexity. Furthermore, ecology is mainly seen as a failure factor by the experts. It will, therefore, be important for NEED to transfer strong success factors against it, or to improve the ecological consequences that the NEED project entail. This thesis provides a picture of what factors are important for this radical innovation. Scientifically, this is interesting as there is no clear framework for radical innovations yet. However, this research does not yet provide the framework. Nevertheless, it could form the basis of further research because of the success and failure factors that are found during the research. These provide information to make a framework in future research. In addition to the reflection on NEED and its implementation, the research methods could also be discussed. It is possible that with extensive research more factors can appear, more experts can contribute to this. With the current small group of experts their answers and ideas are limited to just their particular field of expertise. If more experts in the same category were used, this would have given a more objective outcome.

The factors that where found in this research have no specific value on how crucial they are. This is also discussed during the focus group meeting. The factor urgency for instance may be more crucial and therefore more valuable for the project. The focus group also emphasizes that the NEED project is in a pre-phase with regard to the concept at the moment that this research was conducted. The concept may look different in the future. Another point of discussion could be found in the generalizability of the factors found for this radical innovation. "Standard" innovation is now compared with one specific radical innovation in which the factors urgency, politics, social acceptance, and ecology are regarded as crucial. The question is, however, whether these factors apply especially to the NEED project or to radical innovations in general. As soon as one speaks of a radical innovation, one should look more individually at the innovation to find the associated factors, because a general research like that has not been conducted yet. One could start by making a list of basic factors coming from this research. Looking at the limitations, the number of experts, as mentioned earlier, has been a limiting factor. By increasing this number one will get a better picture and certainty of all factors that play a role. More time can lead to even more depth in both the literature study and the number of experts, but also to conduct the Delphi method.

Recommendation

For the general scientific recommendations, it would be recommended to interview more experts in the future. More experts could help to find a better consensus. Another recommendation for future research is to adapt the approach of a similar type of research. When sufficient time is available, it is desirable to use another research method. The Delphi method entails better validation and reliability. Besides the Delphi method a value overview can be drawn up for a similar study. This contributes to the clarity of the aspects and how they weight up against each other. Finally, this research could also be drawn more generally. This means that it could be interesting to examine whether the success and failure factors that form the result and conclusion of this research, might also be applicable to other kinds of radical innovations.

The recommendations for future of NEED would be to conduct the same research again in a later period of time. The NEED project is only an innovation in pre-phase at the moment, as the focus group underlined. The aforementioned scientific recommendation, the overview, can also be useful here. Furthermore, it is an option to dive deeper into the success and failure factors that result from this research. Extensive research into these aspects might lead to new insight or practical tips for the NEED project or comparable radical innovation projects in the future. In addition to these recommendations specific for NEED, the aforementioned scientific recommendations will also be an improvement for NEED for further research.

List of Acronyms

1.	NEED	Northern European Enclosure Dam
2.	RQ1	Research Question 1
3.	RQ2	Research Question 2
4.	SQ1	Sub-Question 1
5.	SQ2	Sub-Question 2
6.	SQ3	Sub-Question 3
7.	SQ4	Sub-Question 4
8.	TU Delft	Technical University Delft
9.	CD	Compact Disk
10.	R&D	Research & Development
11.	NASA	National Aeronautics and Space Administration
12.	MLP	Multi-Level Perspective
13.	OIS	Organizational Innovation System
14.	NIS	National Innovation System
15.	TIS	Technological Innovation Systems
16.	KPI	Key Performance Indicator
17.	WINN	Water Innovation Program
18.	CIM	Cyclic Innovation Model
19.	E1	Expert one, a Innovation strategic
20.	E2	Expert two, a Innovation management prof.
21.	E3	Expert three, a Hydrogen expert
22.	E4	Expert four, a Project innovation advisor
23.	E5	Expert fifth, a Civil maritime engineering tutor
24.	E6	Expert six, a Civil hydraulic consultant
25.	E7	Expert seven, a Project manager
26.	EU	European Union
27.	OMT	Outbreak Management Team

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1 Introduction

1.1 Background

It is becoming increasingly clear that the current climate change is not benefiting our planet. Due to the climate change, animals are becoming extinct, temperatures are rising, the ice sheets are melting and the weather is changing (Rignot et al., 2011). The melting ice sheets cause one of the great dangers that climate change brings; the sea level rises considerably (Jevrejeva et al., 2014). Due to the sea-level rise, many residential areas are endangered. A solution is being sought to prevent this. One of the best-known plans to solve the problem can be found in the Paris agreement (Levine & Steele, 2021).

The agreement aims to reduce the drastic changes caused by climate change, which cause the warming up of the earth. This, therefore, can be linked to the melting ice and thus also to the rise of the sea level. However, not all countries are keeping up with the promises and agreements that were included in the Paris agreement. An example can be found in the previous president of the United States, Donald Trump, who has officially withdrawn the United States from the agreement in 2017 (Lin, 2020). On January 20, 2021, Joe Biden was named the new president of the United States. Unlike his predecessor, Biden is a supporter of the Paris agreement. This has led to the United States participating again in the Paris agreement on February 19, 2021, (Burki, 2021). However, the United States has fallen behind considerably. Looking at achieving the goals in the agreement, an enormous catch-up is being asked to achieve the goals of the Paris agreement that have been set for 2050 (Iyer et al., 2017). As the United States form one of the most influential parties in the original agreement, the chance that the agreement does not work out as planned is seemingly increasing. If we look at the other countries that participate in the Paris agreement, there is a big difference in the agreements and also whether they are being observed. The Paris agreement is made in such a way that each country has set its own goals for 2030. After, an evaluation takes place for the new goals in 2050. However, these goals differ so much among countries that there is no strong line to be found in them. The reducing emissions for 2030 differ per country between 1% and 50% (Pearce, 2015). Of course, the amount of emission differs per country and it can be said that targets have to be adjusted accordingly, but that is not entirely the case. The goals are simply set to what extent the countries are willing to reduce their emissions. On top of that, it appears that many countries are unlikely to achieve their own goals. Apart from the United States, it appears that Russia, Turkey, Ukraine, and Saudi Arabia are making little or no progress, this results in that the entire agreement is on the verge of failure.

If the countries that are behind schedule come around, there is a chance that the agreement will still be achieved. At the moment the general idea is that if the Paris agreement is reached, climate change will decrease, or even stop. However, how sure are we of this? Looking at the goals of the agreement, the overall goal is to prevent a global temperature rise of 2 degrees Celsius. The Paris agreement is certainly a good goal and will also contribute to the decrease in climate change. But will it be enough? Assuming that all agreements in the Paris agreement will be reached by the end of 2050. What if it turns out that climate change has not slowed down enough to keep the changes below 2 degrees Celsius, with all the associated consequences. Meinshausen (2016), writes that the goal of keeping the temperature change below 2 degrees Celsius will not be achieved, with the current Paris agreement. Several studies indicate that the global temperature will have risen by 2.3 to 3.5 degrees Celsius in 2100 if countries keep to their pledges in the Paris agreement. Meinshausen (2016), points out that the agreements will have to be adjusted if the world wants to stay below those 2 degrees Celsius to prevent the consequences of climate change (Meinshausen, 2016).

Thus there is a chance that the agreement does not work out as planned. It is therefore important, and socially most-relevant, to think about what to do if this happens. This means that alternatives are also being looked into and examined. A drastic alternative, can be found in the NEED program. What this program exactly consists of will be discussed in the following paragraph.

1.2 The Northern European Enclosure Dam

The abbreviation NEED translates to North European Enclosure Dam (Groeskamp & Kjellsson, 2020). The project focuses on building a dam to protect the north of Europe from the rising sea level. The idea to create this dam comes from oceanographer Sjoerd Groeskamp and engineer Joakim Kjellsson and came to life in 2019. The dam brings protection from rising seawater to 15 countries, directly protecting over 25 million people (Groeskamp & Kjellsson, 2020). It will do so by linking strategically chosen landmarks in France, the United Kingdom, and Norway. Thus, the dam would consist of two parts:

- The first section runs from Ploudalmezeau (France) to the Lizzard Heritage Coast (England). This section is also referred to as the South Need as shown in figure 3. This dam has a length of approximately 161 km with an average depth of 85 meters, however, the maximum depth of the dam is 102 meters.
- The second section runs from John O'Groats (Scotland) via the Orkney Islands to the Isle of Noss (Shetlands Islands) with a length of 145 km and an average depth of 49 meters. This is the left part of the North NEED, which can be seen in figure 3, this is also the smallest dam of the entire project.
- The dam then continues from the Shetlands Islands to Bergen (Norway) with a length of 331 km with an average depth of 161 meters. This is the right part of the North NEED and can be seen in figure 3. This is not only the longest dam on the project but also the deepest. In some places, it reaches a depth of 321 meters to the seabed.

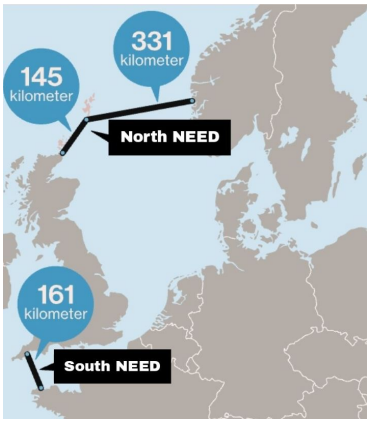

Figure 3: A schematic overview of the NEED project, divided in the North and South NEED, ("Northern European Enclosure Dam", 2020).

The NEED project will touch a lot of scientific fields in its development and will pose unique challenges for each of them. For example, one could take a look at this project from a financial management point of view; who will pay to build this dam? There are several technological challenges that the project faces; how to make a dam that reaches a depth of more than 300 meters? Aside from that, a project like NEED will have an incredible ecological impact on the North Sea and Baltic sea; is there a way the saltwater won't turn into freshwater eventually and to conserve the current ecosystem? The social-political side of the project might be interesting for political science; Brexit will not make it easier to make these innovative projects become reality. Furthermore, to close the North and Baltic creates logistic challenges to all of the countries, like Belgium and The Netherlands who now have flourishing ports where tons and tons of products are being shipped to and from every day. The aforementioned points and many more will pose challenges if the NEED project is built. For such a large project like NEED, it is important to know in advance what the potential pitfalls are and what the right way is to make the innovation successful.

1.3 Problem statement

To narrow down the topic for this research, the focus is specifically on identifying success and failure factors of a radical innovation such as the NEED project compared to a "standard innovation". Innovation plays a key role in the project. Never before has such a large dam been realized, involving so many countries, which makes it complex. If one looks at the available literature on innovation theories and the success and failure factors of innovation, then there is a lot of research done for this on "standard innovations". However, when looking at radical innovations, there is no distinction made, whether there are other success and failure factors compared to "standard innovations". The gap emerges from the literature study that starts on page 21. This gap in scientific knowledge, concerning innovation theories and the success and failure factors of radical innovation projects such as the NEED project, will be covered in this research.

1.4 Research objective and questions

The objective of this research is to investigate and define the success and failure factors of large-scale, international and innovative projects such as the NEED project. The research will examine whether there is a difference in the success and failure factors of innovation for extremely large projects also in comparison to "standard innovation" projects. To achieve this goal, two research questions have been chosen for this study. The two main research questions can be seen below.

RQ1: *What are the success and failure factors of the NEED innovation?*

RQ2: *To what extent do these radical successes and failure factors differ from a "standard" innovation?*

Looking at the term success and failure factors for this research. Then the factors are aspects that influence the realization of an innovation. Where the success or failure of a factor depends on whether the factor is a positive or negative influence on the realization of the innovation. A clear picture must be formed regarding the meaning of innovation and what the success and failure factors are before one can start looking at these factors for NEED itself. This picture can be formed based on innovation theories by linking them to each other with the help of literature study. Because something such as this project has never been exhibited before, relevant literature will have to be examined. This focuses on comparable-sized projects. Sub-questions have therefore been created. The sub-questions involve looking at which questions have added value in helping answer the main questions. The sub-questions for this research can be seen below.

SQ1: What is radical innovation?

SQ2: What are the characteristics and the success and failure factors of a "standard" innovation process?

SQ3: What are the characteristics and the success and failure factors of extremely large radical innovation projects?

SQ4: What are the characteristics and the success and failure factors of projects similar to NEED on radical innovation?

Literature study will not be sufficient to answer all the sub-questions. The success and failure factors can very much depend on the type of innovation and project. Looking at the NEED project, the innovation is radical in such a way, that similar literature will be scarce or not (yet) available. To fill the gaps left by the literature study, research methods will be used to fully answer the questions. These research methods are clarified in chapter 2 Research Methodology.

1.5 Research outline

This research will continue with the research methodology in chapter 2. Several research methods and reasons are discussed about which research methods is chosen for this research. This chapter dives into the research methods that are used and the processes that will lead to answering the main and sub-questions. This will be continued with the experts that have been selected for this research and what questions have been formed for the interviews based on the conceptual model. Thereafter, in chapter 3, the theoretical framework is presented, which addresses the scientific literature study that highlights different aspects. This is important so that it can be examined which aspects are already theoretically known. These aspects are how to define innovation and the success and failure factors of innovation using innovation theories, what role innovations play in large projects, and what kind of literature is available on innovation for projects that can be compared to the NEED project. The conceptual model emerges from the findings of the literature study which have been used for the interview questions in chapter 2. Chapter 4 discusses the results found based on the findings of the experts. Subsequently, the conclusion is presented with the answers to the research questions in chapter 5, based on the previous chapters. Finally, Chapter 6 encompasses the discussion and limitations of the research.

2 Research Methodology

This chapter looks at the research approach and which research methods were used to answer the research questions. The initial paragraph explains the approach and the contribution of chapter two for this research. This is followed by a more in-depth explanation of the chosen research method and the research process in 2.2. Finally the research design is presented in paragraph 2.3.

2.1 Research approach

To answer the main questions, multiple sub-questions were used as mentioned in paragraph 1.4. To answer these sub-questions one or multiple research methods were used. The first sub-question "What is radical innovation?" is a descriptive question (Sekaran & Bougie, 2016). This question is answered by using scientific literary resources. The resources consist of scientific books and articles, coming from databases such as Web of Science and Scopus.

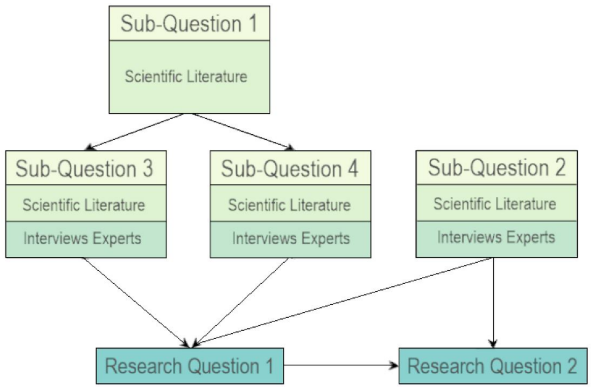

Figure 4: Schematic overview of the research process.

The other sub-questions also use scientific literature. However, additional research was necessary to support and complement the literary research. As shown later in the literature review, it emphasized the properties of radical innovation. The gap between standard innovation and innovation of extreme projects is slightly emphasized. Some of the literature revealed what the success and failure factors are when looking at the projects. It was striking that as soon as the successes and failures of a project were discussed, there was little to no consideration for the origin of these results. Whether these results were also positively or negatively impacting similar projects was not considered. The problems that arise during a project, are mainly solved with applied research, whereby the problem is solved on the spot. However, no fundamental research has been done on the success and failure factors of radical innovations in comparison to "standard" innovation, which only emphasized the value of this research. This gap of extreme wild innovation ideas such as NEED and "standard" innovation whether a different innovation process should apply, cannot be answered with scientific literature alone. This resulted in the choice of taking different research methods into account. Each investigated method was taken under deliberation whether it was suitable for this research. Not only must the content of the methods be considered, but also the feasibility of implementing the method for the research.

2.1.1 Data collection methods

Looking at the other sub-questions, scientific literature was, as aforementioned, a good basis. One of these methods is Desk research, which is a data collection method. Only secondary data is used in Desk research, often in the form of literature, as is the case here. The results of Desk research often lead to new questions. An example for this research was that literature research showed that there are other success and failure factors that need to be taken into account for radical innovations. However, it is not explained what these factors are when one speaks of radical innovation. It is therefore prudent to keep in mind that the Desk research is likely to raise additional questions. The aim was to gain insights into the different interpretations and views that one has and the

meaning that one attributes to certain innovations. Qualitative research is often used in complex studies, a category under which this research assuredly falls. To obtain these interpretations from people, interviews are often used. Looking at this research, it was interesting to obtain experts' interpretations of the views of the success and failure factors. Surrounding radical innovations and in particular that of NEED. An semi-structured interview was therefore a useful research method to obtain answers that the scientific literature could not answer or the questions that the literature study itself generated (Sekaran & Bougie, 2016). Another approach which was applicable to this research is fundamental research. This mainly concerns the acquisition of knowledge that does not directly consider the application of this knowledge in practice, also known as applied research. However, the separation of fundamental research and applied research is not as linear as it seems. Often the knowledge gained during the fundamental research is used to apply it into practice, this might also become the case for NEED with this research. This research primarily involves fundamental research, the aim of which is to answer the gap in terms of success and failure factors of radical innovations and whether these deviate from "standard" innovations. However, if the research shows that there are indeed other factors at play for radical innovations compared to "standard" innovations. Then it is plausible that when the NEED project is carried out, and this research is taken into account, that the results are included for the practical approach (Sekaran & Bougie, 2016).

2.2 Research method and process

To include all previously mentioned data collection methods in the research. The semi-structured interview method was chosen as the research method for this research. An semi-structured interview offers a solution for a qualitative study in which research can be conducted into fundamental research. The questions arising from Desk research could be answered using interviews with experts. However, this was not the first choice for this research. Initially, the Delphi method was preferred. The Delphi method is a combined qualitative analysis, in which a series of open-ended questions is presented to experts, just like a semi-structured interview. Afterwards a quantitative analysis is made of the answers of the experts. The answers are summarized and remain anonymous during the survey. The summary with the answers is presented to the experts again, with feedback. This last process of feedback can take place several rounds, with which a consensus is ultimately sought. This method made a better contribution to the validity and reliability of the research. The Delphi method was not feasible for this research, mainly due to the time available for this research and the time the interviewees had for several rounds. Therefore the semi-structured interview method was chosen. Section 2.2 looks at what the semi-structured interviews entail for this research. Whether the method is valid and reliable, and whether it is feasible.

2.2.1 Semi-Structured Interview Method

An interview is a qualitative research method, where it has several properties that one research can encounter (Crotty & Crotty, 1998). An interview is a conversation between the person being questioned and the interviewer himself. During the interview, several questions are asked to obtain the opinion of the interviewee. An interview is a type of framework in which several questions or problems are presented to the interviewee (Corbin & Strauss, 2014). An interview has the property that the researcher receives several inputs from several respondents. During the interviews, the interviewee will remain completely anonymous so that the interviews and the research remain reliable. However, for this research, only experts were considered to contribute to the NEED research. The experts' views are examined to see whether they have different views or findings regarding the success and failure factors surrounding NEED, compared to the literature review. That is why selection had to take place, in which it is checked whether a potential interviewee was suitable for the research. The interviews were semi-structured for this research. This means that the questions had a fixed order, but an open answer (Jamshed, 2014). Efforts were also made to ensure that all the interviewees had the same amount of time in the same environment. However, the same environment is difficult to guarantee. In order to achieve this as well as make this possible, including aforementioned practical reasons, all interviews have taken place digitally on the same platform called Microsoft Teams. All interviews with the experts lasted approximately

30 minutes. Prior to the start of the interview permission to record the interviewee was always asked indicating that the interview was for research purposes only. Each interviewee was also asked whether he or she agreed that his or her ideas and views that emerged during the interview were used in this study anonymously. It would then be implemented in the study, a schematic overview can be found in figure 5.

Figure 5: Schematic overview of the interview process.

2.2.2 Validity and Reliability

It was important to guarantee reliability and validity with the semi-structured interview method, because we look at experts' opinions. Since the experts were chosen by the researcher and the researcher also determined the number of experts. The researcher must have guaranteed the reliability of the research. The opinions of the experts were reread by themselves, before the interviews were adopted into the research. This is beneficial to the reliability. This helps to provide a reliable consensus. The researcher also had to guarantee the validity whereby the experts participating in the research had to have a valid reason/background as to why they could be of value to the research. The experts selected were experts with scientific knowledge in the field of innovation. However, not only experts with scientific knowledge would be of value for this research. Experts with technical knowledge of similar projects such as NEED would be of value as well. This is mainly because they know the success and failure factors of a dam, regardless of the size or how radical it is. Finally, we looked at experts in the field of radical innovations and the success and failure factors that played a role in this. To get a good consensus, it is also important that we do not have one expert from each category, but several. This in turn ensured that the consensus per category also remains reliable and valid. The aim was therefore to find at least 2 experts from each category. This meant that the entire semi-structured interview method consisted of at least 6 experts in total. The experts must have a good overview of the innovation and not just one branch. This was important so that success and failure factors were not missed out.

Looking at the sub-questions regarding the qualities of both "standard" innovation projects and extremely radical innovation projects, both subjects can be examined through the semi-structured interview method. There may be a gap in the innovation process. The semi-structured interview method was used to find the success and failure factors of the NEED project. The last sub-question looked at the outcome of the previous sub-questions, the success and failure factors that emerged from the semi-structured interview method that were compared with the success and failure factors that emerged from the literature. Figure 4 gives a schematic overview of the research process for the sub-questions. Once this process is done, one can look at the main objective and answer the main questions accordingly.

2.2.3 Feasibility

Determining the feasibility of this research shows no direct bottlenecks in regards to neither the scientific literature study nor the semi-structured interview method. However, a few remarks should be made. The semi-structured interview method aimed to ask multiple open-ended questions from multiple experts. The experts who will participate will most likely not all come from the Netherlands, where the research takes place. Especially since the experts are chosen for their expertise, with many radical innovations taking place outside the Netherlands. To be able to put the questions to the experts, it was therefore decided to take all open questions/interviews digitally. The research will also take place in the year 2021, in which the Covid-19 epidemic still plays a major role. Taking these arguments into consideration, it is more sensible for both experts within and outside the Netherlands to conduct the research digitally. The research has had a duration of 6 months. Due to this limited amount of time, 7 experts participated in the study to make it feasible, as aforementioned. Taking into account that their opinions had to be processed, after which sufficient time had to be left in order to answer the main and sub questions.

2.3 Research design

This section of the paper looks at the basics used for the semi-structured interview method. The experts that were appointed and the questions that were used for the study are shown below. The interviewees' results on the questions from the interview are presented in Chapter 4.

2.3.1 Experts

As stated prior, the experts have been carefully chosen. These specific experts were chosen based on their profession and if they fit the three categories based on the scientific research, but also whether the number per category is sufficient for the research. The experts varied from innovation expert, civil engineering manager to experts working on large innovative projects. Table 2 lists the experts who have been selected. Only their profession is mentioned to guarantee the reliability of the research and the privacy of the experts.

Code	Appendix / Page	Profession	Category
E1	B / 72	Innovation strategist	"Standard" innovation theory / Large projects
E2	C / 78	Innovation management prof.	"Standard" Innovation theory expert
E3	D / 83	Hydrogen expert	Large innovative projects
E4	E / 88	Project innovation advisor	Comparable innovative projects
E5	F / 94	Civil maritime engineering tutor	"Standard" innovation / Comparable projects
E6	G / 100	Civil hydraulic consultant	Comparable innovative projects
E7	H / 105	Project manager	Large innovative projects

Table 2: Experts who have been selected for the semi-structured interview method.

2.3.2 Semi-structured interview list

The questions used for the semi-structured interview for this research are shown in table 3 on page 19, and will be presented to the experts. In the semi-structured interview, a distinction has been made between two components. The first component is the general questions. These questions look at the background of the experts and how innovation plays out in their daily lives. But also what the general findings of the experts are regarding success and failure factors. It is possible that the experts themselves can identify factors that will not emerge from the literature study. They are also asked what they think about NEED, where they share their expertise and thoughts on NEED. Doing this may already reveal a list of factors that play a role. It is possible that during the interview, the experts' opinion about NEED may change for the better or for the worse. Where certain factors come out stronger or completely new factors come up with a second thought looking at NEED.

The second component of the semi-structured interview is based on the conceptual model in figure 14 on page 41. The conceptual model is based on the scientific literature study, therefore, the second component of the questions were formed after the scientific literature study was done. A distinction is made between the different factors found in the literature study. Based on the literature study, some factors were already clearly a success factor, for example the factor provision of work. These are indicated with green in the conceptual model. Other negative factors are already clearly a potential failure element for NEED, such as tunnel vision. These are indicated with red in the conceptual model. Thus it was decided not to include these in the semi-structured interview given the limited time of the interview and the contributions that questions have had. Therefore, the interview mainly looks at the success and failure factors that can turn out positively and negatively. These are indicated with yellow in the conceptual model. For example, politics can be a success or failure factor, according to the literature study. The expert findings contributed to determine which side these factors stand out to in regarding to NEED. The success and failure factors that were examined in more detail by the experts were therefore unexpected consequences, politics, environment/sustainability, society, openness, alternative solutions, leadership and their own findings regarding success and failure factors for NEED.

General questions	Section / Page
- What is your profession?	4.1 / 42
- What part plays innovation in your daily life?	4.1.1 / 42
- What does it take to make an innovation a success?	4.1.2 / 43
- What are common failures while working on an innovative project?	4.1.3 / 44
- What do you think of the NEED project itself?	4.1.4 / 45
Success and failure factors looking at NEED	Section / Page
- What success and failure factors do you think a project like NEED will encounter?	4.2.1 / 46
- Which factor is the most important and, which is less important?	4.2.2 / 47
- Do you think that there will be unexpected consequences with NEED?	4.2.3 / 48
- To what extent did politics play a role in the implementation/development of NEED?	4.2.4 / 49
- How can environment/sustainability play a role in the NEED project?	4.2.5 / 50
- How do you think the NEED project will be received in society?	4.2.6 / 51
- What role will openness to society play in the acceptance of the NEED Project?	4.2.7 / 52
- What are similar/alternative solutions to the problem that NEED is trying to solve?	4.2.8 / 53
- Who should take the lead in working on the NEED Project?	4.2.9 / 54
- What do you think of the NEED project itself?	4.2.10 / 55

Table 3: Questions for the semi-structured interview method, based on the literature study.

2.3.3 Data processing

The experts participating in the interview were questioned for approximately 30 minutes. This gave a large amount of data that needed to be processed. To do this properly, a content analysis was needed. For this research, the data process consisted of two steps. The first step was to transcribe the interviews. Every word that had been said in the interview was included. Once transcribing was complete, the interviews were translated into English and sent to the experts for approval. Because this involved a large amount of data, it was decided to put the full interviews in this study's appendix, starting at page 72. The second step is coding. This consists of three phases namely; open, axial, and selective coding. There is no specific order between the phases. It is possible to go back and forth between the coding process. However, in most studies, it is common to go from open to axial to selective coding (Walker & Myrick, 2006). For this research open coding was chosen as the initial starting point. In this phase, the transcribed interviews have been thoroughly read. In this process, there are codes connected per fragment. These codes represent the opinions of the experts. Subsequently, axial coding was applied. During this process, the assigned codes were compared with each other and the ones that belong together were put in an overarching code. For this research, the overarching codes were formed by the success and failure factors. The final phase is selective coding. The overarching codes / factors that have been found were then examined. With this, a theory was build that is based on the findings of the research and contributes in answering the questions for this research. For this study, the theory did not only consist of the research results but also the results of the literature study. The theory based on this interacts with the conclusion and is disclosed in chapter 5.

2.3.4 Validation focus group

The results were processed at the end of the semi-structured interviews as mentioned above. These results were then presented to a group of people working on NEED. The response, which the focus group NEED gives to the results of the semi-structured interviews, provides insight into the validation of the research. It also ads to the groups perspective on the research, and the points of improvement for this research. The focus group consists of people who have a variety of knowledge regarding aspects of NEED. Therefore is this a heterogeneous focus group, which leads to different insights. The focus group's response to the presentation is shown in 4.4.5 on page 62.

3 Theoretical Framework

This section deals with the literature study that is relevant for this research. First, the scope of the literature study is examined, and which means were used during the literature study. This section describes which literature applies to the research and which criteria it must meet, this is discussed in paragraph 3.1. Thereafter, the literature study is displayed in 3.2. The literature is divided into parts that are applicable for NEED and the sub-questions of this research. Finally, 3.3 provides a conclusion of the theory that was found and the conceptual model for this research based on the literature study.

3.1 Description and Selection Criteria

The starting point for determining the scope of the literature study was done with the help of a mind map. For the mind map, one looked at the issues related to the NEED project and innovation itself. The mind map was formed by circles that correctly rank the interests of things. The ranking made it possible to form a feasible scope, which ultimately formed the basis for the literature study.

The study includes various books and articles. The articles come from different kinds of scientific articles: the journal of consumer marketing, the journal of product innovation management, the journal of management science. To access these sources, two databases were used: Scopus and Web of Science. Searching through these databases also helped to find articles related to articles that were already included in the schematic overview. Besides that, they helped with looking for closely related articles and keywords during the search.

The beginning of the literature study is starting with some of the scientific books that were provided by professors of the Delft University of Technology (TU Delft) during classes on innovation: Strategic management of Technological innovation by (Schilling, 2020) and Managing knowledge, work and innovation written by (Newell et al., 2009). Starting by defining innovation and the different types it was made possible to constrict the literature research. These sources helped to define keywords to use for the first searches for this literature study.

During the first online search on Scopus and Web of Science, the following keywords are used: 'innovation, decision-making processes, technical innovation, types of innovation'. Examining the different scientific articles, It was clear that the focus was too broad for this study. It was impossible to include all kinds of innovation and decision-making processes. Therefore the decision was made to focus solemnly on innovation and the most applicable and relevant forms for the NEED project or comparable projects: radical innovation. This study is described in section 3.2 in paragraph 3.2.1.

Once there was enough relevant literature on innovation and radical innovation itself, it was important to apply these subjects to the NEED project. During the search, it was noticeable that not much had been written on the NEED project itself, as it is still a prospective project. Therefore the research strategy was changed and the study focused on the scientific literature on innovation and radical innovation linked to comparable, large international projects. The projects, at this stage of the research, did not necessarily have to be related to the NEED project. Looking into this, however, provided an insight into what role innovation plays in large international projects. The keywords included: 'large scientific project, major/large innovative project, radical innovation projects, decision-making processes project, innovation international projects, world innovation.

The scientific articles and the reference that were found in the databases led to look deeper into projects that are comparable to the NEED project, however on a much smaller scale. Examples can be found in the development of the Zuiderzeewerken and Afsluitdijk in the Netherlands (Borgesius & E, 2017) or Saemangeum Seawall in South Korea (Sato et al., 2007). The following keywords have been used: enclosure dyke, Northern Europe, dam, North European Enclosure Dam, waterworks, closure dyke innovation, Saemangeum Sea-wall, Saemangeum Seawall innovation, Enclosure dam, Dam innovation.

During the research, there were several criteria to include or exclude scientific sources from this review. When an article or book was examined, there was taken a look at the title, index, and abstract. This enabled the study to find the subject of the article and the scope of the article on innovation, radical innovation, or innovation during large or related projects. The articles that seemed applicable to the literature study were looked into. At first, the focus is on the introductions and findings for the most relevant conclusions that could be relevant to this paper. If these parts of the papers or books showed relevant information, the article was read completely. To make this task cleanly cut, a schematic overview was made, which included the subject, title, scope on innovation, the year that the source was published, relevance for the literature study, and the journal it was published in if it concerned an article. This process resulted in 14 of the 31 articles being selected for further study for this literature research. Criteria for excluding some of the articles were mostly due to the limitations of this paper, but also the year that an article was published which made it less relevant than other papers that would combine the basic principles of older studies with newer and more relevant innovation theories.

3.2 Literature Study

Desk research and the literature study that goes with it are important for this research. The literature study helps to answer the sub-questions mentioned earlier. The study also ensures that questions can be formed for the semi-structured interview method. The questions formed based on this literature study can be found in section 2.3 on page 18.

Examples of innovation can be found in every aspect of life: how listening to CDs turned into listening to Spotify (Newell et al., 2009) or how cars can nowadays drive on electricity instead of gasoline. But also seemingly small changes or extensions to existing products can make a difference. During this research, various sources were examined to find relevant literature on innovation, with a focus on the NEED project. What is innovation? What kind of innovation is the NEED project? What are success and failure factors looking at innovation? What innovation theories could be applicable for the NEED innovation? How has innovation played a role in former, comparable projects? These questions have guided the literary research and formed the literature study. The findings of this literature study are organized as follows:

- Defining innovation and the types of innovation that exist and are relevant to the NEED project.
- Defining the innovation theories for "standard" innovations that could also be applicable to NEED.
- Defining success and failure factors looking at innovation.
- The role of innovation in large projects.
- Innovation in projects that are comparable to the NEED project.

3.2.1 What is innovation and what type of innovation is relevant to the NEED project?

As innovation is a broad concept, it is hard to do it justice. What is innovation? This is the question Kuczmarski (2003) is asking in his paper *What is innovation and why aren't companies doing it more?* According to Kuczmarski (1995) ' innovation is a way of thinking, a mentality that does not look at the present, but is focused on the future vision'. What Kuczmarski is trying to say in this chapter, is that innovation cannot be captured by just one definition. It combines strategy, benchmarks, new-to-the-world-processes, management, and leadership (Kuczmarski, 2003). Innovation is triggered by a competitive advantage (Kuczmarski, 2003). For an innovation to be an innovation it must be focused on something the world has not seen yet and provide consumers with benefits they did not know they needed. This definition perfectly fits the new-to-the-world innovation of the NEED-project.

Newell et al. (2009) emphasize the importance of knowledge when it comes to innovation in their book Managing knowledge work and innovation. Knowledge is ‘ essential to efforts to improve competitiveness and innovation’ (Newell et al., 2009). To be able to define innovation, they first define knowledge. Clegg and Bailey’s (2008) definition of knowledge is their working definition: the ability to discriminate within and across contexts. (Newell et al., 2009) avoid defining innovation as a self-contained concept. Instead, the focus lays on outlining different theories and frameworks that sketch the process of innovation. The process of innovation is defined as ‘ dynamic, social, and knowledge-intensive ’ (Newell et al., 2009) and consists of three core activities: invention (generating ideas), diffusion (spread of ideas), and implementation (application of ideas). These three activities constitute innovation (Newell et al., 2009).

Furthermore, Newell et al. (2009) make a traditional distinction between product innovation and process innovation. Product innovation is defined as the application of knowledge to the development of tangible new products of services. Process innovation, on the other hand, is defined as the development of new management, work, or organizational practices (Newell et al., 2009). To conclude, Newell et al. (2009) appoint some limitations to this traditional views on innovations with, amongst others, the argument that most innovation cannot just be introduced as a ‘technical fix’ with predictive outcomes and that innovation involves the reworking of the initial idea in which it becomes ‘blended and adapted’ (Clark, 2003) for different situations. Even though Newell et al. (2009) continue their book by diving deeper into open innovation and networked innovation, it is important to also have a look at more recently described types of innovation and innovation definitions. As the concept of innovation and types of innovations there are to be defined are constantly developed, Newell et al. (2009) show a minor gap of knowledge because of the time that has passed since the book was published.

Therefore another book, written by Schilling (2020), was also used to examine innovation from a broad perspective. Schilling (2020) places innovation in the scope of strategic management and technological innovation. According to Schilling, the importance of innovation is increasing nowadays because of international pressure. Globalization makes markets become one, and foreign competition makes all parties want to continuously innovate their products and services to differentiate and stand out. Various types of innovation are described and deposited against each other by (Schilling, 2020): product innovation against process innovation (which can also be found in (Newell et al., 2009)), radical innovation against incremental innovation, competence-enhancing innovation versus competence-destroying innovation, and lastly architectural innovation versus component innovation. Due to limitations to this paper, there will be only a description for the most relevant and applicable types of innovations for this paper:

Radical innovation is referred to by Schilling as an ‘innovation that is very new and different from prior solutions.” This form of innovation is deposited to incremental innovation which is defined as a form of innovation that just makes minor changes to an existing product or service (Schilling, 2020). The radicalness of the innovation depends on ‘the degree to which an innovation represents a departure from existing practices’ (Daft & Becker, 1978). Radicalness exists of a combination of newness and at the same time a degree of differentness. Technology can be new to the world, as is the NEED project, but also solemnly new to an industry, a company, or a business unit. What defines radical innovations, according to Schilling (2020), are that they should be new to the world and exceptionally different from projects and products that have already been invented. Secondly, the radicalness of innovation can also be defined in terms of the risk that comes with the project (Schilling, 2020). As radicalness is often based on new knowledge, it will automatically come with new experiences for consumers and producers and therefore their experience and familiarity with the innovation will lead to their opinions and judgments of the innovation’s usefulness and or reliability (Dewar & Dutton, 1986). Finally, Schilling (2020) mentions that the radicalness of innovation is relative and changes over time. An innovation could be radical at a certain point in time, but as knowledge increases and bases the innovation, it will automatically become less

radical. An example can be found in the Zuiderzeewerken and the Afsluitdijk (Borgesius & E, 2017) which were radical when they were being built but are now established projects. According to the above-mentioned definition of radical innovation, the NEED project fits well.

Also, McDermott and O'Connor (2001) emphasizes the difference between radical innovation and incremental innovation. They use the definition of Green et al. (1995) that incorporates four dimensions to define how radical innovation is: technological uncertainty, technical inexperience, business experience, and technology costs. According to McDermott and O'Connor (2001), most radical innovations are long-term developments and require a lot of time and millions of investment money. Furthermore, they dive into how the long-term success of radical innovation is supported internally by companies and strategic issues that are faced by large firms as they develop radical products (McDermott & O'Connor, 2002).

The strengths of the literature described above are that they combine the established definitions of (radical) innovation (Green et al., 1995) (Daft & Becker, 1978) (Dewar & Dutton, 1986) with the more recently developed literature and examples. It is however important to keep in mind that these studies focus on innovation and radical innovation in a business environment, whereas the NEED project will be led by several governments and is motivated not from a commercial point of view, but driven by the safety of societies and use, even though there probably will be ways that countries will make a profit from this project eventually.

3.2.2 Defining the innovation theories that are applicable to NEED.

Functions of Innovation-systems. In addition to defining innovation, there are also several innovation theories and literature that define innovation frameworks. According to Hekkert et al. (2007), innovation systems must change equally to the change in technology. Insights from innovation systems are essential to make this happen. Hekkert et al. (2007) define traditional methods of innovation system analysis to be insufficient. These methods mainly focus on the structure of innovation systems that are based on theories. These methods follow a standard route, which leads to a quasi-static analysis (Hekkert et al., 2007). Also, according to Hekkert et al. (2007), the traditional methods fall short because innovation is looked at from the macro level, without noticing the micro-level of innovation. This is a shortcoming. These two points of critique lead to an almost deterministic outcome of an innovation system analysis, which should not be the intention. To solve this problem, Hekkert et al. (2007) devised an innovation theory in which he looks at a framework. This framework focuses on several processes that are very important for well-performing innovation systems. Hekkert et al. (2007) calls these processes functions. According to him, there are seven important functions to be used when mapping the key activities in innovation systems.

- Function 1: Entrepreneurial activities, entrepreneurs are important for the proper functioning of an innovation system. The entrepreneurs have the role of converting potential new knowledge, but also entire markets into concrete actions. By doing this new business activity are developed. This can be done by old/experienced entrepreneurs who adjust their strategy to take advantage of a potential market. But this can also be done by new entrepreneurs who have a vision of new business possibilities in new markets.

- Function 2: Knowledge development, looking at innovation processes, learning moments always take place. According to Hekkert et al. (2007), these knowledge developments can be indicated through indicators. This can be done based on 3 types of indicators namely, Research & Demand (R&D) projects, patents, and R&D investments. With the help of these indicators, knowledge development can be charted and, so to say, a learning curve. For example, a company can apply for a large number of patents in a year, in which case it can be assumed that the knowledge development within that company is well safeguarded.

- Function 3: Knowledge diffusion through networks, the core of networks is the sharing of information. This is important in the R&D environment and in particular where R&D comes together with the government, competitors, and markets. For example, political decisions must take into account the latest technology insights. It is important here that sufficient knowledge exchange takes place between the government and business sectors. Even within organizations, better innovation and performance depend on their network position. As soon as one has a good network position, which leads to an easier acquisition of new knowledge, this will lead to a better innovation process.

- Function 4: Guidance of search, during an innovation it is important that not only the process is considered, but also what is needed for it. Leading an innovation mirrors the resource allocation process. As soon as innovation requires certain resources and manpower, this must be feasible. If this is not the case, the innovation will decline and be given a lower priority due to lack of resources. It is therefore important that during an innovation, a focus is placed on the resources/investments that are required to make it a success and whether it is worth it. This resource allocation process is fulfilled by multiple system components, such as industry, government, or the market.

- Function 5: Market formation, it is often difficult for new technology to compete with existing technologies. It is therefore important to give this new technology a protective place. This can be done to use the new technology for specific applications in temporary niche markets. Another way to give new technologies a chance in the market is to look at competitive advantages. This could include tax benefits, minimum purchase quantities, and the government can also be a catalyst for the new technologies.

- Function 6: Resources mobilization, resources are a necessary input for all activities in an innovation system. Both financial input and human capital are important. These two factors are necessary for a successful innovation system. This includes financing the project itself, but also the knowledge and skills that are involved in innovation.

- Function 7: Creation of legitimacy and counteract resistance to change, to develop properly, the new technologies must participate in the market. The new technology must be part of the established regime or must overthrow the established regime. Competitors of the new technology will often try to counter innovation and strongly oppose it.

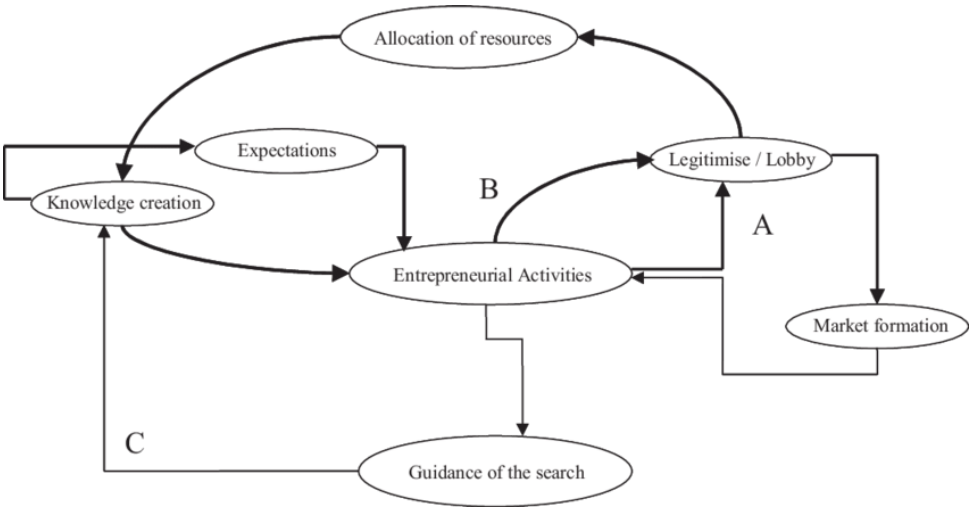

Figure 6: The three patterns, also known as the engines of change, (Hekkert et al., 2007).

According to Hekkert et al. (2007), these 7 functions are important for a performing innovation system, in which the two points of critique are avoided. From Hekkert et al. (2007) research it becomes clear that as soon as a change takes place in a system, the innovation system that goes with it starts with a limited number of functions. These limitations do not only affect the particular part to which the limitation belongs. Other parts of the system will also be affected by these limited functions. To properly display the functions with the associated changes, Hekkert et al. (2007) has opted for three patterns. He calls these three patterns the engines of change, these three patterns A, B, and C can be seen in figure 6.

The first pattern starts at the guidance of search. Problems such as government goals, social problems, and political problems are identified here. To solve these goals and problems, new means are needed, which lead to knowledge creation. Once knowledge has been acquired/created, certain expectations will come into play. This in turn leads to entrepreneurial activities in which new goals/problems are formed, creating a so-called virtuous circle, pattern C. The two other virtuous circles are slightly different. Here both patterns A and B start with the entrepreneurial activities, which lobby for better economic conditions. By doing this they enable future technology development. Subsequently, one can lobby for more resources to make R&D possible, which leads to knowledge creation and thus the expectations it entails. This pattern is indicated by the letter B. Pattern A chooses from lobbies for a better economy, not for resources but market formation. When markets are created, this ensures a positive effect on entrepreneurial activities. (Hekkert et al., 2007) (Hekkert, 2008).

Strategies for Learning from Failure. Another innovation theory is Edmondson's theory. Edmondson (2012) does not necessarily look at the framework, but mainly focuses on the failures that come with innovation. In general, wisdom comes from failures. However, few companies have been around for a long time that does it exceptionally well. Edmondson (2012) has spent 20 years studying various branches and companies in the field of failures such as pharmaceutical, construction, and product companies and NASA's space shuttle program (Edmondson, 2011).

Edmondson (2012) states that these companies have not learned the right way from previous failures. The reason lies with the managers. The managers believe that failure is always bad, with the solution being straightforward. The solution is often sought by putting a team on a reflection report to prevent future errors, which are then distributed by the organization. With the idea that the failures have been handled correctly. According to Edmondson (2012), these actions and thoughts are wrong about failures. First, failures aren't always bad. A failure can be bad, but also inevitable, and sometimes even good. Second, learning failures is everything but straightforward. The attitude and activities required to learn from difficult complex failures are insufficient (Edmondson, 2011). Thus, businesses and organizations must need better and new ways than just superficial reflections. That leads to putting aside the old beliefs and embracing the lessons of failure for the future. The first step for embracing the lessons is to understand how the blame game works (Edmondson, 2012).

Looking at the blame game, mistakes and being blamed for something are linked together. We have learned from an early age that if you do something wrong, you have to admit guilt, which gives a bad or unpleasant feeling. Often this is not only psychological but there is also a punishment for your mistake. This is taken into account in the development of your life and is also practiced in the workplace. Nobody wants to get the blame for something and always try to avoid it, thinking about the consequences one will get. It is more common to point the finger at someone else rather than plead guilty. Edmondson (2012) has interviewed several business managers from different branches. Where they all feared if people were more open to failures that an anything-goes policy would arise. Where there is no more pressure to do the right thing and no fear of doing the wrong thing. However, these thoughts are based on a false dichotomy. A culture in which it is safe to report a failure without consequences can still and sometimes has to work with high standards. The interviews also revealed that probably only 2% to 5% are truly blamewor-

thy. However, 70% to 90% of the cases in the workplace are referred to someone for the blame. According to Edmondson (2012), this error, which also hinders the openness to certain failures, is because one does not discriminate and makes failures in itself. The first and most important thing in innovation is being open to failure. The second is to see what kind of failure is involved, it is therefore important to look at the spectrum of reasons for failure, see figure 7. There are distinguished three types of categories for failures, preventable, complexity-related, and intelligent.

- Preventable failures in predictable operations, Most failures in this category, are bad. These failures are often the case when the necessary technology and knowledge are present in the work environment during the innovation. However, there is a failure that could have been prevented with this knowledge and technology. To prevent these failures in the future, appropriate training and support offer a solution. Which employees can follow and processes so that these failures do not occur. If this does not happen, the reason for failure is often deviance, inattention, or lack of ability. However, to avoid these reasons, companies can use a checklist. Where the employee is confronted if these failures threaten to arise through the checklist. Toyota also uses a system as soon as a failure occurs that every employee can ring the bell. After which the failure is addressed and production continues when the problem is solved (Edmondson, 2011). By doing this, all employees are not only a checklist of each other, but as soon as someone cannot solve it, the problem can still be tackled immediately, due to the support that one can expect when they ring the bell (Edmondson, 2012).
- Unavoidable failures in complex systems, the second kind of failure is much more complex, according to Edmondson (2012). She recognizes that innovation comes with a lot of information, knowledge, and expertise. However, because it is an innovation, factors can come together that have never come together before, which can lead to failure. This uncertainty of work: “a particular combination of factors that have never occurred before”. Failure might have been prevented, but one has to be very thoughtful and open about the complex factors that play a role. The example that Edmondson (2012) uses here is a hospital in which many complex factors and knowledge come together. However, something can be done about these failures. Looking at a hospital, cases come in every day where factors can come together that have not yet occurred. This can lead to failures with negative consequences. According to Edmondson (2012), serious failures can be prevented by tackling the small failures immediately. An irreversible failure often arises from several small problems. Once these small problems are tackled immediately, the big failures can be avoided (Edmondson, 2012).
- Intelligent failures at the frontier, in this last category the failures can be considered as ”good”. This is because these failures provide valuable new knowledge that can help the company or organization move forward and even get a better position compared to its competitors. According to Edmondson (2012), intelligent failures can therefore never be prevented because the failure was one of the first, where the knowledge was not yet available for the failure. This is because a project or process is so innovative

Figure 7: Spectrum of reasons for failure, (Edmondson, 2011).

that it has never been exhibited before. With this failure, Edmondson (2012) emphasizes that not all failures necessarily have to be bad. People want to prevent failures, but failure can certainly help people, as long as they learn from them. Edmondson (2012) therefore stimulates this type of failure and calls it necessary for the development of our knowledge of innovation (Edmondson, 2012).

All these three categories will take place from regular work to extreme innovations. It is only important how one deals with it, failure is not necessarily bad. It depends greatly on the type of failure. In fact, by naming all failures bad, one only obstructs the process of gathering knowledge. The failures that one would like to prevent can certainly be done by the aforementioned points, but one must be open to failures that only improve the process (Edmondson, 2012) (Edmondson, 2011).

Multi-level Perspective on System innovation. The third theory that is applicable to NEED is the theory of Geels. This involves looking at the integrative conceptual perspective on the dynamics of system innovations. Geels (2006) says that understanding these dynamics is important for system innovations, especially since a lot of attention has recently been paid to environmental sustainabilities. Modern societies have structural problems here, in which entire branches have to change to make environmental sustainability possible and feasible. Weterings et al. (1997) research shows that environmental efficiency can improve through incremental improvements in a system. However, if one wants to make great leaps in environmental efficiency in a system, system innovation and transitions are necessary, resulting in a whole new system (Weterings et al., 1997). Geels (2006) agrees with Weterings et al. (1997) and states that system innovation does not only involve changes in technical products. But that policy, infrastructure, industry, user-friendliness are also important and necessary. Geels (2006), therefore, rephrased system innovations into changes from one socio-technical system to another (Geels, 2006). Figure 8 gives an example of this when looking at the elements in the transport sector.

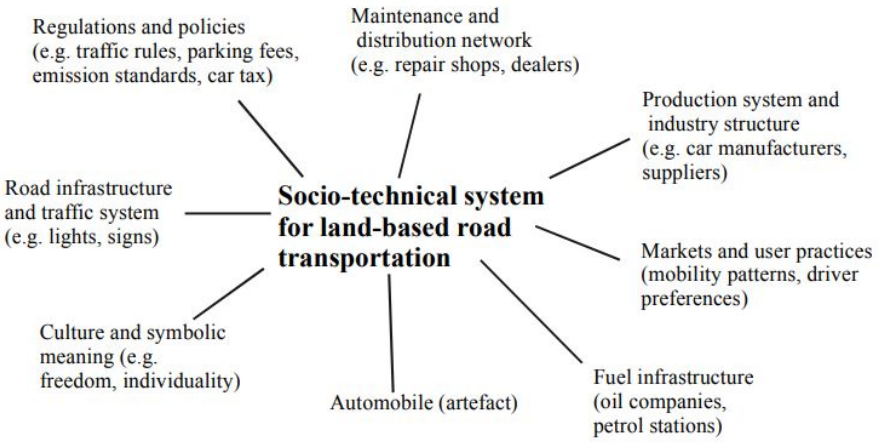

Figure 8: The elements for a socio-technical transports sector, (Geels, 2006).

These elements do not function on themselves but are led by human actors belonging to social groups, these groups produce and reproduce socio-technical systems. Some examples for a social group are financial network, suppliers, user group, societal group, and research network Looking at system innovations themselves, they have different characteristics. They play a role in the evolution of the elements. They affect both the supply and the demand side. Many human actors are involved, which in turn ensures that they are long-term processes. This entails challenges in terms of policy, politics, but also with the time that is available.

According to Geels (2006), both economists and institutional theorists argue that socio-technical systems are created based on regimes. These regimes coordinate the human actors and the associated social groups. These voluntary groups form a stabilizing force that defines the path of today's systems. Geels (2006) is therefore looking at how the transition takes place from a current system to a new system. Geels (2006) does this on the basis of the multi-level perspective (MLP) (Kemp et al., 2001). The MLP looks at the emergence of technological transitions. The interaction between the actors, the environment, and the innovations is examined. Evolutionary economists and technical studies find each other based on MLP, which ultimately leads to a new system. The MLP consists of three levels, each of which has its particular function, the three levels are presented in figure 9.

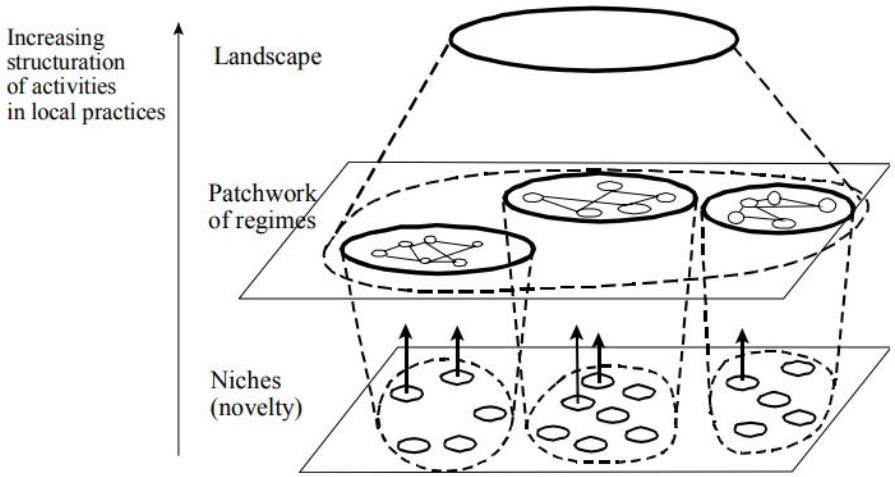

Figure 9: The three levels ordered by hierarchy, (Geels, 2006).

- The first level is the micro-level formed by technical niches. At this level the radical innovations take place. This level is seen as a supply consisting of "incubation rooms", where a market or technology is given the space for research and learning through experience in a room. At the micro-level, the innovations can be protected in several ways. This is done by governments, companies, but also, for example, by providing subsidies to get the ideas out of the rooms and turn them into real-life experiments, involving many actors. The last way of protection can be done to label the niche as a special performance. whereby entry of the market or product depends on selection criteria.

- The second level is the meso-level looking at regimes. This level contains the so-called rules or grammar that are the standards of the regimes. One should think of the rules for processes, technology, institution, etc. The niches of the micro-level must comply with the meso-level and the rules that go with it. At the meso-level, in addition to the rules, the trajectory of incremental improvement is also looked at. However, the regimens can also change. This can happen because a lot of changes happen over time, both within and outside the niches, as a result of which the regime takes a different position.

- The third and final level is the macro level, which is formed by the socio-technical landscape developments. The macro-level looks at the developments of the environment, such as culture, society, globalization, and the environment. Not only the current state is therefore considered, but also the current problems and those that may arise in the future. The word landscape is used here to indicate the hardness, including the material aspect of society. Considering the spatial arrangements of entire cities, companies, roads, infrastructures, etc. The meso-level with the regimes must therefore fit into this overarching factor.

Apart from the levels themselves, Geels (2006) also looks at the movement between the levels. There are several reasons possible why a technical transition goes from the niche to the regime. Evolution can be one reason, where niches offer simple and fast innovations that are controlled by the regimes. It can also happen that tension arises between regimes for whatever reason. A niche innovation can fill this up and offer a solution. Finally, innovation can arise that is a technical breakthrough, where the old can be directly linked to the new, without creating competition between the old and the new technology. There are other reasons when one looks at why the technical transition goes from regime to landscape. This may be because a regime will form an external structure or context for interaction between actors. Another reason could be that the regime is changing so slowly that it can fall into a landscape. The last reason looks at factors such as wars, politics, economic growth, environmental problems, etc., which can lead to a regime becoming a landscape (Geels, 2006). Figure 10 shows the three levels with and a path an innovation could take.

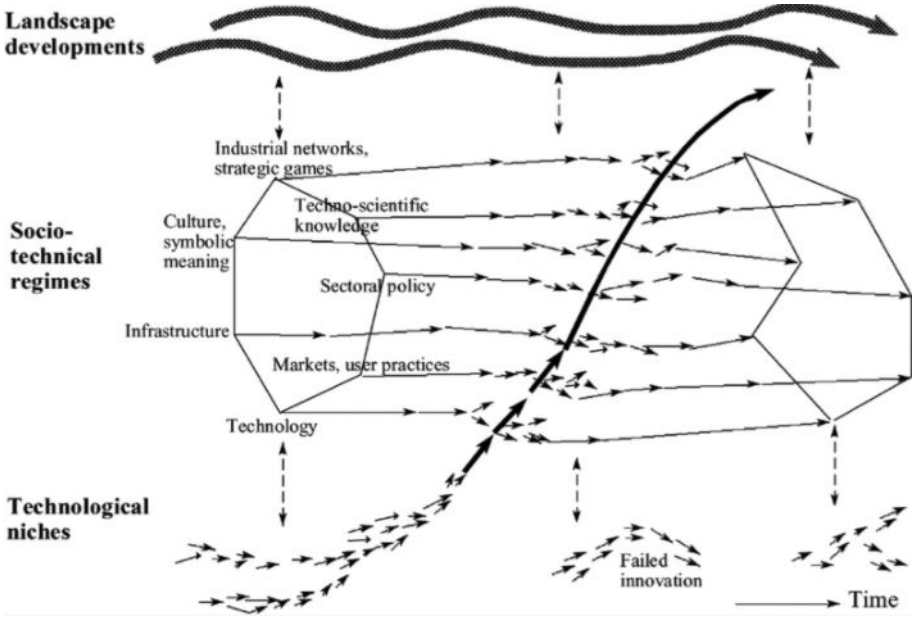

Figure 10: The three levels of the MLP with a perspective on system innovation, (Geels, 2006).

The MLP that Geels (2006) uses gives a structure to the dynamics of system innovations, whereby the transitions are clearly represented by levels. However, there is also criticism of the MLP that it is not all-inclusive, think of freedom of movement in the model, for example. However, Geels (2006) does state that MLP is a correct basis for system innovation, which gives more clarity in the dynamics of the process.

The Political Economy of Transport Innovations. The last innovation theory that can be used for NEED is Feitelson and Salomon's theory. Feitelson and Salomon (2004) states that the past century is full of innovations. These innovations include new technologies, new ways of organizing, and new ways of managing systems. Recognizing that adopting these innovations has affected our daily lives. However, not all innovations proposed over the past century have been adopted. Or the innovations have been adopted but declined afterward. Feitelson and Salomon (2004) research, therefore, looks at why innovations are or are not adopted. It is recognized that innovation must of course be useful and that people want to start using it. Looking at the economic field, it goes without saying that some innovations will fail because the investments for the innovation are too high. Certain rules or statutes can also hinder or even hold back innovation. Therefore, these innovations cannot be analyzed purely as an outcome of an atomistic decision-making process. Feitelson and Salomon (2004), therefore, looks at the societal processes,

specifically looking at the factors that influence the adoption of innovations at the societal level. To do this, Feitelson and Salomon (2004) makes a distinction between penetration and adoption of an innovation. When innovation is penetrated, one speaks that the innovation is available for use. While with adoption one looks at the actual use of the innovation itself, which is after the penetration of an innovation. Feitelson and Salomon (2004) focuses on predicting the use of innovation based on requirements and factors (Feitelson & Salomon, 2004). Looking at the adoption of innovation, there are three requirements. These requirements are each influenced by factors and active agents, this is represented in figure 11.

- The first requirement is that innovation must be technically feasible to be used. The biggest problem innovators encounter is convincing others to use their innovation. This applies to both technical innovations and policy innovations. If innovation is technically feasible in terms of knowledge, this does not offer any certainty. Experts will of course influence the technical feasibility of the knowledge. But one should also consider, for example, privacy. As soon as an innovation is technically feasible, it does not mean it is accepted. Technical feasibility is necessary for the adoption of an innovation, but not sufficient for the entire adoption of an innovation in itself, there must also be a demand for the innovation.

- The second requirement that Feitelson and Salomon (2004) mentions is therefore social feasibility. There must be sufficient demand for innovation if it is to be used and thus adopted. This way, the experts can be convinced of the technical feasibility, but this does not provide any certainty that they want it. This depends on several factors. Two factors for social feasibility are that the innovation must be perceived as effective and, the benefits must outweigh the cost of the product.

- The third requirement is political feasibility. According to Feitelson and Salomon (2004), political feasibility is important to adopt an innovation. It is strongly influenced by the different requirements of social feasibility, which is also to be expected since they are interconnected in daily life. Problems and industry interests also play a role. Consider, for example, the corona crisis in which medical innovations get off the ground, partly because of the crisis, which gives stronger support in the political field. Interest groups, decision procedures, and experience can also play a role in political feasibility, for example, the experience in a particular policy.

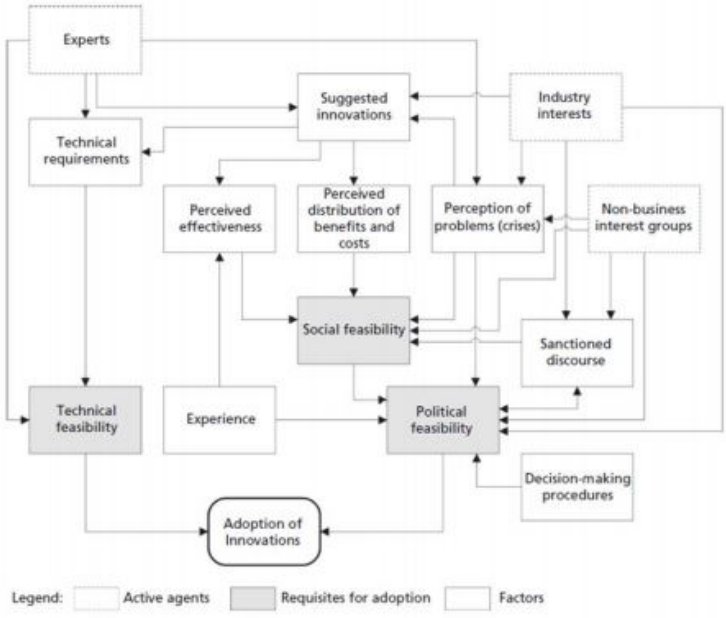

Figure 11: A political economy framework, (Feitelson & Salomon, 2004).

Feitelson and Salomon (2004), therefore, concludes that technical feasibility and social feasibility are important to adopt an innovation. However, it is emphasized that political feasibility is crucial, which must therefore be taken into account. During the research, Feitelson and Salomon (2004) speaks of innovation in itself, but mainly reflects on transport innovation. Therefore, concluded that future transport innovation studies should pay more attention to the political part. This must be included in the implementation of future decision-making structures. However, Feitelson and Salomon (2004) says that this can also apply to other innovations and must therefore be included in the future decision-making structures of innovations in general. The model does not take time into account, with Feitelson and Salomon (2004) also emphasizing this and indicating that there is room for improvement for the model in itself (Feitelson & Salomon, 2004).

3.2.3 Defining success and failure factors looking at innovation.

The Organizational Innovation System. The paper of Van Lancker et al. (2016) developed the organizational innovation system (OIS) to facilitate the study of innovation processes. They point out that nowadays there are more and more world problems that ask for radical innovations because incremental innovation is not enough anymore. One of the bigger problems that need radical innovation according to Van Lancker et al. (2016) is global warming. To solve this problem a so-called 'new-to-the-world concept' such as NEED is necessary. Big problems, such as the rising sea level, exists of multi-dimensional aspects, whereas most innovation models still focus on a single dimension of innovation or just some dimensions.

To be able to analyze bigger organizational innovation systems the OIS was developed as a framework that aims to give a better and complete overview of possible issues that might appear during a radical innovation project. The OIS is based on three different innovation systems: national innovation system (NIS) which is shaped by nation-specific institutions and policies (Fromhold-Eisebith, 2007), sectoral innovation system (SIS), which is described as innovation systems that are formed by specific economical of industrial areas (Coenen & López, 2010), and lastly technological innovation systems (TIS), that focusses on agents in a specific area of technology. Altogether these systems form the definition of the OIS: 'a innovation network of diverse actors collaborating with a focal innovating organization in an innovation process to generate, develop and commercialize a new concept, shaped by institutions' (Van Lancker et al., 2016).

The three main phases that are part of the OIS are the idea development phase of a radical innovation process, the invention phase, and the commercialization phase. Each phase comes with its own stakeholders that affect the innovation process. Besides taking into account these stakeholders, Van Lancker et al. (2016) define seven supporting functions of an OIS, to allow a better understanding of how OIS should be configured to maximize the chances of success and facilitate the analyses of an OIS. The seven functions are as follows: provide opportunities, trends, and ideas, reduce uncertainty about the innovative idea, provide complementary human and financial resources, act as a reference group during the innovation process, create awareness, legitimacy, and support for the innovation, facilitate market information, and aid in supply chain formation (Van Lancker et al., 2016).

Besides the seven functions, there are also several system failures that form the OIS. These imperfections, as defined by Van Lancker et al. (2016), can be categorized into ten different groups. Either one or even more of these imperfections can explain why a radical innovation fails to successfully enter the market. The ten groups exist of: dimensional blindness failure, iteration failure, resource failure, representative failure, openness failure, cooperation failure, lock-in failure, hard institutional failure, soft institutional failure, and capacity failure see table 4.

OIS failure groups	Explanation
Dimensional blindness failure	Overlooking of one or more dimensions or not focusing on one or more dimensions soon enough
Iteration failure	Improper balance between too much iteratively and too little feedback loops
Resource failure	Too few financial resources or human resources within the OIS to successfully generate, develop and diffuse the innovation
Representativeness failure	Improper stakeholder group representativeness, non-representative organization or individual for the group, or non-representative individual for the organization
Openness failure	Improper balance between consulting and participating with too many stakeholders and too few
Cooperation failure	Too few strong ties in the innovation network, leading to, for example, trust issues and difficulties in cooperation
Lock-in failure	Too many strong ties, leading to, for example, 'group think', resulting in myopia and inertia within the innovation network
Hard institutional failure	The lack or underdevelopment of formal arrangements, e.g. collaboration contracts, IP arrangements, and non-disclosure agreements
Soft institutional failure	The lack or non-alignment of informal arrangements, e.g. shared vision, social values, culture and norms, mutual trust, goals of the different partners and business models
Capacity failure	The lack of certain capacities of the innovation organization to maximally profit from the OIS, e.g. absorptive capacity or network management capacity

Table 4: OIS failure groups, (Van Lancker et al., 2016).

In conclusion, the OIS framework of Van Lancker et al. (2016) is developed based on the functions and system imperfections described above. It offers a possibility to acquire insights on how to improve or adjust radical innovations under study. This can be done by following seven steps. First, a project of study needs to be selected. Second, the success of the project needs to be determined based on the key performance indicators. Third, the structural components of the project are described. This could for example be characteristics of the innovating organization or actors in the innovation network. Fourth, there is to be analyzed which functions are developed, underdeveloped and undeveloped for the radical innovation project. Fifth, the project is reviewed to find system imperfections that could lead or could have led to not meeting the KPIs or will lead to the failure of the project. The sixth step is formed by writing innovation management recommendations and lastly, in step 7, the OIS can be altered based on the recommendations in step six (Van Lancker et al., 2016).

Success and failure of 50 innovation projects in Dutch companies. Another study that can be examined to define success and failure factors of innovation projects is a study by Cozijnsen et al. (2000), that focuses on 50 Dutch companies. The main research question that they try to answer is 'What are the differences between innovation projects that succeed and those that fail?'. Cozijnsen et al. (2000), start their research by explaining that there has been done a lot of research after completing innovation projects, but often without clearly defining success criteria. Former literature still lacks conclusions about which factors positively affect innovation (Wolfe, 1994) (Cozijnsen et al., 2000). Cozijnsen et al. (2000) describe five different perspectives that are commonly used in innovation research. First, adoption behavior, which focuses on the initiation phase or

decision-making phase when it comes to innovation. Success is measured in the speed of diffusion and adoption of the innovation (Cozijnsen et al., 2000). Second, the perspective of planned change is described (Cozijnsen et al., 2000), where innovation plays a role in the management process and dynamic processes within a company. In this perspective, success is measured as the degree to which there is acceptance of the innovation. Third comes the organizational-structural perspective. In this perspective, an innovation project is successful depending on the extent to which an organization is structurally or culturally able to quickly enable innovation (Cozijnsen et al., 2000). A less well-known perspective is the fourth perspective, implementation. In this perspective, the degree of success of an innovation is measured by the results of the implementation of an innovation, specific to an organizational context. The fifth and last perspective is formed by a strategic perspective that focuses on economic measures such as turnover or profits (Cozijnsen et al., 2000). Cozijnsen et al. (2000) continue their study by pointing out that if one wants to measure the success of an innovation project, one must quantify the results of the project. This immediately leads to the problem and shortcoming of their research, as they also point out that 'there simply is no success measure external to innovating organization that is useful for organizational as well as technological and product innovations' (Cozijnsen et al., 2000, p. 154). To evaluate the 50 Dutch projects they decide that the objective of the innovation project will have to serve as a reference. The degree to which the goal of the project is achieved will then become the success measure.

Besides this success measure, Cozijnsen et al. (2000) take into account several other factors to make the success of innovation project quantifiable: increased profits, increased turnovers, increased efficiency, improved effectiveness, higher productivity, increased market share, improved environment, and quality improvement. To answer the research question, Cozijnsen et al. (2000) examined four hypotheses, each with a management factor that could have a negative correlation with the degree of success of an innovation project. The four negative factors, implementation factors, were: management of time, cost management, information management, and decision making. All the aforementioned factors were combined into three selected factors: (1) resistance to leadership, (2) resistance against (political) power structure, and (3) resistance against too many or previous innovations.

The research was conducted through a survey, of which 50 came back successfully. The most important conclusion of the study was that there were no success or failure factors that had an unambiguous influence on the success of all types of innovation projects. There was however a significant correlation between the first selected factor, resistance to leadership, and innovation success. Finally, more than 60 percent of the differences in innovation success were explained by nearly all the different implementation factors (e.g. time management, cost management, information management, decision making, and resistance to leadership).

Success Factors in Product Innovation. The third literature review of success and failure factors for this study looks at Cooper and Kleinschmidt (1987) success factors related to product innovation. New products are often labeled as success or failure. However, according to Cooper and Kleinschmidt (1987), there is a flaw in this. One is looking at the financial side of a product, where it is then determined whether the product is innovative or not successful. But other aspects can make a product successful, apart from the financial aspect. For example, a product can make little profit. However, the product can make a significant contribution to the market or industry. The product can also open several doors to new opportunities for a firm. These aspects can therefore also ensure that product innovation is indeed a success, regardless of the financial picture. For example, think of the first Tesla car. Which in the beginning certainly did not yield a profit, but was groundbreaking for electric consumer cars (Kikkas, 2020). According to Cooper and Kleinschmidt (1987), there are therefore three independent and strong dimensions that characterize new product performance (Cooper & Kleinschmidt, 1987).

- Financial Performance: This dimension looks at the whole picture of the product on the financial side. This involves looking at the profit, turnover, payback period, sales, and profitability level. Reference is also made to a good marketing strategy and strong management. It is often considered that when these factors are at issue, the product is a success and otherwise a failure.
- Opportunity Window: This involves looking at the degree to which the product has created new opportunities. Sometimes one product is necessary and acts as a key to the creation of a whole new branch in a company or even in a market. Consider, for example, the horse and carriage. Without the product innovation of inventing the wheel, the carriage and the market that goes with it would never have emerged.
- Market Impact: The last dimension that Cooper and Kleinschmidt (1987) addresses are about how a new product can impact its market, but also the markets that are not directly linked to it. This often concerns products that obtain high market shares both domestically and abroad. For example, three-dimensional printing has had a significant impact in the manufacturing of everyday things, but also in the making of prostheses. As a result, the prosthesis market, which was relatively far away from three-dimensional printing, certainly feels the impact of product innovation (Marro et al., 2016).

Besides the factors that are important according to Cooper and Kleinschmidt (1987). We also look at the factors that make no difference in the success of product innovation. It turns out that a lower price is not as effective for successful product innovation as people think. The last two points show that industrial design does not play a role in success. It also makes no difference whether the innovation is a success if the aim of the product is for a small or large market. This is quite striking since the overall idea of a successful product depends on the size of the market, what the product looks like and whether it is affordable. In addition to the three dimensions that do play a role, Cooper and Kleinschmidt (1987) also draws five lessons from his research that are important for successful product innovation.

The first lesson Cooper and Kleinschmidt (1987) mentions is that it is important to have a product where the concept is multidimensional, looking at the aforementioned dimensions. It is also important that the new product has a consistent and logical pattern. The product must have several factors of the three aforementioned dimensions that lead to success. For example, it may happen that initially people do not choose the product looking at the financial dimension, but choose because of the opportunities that are created with it. The third lesson is that product advantage is a dominant factor in success. Once a product is superior in the eyes of a customer, it will be bought more quickly than the alternatives. As soon as a product is brought onto the market that has almost no advantage, the chance of success for successful innovation is much smaller. Another lesson is that a well-defined project must precede development. This means that potential flaws of the product surface earlier, so that this does not arise in the development process. This is critical to the success of product innovation. The final lesson is that synergy is vital for achieving financial performance for a new product. Making a product in an environment that a company is familiar with has a much greater chance of success than making a product in a market that they are not familiar with (Cooper & Kleinschmidt, 1987).

Success and Failure of Innovation. The last literature review study that is being looked at for NEED is the study by Kleinknecht et al. (2003). This research looks entirely at the success and failure of innovation. This research emphasizes that many studies have been conducted where success and failure factors are available. However, there is no strong conclusive picture of the exact nature of these factors over the past 20 years. Kleinknecht et al. (2003) research looks at success and failure factors in recent years, after which a clear picture can be formed with the important factors. To make a clear classification of the factors, they have been divided into four categories. Namely firm-related factors, project-related factors, product-related factors, and market-related factors. During Kleinknecht et al. (2003) research, it emerged that the four factors influence different viability. For example, firm-related factors and project-related factors influence technological

viability. Where product-related factors and market-related factors influence commercial viability, this is shown in figure 12.

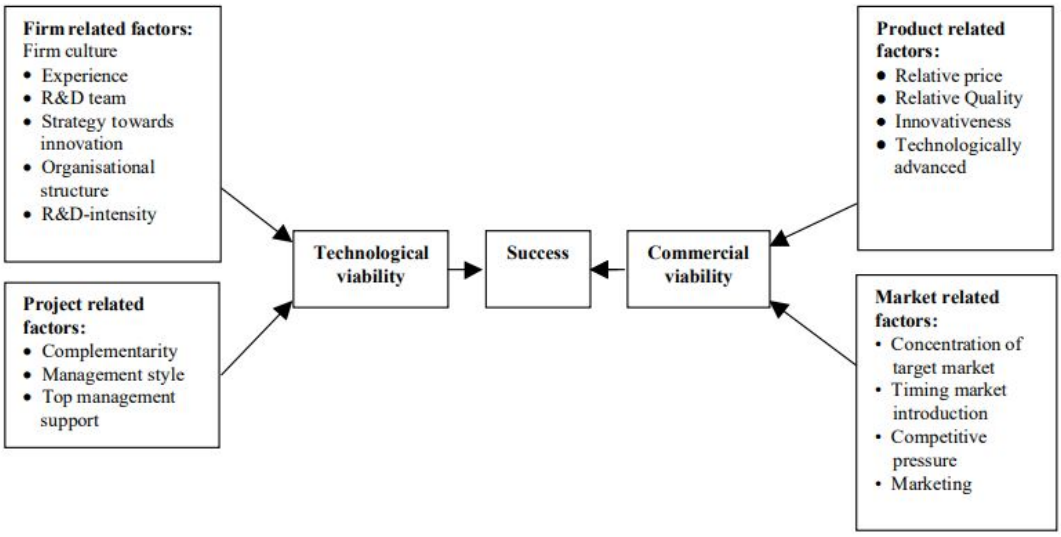

Figure 12: Factors that influence the viability for innovative success, (Kleinknecht et al., 2003).

These four categories of factors that Kleinknecht et al. (2003) describes as crucial factors are based on his research. After these factors were clear, a qualitative review was carried out. It emerged that the highest-ranking factors constituted a significant degree of similarity with nine other studies. Where there was mainly similarity in the studies concerning the firm and product-related factors and to a lesser extent for the project and market-related factors. The qualitative review showed that the factors in table 5 enhance innovation success.

-	A firm's culture that is dedicated to innovation and explicitly recognizes the collective nature of innovation efforts.
-	A firm's prior experience with innovation projects (learning-by-doing; learning by-failing).
-	The multidisciplinary character of the R&D team; in particular a balance between technological and marketing skills, and the presence of a product champion.
-	A clearly articulated innovation strategy and a management style suited to that.
-	Compatibility of the project with the firm's core competencies.
-	An innovation's product quality and price relative to those of established products.
-	A good timing of market introduction.

Table 5: Factors that enhance innovation success, (Kleinknecht et al., 2003).

Apart from the research Kleinknecht et al. (2003) has done with regard to finding these factors. It is acknowledged that assumptions have also been made during the research that may cause the factors to deviate from certain situations. For example, Kleinknecht et al. (2003) argues that broader research will have to be carried out in which a distinction is made between "easy" and "heavy" innovations. It may be that the factors for success in this differ. Time was also not included in the study. What can be a potential factor influencing the success of an innovation. In addition to these potential additions, it is clear that Kleinknecht et al. (2003) research sees a strong foundation in factors that are crucial for a successful innovation (Kleinknecht et al., 2003).

3.2.4 The role of innovation in large projects.

To make large projects relevant, the projects must be radical innovations. According to Carlile (2004), an innovation project must be reciprocal interdependence, i.e. high project interactivity. Carlile is convinced that for tasks that are knowledge-intensive and high in novelty, where the outcomes are unknown. It is of utmost importance not only to transfer the knowledge but also to transform the knowledge to the project itself. High project interactivity is necessary to manage the interdependencies and keep the innovation process moving forward (Carlile, 2004). This is partly because radical innovation cannot follow a standard schedule to make the project a success.

Deltas for the future. The Van der Duin et al. (2011) paper already highlights the future problems of the time, such as flood protection, sustainable energy, and freshwater supply. To be able to tackle these problems properly in the future, Rijkswaterstaat, in collaboration with Deltares, has executed a water innovation program (WINN). This major project was carried out from 2002 to 2010, with Van der Duin et al. (2011) paper emphasizing the findings of the WINN program. Van der Duin et al. (2011) analyzes the most important outcomes using the cyclic innovation model (CIM), intending to find the key factors that are important for successful innovation in projects and recommendations for effective organization. The CIM is based on the assumption that for successful innovation there must be constant interaction between the different actors, whereby knowledge exchange is possible. During Van der Duin et al. (2011) analysis, three large projects in WINN are looked at with the help of CIM. These three projects were chosen because they deal with the links and connections that are important in innovation, with the three projects differing from each other (Van der Duin et al., 2011).

The first project was the sand engine. A large amount of sand is deposited here, where natural weather conditions help the process further. For example, the wind, waves, and the sea current must ensure that the sand deposited is spread. This leads to safer art, after which, in the long term, the new terrain not only offers added safety but also offers the opportunity for nature to grow further. This project is also referred to as "building with nature". Rijkswaterstaat was very enthusiastic about this idea, as it was cheaper than the method it used previously and it also offers opportunities for recreation and tourism. The second project for the analysis looked at the project Energy from water. The feasibility of generating energy from Rijkswaterstaat infrastructure assets, such as canals, dikes, and locks, was also considered. Rijkswaterstaat is open to renewable energy as the Netherlands wants to reduce its carbon dioxide emissions. However, the Netherlands is mainly looking at biomass, solar energy, and wind energy at the time when this project came forward, which makes the chance of acceptance smaller. The third project that Van der Duin et al. (2011) analyzes is the project 'The most beautiful and safe delta'. This project does not so much look at one innovation, but at several together. In this way, the aforementioned projects can be part of it. The goal is that all innovations jointly lead to an environmental-friendly way that fulfills the international treaties using different innovations that are combined. Van der Duin et al. (2011) has concluded four lessons from these three projects based on CIM. According to Van der Duin et al. (2011), these three lessons are generally applicable to radical innovations (Van der Duin et al., 2011).

- The first lesson that Van der Duin et al. (2011) gains from the projects are that a well-formulated vision of the future must be that appeals to a large group. Several projects must be linked to it, so the communication of the vision to interested and external parties is very important. Also, the vision must be a guideline for the entire innovation program, increasing the acceptance of interested and external parties for the entire project to keep the support.
- The second lesson is that a clear innovation process is important. The path that innovation must take to get to the goal it wants to go must be clear. During innovation, it is common for the path to change, but this should be communicated to all who are involved, regardless of how often the innovation process deviates from the predetermined path.

- The third lesson is that one must be aware of the systematic changes that can take place during the innovation to be able to realize the project. It is therefore important to involve stakeholders in the innovation at an early stage, who can remove system barriers and involve external stakeholders at an early stage.
- The last lesson that Van der Duin et al. (2011) learns from the projects is that people must be aware of the role of leadership. This means that it is important to realize that if they are the leaders, extra things are also expected of you. Leaders must be assured of the political positions of government leaders towards their innovation. Likewise, they must be sure that as soon as they pass the leadership on to another party, that the transfer happens to the right party at the right time (Van der Duin et al., 2011).

Exuberant Innovations: The Apollo Program. Another large project, but what certainly belongs to radical innovation is the Apollo project. The project was so large that in that respect it is comparable with NEED. In Gisler and Sornette (2009) literature, an analysis is performed on the economic, political, and social factors associated with the Apollo program. This involves looking at how this project has taken place at all. The Apollo program is one of the most exceptional and expensive projects ever in United States history. Gisler and Sornette (2009) uses the term bubble to explain how this project could have happened. The term bubble is often used in the economic aspect. This is the case when one speaks of very optimistic economics that has no fundamental foundation, whereby the term bubble is therefore negative in this context and can also burst. However, Gisler and Sornette (2009) uses the term bubble differently. Gisler and Sornette (2009) uses the concept of "pro-bubbles", in which these bubbles are inevitable for the development of a technical and social enterprise. The pro-bubble ensures that people are fixated on the goal and make unrealistic decisions to achieve this goal. This bubble that lives on enthusiasm naturally has negative aspects, such as extremely high costs and high risk. However, a pro-bubble ensures that exceptional niches or innovations are given a chance regardless of whether it is affordable or not. Normally, a project is carried out when it is financially feasible and when the risk is low and therefore the chance of success as well, a lot of radical innovations do not get a chance because they do not meet these requirements. Gisler and Sornette (2009) uses the Apollo program to indicate that a pro-bubble has also been the case with this project and because of the pro-bubble the project was possible.

Due to the enthusiasm for the idea that a human can be put on the moon, this has led to the social acceptance of the project itself. There was also a lot of support in the political field. This was mainly because the idea was very appealing, but also that a kind of race arose as to who could get a human on the moon first. The United States wanted to win this race, with the result that the project received a lot of support from both a social, political, and financial point of view. According to Gisler and Sornette (2009), the project was a big risk to do it, politically and technology alike. However, because the project was so large and outside the box. Apart from the project itself, it has led to a large number of additional innovations. Partly because there are so many obstacles involved in such a project, the sharing of knowledge between the parties involved has led to solutions to the problems that the project encountered. As a result, not only was the project radical in itself, but also that many small innovations arose through the project. Gisler and Sornette is therefore convinced that these additional innovations would not have come about if the Apollo project had not taken place (Gisler & Sornette, 2009). However, Gisler and Sornette (2009) also asks whether the innovations created by the Apollo program have been worth the investment. For example, he acknowledges that some of the innovations that arose at the time are still being used. But looking at the pro-bubble of the project, the bubble started almost immediately after completing the Apollo program. There have been quite a few missions since then, but the entire enthusiasm was hard to find in the community compared to the Apollo project. Gisler and Sornette (2009) therefore argues that huge radical projects can happen if there is a pro-bubble. Excessive risks can be accepted, whereby the cost-benefit is not a point of criticism. The question is whether it is all worth it in the long run (Gisler & Sornette, 2009).

Northern river reversal. Another large project, which can certainly be called radical and ambitious, is the Northern river reversal also known as the Siberian river reversal. The idea was to divert the flow of the northern rivers in the Soviet Union to the south towards central Asia. This idea arose mainly because there was a shortage of water in Central Asia, whereby the water from the Soviet Union could serve as a solution, as it would otherwise flow unused in the Artic Ocean. The project was conceived in 1830, but attention was only paid on a large scale between 1960 and 1980 (Zherelina, 2003). For various reasons, the project was canceled and the submarine was closed in 1986. Although the project did not get off the ground in the end, it is all the more interesting why such a great radical innovation was ultimately not continued.

The Soviet Union, which eventually became Russia, has worked with other regional powers for more than a decade on this project to realize it. The costs and benefits surrounding the project were examined. The goal was to divert water to central Asia and neighboring regions of China. This project became particularly interesting because the water could be used for agriculture, consumption, and industry. Where there have even been talks for the deer of the Aral Sea, which was previously used a lot. In 1986, the Political Bureau of the Central Committee of the CPSU ended the project because, apart from its advantages, there were also disadvantages. According to the NGO Center for Russian Environmental Policy, as little as 5 to 7 percent reorientation of the current could lead to a change in the climate of the Arctic in Russia and elsewhere. Despite the increase in Siberian rainfall, an abundance of water is said to have been especially politicized. The diversion of the water to the south can not only lead to a change in the climate but can also lead to a water shortage in Siberia. Although the project was shut down years ago for these reasons, there is still a call to reopen the project. The negative consequences that the project entails remain the same. However, the calls from concerned countries that benefit from it are getting louder (Zherelina, 2003).

3.2.5 Innovation in projects that are comparable to the NEED project.

The literature written about the NEED project is scarce. This is mainly because of the scale of the project and because it is a new-to-the-world (Kuczmarski, 2003) and never-been-done-before innovation. However, studies and projects have been carried out that are comparable to NEED, but on a smaller scale. Projects such as the Dutch Zuiderzeewerken and Afsluitdijk, Saemangeum watershed, and other delta works. This part of the analysis, therefore, looks at the findings of the literature on these types of projects.

Afsluitdijk and the Zuiderzeewerken. The idea of building a large-scale dam comes from the Dutch oceanographer Groeskamp and Kjellsson (2020). However, this is not the first dam to come from Dutch soil. The best known is also Europe's longest dam is the Afsluitdijk which was part of the Zuiderzeewerken. According to Borgesius and E (2017), the Zuiderzeewerken and the Afsluitdijk were the innovation of the century for the Netherlands, but also innovative waterworks in Europe. The Zuiderzeewerken was seen as a local phenomenon, reflecting the modernity of Europe. The project had foundational and irrevocable consequences on a national scale. This resulted in a whole new industry with an eye for sustainable flood protection. Besides the fact that the project created work for the Netherlands. The innovation also led to gaining knowledge and development in the hydraulic works field. The project also brought new opportunities which lead to more profit for the country. Borgesius and E (2017) also states another side effect that benefited the project and as a positive impetus in the determination of the project. In addition to the aforementioned benefits, the Dutch were also proud of the project, it ensured and strengthened national solidarity. The country had taken a big step in the war against the water and all of Europe was amazed by the project. In addition the innovation was also embraced by Europe because it fits within Europe's vision of large-scale planning (Borgesius & E, 2017).

This is confirmed by Zwaneveld and Bos (2017), emphasizing that the Netherlands has become a global reference for waterworks, for example through the Zuiderzeewerken. According to Zwaneveld and Bos, this is mainly due to a mix of world-class civil engineering projects in combination with innovative concepts related to water governance. In the innovation work, attention needed to be paid to cost-benefit analysis. Which can also benefit the rest of Europe (Zwaneveld & Bos, 2017).

There is also a lot of literature about the renovation of the Afsluitdijk and the Zuiderzeewerken. According to Raadt et al. (2015), it appears that there are several innovative ideas to renovate the Afsluitdijk to counteract the dangers such as rising seawater. This is, in the first instance, consistent with the reason why NEED was conceived.

Saemangeum. Another project that is very similar to NEED but in smaller respects is Saemangeum. Although this dam is only 33 km long, the dam is the largest in the world at the moment, the reason for building this dam is very similar. The dam protects the extensive tidal flats. The dam is therefore satisfactory in terms of the physical protection of the communities behind the dam. The construction of the dam started in 1991. The construction process was done in two parts, the northern part of the dam and the southern part. The northern part was completed in 2003 and the southern part in 2006, a schematic representation of the dam can be seen in figure 13.

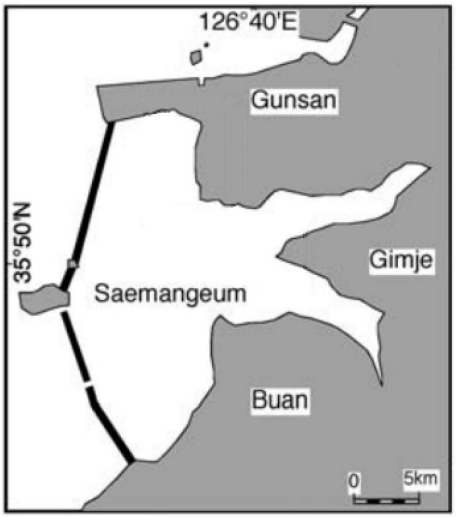

Figure 13: A schematic overview of Saemangeum seawall, (Sato et al., 2007).

However, scientific research shows that the innovative Saemangeum also entails other aspects than just protection. According to Sato et al. (2007), the coastal communities have been hit hard by the dam. Looking at the fauna, extensive research has been conducted by Je (2000). Je (2000) concluded that the mean density of the animals that lived behind the dam decreased from 1225 to 214 individuals per square meter due to the dam. It was therefore concluded that the dam had a negative impact on the fauna (Je, 2000). Not only on the number of animals but also the number of species. To make sure these were the consequences of the dam. Je (2000) did also conduct an investigation based on the data from Yamashita (2006). the number of species of animals was examined behind the dam and on location, those species were similar in the environment as the Saemangeum, which did not contain a dam. It was noticeable here that in the beginning, the number of species of mollusks was almost the same. However, with the completion of the southern part of the dam around 2005, the number of species behind the dam decreased dramatically compared to similar sites without a dam. The flora has also been negatively affected by the dam. According to Sato et al. (2007), the number of plants has decreased sharply, as has the number of species. This also contributes negatively to the fauna. However, Sato et al. (2007) states that flora and fauna are dependent and influence on each, but that they are both negatively influenced by the dam and that one is not the result of the other. Sato et al. (2007) also looks at the population that lives behind the dam. The measurement data from his research clearly shows that the population has also been affected by the decline in flora and fauna. People who lived off the flora and fauna can no longer collect their necessities of life. As a result, the population of the environment and the animals lived, starved, leading to a higher mortality rate. Sato et al. (2007), therefore, raises the question, even though the dam protects the community from flooding, whether the benefits outweigh the costs (Sato et al., 2007).

Jakarta's Great Garuda Sea Wall Project. The last project in this literature study is a project in Jakarta. The capital of Indonesia has been struggling with severe flooding for several years. The Indonesian government in collaboration with Dutch companies is working on a huge seawall to combat the floods. The seawall must not only counteract the current flooding but also the future seawater rises. This project, therefore, has similarities with NEED in several aspects. The plan is to build a sea wall around the Bay of Jakarta. The seawall makes it possible to build more because of the reclaimed land. It was therefore decided to build a new waterfront city of 1000 hectares in the form of the national symbol of Indonesia. Construction of the project has already started and is scheduled to be completed by 2025. Before the construction of the seawall began, engineering consultants and political elites expressed the view that this was the best solution to the flooding problem in Jakarta. However, the project is not directly aimed at subsidence, although this is considered to be the main cause of the flooding, regardless of the sea-level rise. The project has nevertheless started due to a great deal of support from the experts and the Indonesian government. According to Colven (2017), this has several reasons.

For the political elites, world-class city aspirations are crucial to supporting such a major project. However, apart from the ambitious plan, Indonesia acknowledged that they did not have the knowledge to make this a reality by themselves. Besides the fact that the Netherlands has had a postcolonial influence in the design of Jakarta. The Dutch are also known as the forerunners and leaders in the fight against water, where history underlines several successes of the country. With the transfer of knowledge and the cooperation with the Dutch, the project gained the confidence of the political elites. However, Colven (2017) emphasizes that the main focus was on how the project could be successful, and not whether this was the best project for the floods. The project will encounter several problems that require innovative solutions. However, the support for the seawall and the city in the form of the national symbol is so great that the project has nevertheless been pushed through by both political elites and hydraulic engineers who consider the project possible. According to Colven (2017), there has been a tunnel vision for the project, in which alternatives have not got a chance due to the enthusiasm for the seawall (Colven, 2017).

3.3 Literature conclusion

The literature study shows that a lot of information can be found about types of innovation and what they relate to. The innovation theories provide a good general picture of what is important for innovation and what is useful for this research to take into account. In addition, the literature provides a good description of the success and failure factors. However, these success and failure factors are mainly described in a general sense, it cannot be said with certainty whether the success and failure factors and the innovation theories can also be applied to large radical projects such as NEED. This literature study indicates that there is a gap in scientific knowledge, especially when it comes to innovation theories and success and failure factors of radical innovation projects or projects equally sized to the NEED project. The study also shows that several unforeseen factors emerged in certain innovations that were not desired. Whether the cause is enthusiasm, tunnel vision, politics, or a pro-bubble, it leads to projects that are being pushed through no matter the cost.

However, one can ask whether the unforeseen factors that arise for radical innovation are necessarily negative, one can also learn from them. As Edmondson(2012) describes in her research, sometimes when factors come together that have never been together before, such as with the NEED Project. Looking at the size of the innovation and all the different scientific fields that play a role in this project, failures cannot be prevented. And, as the project that leads this thesis is a project that has never been dealt with before, the current literature will not be sufficient to conclude. Therefore, this thesis does not only dive deep into available literature but also uses the semi-structured interview method to use experts' opinions on success and failure factors for this kind and size of innovation.

A model based on the factors that play a role in innovation has been made, this is shown in figure 14. The model is based on the literature which contributes to the formation of the questions that help with the semi-structured interview method.

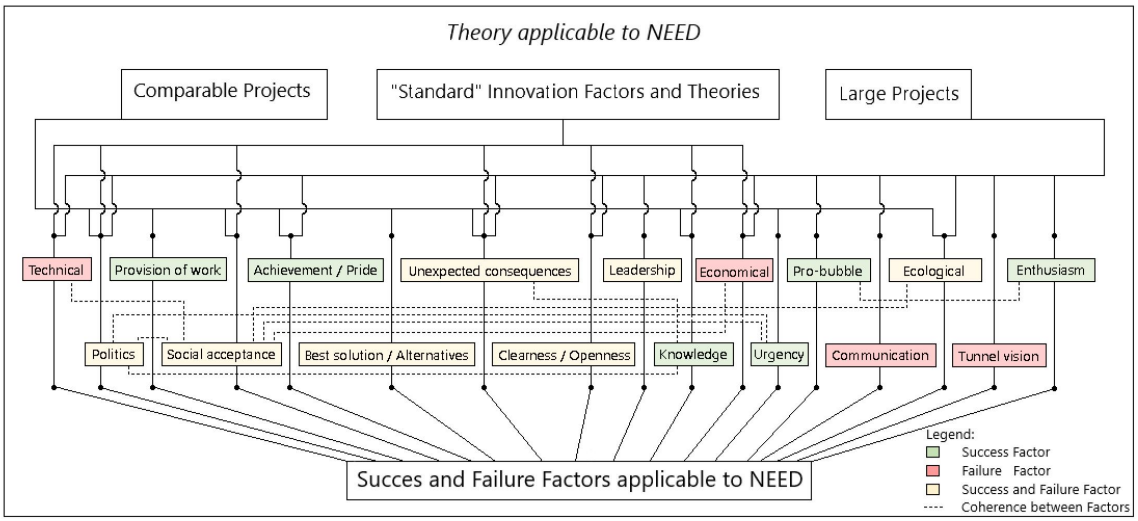

Figure 14: The conceptual model based on the literature study.

The model looks at the lessons that emerge from the literature and the factors that come with it. For this, a distinction has been made in the model between comparable projects, large projects, and the innovation factors and theories that are often applied to "standard" innovations. In addition, it also shows that certain success and failure factors are related, as Feitelson and Salomon (2004) also clearly describes. For instance the social acceptance of a project depends on urgency and the need of a innovation. The literature shows that comparable projects do not always consider whether it is the best solution. However, an important factor is whether it is socially and politically acceptable or not. This can break or greatly reinforce an innovation. Likewise, the literature shows that the environment and surroundings an innovation depends on. A project can be completed, but it still cannot go ahead because there is too much collateral damage. Apart from these points, it is also important whether the knowledge is available to support innovation. Once this is in place, acceptance will be more quickly accepted in both social and political terms. Looking at the large projects in general, there are still differences. As the size increases, the importance of communication also increases. In addition, it appears that with large projects it is important that there is openness to people involved as well as in the social field. As soon as one has the feeling that they are involved, the innovation has more support. Clear leadership is also important in a large innovative project. There must be a hierarchy of who is responsible for what. The environment can also play a major role in innovations here. Finally, for large projects, a tunnel vision can arise. the project seems to be the only solution where it is pushed through, with less regard for the consequences. Some factors apply to both comparable and large projects. For example, it emerges that as soon as an innovation is radical, what a pride entails. An enthusiasm can arise that opens doors for the project that were not possible before, for example, the cost picture. In addition, the literature shows that unexpected consequences always arise during the project. It is important how this is dealt with during the innovation.

The innovation theories provide a structure that is used in "standard" innovations and which factors are important here. By comparing this with the previously mentioned findings in the literature and the semi-structured interview method, one can answer the questions for this research. Altogether, this will help the NEED project to be aware of the additional problems and what the success and failure factors could be for the innovation itself.

4 Results

This section presents the results and findings of the interviews with the experts. The report looks at each question individually and the general response and whether there are findings that deviate from the general opinion. The result of the content analysis will be displayed. In addition, certain findings of the experts will be specifically addressed, if they have significant contributions to the research. The full interviews can be found in the Appendices beginning at page 72. All interviews that were conducted and that were included in the study have received approval from the relevant experts themselves. Finally a total reflection is presented, looking at all the information that is obtained throughout the research.

4.1 General information looking at innovation.

The interviews are divided into two chapters, the first chapter looks at the background of the experts and their vision on innovation and the success and failure factors that come with it. This can contribute to finding the factors associated with a "standard" innovation in addition to the literature study. As a result, it is possible to examine whether these differ from the factors of radical innovations, such as NEED, which will be discussed in the second chapter. It is also checked whether all experts start with the same information regarding the NEED project and, if necessary, additional information is provided. This is done so that every expert starts with the same value and knowledge about the NEED project before participating in the interview.

4.1.1 Profession and innovation

The first part looks at the profession of the experts. In addition, it is examined to what extent innovation plays a role in their profession and their daily lives. Expert one (E1) is an innovation strategist, where innovation is often related to his or her work, the background of E1 is also electrical engineering besides to innovation. E1 also tries to bring innovation into daily life, but it can be more sustainable. Expert two (E2) is a professor of innovation management, where E2 teaches about the different aspects of innovation management. E2 mainly sees NEED as research that precedes the project. In E2's profession, innovation is a daily principle, however, he or she admits that outside the profession it is not so innovative. E2, therefore, calls itself a fast follower in daily life, in which he or she is an proponent for simple innovative solutions. Expert three (E3) is not so much an expert on innovation or civil oriented, however, he or she does work on large radical innovative projects. The profession that belongs to E3 is hydrogen expert. During the profession of E3, many innovative solutions have to be devised to make the large projects a success. Expert four (E4) works on comparable innovative projects, E4 looks at the innovation and knowledge department within his or her company. In addition, these comparable projects are sometimes of large project size. In doing so, he or she looks at the sustainability of innovative projects, but also the environment and the social added value of the innovations. The innovations mainly come to him or her when the research concerning radical innovations has already been done. E4 is therefore mainly concerned with applying radical innovations in practice, bearing in mind the aforementioned aspects. The fifth expert (E5) is a teacher of civil maritime engineering, looking at different aspects of maritime engineering. E5, therefore, mentions that innovation occurs in his daily life in two ways. In the first instance the teacher of his profession and the constant innovation that is required for this. In second, he or she looks at the technical side, where innovation plays a major role in the projects. Several major innovations are devised, sometimes being implemented in the field and sometimes failing due to certain factors. Expert six (E6) is a hydraulic consultant in the civil field. however, E6 is working on similar projects as NEED on a smaller scale. Looking at innovation, he or she mainly notes that innovation played a role, especially during study time. Now with the profession of E6 people also try to innovate, but the business community is more focused on profit than there is a lot of attention for innovation, nevertheless, the internal activities are slowly changing due to innovations. The profession that expert seven (E7) practices are managing large engineering projects. This includes various projects that have also taken place in the North Sea. When E7 looks at innovation, it's pretty much present in its profession. His or her company is quite prominent, with innovation often receiving attention. In addition, he or she also tries to be innovative in daily life, provided that the financial means allow it.

4.1.2 What makes an innovation a success

The experts look at what makes an innovation a success. This is still separate from NEED and therefore mainly relates to own profession and the associated findings. The main points have been extracted from the interviews. In addition, they are categorized according to the corresponding factor.

Experts	Main points (Open codes)	Factors (Axial codes)
E1	Depends on what kind of innovation it is. As soon as there is no urgency for a certain innovation, it becomes difficult to make the innovation a success. Innovation is premature, which also carries risk.	Kind of innovation, Urgency, Risk
E2	Multiple "standard" list of factors and kind of innovation. As soon as a innovation deviates, the list need to adapt to the specific innovation.[I]	Kind of innovation, List of factors
E3	believers, persistence, early adopters, the right time and society acceptance.	Social acceptance, Time
E4	Multiple "standard" list of factors, course steps innovation interacts with different list of factors, adjustment possibility and appeal to the target group / necessity demand.	Kind of innovation, Social acceptance, List of factors
E5	Different aspects, costs, technological limitations, does what it's supposed to do, aspect change for room innovation and wild idea requirement.[II]	Economical, Technical
E6	Time, the more complicated the more time.	Time
E7	Public opinion for innovation adoption, technical feasibility, financial resources, theory can be different compared to bringing innovation into practice and politics.[III]	Social acceptance, Technical, Economical, Politics

Table 6: 'What does it take to make an innovation a success?'.

Extensive explanations

[*I*] : E2 believes that there is a whole range of lists of factors that make an innovation a success. E2 does say that these success factors mainly apply to general "standard" innovations. As soon as one deviates from a "standard" innovation, for example, radical innovations, this list of factors will have to adapt to the specific innovation. As a result, the list of success factors can differ greatly from the "standard" success factors.

[*II*] : E5 believes that different aspects must be tied together for an innovation to be successful. Often when someone thinks they have a good idea, the idea turns out to be good in itself, but it is hampered by other aspects. For example, the costs, technological limitations, or simply that it simply does not work. E5, therefore, states that an innovation leads to a success when several aspects change, with the result that there is room for the innovation.

[*III*] : E7 mentions that an innovation on paper is something completely different than in practice. An innovation can appear to be a success on paper. However, unexpected problems will undoubtedly arise during the innovation process. Which can sometimes lead to an innovation no longer developing into a success.

4.1.3 Common failures in a innovation project / process

Common failures during an innovation will be looked at, this will mainly relate to the profession of the experts and their findings.

Experts	Main points (Open codes)	Factors (Axial codes)
E1	Failure occurs mainly in the last phase, projects differ where the innovation process can't easily be adopted, innovation process transfer, collaboration, sight of the goal, flexibility, more parties more chance of failure.	Communication, Collaboration, Innovation purpose
E2	Optimism, different view about the innovation	Innovation purpose, Optimism
E3	Momentum, properly transferred, time of revealing can lead to failure implementation.$^{[IV]}$	Communication, Release time
E4	Unclear of who is important, lack of cooperation, different focus during innovation process, enough support, financing, bad collaboration between stakeholders.	Collaboration, Economical, Leadership, Innovation purpose
E5	Costs, overlook the financial aspect.$^{[V]}$	Economical
E6	Besides financial and time, the biggest failure is fear of implementation.$^{[VI]}$	Economical, Fear, Innovation time
E7	Financial aspect, lack of communication mainly in on the technical side of the innovation, rules and safety standards.	Economical, Rules, Communication

Table 7: 'What are common failures while working on an innovative project?'.

Extensive explanations

$[IV]$: According to E3, it is important to look at the momentum of innovation. It may be that there is a good innovation to the light of day. However, it cannot be properly transferred, which leads to a failure for the innovation. In addition, E3 mentions that the time when the innovation is brought forward is also very important and can lead to a common failure. It is possible that an innovation was conceived and developed too early or too late, with the result that the innovation is not implemented.

$[V]$: E5 mainly looks at costs as a common failure. He or she believes that many things can be done, but the cost will not allow it. Especially when innovations that are better for the environment, but bring few financial benefits, fail. A lot is technically possible according to E5, but if it doesn't yield anything financially or even only costs a lot of money. The common mistake according to E5. is to overlook this aspect.

$[VI]$: E6 finds the biggest common failure fear of the innovation to implement it. Innovations cost a lot, both financially and time. Besides these two hurdles that are sometimes overlooked, the biggest failure maybe fear of implementation of the innovation.

4.1.4 NEED impression

In the first instance, the opinion of the experts on NEED is examined. This was done after they all read the same summary about the innovation. A schematic representation of NEED was also exhibited during the semi-structured interviews, the schematic overview was the same figure as the front page of this report.

E1 thinks that NEED will be a difficult story and whether it will get there at all, although he or she is open to new solutions. Other major projects are mentioned, where political issues make the projects difficult. Also looking at the financial aspect and the political foundation that goes with it will cause many problems.

E2 sees it a little differently. E2 notes that the sea rise is not yet really aware among the community, but it can become a serious problem. Everyone thinks of the old ideas of raising the dikes. So this solution is slightly different from the current line of thought. E2 also notes that the solution is not something new in terms of technical aspects. It is building a big dike, which is supposed to come from the old book. E2 states that the idea will get a lot of response, especially from the environmental supporters. NEED will have a lot of influence on the environment and can therefore expect a lot of response.

E3 has the thoughts on NEED "go big or go home". E3 mentions that NEED is very complex in various parts, such as costs, politically, and technically. E3 also compares NEED with the Delta Works. He or she also notes that the Delta Works was also a huge project. At that time, however, the decisions of the government were adopted more often. Nowadays, a project like NEED can expect more responses.

E4 especially notes that it's not an entirely new idea. The same idea has already been applied to the Zuiderzee. However, it doesn't mean it's a bad idea, looking at the dikes that other countries have to build and maintain individually. E4 is not too concerned about technical feasibility, but he does wonder whether other countries have just as many needs and benefits from NEED as the Netherlands. E4 is therefore of the opinion that other countries that are behind NEED can handle more water than the Netherlands currently and it will therefore be difficult to get them behind the idea. In conclusion, E4 states that the profit on various aspects of NEED should be visible and better than the current approach to the problem.

E5 calls NEED a wild idea, which is technically feasible but entails enormous costs. In addition, E5 emphasizes that public opinion, in particular, can break NEED. Especially if environmental organizations will be fiercely against NEED, which E5 expects. Once public opinion goes along with this, E5 states that it will be very difficult to realize NEED. He or she also mentions that the time in which we now live has an influence, in the past extreme projects were more possible due to monopolistic powers, which made the NASA program possible, for example. Fortunately, that is no longer the case today.

E6 looks differently from the other experts, he or she mainly asks the question of whether NEED is really necessary. Whether the sea level is actually rising so drastically that raising the dikes is no longer profitable. E6 sees a need for a sea-level rise in the worst-case scenario. He or she thinks it is technically feasible. Should it happen, E6 also emphasizes that the consequences on the environment will be enormous and that the uncertainties are numerous.

E7 mainly looks at the location of NEED and immediately asks the question why not at Calais. He or she also thinks that it is technically feasible, but it will not be easy. Certainly not in the part of Norway, reflecting on the projects E7 has carried out itself. E7 also mentions shipping, which is important for many countries. With the arrival of NEED, this will become more difficult and the solutions more complex.

4.2 Success and failure factors looking at NEED.

The second chapter is questions specifically related to NEED. This consists of 10 questions, which are based on the conceptual model from the literature study. The questions were asked to each expert under the same circumstances.

4.2.1 Presumably success and failure factors NEED

Experts	Main points (Open codes)	Factors (Axial codes)
E1	Success: Urgency could result in significant steps in the project and it could have a positive influence on politics and cooperation between countries. Failure: Environmental organizations, mainly looking at the flora and fauna.	Success: Urgency Failure: Ecological
E2	Success: Involved parties need to be involved from the start of the innovation process. Failure: Involved parties are not involved from the start of the innovation process.	Success: Collaboration, Openness Failure: Collaboration
E3	Success: Approach of the organisation around NEED, European level, clear picture about costs, benefits, necessity of NEED and good argumentation. Failure: Lack of approach on NEED	Success: Approach, Openness Failure: Approach
E4	Success: Benefits, clear points why NEED is beneficial can lead to a positive receive. Failure: Resistance from the outside.	Success: Approach, Benefits Failure: Public opinion
E5	Success: Environment, NEED will influence the environment, but this can be positive. Failure: Environment, NEED will influence the environment, but this can be also in a negative way.[VII]	Success: Ecological Failure: Ecological
E6	Success: Water control, current water protection structures have to be less good and safe, possibility NEED combining with other aspects. Failure: Environmental organisations, technical feasibility and complexity of the associated politics.	Success: Benefits Failure: Ecological, Technical, Politics
E7	Success: Urgency, looking mainly at fear or a disaster. Failure: Politics, financial aspect and technical aspect.	Success: Urgency Failure: Politics, Economical, Technical

Table 8: 'What success and failure factors do you think a project like NEED will encounter?'.

Extensive explanation

[VII] : E5 mainly looks at the environment and its consequences when it comes to success or failure factors. He or she shows that the environment can be both a success and a failure factor. NEED will undoubtedly affect the environment, but the consequences can be positive and negative. In this way, new things can arise with regard to flora and fauna, but also looking at the influence on the dikes and sandbanks if NEED is built.

4.2.2 The most / less important factor

Of all the factors mentioned above, the experts are asked which one is most and which one is the less important factor with regard to NEED.

Experts	Main points (Open codes)	Factors (Axial codes)
E1	Most: Urgency. Less: Ecological.[VIII]	Most: Urgency Less: Ecological
E2	Most: Collaboration with the outside world and the stakeholders. Less: Internal process.	Most: Collaboration Less: Internal process
E3	Most: Public opinion which is related to urgency. Less: All factors are not necessarily less important for NEED.	Most: Social acceptance, Urgency Less: N/A
E4	Most: He or she mentions a few namely, Technical aspect, kind of business, lead to profit, construction strategy, disaster. Less: Depends on the phase of the innovation.[IX]	Most: Technical, Benefits, Urgency Less: N/A
E5	Most: Environmental(Public opinion), management of the innovation. Less: Environmental(personal).	Most: Ecological, Social acceptance, Leadership Less: Ecological
E6	Most: Public opinion. Less: Economic aspect.	Most: Social acceptance Less: Economical
E7	Most: Politics. Less: Financial aspect(in combination with safety).[X]	Most: Politics Less: Economical

Table 9: 'Which factor is the most important and, which is less important?'.

Extensive explanations

[VIII] : E1 states that urgency is the most important. E1 finds it difficult to name a factor that is not or least important. He or she states that public and political opinion are closely related and that it is difficult to say which is less important. He or she, believes that the economic factor is more important than the ecological factor at the moment. However, E1 implies that although the ecological factor is less important at the moment, the importance of the factor increases over the years.

[IX] : E4 has the opinion that there is indeed a least important factor, but this depends on the phase the project is in. For example, the technical aspect can be of great importance in the beginning. But when the concept of innovation in the technical field is finished. The technical factor decreases in importance and, for example, the public opinion and the financial factor increases.

[X] : E7 has a different opinion regarding the most ans less important factor compared to the other experts. He or she believes that the most important factor is politics. E7 looks from its own experience, that these kinds of projects are very difficult from a political point of view. The least important factor, he or she states that the financial aspect will play little or no role when it comes to safety. E7 also bases this on its own experience, where costs are overruled by safety, with the result that the financial aspect is the least important factor in combination with safety.

4.2.3 Unexpected consequences for NEED

The eighth question of the interview looks at whether the experts expect NEED to encounter unexpected consequences. These can be both positive and negative consequences. In addition, it is left open whether it concerns the innovation process itself, or whether it concerns the consequences that NEED can cause. This question looks at which factors arise that are linked with the unexpected consequences.

Experts	Main points (Open codes)	Factors (Axial codes)
E1	Yes, impact on the entire North Sea, Lessons can be learned from the unexpected consequences, possibilities and solutions.	Ecological, Side innovations
E2	Yes, depends on the effort beforehand, still political unexpected consequences.[XI]	Political
E3	Yes, environment, flora / fauna but also economical, side innovations could make a positive contribution.[XII]	Ecological, Economical, Side innovations
E4	Yes, flora / fauna undoubtedly will be affected by NEED.	Ecological
E5	Yes, innovation will run into many things, hard to predict, undoubtedly there will be consequences.	N/A
E6	Yes, mostly in the technical field, output will lead to unexpected consequences.	Technical
E7	Yes, new innovations, climate consequences.[$XIII$]	Ecological

Table 10: 'Do you think that there will be unexpected consequences with NEED?'.

Extensive explanations

[XI] : E2 explains that the number of unexpected consequences mainly depends on the effort put into the innovation beforehand. The more effort put into the preparation, the fewer unexpected consequences. However, E2 expects that there will always be a few unexpected consequences where he or she thinks of political unexpected consequences.

[XII] : With unexpected consequences, E3 tends more to the negative side. E3 also mentions the impact that NEED will have on the environment. Both in terms of the environment and aspects that depend on the environment. For example, E3 mentions shipping as an example, but also fish that can no longer easily enter and exit the North Sea. In addition to the negative unexpected consequences, E3 also mentions the chance of positive ones. Certain side innovations will be needed to make NEED a reality. These side innovations may be unexpectedly needed and make a positive contribution.

[$XIII$] : E7 mentions the point that innovations will be needed to make NEED a success. Not all of these innovations are obvious in advance and some will therefore occur unexpectedly. E7 also thinks that there will be many unexpected consequences with consequences for the climate. The closing of the North Sea will have consequences for the climate, but it is difficult to predict all the consequences. For example, E7 states as an example that the temperature will change, with all the unexpected consequences that entail.

4.2.4 The role of politics

Based on the literature study, it appears that the politics can play a role and be a factor in radical innovations. That is why the experts were asked to share their views on the politics and their role on the implementation and the development of NEED. Because a factor is specifically looked at, the axial codes consist of factors influencing the political factor, which according to the experts are relevant.

Experts	Main points (Open codes)	Factors (Axial codes)
E1	Important role, important with the implementation, reflection of the public opinion.[XIV]	Social acceptance
E2	Gigantic, for all the countries behind NEED.	N/A
E3	Big role, influence on all the coastlines behind NEED, public opinion and politics are closely linked.	Ecological, Social acceptance
E4	Too early to look at politics, politics will help with the implementation, first necessity is needed, once there is a treat its too late.[XV]	Social acceptance
E5	Important and related to the public opinion, politics should not be the driver for NEED, once the necessity of NEED is aware with the public then the politics should act.	Social acceptance
E6	Necessary to get the public opinion involved, consider how to bring it.	Social acceptance
E7	Important role especially in this age, role of properly communicating, wrong communicating leads to resistance and misconceptions.[XVI]	Communication, Social acceptance

Table 11: 'To what extent did politics play a role in the implementation/development of NEED?'.

Extensive explanations

[XIV] : E1 can't imagine NEED becoming real without the politics. Politics will therefore have an important role and will also be important in the implementation of NEED. He or she concludes that politics is a kind of reflection of public opinion. Where public opinion again follows from the urgency aspect.

[XV] : E4 has a different opinion. He or she mainly argues that it is too early to look at politics and its role in it. E4 does believe that politics can help implement the idea. But that the idea is still too early because the general feeling is that the need for NEED is not yet high. E4, mentions that only as soon as there are visible facts that NEED is necessary, it is too late. This also makes it difficult to find the right time to implement the innovation. E4 states that building NEED in parts can be a solution in the implementation of NEED and the role that politicians play in this.

[XVI] : E7 believes that politics will play an important role, especially in this day and age. E7, therefore, looks at the entire politics in the EU and that this is mainly in the right direction. In addition, E7 also emphasizes that politics has a role in properly communicating NEED. E7 is therefore of the opinion that if this does not happen, a group can arise that turns against NEED. And that today the smallest group that screams the loudest gets the most attention from the media. As a result, a small group of people can break NEED, politics will play a role in getting the NEED across as best as possible so that there are no misconceptions.

4.2.5 The role of environment/sustainability

The literature study and the concept model also show that the environment/sustainability can be a factor in an innovation. That is why the experts are asked what the impact will be of this specific factor with regard to NEED. Because this factor is specifically looked at, the axial codes consist of factors influencing the environment/sustainability factor.

Experts	Main points (Open codes)	Factors (Axial codes)
E1	I wouldn't say that it is a important role, however it is associated with the economic factor and will influence each other.[$XVII$]	Economical
E2	Negative consequences, factor for the public opinion, will disappear with a disaster.[$XVIII$]	Social acceptance
E3	Looks from two sides, could potentially break NEED, could also speed up NEED once there is a urgency.	Urgency
E4	Looks mainly at shipping, NEED huge obstacle for the economic side. expects a lot of resistance for this reason.	Economical
E5	NEED will have a major impact, but this doesn't mean it is necessarily bad, slight change will already have a impact on the environment.	Ecological
E6	Not in general bad, NEED will have impact and it will take time to get to a new equilibrium, flora and fauna will be negatively influenced in the water behind NEED, but the land behind NEED will be preserved.[XIX]	Ecological, Time
E7	Neutral, Consequences for flora and fauna, but also possibilities, generate energy, regulate salt water for the flora and fauna, could give a economic impulse.	Ecological, Economical

Table 12: 'How can environment/sustainability play a role in the NEED project?'.

Extensive explanations

[$XVII$] : E1 does not immediately state that the environment and sustainability have an important role. E1 does state that the factor is associated with the economic factor. The two factors will influence each other with regard to NEED.

[$XVIII$] : E2 mentions that this factor will have negative consequences for the innovation NEED. Certainly, nowadays there is more attention for the flora and fauna, on which NEED will have an impact. E2, therefore, believes that the environment and sustainability can be a factor and argument for public opinion to oppose the innovation. E2 also emphasizes that these factors disappear as soon as a serious problem arises due to the sea rise, with urgency overshadowing these other factors.

[XIX] : E6 thinks it will be very difficult to sustain the current economy once NEED becomes real. NEED will upset the equilibrium therein and it will take time before a new equilibrium is established. A lot of flora and fauna will be lost, which will be a negative factor towards NEED. Looking at sustainability, due to the innovation of NEED, the land behind NEED will have less influence from the seawater level rise. If you look at it in this way, NEED can therefore make a positive contribution to the environment and sustainability.

4.2.6 Society acceptance

The experts are asked to look at the specific factor society acceptance or in other words the public opinion. The experts are asked how NEED will currently be received by society. Because this factor is specifically looked at, the axial codes consist of factors influencing the society acceptance factor.

Experts	Main points (Open codes)	Factors (Axial codes)
E1	Opinions are polarized, makes innovation difficult, many advantages and disadvantages.[XX]	N/A
E2	NEED will certainly not be accepted just like that, environmental movements will be against, NEED will lead to a lot of discussion.	Ecological
E3	Society very mixed, makes distinction in classes, looks at education where certain people won't understand NEED, acceptance depends on the benefits and the clear communication of it, some will feel that NEED is beyond there reach because of the size.	Communication
E4	No positive response from the environmental clubs, innovation is too early for the general Dutch person, important to get allies for NEED for the social acceptance, beneficial/profitable play a role.	Ecological, Time, Benefits
E5	Not accepted in this time, not aware of seawater rise, no urgency feeling, other countries less dependent of the seawater level.	Time, Urgency
E6	Negative reaction of society, in general society needs time to accept a innovation, beginning a lot of resistance, but if conveyed well and clear benefits could lead to acceptance over time, emphasizes urgency/necessity could help.	Time, Benefits, Urgency
E7	Pros and detractors, general citizen will accept it, but urgency argument is a must.[XXI]	Urgency

Table 13: 'How do you think the NEED project will be received in society?'.

Extensive explanations

[XX] : E1 believes that nowadays opinions are polarized. He or she, therefore, expects this to apply to NEED. According to E1, that makes innovation all the more difficult, and so there will also be many advantages and disadvantages.

[XXI] : E7 believes there will be pros and detractors. Looking at people who benefit from it and, for example, environmental organizations. However, E7 thinks that the general citizen will probably just accept it because it is too far from them. He or she also believes that the subject is not really at its peak, which makes acceptance difficult. People are not very aware of the potential problem looking at seawater rise. However, E7 also believes that if you do not use the urgency argument, the support among the general citizen will be hard to find. And that people just see it as a piece in the newspaper.

4.2.7 The role of openness

To answer the factor involvement and clearness for NEED. The experts have been asked to what extent openness will play a role towards society for the innovation.

Experts	Main points (Open codes)	Factors (Axial codes)
E1	Important to be open about it, if it comes out after the decisions are made will lead to a lot of resistance, first publication will lead to negative response, but openness is important, give the public the feeling that they are listened to.[XXII]	Social acceptance
E2	Would go for openness looking at NEED, although openness is not always the better case, but this case openness is the only option.	N/A
E3	Full disclosure should always be assumed, but care must be taken, small risks could twist leading to fear.[XXIII]	Risks, Fear
E4	Thinks one should do something with the public for NEED and therefore openness, openness with other country is a must, where multiple variants for the problem is important.	Social acceptance, Communication
E5	Important in general, but especially in this case, public opinion will feel like NEED is absurd, but openness can lead that the public get used to the idea and helps with the implementation.	Social acceptance
E6	Openness important to avoid suspicious thoughts, the concept can stay in the background, but openness will be important for the definitive plan to the public.[XXIV]	Social acceptance
E7	Openness is important, looks at other projects where openness generate sympathy and compassion, emphasises the matter openness is displayed to society.	Social acceptance

Table 14: 'What role will openness to society play in the acceptance of the NEED Project?'.

Extensive explanations

[XXII] : E1 believes it is important to bring it out openly. He or she also believes that as soon as NEED comes out where the decisions are already made, it leads to less acceptance. However, publishing it in the newspaper tomorrow will also provoke negative reactions. But it is important that there is openness about the innovation. According to E1, it is also necessary to get along with public opinion, otherwise, people get the feeling that they are not being listened to.

[XXIII] : E3 believes full disclosure of projects and innovations should always be assumed. Care must be taken to clearly state what the consequences may be. If one brings out that somewhere has a small risk, one can twist it, causing unnecessary fear.

[XXIV] : E6 finds openness especially important to avoid suspicious thoughts. As soon as there is openness, there will be less suspicion. A concept of NEED can be kept in the background, but when it comes to a definitive plan, it is important that there is openness to society.

4.2.8 Alternative solutions

The experts are asked based on the concept model whether this is the best possible solution, or whether they think an alternative idea is better.

Experts	Summary main points
E1	The idea of building a dam is not good, the idea should fit more in the daily mindset, that is why openness is important, where alternatives arise, research into NEED leads to awareness.[XXV]
E2	An alternative is simply raise the dikes, or give up part of country that cannot cope with the sea level rise.
E3	NEED is a symptom solution, Rather see a solution to the cause, not only looking at the EU, but the whole world.
E4	Thinks of NEED as a solution if all other solution fail, alternatives would be rising the sandbanks, or an airport in combination with a dike in sea, or just simply raise the dikes.[XXVI]
E5	NEED is too radical, other countries will not join, a smaller variant would be more relevant and feasible, this will also make it more easier looking at politics, technical feasibility, and countries that are forced to participate.
E6	Raising the dikes is the easiest solution, or laying an entire dike ring around the Netherlands.
E7	Smaller variant, not all the countries will feel the need for NEED.[XXVII]

Table 15: 'What are similar/alternative solutions to the problem that NEED is trying to solve?'.

Extensive explanations

[XXV] : E1 thinks the idea of building a dam is not a good one. He or she will go for an idea that fits into the daily mindset. That is why openness is so important where alternative solutions arise. E1 emphasizes that research into this innovation is important to raise awareness. NEED does not necessarily have to be the solution, but it can be the innovation that allows people to become aware that leads to alternative solutions.

[XXVI] : E4 mainly thinks NEED is a solution when other ideas and solutions don't work. For example, he or she identifies raising the sandbanks or an airport in the sea in combination with a dike as potential solutions that can make a significant contribution. E4 also mentions that raising the dikes is a solution. Or to build part of NEED, which can already have an effect on the Netherlands.

[XXVII] : E7 is looking at a smaller variant, as not all countries will feel the need for NEED. However, the dam will run from England or Scotland, but then towards Denmark. E7 also emphasizes that the location of the southern part should still provide a view of Calais. Because you want to do a smaller variant of NEED, the complexity will decrease.

4.2.9 The lead of NEED

Because it appears from the literature study that leadership is an important factor for innovation, it was decided to ask the experts who should take the lead if the NEED innovation becomes an reality.

Experts	Summary main points
E1	A company shouldn't be in charge, a kind of committee should take the lead, with a representative of each country, multiple levels in the innovation where it is important that all the parties go along with it.
E2	Kind of committee with all the countries, stakeholders should also be involved in the process.
E3	EU should take the lead in a committee form, where the EU has a coordinating capacity and is the main stakeholder.
E4	Who benefits the most and the countries that are attached to NEED, they will play an important role in leading the innovation, once approved a project leader should be addressed, from a different country.
E5	Group of people with a certain knowledge / expertise should have the lead, where the politics get later involved who take the advice into account of the knowledge group.
E6	Separate committee because the southern countries of the EU will not be interested, management should be created.
E7	EU should take the lead, where a committee should be formed because of the size of the project, with a representative of each country.

Table 16: 'Who should take the lead in working on the NEED Project?'.

Extensive explanations

$[XXIX]$: E1 doesn't think a company should be in charge, because it's a big social project. According to him or her, there should be some kind of committee, where a representative of each country will be present. E1 insists that there will be multiple levels of innovation and that it is important that all parties go along with it. Once NEED is executed, a few partners will be enough to actually execute it. But a committee is important beforehand.

$[XXX]$: E4 mainly looks at who benefits the most and that would probably be the Netherlands. He or she also names the countries to which NEED is attached. They will play an important role in leading the innovation. Once the plan is approved, some sort of project leader will have to be chosen. E4 emphasizes that this must be someone who does not come from the three countries to which NEED is attached, for example, someone from Switzerland.

$[XXXI]$: E6 believes that the Dutch can mean a lot in the technical field. E6 also names the EU. However, E6 notes that this only concerns part of the EU. And that the southern countries are not fascinated with NEED and therefore do not have to be in the lead. He or she, therefore, believes that there should be a separate committee for the countries that are involved in NEED and that management should be created from this

4.2.10 NEED opinions after exposure to possible factors

The experts have now answered several questions regarding success and failure factors surrounding NEED. The last question is a repeat to see if the Experts' opinion on NEED has changed. For example, this may be because the questions have led to the experts also experiencing NEED from another side and exposed to possible new factors.

Experts	Summary main opinions
E1	Still believes that NEED is going to be very tricky to execute. However, this project will be viewed differently 100 years ago than it is now. In addition, E1 is in favor of looking at NEED as a radical innovation and developing it more. Even if it is only to learn from it, and that it can contribute to other solutions or alternatives.
E2	Opinion has not changed.
E3	Thinks NEED is a very large and complicated project. However, because it is so radical, it is stimulating. It has a certain challenge, which stimulates a different way of thinking.
E4	Finds the innovation NEED simple in itself. It's something we've all been doing for years, all big. However, there must be clear advantages why one has to realize NEED and that all countries also go along with it. E4 also mentions urgency as a key factor, which means that NEED is becoming a lot more realistic. In addition, E4 strongly believes that it should be done in parts, where the impact will be less drastic in one go and that it can also have a positive influence on costs and the way NEED is built.
E5	Believes it is very challenging and also makes clear what challenges lie ahead. However, E5 believes that NEED will happen, he or she thinks it is too radical. There will be too much resistance from society, but he or she does not rule out a dam around the Netherlands itself.
E6	First wonders whether NEED is really necessary. Whether the seawater will really rise that much and whether NEED is the solution. Even if the water rises that much, he or she thinks NEED will be the answer. E6's gut feeling says that there is too much resistance from society, it has so many obstacles or potential negative consequences that it will fail. E6 therefore expects that the Netherlands will keep the lake to itself and redesign the water safety system.
E7	Less negative about NEED. Considering the future problems with the sea water, NEED can be a serious solution. The innovation is feasible, but as soon as the need is not high, NEED will disappear on the bookshelf.

Table 17: Experts opinions about NEED after exposed to possible new factors.

4.3 Reflection on the results of the semi-structured interview.

The first chapter of the interview mainly focuses on a "standard" innovation. Here the experts are asked what makes an innovation successful, but also what the common failures are. To get a good idea of which factors play a role. It has been decided to make a schematic overview of the factors that relate to "standard" innovation according to the experts that emerge from 4.1. This overview can be seen in figure 15 The factors found are based on the axial codes presented earlier in the preceding tables. It is striking that in general there are more factors that can be a failure for innovation than a success. It also stands out that the experts link few factors to each other when it comes to "standard" innovation.

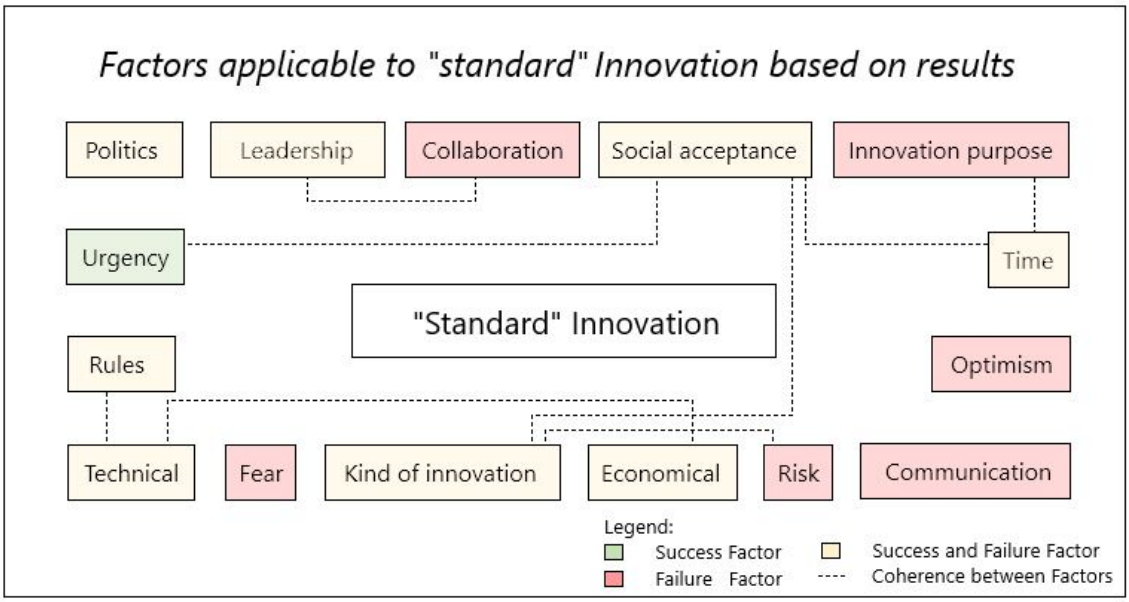

Figure 15: Factors that are applicable to innovation according to the experts.

After the experts give their findings on the success and failure factors related to "standard" innovation. They were asked what their opinion is about NEED, this is done in section 4.1.4.

There is not one general response to the NEED innovation when we are comparing the seven experts. However, there are some similarities that the experts point out when they are asked about their stance in this matter. Amongst others several experts point out that political issues and public opinion will play a key role in getting NEED out there. There is also a shared belief that the technical parts of this innovation will not be the problem, except for the depth of the sea around Norway. Most of the experts state that NEED is 'just' something that people have been doing for years – red: building dikes – but will now do in a bigger form. To support this argument, examples are pointed out such as the Delta Works and the Zuiderzee in the Netherlands. In conclusion, at the start of the interview all the experts acknowledge that there is not just simply one factor that will make this innovation challenging. All of them are pointing out that there is multiple factors that affect the project and also affect each other.

The second chapter looks at NEED specific, this is done in section 4.2. In the beginning, the experts are asked about the success and failure factors for NEED. The experts may come up with factors that are not included in the conceptual model. After that, questions are addressed that are based on the conceptual model from the literature study. These are mainly the factors openness, social acceptance, ecological, politics, and unexpected consequences. To clarify this, a schematic overview has also been made, which can be seen in figure 16. It is striking that more factors are mentioned than with a "standard" innovation.

The NEED innovation also contains more failure factors than success factors. However, it should also be noted that some factors are much more emphasized in how important they are for the NEED innovation. The urgency factor is strongly underlined by the experts and is a must for the innovation to be successful. Looking at important failure factors, it is noticeable that two factors play a greater role. Especially social acceptance and ecological are potentially strong failure factors for NEED. Because it is a major radical innovation, one can expect a lot of reactions, according to the experts. This reaction is therefore strongly associated with ecology. According to the experts, NEED has undoubtedly major ecological implications, influencing public opinion. In addition, the influences of the factors on each other are mentioned more often, this only underlines how complex the NEED innovation is.

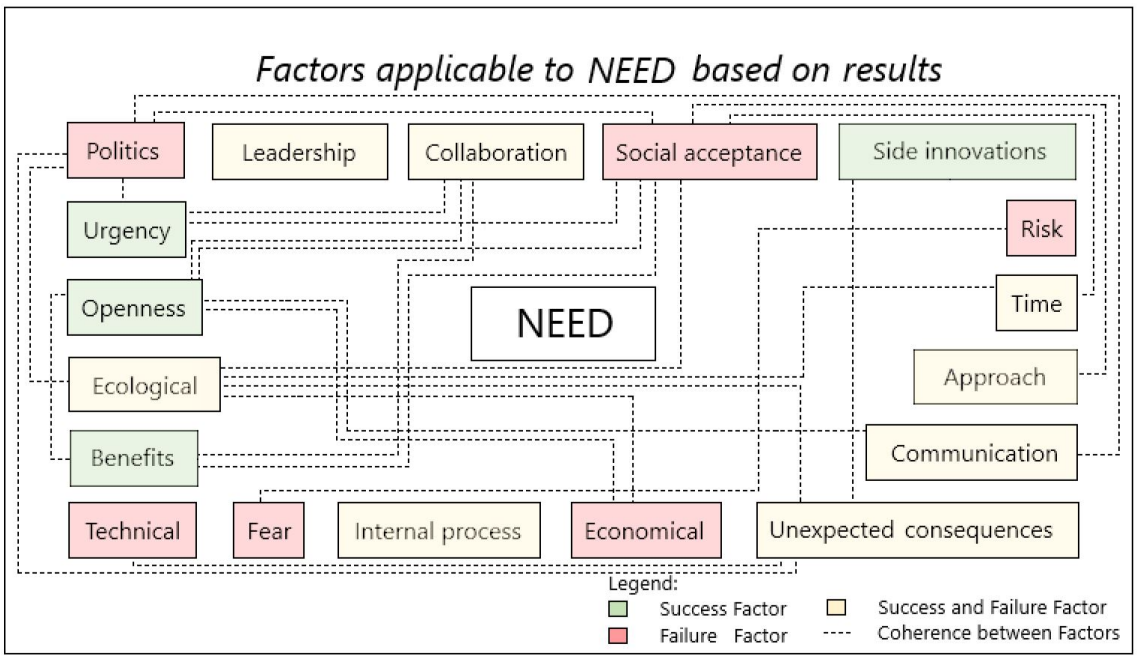

Figure 16: Factors that are applicable to NEED according to the experts.

After being exposed to possible success and failure factors there could be stated that some of the experts have changed opinions or that their points of view have slightly changed. What stands out is that most of the experts involve other arguments that weren't mentioned at the start of the interview. This means that the remaining part of the interview triggered them to think about other success and failure factors that might affect the NEED innovation. For example, E6 did not mention society or the public opinion at the first question, but after completing the interview this factor is mentioned by E6. Another example can be found in E1, whom mentions the financial and political foundation of the innovation at the start of the interview, but focuses on the learning possibilities at the end of the interview.

4.4 Reflection on the semi-structured interviews + scientific literature.

After having obtained all information from both the scientific literature study and the semi-structured interview with the experts. Is it possible to process all information together, which creates a clear picture of what has been obtained. This is done in the next four paragraphs from 4.4.1 to 4.4.4. These paragraphs are divided according to the sub-questions that were formed.

4.4.1 Radical Innovation.

According to Schilling (2020), radical innovation is very new and different from previous solutions. It is the opposite of incremental innovation which is defined as a form of innovation that just makes minor changes to an existing product or service. Daft and Becker (1978) support this idea, explaining radical innovation as an innovation that depends on a combination of newness and at the same time a degree of differentness. It is also emphasized that radical innovation is possible in all aspects. This can take place, for example, in technology, but also industry, a company, or an entire project such as NEED. Schilling (2020) adds that a radical innovation must be completely new to the world and different from other projects, whereby the radicalness often also goes hand in hand with new knowledge. Finally, Schilling (2020) adds that radical innovation is time-dependent. In the beginning, an idea or design can be very new and different. But as time goes by and others go along with the radical idea or design, the innovation will become less radical along the way. For example the Afsluitdijk, which was a radical innovation in its time. However, if the same project is carried out again, it will not or less fall under a radical innovation. McDermott and O'Connor (2001) also emphasizes the differences between radical innovation and incremental innovation. Using different dimensions; technological uncertainty, technical inexperience, business experience, and technology costs, one can see how radical an innovation is. McDermott and O'Connor (2001) also emphasizes that radical innovations are long-term developments and require a lot of time and millions of investments. Furthermore, they dive into how the long-term success of radical innovation is supported internally by companies and strategic issues that are faced by large firms as they develop radical products.

In conclusion, radical innovation is the opposite of incremental innovation. Where a radical innovation is new and different from other innovations, which is often accompanied by new knowledge. Furthermore, radical innovation can take place in various aspects where it depends on time. Radical innovation is a long-term development and requires a lot of time. But how radical innovation also depends on the adoption of the innovation. As time goes by after a radical innovation, implementation of the innovation can lead to less radicalness.

4.4.2 Success and failure factors of a "standard" innovation.

Looking at the literature study, several factors and lists/schemes emerge that are important in "standard" innovations. The factors that are very prominent according to the theory are; *technical, political, social acceptance, unexpected consequences, knowledge, and economical.* These factors have been mapped using a conceptual model, which can be seen in figure 14.

In addition, the experts may also consider other factors important. That is why the experts were asked what success and failure factors are, with regard to innovation. Other factors compared to the literature study emerged from the semi-structured interview. The factors based on the opinions of experts are shown in figure 15. Here too it emerges, as in the literature study, that factors cohere with each other such as Feitelson and Salomon (2004) theory also describes. To give a clear picture of all success and failure factors that play a role in the "standard" innovation and the coherence between them. A schematic overview is made of the factors of both the scientific literature study and those of the semi-structured interview. This is shown in figure 17.

What is striking is that the number of factors as a whole is more than from the literature study. But the number of failure factors is larger and the coherence between the factors is clearly present.

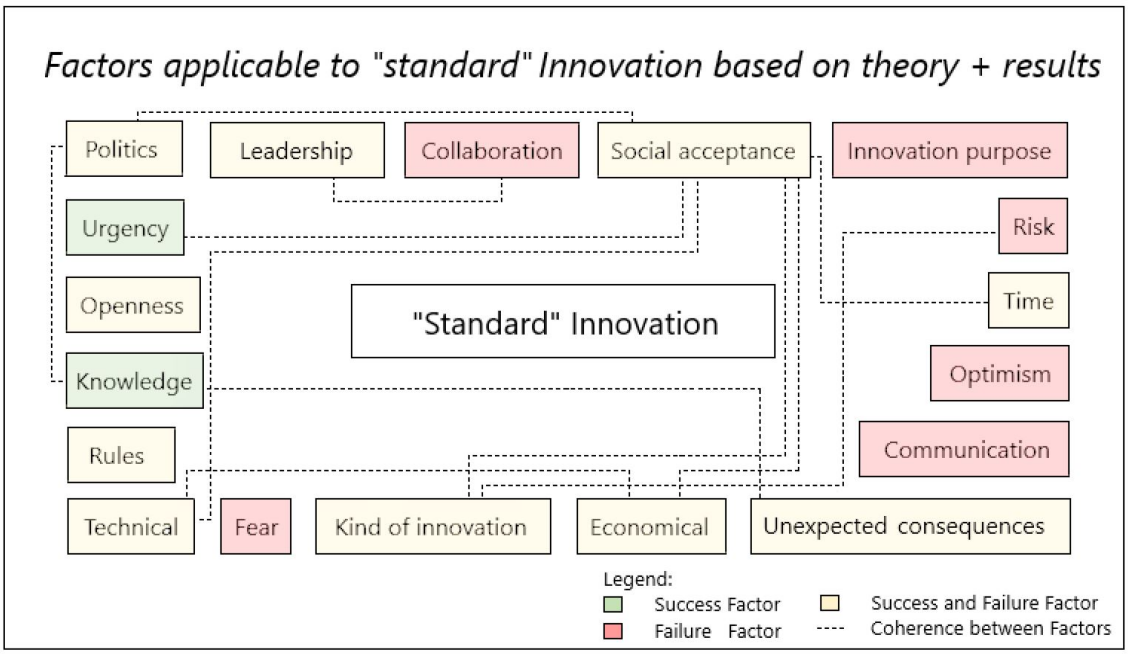

Figure 17: Factors applicable to innovation according to the experts and the literature study.

4.4.3 Success and failure factors of an large innovation process and similar projects.

Because NEED is a radical innovation, it is difficult to find the factors that influence NEED, both in terms of success and failure factors. In order to eventually arrive at these factors, a distinction has been made between major innovations and comparable innovations. By combining these two aspects in addition to the "standard" factors associated with innovation, one arrives at a reasonable assumption for the factors that influence NEED.

Looking at large radical innovation projects, scientific literature is used to find these factors. The factors that emerge have been included in the conceptual model. The conceptual model is the basis for the questions for the semi-structured interviews as mentioned earlier.

As a result, the factors found in the literature are; *technical, political, achievement/pride, unexpected consequences, clearness/openness, leadership, economical, pro-bubble, communication, ecological, tunnel vision, and enthusiasm.* If necessary, these factors are also specifically addressed to the experts in the semi-structured interviews regarding NEED. This is done when a factor can be both a success and a failure factor and to see if they are applicable to NEED.

Looking at the success and failure factors of similar radical projects. These can be projects on a large or small scale, provided the project has a similar purpose. Scientific literature was also used to find out about these factors. These factors are also shown in the conceptual model in figure 14.

The factors that emerge from the literature regarding comparable projects are; *politics, provision of work, social acceptance, achievement/pride, best solution/alternatives, unexpected consequences, clearness/openness, knowledge, threat, ecological.*

It is now possible to describe all the factors applicable to NEED, based on scientific literature and the semi-structured interviews. At which the most important factors applicable to NEED will be addressed. This will be done in the next paragraph.

4.4.4 Success and failure factors of NEED.

Since NEED is a radical innovation that has never been seen before. It could be that other factors apply to NEED than to a "standard" innovation. Because NEED is a radical innovation, this question cannot be answered directly on the basis of scientific literature. However, with the help of previous paragraphs, it is possible to estimate which factors influence NEED. With this it is possible to look at the "standard" factors that apply, factors that apply to large radical projects, and similar radical projects such as NEED. However, this is still not enough to get a full scope of the factors involved in NEED and coherence between these factors. That is why it was decided to create clarification in the second chapter of the semi-structured interviews about certain factors and to obtain information about factors that also apply to NEED, that did not emerge from the scientific literature study.

To get a clear picture of which factors are applicable to NEED, an overview has been made which can be seen in figure 18. These factors are based on the conceptual model from the literature study and on the results of the findings of the experts on NEED based on the interviews. As can be seen from the above figure, the factors affecting NEED are many. It seems that there are more success factors than failure factors in general. This needs to be clarified as certain factors were underlined more often during the study and thus appear to play a larger factor.

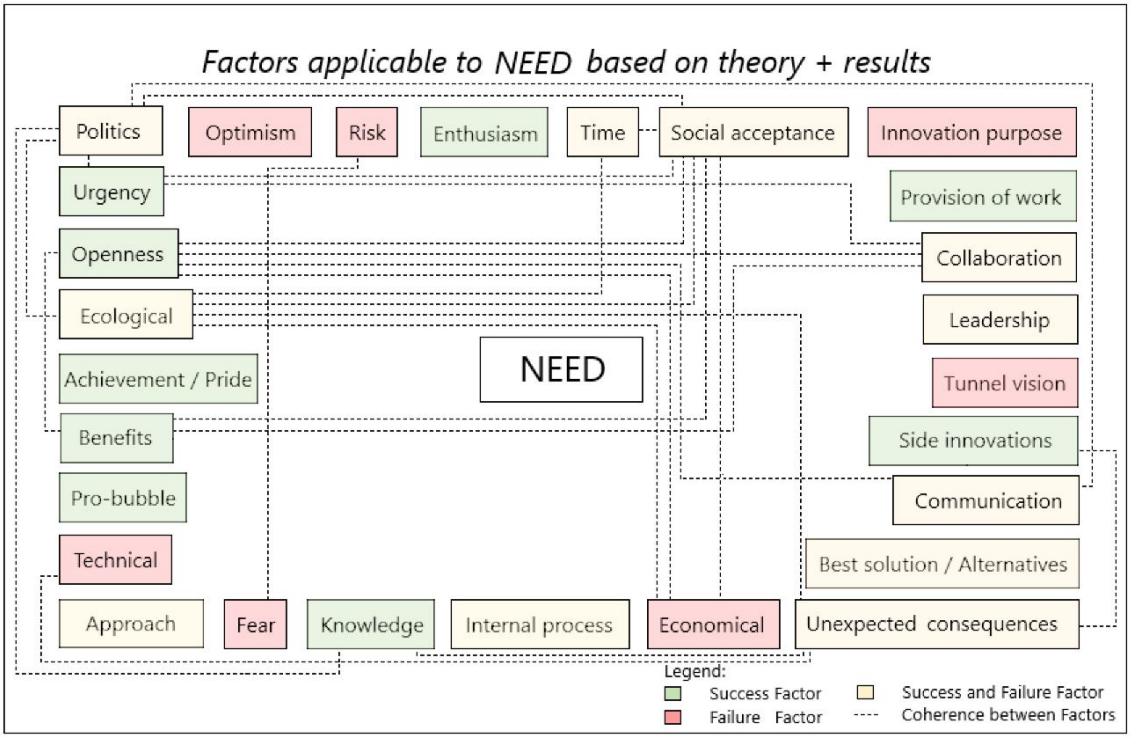

Figure 18: Factors that are applicable to NEED according to the experts and the literature study.

Looking at NEED, four factors stand out that come up repeatedly and seem more crucial than the rest. These crucial success and failure factors are *politics, ecology, social acceptance and urgency.* These factors already emerged during the scientific literature research, but are emphasized much more by the experts in the semi-structured interviews as crucial for NEED. These crucial factors are of more importance than other factors for the radical innovation NEED.

Looking at the first crucial factor, politics, the literature study shows that politics can be both a success and a failure factor. This also emerges from the interviews, in which politics plays an important role in NEED, both positively and negatively. However, especially from the interviews,

it emerges that the politics of looking at NEED is extremely complex. This is due to the fact that you are not working with the politics of one country but with all the countries involved in NEED. Several experts, therefore, state that there should be some kind of committee, whether or not at the European level. Where the general impression of the experts on the political factor is seen as a failure factor. Because so many countries are involved, the complexity at the political level is high. Not all countries will see the need for NEED or find it the right solution. In addition, the political factor is closely related to factors, social acceptance, communication, urgency, ecological and knowledge. Politics is thus an crucial factor that can be a serious obstacle to the radical innovation NEED.

The second big factor that stands out for NEED is ecology. This factor is used several times as a failure factor, partly because NEED will have a major impact on the environment. It is also argued by some experts that NEED protects the ecology on land. However, the main focus is on the damage that NEED will cause to the North Sea. The research, therefore, shows that this factor is mentioned several times as a negative factor. The factor that will most often be used as a counter-argument for the radical innovation NEED. The factor, coheres with other factors, namely; politics, time, social acceptance, unexpected consequences, and economics.

The third factor that is crucial is social acceptance. Both the literature and the experts underline this factor. Public opinion can give NEED a positive or negative impulse. This mainly depends on other factors that cohere with this factor. For example, this factor is strongly influenced by the previous two previously mentioned factors, politics, and ecology. In addition, the factors of time, urgency, openness, benefits, and economy play an important role on social acceptance.

The last crucial factor is urgency. Urgency is strongly stated several times that it is a requirement and a success factor for NEED. Without urgency, radical innovation will have little to no chance of getting off the ground. This is mainly because this factor has a major influence on social acceptance. as soon as the urgency increases due to, for example, a disaster or noticeable negative effects. Then urgency can positively influence the social acceptance factor. So much so that the previously mentioned important factor of ecology is overlooked. In addition, urgency also coheres with the factors politics and collaboration.

These four crucial factors are closely related to each other and to other factors. However, it is important to emphasize that none of these four factors can be ignored when NEED is implemented. This is mainly based on the experts emphasizing how crucial these factors are. It can therefore be said that for the implementation of NEED not one factor should be looked at, but all four crucial factors specific. These four crucial factors cohere with other factors, as figure 18 shows. The other factors, for instance ecological, can contribute in a positive or negative impulse to these four crucial factors and can therefore not be forgotten.

With all these previously mentioned results, an end result can be formed regarding the core findings of this research, looking at the difference between NEED and "standard" innovations. There are many different factors that influence NEED. A total of twenty seven factors affect NEED. Nine of these factors form success factors, namely; *urgency, openness, achievement/pride, benefits, probubble, knowledge , enthusiasm, provision of work and side innovations.* Seven factors form failure factors; *technical, fear, economical, tunnel vision, innovation purpose, risk and optimism.* The last eleven factors can be both a success and a failure factor, these are; *politics, ecological, approach, internal process, unexpected consequences, best solution/alternatives, communication, leadership, collaboration, time and social acceptance.* Finally, the results have shown that certain factors are of greater importance than others and play a greater role. These factors are; *politics, ecology, social acceptance and urgency.*

Looking at the number of factors in a "standard" innovation is much less than the number of factors related to NEED. In "standard" innovation eighteen factors play a role, at which NEED depends on twenty seven factors. Two of these factors of "standard" innovation are a success factor, namely; *urgency and knowledge*. Six factors are a failure factor; *fear, innovation purpose, risk, collaboration and communication*. The last ten factors can be both a success and a failure factor, these are; *politics, unexpected consequences, leadership, time, openness, technical, rules, kind of innovation, economical and social acceptance*. In addition to the number, the previous results have showed that the coherence is more present with the factors applicable to NEED. The four factors that play a bigger role looking at the NEED factors do not play a bigger role looking at the factors of "standard" innovation. These core results are presented at the focus group which is discussed in the next paragraph.

4.4.5 Response focus group

Once when the results were clear and what factors matter to NEED. These results were presented to the focus group working on NEED itself. After the presentation, the focus group was able to reflect on the results, and several points for improvement emerged. The most highlighted comment by the focus group is that these factors are useful and interesting. However, these factors are both positive and negative based on the concept of NEED. It is possible that NEED will look completely different, which means that a new research will have to be carried out. The focus group, therefore, states that these factors are of value, but it must be taken into account that they are about an ideological concept of NEED.

The focus group also emphasizes that a value overview based on, for example, numbers can provide clarity in how crucial the factors are. In addition, it is also emphasized that the results will also partly be influenced by the experts' own views. This could be removed by interviewing more experts per category or giving them more implementation time on the topic. The focus group also realizes that this is not realistic for this study due to the time available. This is interesting to include in future researches where this time is available.

5 Conclusion

In the conclusion, this paper provides an answer to the two main research questions that were stated in the introduction. To be able to answer the research questions, the findings and results of the research are taking into account. The answer to the two research questions have their own paragraph in order to provide clarity in the research answers.

5.1 Success and failure factors of NEED.

The first research question is as follows: *'What are the success and failure factors of the NEED innovation?'*. This question dives into factors that might positively or negatively affect the NEED project.

To be able to answer this questions two main methods were used. The scientific literature study already provided several factors that might lead to success and failure factors for innovations in general. However, no research has been done on NEED specifically, and there has also not yet been a scientific study that focused primarily on success and failure factors for radical innovation specifically. Therefore the literature study could not completely provide the answer to the first research question. Semi-structured interviews have been conducted with innovation experts from different fields of work to complete the answer to this question.

Both research methods provided several potential success and failure factors. Also, both research methods proved some of these factors to be double sided, as can been seen in figure 18. As they could cause both success and failure to the project. Eventually the research examined four factors as crucial for the NEED project: *politics, ecology, social acceptance* and *urgency*. These factors will play a more important role for the project as all the other factors, based on the outcome of the literature study and the semi-structured interviews with the experts. For the NEED project to be implemented, these crucial factors will need to receive more attention than the other factors, as they are a prerequisite.

Thus, to answer the first research question, there are several success and failure factors applicable to the NEED project as can been seen in figure 18. The factors *politics, ecology, social acceptance* and *urgency* will probably play a crucial role in the development in the further implementation of the project.

5.2 Difference between factors of NEED and "standard" innovation.

The second research question states as follows: *'To what extent do radical successes and failure factors differ from a "standard" innovation?'*. It examines whether there is a difference between success and failure factors for the radical innovation NEED and these factors for "standard" innovation.

The outcomes of this research showed that the number of factors that affect a "standard" innovation are much less than the number of factors related to the NEED project. In addition to the numbers, the results showed that the coherence is more present with the factors applicable to the radical innovation NEED. According to the experts this is caused by the complexity of the NEED project. This complexity also reduces the chance of success. The four crucial factors, *politics, ecology, social acceptance* and *urgency*, play a bigger role looking at the NEED project, in comparison to the part they play for "standard" innovation.

In conclusion, the research has shown that there is a difference between the factors of radical innovation NEED and "standard" innovation. The difference is in the number of factors as well as the importance of certain specific success and failure factors. In addition, the coherence between the factors related to NEED is greater than the coherence between factors of "standard" innovation.

6 Discussion

This section elaborates on the interpretation of the findings and reflects on them. After which it continues with discussing the limitations found during the research. A distinction has been made between these subsections to provide clarity.

6.1 Reflection

What emerges from this research is that the NEED project is very complex. The radical innovation involves so many extra factors compared to "standard" innovation, that a standard research approach does not seem to offer the right solution for NEED. The coherence appears to be greater with NEED compared to "standard" innovation between factors. In addition, certain factors are crucial for NEED, which require extra attention during the execution of the innovation. One of the crucial factors is politics. Because NEED involves so many countries that have to work together on the project, this factor alone seems like a challenging one. The other three crucial factors also raise questions. The factor urgency is of great importance. However, the urgency will only become clear when a treat is clearly present or when a disaster strikes. Referring to the experts' answers, the urgency to do something about the sea level rise does not seem very high in general in society. In addition, the social acceptance of this innovation is not only influenced by urgency, but also by a number of other factors, for example time and economics. In the climate agreement, discussed at the start of this research, it has repeatedly become apparent that people prefer to opt for economic benefits instead of combating climate change despite the increasing urgency of the matter. Furthermore, the factor ecology is also crucial. Ecology is mainly seen as a failure factor by the experts. It will, therefore, be important for NEED to transfer strong success factors against it, or to improve the ecological consequences that the NEED project entail. Ecology also plays a increasing role in politics and social acceptance. This coherence emphasizes the complexity of the radical innovation even more.

Concluding, this thesis provides a picture of what factors are important for this radical innovation. Scientifically, this is interesting as there is no clear framework for radical innovations yet. However, this research does not yet provide the framework. Nevertheless, it could form the basis of further research because of the success and failure factors that are found during the research. These provide information to make a framework in future research.

In addition to the reflection on NEED and its implementation, the research methods could also be discussed. In this research, success and failure factors were found based on a scientific literature study in combination with expert interviews. It is, however, possible that with extensive research more factors can appear. This can be the case for both the literature study and the semi-structured interviews. The factors of success and failure have been found because of the interviews with the seven experts can be extended. The experts varied in their profession and were places in three categories used in this research. However, this small group of experts which can jeopardize the validation and reliability of the research. Their answers and ideas are limited to just their particular field of expertise. If more experts in the same profession group were used, this would have given a more objective outcome. The experts could be influenced in their responses by, for example, subjective ideas coming from their political background, social situation, education, etc.. If more experts in the same category were used, the diversity, and the general opinion of that particular category group would be more accurate. The outcome could be evaluated per expert group. The results could then be looked at per category which excludes the emotional connection of the experts to the specific subjects. A fact that is not explicitly included in this research paper, is that this research is performed amongst experts with different ethnic backgrounds. However most of the experts were Dutch with a Dutch view on the innovation and society.

This research clarifies that there are four crucial success and failure factors for the NEED project. In addition, there are many other factors that play a role in NEED, and that cohere together, as can be seen in figure 18. In this research, However, no specific value has been given to these factors.

This is also discussed during the focus group meeting. Therefore, it is very difficult to mention to what extent one factor outweighs the other. The four crucial factors are clearly specified for particulars of the NEED project. However, the factor urgency for instance may be more crucial and therefore more valuable for the project. This research, therefore, exposes the success and failure factors with regard to the NEED project, but not the value of the factors weighed against each other.

The focus group emphasizes that the NEED project is in a pre-phase with regard to the concept at the moment that this research was conducted. The current success and failure factors that have been found are based on only the first concept of NEED. The concept may look different in the future. This may eventually also lead to the factors that are distinguished in this research, being less related to NEED in the future or to the discovery of even more factors that are applicable to NEED when it is further developed. The current factors that are found may also be of value to NEED to move in the right direction. However, there is no guarantee that these factors will be equally crucial in the future where the concept of NEED may have changed.

Another point of discussion could be found in the generalizability of the factors found for this radical innovation. "Standard" innovation is now compared with one specific radical innovation in which the factors urgency, politics, social acceptance, and ecology are regarded as crucial. The question is, however, whether these factors apply especially to the NEED project or to radical innovations in general. There will undoubtedly be a difference with the factors for "standard" innovation and radical innovation. However, it cannot be assumed that the factors found in is research regarding the NEED project, also generally apply to radical innovations. Put differently, this research highlights only the difference between the radical innovation NEED versus "standard" innovation. It seems inevitable that success and failure factors differentiate between radical and "standard" innovation, in general. As soon as one speaks of a radical innovation, one should look more individually at the innovation to find the associated factors, because a general research like that has not been conducted yet. A general list of success and failure factors for radical innovation, is therefore, at this moment, impossible to realise. One could start by making a list of basic factors coming from this research. For example, the urgency factor may always be a necessity for radical innovations.

Finally, this research can be of value if the NEED project becomes reality. Factors that lead to both success and failure can be taken into account with the execution of the innovation. However, it is important to keep in mind that these factors are complicated and do not exist individually. Coherence alone will not be sufficient to properly guide or bypass the failure factors. Specific factors will therefore require more research to better define the actual nature, consequences and their value. This is especially important, because NEED is a radical innovation where many unexpected consequences can be expected to appear, as the experts mention. More research into these specific factors may lead to greater clarity and decrease the number of unexpected consequences and risks.

6.2 Limitations

A limitation of this study could be found in the number of experts that were interviewed. Seven experts were interviewed for this research. This number is mainly shaped by the time that was available to conduct the research. Although at least two experts per category have been used, it is desirable to use more experts to draw more generalizable conclusions.

Another limitation is the use of semi-structured interviews. Initially, the use of the Delphi method was desired for this research. Although the semi-structured interview is worthy for this research, the Delphi method would probably have lead to better validation and reliability. The Delphi method ensures that the experts' findings are checked by other experts, based on multiple rounds of interviews, as explained earlier in this paper. This could lead to new insights for the experts and the research. However, both timing and the unwillingness or availability of some experts to

do multiple rounds of interviews shaped this research into semi-structured interviews.

The biggest limitation, which has been mentioned several times before, is time. In addition to the two limitations mentioned above, time has also created other limitations. More time than could not only have lead to being able to interview more experts, but also to focus more on the categories they fall into and the ethnic background they have. Also, more time could have led to more in-depth research in the form of the Delphi method. More time makes it possible to conduct several rounds of interviews. This could have been better to give specific value to a factor to what extent it is crucial. More time also could have make it possible to explore other ideas and weigh them against the NEED project. An alternative may involve more or fewer factors, which may be more desirable.

Recommendations can be made based on the aforementioned conclusion and the discussion. This could be useful for future research on NEED or similar studies, the recommendations are discussed in the next page of this report.

Recommendation

This research on NEED clearly recognizes the success and failure factors that might influence the progress around the NEED innovation. However, this research also offers the possibility for further and future research. The recommendations for further research are subdivided into general scientific recommendations based on this research in general and recommendations applicable to NEED.

General scientific recommendations

It would be recommended to interview more experts in the future. For this research the outcomes show a lot of different success and failure factors and aspects of innovation. It is innovative in, amongst others, technical, environmental, biological, and governmental fields of work, which makes it interesting to conduct this research in each of these working fields. All fields might point out different success and failure factors that come into play when the NEED project will be developed. It would then also be interesting to compare the different factors that may come from these new researches and this might lead to a shared consensus about which success and failure factors are the most important.

Another recommendation for future research is to adapt the approach of a similar type of research. When sufficient time is available, it is desirable to use another research method. The Delphi method entails better validation and reliability. In addition, the Delphi method can lead to sharper answers from the experts, which makes the research clearer and easier to process, looking at the codes used for this research. An addition to the previous recommendation, is that a value overview can be drawn up for a similar study. This can be done by including this in the interviews, where the experts can give a value to the, for them, most relevant aspects. This is possible for the current research method, semi-structured interview, as well as for the potential research method, the Delphi method. Such an overview clarifies to what extent certain aspects are important and more crucial. This contributes to the clarity of the aspects and how they weight up against each other. In addition, the research makes it easier to continue because certain fixed values have been found that can be worked on further in the future.

Finally, this research could also be drawn more generally. This means that it could be interesting to examine whether the success and failure factors that form the result and conclusion of this research, might also be applicable to other kinds of projects. The factors that are now defined in this thesis could form the basis of further research which can discover if these factors are just applicable to NEED or also to other radical innovations or large innovative projects. In this case, this research forms the basis of further research and can be extended by future scientists.

Scientific NEED recommendations

The first recommendation for future of NEED would be to conduct the same research again in a later period of time. The NEED project is only an innovation in pre-phase at the moment, as the focus group underlined. The expert's opinion and the success and failure factors might change during the process of the project development. Repetition of the research also offers the possibility to compare success and failure factors that are mentioned in this paper, versus the factors that are mentioned further in time. The aforementioned scientific recommendation, the overview, can also be useful here. The more NEED gets a final concept, the more interesting it is to add a crucial value, for instance a number, to these specific factors.

Furthermore, it is an option to dive deeper into the success and failure factors that result from this research. Further research could dive deeper into these different aspects and more specific literature on the aspects that could be linked to these factors. Extensive research into these aspects might lead to new insight or practical tips for the NEED project or comparable radical innovation projects in the future. Further research could prevent failure factors to actually cause failure to these kinds of projects. In addition to these recommendations specific for NEED, the aforementioned scientific recommendations will also be an improvement for NEED for further research.

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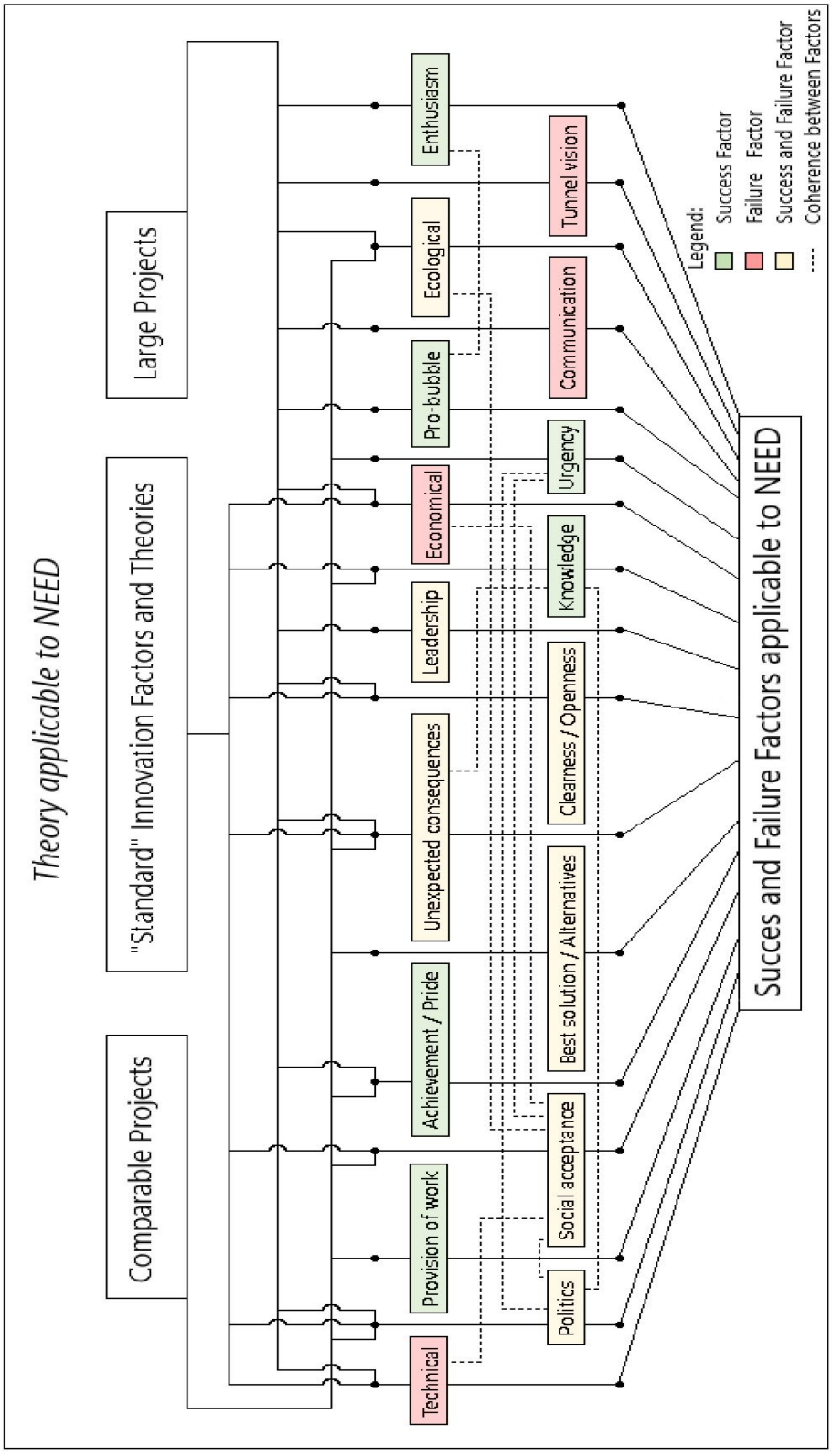
Appendices

Appendix A: Conceptual model



Appendix B: Innovation strategist - interview

Questions	Answers
- What is your profession?	Yes, that is not an easy question. Sometimes you are jealous of people who are just carpenters, then the profession is very clear. In any case, I will briefly explain the relationship with this project. I also studied mechanical engineering, a while ago, but after that, I started working in the energy sector and then quite quickly at a network company XXX. There I worked for more than 10 years on the energy infrastructure and especially on innovation. I also did a PhD, more in electrical engineering, by the way, energy systems into the impact of changing energy in households, and what impact that has on infrastructure. And before, I also worked on a lot of innovations related to infrastructure. So, I do have some relationship with this, and also organizing innovations, both within the company - how do you get it done, etc., where many collaborations come into play with knowledge institutions - and with startups and large companies, the municipality, and other governments. I continued independently. At the moment I work in XXX mainly looking at linking science and education to energy, projects, and challenges are involved. I'm having a great but busy time.
- What part plays innovation in your daily life?	I always say that the red line - I have done research and other innovation projects - is that I do like to work on issues that have not yet been answered. That you are working on that and that you are always looking for better solutions. That is often innovative and sometimes not. In that case, you should also leave it nice or just do it more efficiently. In private, I like to practice what you preach. Although I do think that my house could be a bit more sustainable, I am less about the latest gadget. I can sometimes be more conservative about that, but I am always open to it and I think that is important. Also concerning innovation, and renewal, and that also applies to the private corner, with travel or art etc.
- What does it take to make an innovation a success?	Yes, that's an important question and the challenge is that it is a fairly open question. On the one hand, you may have new innovations, and a lot of innovation is market-driven, for example around IT developments or with new services or apps. That's just how the market works, whether it works or not. You may wonder whether these are also the desired innovations because, with this project in the background, that is a completely different kind of innovation.

Questions	Answers
	If you look at the energy transition, what is needed in terms of innovations; adjustments, and infrastructure changes, and the developments that I have seen over the past 10 / 15 years. I started working on this in 2007 when we already knew that the energy transition was coming. During my dissertation in 2013, it was already clear what kind of investments were needed in the network. Of course, things have happened over the years, but every now and then you feel - that was my frustration - that you are sometimes still preaching for the adjustment. However, now it starts to crack, and then I also think that it is now really necessary that they start to crack now, to feel the urgency. I think we learned lessons in that last year with the Coronavirus. If there is a certain urgency, things can happen. If it is felt a little less, then it becomes a lot more difficult. Premature is therefore much more complicated and then it depends even more on certain people, who dare to make choices, and who also have a position in this. When I was reading the summary, I also thought of the statement of my dissertation "better decisions would be made if people were less afraid of risks". That came a bit from the company where I worked at the time. For companies with a lot of infrastructures, I think, they are woven into the culture, reliability, and good care for a good network. That is also very important, so exclude risks, but sometimes it is a greater risk to keep doing what you are doing. If you look at the energy transition, things are obviously going wrong there. We see on all sides that we are not achieving our goals and what is coming at us, and yet we still do not know how to make other choices or decisions that do contribute to this. There is still a lot of uncertainty and people also do not make choices and take responsibility. Of course, this also depends on company behaviour; for example, if someone says we are going to do this, he or she becomes responsible for it, and they would rather not burn their hands with it.
- What are common failures while working on an innovative project?	I'm thinking of an example. Sometimes you have innovative projects. Mostly it is often a project with a start and a beginning, for which money has often been made available or subsidy has been applied for, which you often have with innovations. Then, the failure is often in the last phase; you work towards the end of such a project, and a new project is started which looks like it, but it cannot always be transferred, for example.

Questions	Answers
	What do we learn from one innovative project, and how do we take care of the implementation of these learning's, and what do we have to do with them within the organization? In the market, this may also be the dead valley, which happens more for market innovations. Another important point where things often break down is collaboration. Collaboration is, of course, a very crucial one, where things often go wrong. I have learned with all innovative projects, to properly describe in the beginning what kind of result you want to achieve. Innovation is often about a new way in which you do not yet know how you are going to do it. You may have a certain idea about how you want to develop, but it can also very well be that partners have different ideas about it, or that you realize halfway through that you have to adjust something. However, in any case, it is important to keep each other sharp, at a certain point you are working on something with a certain solution and then that solution does not work, or it might work, but you still have to ask yourself were we also knew what we wanted to achieve with it. Thus, it is important during an innovation that you can always adjust the project, partners will have different opinions. That's why collaboration is so important, especially if someone leaves the organization and someone else follows up. If the new person is different, it can have a big impact on the innovation. I think that in general, the more parties, the more complex the innovation project becomes. It depends a bit on what exactly falls under an innovative project, but it always helps if the division of roles is clear. In that sense, the role division is a clear driver of the project. Another risk is, of course, financing. In that case, you talk about things that have not been started up. Financing has a very significant influence. For example, a director changes the organization, and how he or she leaves room for innovation can be decisive. However, talking about several parties, it is important how everyone is involved and what agreements you make with each other. Sometimes it depends on people that it works very well. But if it depends on people, the risk is that things might go wrong if the people working on the project change, so will change the agreements made amongst each other. Therefore, it is very important how everyone is involved.

Questions	Answers
- What do you think of the NEED project itself?	Well, I have a hard head, I mean, I'm always open to new solutions, but when I see a north-south line, I think how complicated could it be to build a good fast train connection from XXX to XXX. However, that has never happened. Just like nuclear fusion, those are such big projects. In that case, countries have to work together, and that produces so much politics, I think these kinds of projects are too political. A large energy island in the North Sea is, of course, also something that I might have thought of a little earlier. That's a little closer, better to have a grip on it. Public opinion also has a major influence, which in turn influences the political choices, and, eventually, it involves such large investments that these kinds of processes are much better done in China, for example. I go there every once in a while, and I think there they would just manage it. Of course, how they manage it is not always in a 'good' way - a lot of people have to make room for a while - but over there, the decisions are made easier. Over there, there is more focus on a community, and the entire system is geared to that. I once remember a documentary that was about whole windmill parks and there was a Chinese professor involved who was asked about how Europe did that (windmill parks). He almost laughed at us with our new policy changes every 3 years! I see that as a very big threshold or obstacle.
- What success and failure factors do you think a project like NEED will encounter?	If you think in terms of success, then I think about the urgency and necessity of the innovation. They create something that needs to be done, and because of that urgency, you can take significant steps. If you look at failure, maybe it can become positive if you do it out there at sea? People are relatively unaffected by it, and, otherwise, a lot more has to be done around everyone. Kind of; it's not in my backyard, but the other way around. However, I can also imagine that a lot of environmental organizations are against this innovation and how it affects the sea and the flora and fauna. So, you can expect contradictions that make the innovation very complicated. Therefore, you need a certain urgency for that and strong political ties or collaborations between the countries involved.

Questions	Answers
- Which factor is the most important and, which is less important?	The most important is the urgency to get the project done. The least important is difficult to name because you try to think about factors that influence it. I think public opinion and politics are very closely linked. So I find it difficult to specifically name a less important factor. I do think that economic considerations trump ecological considerations because that means that we are becoming more and more aware of the impact of our presence on the earth. However, I think that economic considerations are more important than ecological ones at the moment. Fortunately, we are becoming more aware of what can ultimately ensure that ecology becomes an important factor.
- Do you think that there will be unexpected consequences with NEED?	I think it is difficult to estimate exactly what the impact of NEED is on the entire North Sea and everything around it. That also has as a consequence. You either learn from where this could be applied well, or whatever negative consequences that we had not foreseen. In that sense, you will learn things along the way that you should avoid in the future. However, there will also rise new ideas and opportunities or solutions for this. For example, we will do a little more to deal with the North Sea in a different way, which might restore nature.
- To what extent did politics play a role in the implementation/development of NEED?	I can't imagine that this kind of politics can be realized. That also makes it the most difficult to implement. I don't think there will be realised such a dam without government support. I think it is true that politics is somewhat following public opinion in general. Most votes are also somewhat reflective of public opinion. To get the majority on board, I think that politics follows public opinion, which in turn follows urgency.
- How can environment/sustainability play a role in the NEED project?	Concerning the economic role, I think there are important considerations for administrators and decision-makers about such a project. For example; to what extent it has an impact on the economy and the environment and sustainability.
- How do you think the NEED project will be received in society?	In general, opinions are polarizing these days, so I think it will be the same here. That probably only makes it more difficult for such a project. Thus, there will be many pros and cons.
- What role will openness to society play in the acceptance of the NEED Project?	I do think it's important to open this up. I also think if you take a look at nowadays society, concerning all the developments that I am familiar with like heat networks, data centers, and wind farms, you generally do not get people on board when fixed facts are made public. If you throw it in the newspaper tomorrow as an idea, you will of course also get a lot of negative responses, so that doesn't necessarily help you either..

Questions	Answers
	However, you will still have to do so. It is a social project in that sense too. Being open and transparent in this case seems the only way to me, especially because at some point you'll get the public against you. If people don't feel listened to, it doesn't matter whether it's a good or bad project.
- What are similar/alternative solutions to the problem that NEED is trying to solve?	I was thinking, even though the dam may finally not come out, for example, could it be a step in a certain direction that does lead to a different version that is profitable for you and that everyone agrees with? That is why I also think that you should open it up. Exactly by doing that you start a conversation with society. Where we'll look at a response. What are the possibilities because we have to do something? So in that sense, I don't like striking the idea down either. It makes no sense and you show not spend your time on it. It also helps to get things going, to start radical innovations, and sometimes just do it and say you're going to do it at the very least. Then, it can open doors for others, and people come up with other ideas and other suggestions. Then, sometimes, things are set in motion that ultimately leads to alternative solutions.
- Who should take the lead in working on the NEED Project?	I am thinking, not a company, because it is a major social project after all. You can organize that in all kinds of different ways. Ultimately someone must be in charge, and at the same time, there must be some kind of committee present, in which the different parties are part. I don't think you can avoid having to have a representative from every country on that committee either. I think the countries behind the dam also like it, maybe in a different way. Of course, you have different ways and levels, but you have to agree with all those countries. And, if you're really going to implement it, you may want to limit it to a certain implementation team, with several partners. But you do have to make agreements with more parties.
- What do you think of the NEED project itself?	Well, I still have a hard time believing in it, that hasn't changed yet. However, for these kinds of large infrastructural projects, and certainly also in a world that is developed, this project would be viewed differently 100 years ago than it is today. So, the project remains a really difficult one, and at the same time what I'm saying; I am absolutely in favor of radical and new ideas and to at least look at them openly, regardless of whether it is a good idea or not. It might open doors to other ideas or solutions.

Table 18: Interview with E1 a Innovation strategic.

Appendix C: Innovation management prof. - interview.

Questions	Answers
- What is your profession?	Well, innovation management, you are doing that master, you undoubtedly know all about it. I am originally a Delft engineer, even a mathematical engineer. I obtained a PhD in the history of calculations and one of the cases was calculations for tidal calculations in the Netherlands in the 1930s / 40s. So that is somewhat close to your project, so I do have an affinity with these kinds of things. I also wrote a book on innovation management, just a summary of the whole field. I supervised a group of 15 people in innovation management. I mainly provide education for people in the field, which we call executive education. That's a bit about myself and these kinds of projects, the success factors. Of course, I have already sent you a paper with the success factors of innovation. This is always a bit of a difficult topic, success factors because that is actually very broad. You could wonder, if you have a list of success factors for innovation, why are you still doing research and all kinds of studies? So to speak, you have a list and if you apply it then they are ready. However, the problem is that in every situation the success factors could be different. I would characterize NEED as an innovation, which it absolutely is, and as a project that is a research project. An innovation project is something that companies have more or less already decided on if they seriously consider doing it in the short or medium term. However, this project is not yet at that stage. This is a research project, so, this project is very far ahead of the actual innovation. How well developed is this idea? For example, it is probably not yet really commercialized. Yes, what could be success factors for types of research projects? I don't have a simple list of success factors for such projects. I personally don't think that much research has been done on this. There are all kinds of clubs that have all kinds of research labs, but they are often looked at from the perspective of innovation management. However, the real research side, I would not just know from memory, where you will find the success factors. It is therefore more my intuition what the success factors are. These are, of course, a lot of success factors in the implementation. Of course, you have to have a good team, good cooperation, the right resources, you name it.

Questions	Answers
	You can name a whole list, if a project is not well organized internally, then it will probably not be successful, or the chances of success will be lower. If you don't have enough resources for your research project... Those are all important things. An enthusiastic sponsor or project leader, someone who knows how to radiate enthusiasm for the project and who really believes in it. Those are some of the obvious success factors. Perhaps a little less obvious, but what I think is very important is the link with what comes after. So, one of the failure factors, is that a fantastic research project is done, but after, it is not picked up by anyone. Because nobody sees anything in it and I think it is very important to make a connection between such a research project and the parties that should subsequently implement it. Include their vision in your project, which also includes their questions and objections. That's the most important factor. But then the real question, in this case, is, who would that be? That is, of course, disastrous to a certain extent, because those are huge lists of parties. The port of Rotterdam for example; it is a very big risk to think we are in such an early phase that it makes no sense to deal with those parties already. You need to talk. You should therefore investigate how the stakeholders are put together. However, then the question remains how to consult with them. Questions like: what is a consultation funnel, which phase of this project will you consult with, which parties, and what will you do with what comes out of it? In my opinion, that is one of the most important success factors. I've once studied companies in Germany. With every research project they conducted, they made a kind of scenario on how a research project would be applied in the products in the future. And they also discussed those scenarios with the product divisions involved. Which makes that you have different product divisions for one research project. In this way, you could also provide information to parties here, and not just to promote the project. But especially to get feedback. A natural reaction from the port would be, of course, huge locks have to be installed. Mammoth tankers and large container ships must be able to pass quickly. Naturally, you already think about that in advance, but aspects will also come up with the parties that were not considered immediately during the research project.

Questions	Answers
	That's basically my main response. You have two kinds of success factors. One is the internal organization and approach of the team, where you can of course extract all kinds of success factors from the literature about projects and teams. The other is that connection or link between a project and the later innovation activities and, in particular, the stakeholders who have to run those innovation activities. It is a huge list and you have to differentiate in it because otherwise you are just talking and you do nothing further. But adding some kind of structure to it.
- What part plays innovation in your daily life?	In my profession. Innovation is the subject of my activities. So, it's about innovation all day long. In my daily life, I will say that I am not the most innovative myself. I am not someone that immediately when a new iPhone comes out, I order it right away. I am a fast follower in daily life because I find that more pleasant. It takes less energy because the path is paved. So, in many cases, I am a fast follower when it comes to innovation. I am in favor of disruptive innovation, so simple solutions to problems, I am in favor of that. If I find a simple solution to a problem, I'm willing to try it out.
- What does it take to make an innovation a success?	I have already answered this question, firstly the list of success factors for innovation in general. You have to adapt that list of success factors to the type of innovation. Thus, for radical or incremental innovation, these factors could be different.
- What are common failures while working on an innovative project?	I once collaborated on a book about technological failures. I'd say it's a huge range, but what comes to my mind is optimism about the market. This happens a lot. For example, so-called ecosystem innovations. These are innovations for which different parties are needed to make them successful. For example, to stay in the former context, I did a workshop with the port of Rotterdam for two different innovations. One is an innovation on a platform for container bookings. Of course, you can never do that on your own, because you need all those operators and shipping companies to work on it. Another innovation was injection dredging in the port of Rotterdam, which also has many implications. Because, for example, even the insurance companies of ships have to be involved.

Questions	Answers
	Ecosystem innovations form the standard mistake. People first design their innovation and, when it is completed, people start thinking about what others have to do with it. This leads to gigantic delays because the others have yet to start. This all results in delays, which are one of the standard errors when it comes to ecosystem innovation. Therefore, you have to involve all parties at the right time and not only when the innovation is ready for the initiator.
- What do you think of the NEED project itself?	Sea-level rise is natural. I have the impression that it is not so certain yet though, but it can become a serious problem. Everyone is, of course, thinking in terms of what already exists. We are going to make the dikes higher and higher, but to look at it in a completely different way. I find that very interesting. Now this project has a bit of the disadvantage that it looks like classical thinking. Nowadays it's all much more of, try to follow nature and go with nature. This project is still really old-fashioned Ijsselmeer-related thoughts, we just put a dike in front of it. Having said that, it is a kind of similar phenomenon to nuclear energy at the moment. Nuclear energy was very dangerous and problematic for a while. Now it could be much better, but the whole public view about that dangerous nuclear energy remains. And that will also affect you here, as people say this is the old-fashioned way of thinking – again. If that sea-level rise continues seriously, then this could still be an option. Thus, it's creating an option for the future. It's quite interesting to find out. In that sense, I'm positive about this project. But environmental interests, are of course, a huge issue. People are talking about an airport in the sea. From a certain perspective that is very attractive, because then you don't have any noise pollution. However, the environmental impact of something like that on the seabed is enormous. The same applies to this project. What will be the effect on the fish stock, seabed life, the currents? The Gulf Stream can no longer go through the North Sea, so it goes around England in increased sizes, etc. Therefore, you have to find out what that all means. The environmental effects are enormous.
- What success and failure factors do you think a project like NEED will encounter?	I already answered this one in the beginning. The failure factor is the opposite of the success factor. A failure factor would be to just run the project on your own and only then find out that no one wants it the way that as you imagined. But there are also independent failure factors, such as optimism about the market.

Questions	Answers
- Which factor is the most important and, which is less important?	I have already said this. I think stakeholders are important and slightly less important is the internal process.
- Do you think that there will be unexpected consequences with NEED?	What is unexpected depends on how much energy you put into coming up with the expected factors. Eventually, I think that unexpected factors arise here too, maybe political issues or you name it. I don't think you will manage to foresee all of the consequences in advance.
- To what extent did politics play a role in the implementation/development of NEED?	The answer is a bit self-evident, gigantic of course. Including everyone behind it, even Latvia. This project is going to affect a big area.
- How can environment/sustainability play a role in the NEED project?	This question has been answered before.
- How do you think the NEED project will be received in society?	It is not just accepted, absolutely not. I think a lot of environmental movements will immediately respond negatively and I think they might have a point. This will cause a lot of discussions.
- What role will openness to society play in the acceptance of the NEED Project?	I would definitely create openness on this project. I don't think openness is always good, sometimes you have to keep it a little under the radar. But in this case, openness seems to me to be the only option.
- What are similar/alternative solutions to the problem that NEED is trying to solve?	You can, of course, raise the dikes everywhere. You can also just give up part of the country. Some people say we are all going to change the border to be placed around Amersfoort, for example.
- Who should take the lead in working on the NEED Project?	This question has been answered before.
- What do you think of the NEED project itself?	The answer to this question has not changed.

Table 19: Interview with E2 a Innovation management prof.

Appendix D: Hydrogen expert - interview.

Questions	Answers
- What is your profession?	I graduated 3 years ago in Delft from Applied Physics. Then I took six months to orientate myself to see where I wanted to start working. After, I finally chose to apply to a large energy company. For my first role, I started in the energy transition team of the company, mostly focused on hydrogen projects. So, we actually had a green hydrogen project there, and a project where hydrogen would be used in residential areas. The company will facilitate the storage of this and also a blue hydrogen feasibility study. So, that is really more of a generational side of hydrogen. In May last year, I started at XXX. That's focusing more on the value chain. It is a little more on the downstream side of hydrogen. The previous company was more about the development and this one focuses more on the application; where can we use hydrogen? Can we stimulate or create that market? Where is the demand for real new business development? Mainly focused on the Netherlands, mostly in mobility, but we also have other kinds of projects. However, especially since this year, we have started to have specialists in everything. So to speak, someone who is in maritime, but then maritime Europe, someone who is in aviation, but then aviation Europe. We still bring in projects in the Netherlands or discuss them and see if it is interesting and possibly link them to our specialists. I really like this job. You're actually in a kind of startup scale-up inside a big company. So, it's very entrepreneurial and you have to solve a lot of problems along the way. There isn't a structure for everything, so I can imagine if you are in a different place in the company, that there are a lot of structures and processes to start a project. And here really everything is invented from scratch.
- What part plays innovation in your daily life?	Especially in our work, we come across this constantly. In addition to innovation in hydrogen technology, we have our own product developers. We also have a lot of innovation in application possibilities or at all. I recently had a conversation with a colleague about a contract for recharge and that it just didn't exist yet. He was a bit bummed that he had to make that when it wasn't part of his job, but actually, he did take a step for the company. He just had to make something that wasn't there yet, or he had to do something to be able to take the next step. In addition, you naturally have a lot of conversations with umbrella parties, or governments, everyone is everywhere figuring out what role hydrogen will play in our society of the future.

- What does it take to make an innovation a success?	I think you need some persevering people, believers in the idea. I think you also need some early adopters. So, if you found something good, but you're the only one who thinks that's good, then it will never really be widely recorded. Eventually, it also just has to fit. Hydrogen is a good example. It is, of course, a wonderful fuel and could have been where it is now 50 years ago, but then the time spirit was not right. Now we see that due to the large use of sustainable energy, the electricity price is coming down. So, CO2 prices are going up and therefore it is becoming increasingly important. The emphasis lies on climate at the moment, so I think that you also have to have a certain amount of luck or momentum within society
- What are common failures while working on an innovative project?	I think on the one hand maybe it's generating momentum. Maybe someone has a cool idea but can't convey it well. I think, on the other hand, maybe it's an idea that's too early or too late. So, for example, the company tried to make solar panels as part of the company 20/30 years ago. In the end that didn't work out at all. I don't know much about it, but I did watch a documentary about it once and then it was discussed. Then it was more about the production side, and now we have a super good solar team. They don't produce solar panels, but they buy them from the parties who can do it well and they run the projects. They ensure that there can be a solar field somewhere, so it is also a bit what role you take in the value chain and play to your strengths.
- What do you think of the NEED project itself?	I think, in general, the feeling with the NEED project is 'go big or go home'. It's really over the top, very complex. Of course, you have to align all countries. That seems very difficult to me. Then, you also have to look at how you are going to divide the costs over these countries and therefore also the benefits. So, I'm glad I don't have to think about that idea! I also had the reflection that the Netherlands has its Delta Works and that must have been a huge investment at the time. This is such a gigantic investment! I think we got everyone on the same page with those delta works. That has all been paid for by the government. We are now busy with the energy transition. We are all in it, it should not cost more. In that case, I think 'guys can't we just talk about it with the mindset with which we founded those delta works then of time?'. If we can't apply that in the energy transition, what will happen? I'll move it a bit to my field. That was a reflection I had on this project. The energy transition may be less tangible and that one may have certain measures of information.

Questions	Answers
	Of course, we live in an information age, a lot of people have an idea that something is being taken from them and I think there used to be a lot more trust in the government and if the government said we are going to do this and everyone is going to cooperate.
- What success and failure factors do you think a project like NEED will encounter?	I think what a possible success factor is, depends on the organization of the project. You have to tap into all countries, so there needs to be an organization at the European level that has to look at that. I think that is a very important success factor, but also a failure factor. So, if the organization is not going well, it will be very difficult. This must also happen with certain seniority, if it is to be taken seriously. Of course, you are also asking for a huge investment from all countries. Therefore, I think it is also very important to clearly articulate the benefits, or what happens if you don't do it, and specify the costs. I think an important success factor is how you make sure everyone is on the same page. That everyone works on a project with the same degree of urgency. Which is, perhaps also very important, if you have a huge amount to spend. How are you going to prove that this is the best way to spend this amount on this? You will of course get people who say invest this amount somewhere else, for example, education or health care, we will get much further with that.
- Which factor is the most important and, which is less important?	I think that in the end the project succeeds or fails with public opinion, which drives everything. If you look at the political opinion, which again leads to the politics and public opinion, it can also generate a lot of protest of 'this is not where we want the money to go'. I think that a major driver of public opinion is, of course, climate change. If climate change suddenly continues very much and the sea level starts to rise, people see the consequences of this, and then I can imagine that the urgency of a NEED project suddenly increases significantly. So, I think it is very important. The least important factor is difficult to name, I think many factors are important and amongst the factors that play a role in NEED, there is not a least of less important factor.
- Do you think that there will be unexpected consequences with NEED?	I lean more towards the unexpected negative consequences. I'm always like that, with these kinds of projects. You naturally intervene drastically in nature. On a scale where you don't know what the consequences could be, and that it is therefore very difficult to modulate. I am not an oceanologist myself, but there are currents along these dikes, for example, that affect the temperature in the Netherlands. For example, maybe if that current just brought in heat or energy, does it suddenly become a lot colder or just the other way around?

Questions	Answers
	Maybe it also had a cooling effect and it just gets warmer. And especially the animals, they can no longer suddenly pass. You have a huge portion that isolates you from the larger oceans. These may not be unexpected consequences anymore because you can already think of it, but what does it do to the fishing rates? In the summary, for example, the shipping industry was already on offer, which is interesting for us too. Should the port of Rotterdam relocate? So, intervening in nature has consequences. However, when you talk about unintended positive side effects, I often think of technological developments that have been included in the process along the way. I'm not a civil engineer myself, but it doesn't seem the most high-tech to me. It's making what you already have a little bigger, maybe you need some material developments to achieve that certain firmness. It seems to me that most of it already exists. For example, if you look at windmills, certain materials have been innovations to make them bigger and bigger, because the bigger the windmill, the cheaper per energy unit you could produce. So, I can imagine that to make a large dam on this scale, some material innovations also have to be made. Thus, I think that is an unexpected positive consequence, but again I'm not a civil engineer, maybe it's already possible, with the technology out there.
- To what extent did politics play a role in the implementation/development of NEED?	Yes gigantic of course, because you influence the coastline of all those countries that border it. I think, as said before, one of the key success factors is the alignment of political and public opinion.
- How can environment/sustainability play a role in the NEED project?	I think if it is very drastic for the ecosystem of the North Sea, it could be a potential breaking factor or a negative factor. I think that if the sea level suddenly starts to rise drastically and starts to affect people's daily life, then I think that you will suddenly have a flight in your momentum towards solutions, where NEED can be one of them. Under the condition, of course, that the amount of momentum could perhaps better be put into prevention concerning sea level rise, instead of putting so much money into this project now, which is only treating the symptoms.
- How do you think the NEED project will be received in society?	That is of course very difficult to answer because society is very mixed. The question is, of course, how do you distinguish between an average Dutch person, perhaps a highly educated person in the Netherlands, and people who have to make ends meet on subsidies.

Questions	Answers
	I think, that a certain part of the population might not even understand, why to invest so much money into this project. I think it also depends a bit on the benefits. If you can articulate very well what the benefits are, then the techies will probably think that's all very cool, this is good. And then you get those people to play an ambassador role for that, to convince people. I think, in general, people think it's a really big project, and it's out of reach. Of course, you have to think big when it comes to innovations.
- What role will openness to society play in the acceptance of the NEED Project?	I think you should always give the highest degree of openness that you can give. I'm always the biggest fan of that myself. I think that makes it the easiest to have a dialogue. The only thing to keep in mind is that you might scare people unnecessarily. You always have to be careful how you communicate risks. When you say "there is a 0.001% chance that something will go wrong", which may actually be a non-existent issue, people will bite into it anyway. Words could be twisted, so the question is 'should you start about it or not?'. However, I would try to always ensure the highest degrees of openness
- What are similar/alternative solutions to the problem that NEED is trying to solve?	Yes, I think you will end up what we discussed a bit earlier. I think NEED comes across to me mainly as a symptom approach of combating the sea level rise. I would rather see that we tackle the cause, that we use the amount that this project costs to store carbon dioxide, to build additional sustainable energy. To kick start the hydrogen economy, to plant trees, to look at bio gas installations. To give such solutions a boost would be better. And also to see how you get the rest of the world on board. That once that money is available, how do you get China and America on board?
- Who should take the lead in working on the NEED Project?	I think the EU should take the lead on this and then maybe a committee of that should be appointed. Ultimately, I think that the EU should have the coordinating capacity and be the main stakeholder.
- What do you think of the NEED project itself?	I think it is a very large project, complex, difficult, but in that sense also stimulating and exciting. It has a certain challenge, it stimulates thinking, so in that sense, I absolutely like that! Therefore, thanks for that!

Table 20: Interview with E3 a Hydrogen expert.

Appendix E: Project innovation advisor - interview.

Questions	Answers
- What is your profession?	My profession, I work at XXX and I am in the knowledge and innovation department. In this, I have a role to investigate ideas or thoughts about sustainability or the living environment, and to look at social added value or economic added value for the company. More generally, social interest is looked at and I am currently working on generating sustainable energy on XXX grounds, with a zero-emission construction site.
- What part plays innovation in your daily life?	Yes, I am mainly talking about my life as an employee,then I mainly look at new things and new opportunities to improve our work. We have also set up a few transition paths based on a wish in the future, to work towards that. As I just indicated, I am currently working on a zero-emission construction site with the aim of making it possible by 2030. To achieve no more emissions of particulate matter or carbon dioxide by 2030. You'll have a more distant goal and we are now trying to investigate what the best actions are to get there. The company is somewhat at the end of a chain, we mainly buy in. Sometimes radical innovations are needed, but that is not always the case. We are mainly at the end, where the radical idea has already been translated into an application. So, the radical innovations are often just in front of us, which is researched by scientists etc. and we come up with a practical offer.
- What does it take to make an innovation a success?	Yes, let me start by saying that there is a general line of how you can talk about innovations. The TRL is a famous example of this as a method. You start with an idea and you end with an application, and determine between steps that you have to go through. Of course, you have more such models. I think that those models indicate how you get from an idea to an application. The art is often about a specific challenge, that each innovation has, and how to deal with it. It is, therefore, always custom work. And dealing well with that customization is where the success lies. One asks for a change in the law, the other asks for a new material that is not yet there. Another innovation asks for users to like it, and that is the case with each innovation that you have; there's a different target group or obstacle or activity. And being able to deal with that well, makes an innovation process successful. And if you look purely at your question, "what makes an innovation successful", then it is natural that it is intended for broad application.
- What are common failures while working on an innovative project?	Yes, where it usually goes wrong is that you have insufficient idea of who is really important in certain phases of the process, but also important in the coming phases.

Questions	Answers
	Where things also go wrong is that you do not collaborate enough with people who have an interest in the project. Especially, in the beginning you have to drag yourself very much on an idea, 'Look how brilliant idea I have'. However, once that idea works, then it is no longer the idea that needs to be formed, but a huge group of supporters what you have to shape. I'm assuming like 20 percent, but that's not so important. Of the people involved there should 20 percent at least think this idea is pretty good, I like this,this has many advantages indeed. It must have support. So, you start tinkering the technique with only a few people. The tendency is to continue with that technique, and to keep saying 'Look how fantastic the technology is!'. What you actually have to do halfway is let go of all the technology and focus on the application and use, and find partners who provide financing and who ensure that training is provided, in order to use that technology in the future. It is therefore more about the stakeholders around it that you'll have to focus on.
- What do you think of the NEED project itself?	Yes, in that sense, it is not new for the Netherlands because, of course, we have already done it ourselves (dikes). So, in that sense, the closure of the Zuiderzee is a great example of what this idea is directly. So, in that view I think it is feasible and a good idea. Building a dam 161 kilometers seems feasible to me. I don't know exactly how deep that is, but that is still a challenge, but the place will most likely have been chosen because it is just not deeper there than other places. It absolutely is a huge challenge, but if you compare it with the dikes that you otherwise need, it is relatively short. I don't know to what extent the other countries already have a problem (with the sea level rise)? I think you've already looked into that more. The Netherlands is already in trouble with a 3 meter rise, a lot of other countries still have a coast that only starts at 3 meters, so I have a little less insight into how long the other dykes are now and what that costs. That could perhaps be a calculation for the project? What are the current dikes like, and what does it cost to maintain, and what would this cost? For example, I always look at an innovation or an idea, like: 'What have we lost now? What would this save and if that gap is big enough?', then you'll have enough to start. If that gap is very small, you will get a lot of resistance in the organization and from those who will pay for it. That will only work if the opportunity is there in the form that the profit is large enough.
- What success and failure factors do you think a project like NEED will encounter?	After, what I already said a bit, who benefits from it and is that advantage large enough for that party to invest.

Questions	Answers
	An investment agreement will therefore have to be made between all countries involved. There will also be some resistance, because it is one of the busiest navigable routes, that will not get support just like that.
- Which factor is the most important and, which is less important?	I find that difficult, then I should delve into it more. But I think many points are important. In the first instance it is the technical side. You always start with that. And something like a business case feeling, for example the depth is 300 meters and how long is that and what does that cost in terms of activities? Then, you can start thinking that I can organize it in such a way that it becomes profitable. Just to brainstorm for a while, you might be able to put solar panels or windmills there that provide free energy with which you may not build it in 2 years, but maybe in 100 years. The time in which you make something can also have an effect on costs and how you deal with it. So, you can start applying different building strategies and if you have insight into that, the technical part. Then comes the whole public part, the English find a tunnel scary, let alone if you get a dam to their island and then also to France. That can be quite a bit of feeling which in the first instance does not invite them into this project. And, a disaster always helps. The plans for closing off the Zuiderzee and also the plans for Zeeland were already there. But first there had to be a flood in order to mobilize enough people and also to free up enough money to realize this. However, like I said you shouldn't call this 'We're going to build this project for a while', but more of us will probably start now and we do a kilometer or so every year. When that's not too much, you could do 4 or 5 kilometers every year, and then I have no problems at first. You don't affect shipping yet and all other things. So that when you become really risky, you can take the last steps. But, of course, that beginning also tells you which way you are going. So, the start must also have an advantage. I think that is also a challenge! How can you have an advantage even with 200 kilometers of dam? Maybe because you put the windmills on it or make a different combination function out of it. Basically you have to make that thing pay for itself because it's already such a challenge. I can't tell you the least important factor, because that also differs per phase. In the beginning it just has to be technically possible, so that's the most important factor. You just need a good story that is technically possible. Then, when you have demonstrated that, the public and the money become much more important.
- Do you think that there will be unexpected consequences with NEED?	Yes, there is a lot to come. The North Sea is protected for I don't even know how many animals,

Questions	Answers
	and then the idea is to close it. The tides disappear and I don't expect that's an easy thing either. Of course, you can start talking about water safety, but everything that lives there and everything that is there now, perhaps also what you want to protect, will disappear. You can also see that in the quite dead parts that now occur in the former Zuiderzee. Although that has become sweet, nature has also been completely destroyed there.
- To what extent did politics play a role in the implementation/development of NEED?	In fact, I think you're still too early. I don't think there's any political support yet. I think it is time to plant the seed and the idea and substantiation of that it is possible. I think that's what you can do now, but the Netherlands does not yet have the feeling that this cannot be controlled at the moment in terms of dikes. So, I think the idea is still too early. Our rivers still drain properly, they can simply discharge into the sea, but if the sea level continues to rise, then at a certain point you will get that the salt runs into the river and that you also have to raise all the dikes of a river! If your sea dikes also have to do something with it, then it becomes a tangible effect. People love that. What can speed this up is that you can indicate that if you have the noticeable effect, then you are actually too late. Then, you could say that we are already building at least half, for example, or are already starting now. Then you have to get a fund, or you have to say, like the Netherlands, that we will pay ourselves. However, I don't think there's a big chance that we will invest without there being a clear added value. For example, what I said earlier with the windmills and solar panels. Therefore, politics has an important role to tell the people that this is a solution. However, a politician will only really move if he feels 'I can now justify this'. Like I just said, the flood disaster'; a politician could then say: 'We are putting away a few billion to do something about safety.', but until then I do not expect a very active attitude from politics in that regard.
- How can environment/sustainability play a role in the NEED project?	My main expectation is that shipping will be a major obstacle, and subsequently the environment will definitely be a major opponent. You get tides for a large part of the North Sea, I can't estimate those effects, but I don't think they will embrace this project as a first measure/solution.
- How do you think the NEED project will be received in society?	I think you will not get a cheerful response with the environmental clubs. I also think, it is too early for the general Dutch person, they feel no effect yet. I think, you should start looking for supporters who already benefit from a piece of dike in that location, a windmill park, perhaps organizing fish farms?

Questions	Answers
	Whatever you can do there to make it profitable and you can get a group of allies that already have an advantage because otherwise you really have to wait until there is a lot of pressure. Especially because people will otherwise list the North Sea as one of the most beautiful natural areas in the world.
- What role will openness to society play in the acceptance of the NEED Project?	Well, this will cost quite a bit, so, you will have to do something with the public and therefore openness. You will have to push a good earning model through it. However, you will still need Norway, England and France. You can't do it alone. It's not something that you can push through, certainly not when collaborating with two stubborn countries. And also other countries that have to pay. Therefore, this is not something to do secretly. Maybe the decision will be heard, but I think there should be some variants on the table first. There should be discusses bout the place, cost-efficiency or shouldn't the Dutch just move? The shipping industry will always be able to say that it is still more convenient to do things differently, I think. You will have to find out where are the vulnerabilities and therefore which countries will benefit from it and is there something that is worth a lot to keep, that is a good inventory to compare against your investments.
- What are similar/alternative solutions to the problem that NEED is trying to solve?	What is discussed in the Netherlands is that we should have an airport in the sea or another coastal defense. That you supplement some more sand so that it becomes shallower and thus reduces the wave action, there are quite a few variants that you will do first. This (NEED) is a variant that, if all those solutions no longer help, and you have tried everything, then, it we decide to move or give up the North Sea. I do not expect that this decision has to be made between now and the next 60 years. It's really a plan in which I don't think we will get a role in, but maybe you can already see if you can do something that makes it easier to do it later. Plan your windmills, ensure that the infrastructure can supply power to excavators or other equipment, for example. In that way you can already think about what you actually need to build and we can already work towards that by planning things that can contribute to that. However, when we get to that point, I think there are still a lot of alternatives. For example, raising the dikes by one meter, seems to be a good thing to me. Until you worry about costs and you say right now, it will even be interesting for the Netherlands to do something now. And that would also help. I suppose you can already build 200 kilometers and with that you might already influence the tides so much that the storm surge,

Questions	Answers
	for example, decreases or the pressure on it. That, might also be enough to make it interesting. For what I have been told by technicians, what we have done in Zeeland with those sliders, we might not do that anymore. Then, we would, for example, just make islands as they were, which you can sail around. You now put it as a dike, but perhaps it could also be a set of islands that ensure that the pressure decreases a bit or that the effect of the tides may decrease slightly. This might also reduce the pressure on the dikes. So, a little thinking about in between solutions seems very good to me.
- Who should take the lead in working on the NEED Project?	Of course, it starts with whoever has the greatest need for it, so I expect the Netherlands to be in favor of the plan. If you want to put someone in charge, it's going to be a three captain thing. It is very difficult to work with three captains. You cannot ignore England, France and Norway. Even if you put money on it, they'll have all the arguments why they don't want it from their port or whatever perspective. So, I don't think I can answer the leadership yet. I would suggest to make the plan together and coordinate it. And then, at a given moment, appoint a project leader. If necessary chose for a German or a Swiss project leader or someone from somewhere else, who is independently responsible for it. So, I wouldn't give one country the responsibility to build it. I would, if we make the decision together, and then we hire someone to do it.
- What do you think of the NEED project itself?	What I said before, the idea is simple and clear and we've already done it ourselves. So, that fits in with a lot of things. However, the impact it has on all countries, and especially the North Sea, is so enormous that I don't expect you to start with this soon. So, you will have to come up with steps that also yield benefits. Enrolling NEED may be a final phase. It will not work yet, to get a signature with France and England and Norway. If we are going to put down a few billion, there are still some steps to come. Costs are no longer relevant if you had to move all of them. Just look at COVID-19, if the need is high, something will be arranged. And if you already put windmills there, that you slowly could build a little bit each time, maybe you can also look at this project from a different view. Not like; we're building that dike in a few years, but we're taking baby steps based on renewable energy from Norway to that depth every time. And, if you do that long enough, it might not cost that much at all. Then, you just use the time! The faster, the higher the costs.

Table 21: Interview with E4 a Project innovation advisor.

Appendix F: Civil maritime engineering tutor - interview.

Questions	Answers
- What is your profession?	I am a teacher in maritime engineering at the XXX school. I have studied maritime engineering myself, but now I teach the theoretical subjects of maritime like hydro-mechanics, mechanics, the strength of materials, and mathematics.
- What part plays innovation in your daily life?	In two areas, first of all, innovation in the educational world. You have a double profession, you are a teacher and technician. Especially in the past year with Covid, we have experienced a lot of innovation in the field of online teaching, online testing. So, in the field of education, we are continuously innovating. On the technical side, I see that many of our graduates ending up with assignments where innovation plays a very important role. And then it is mainly the application of innovations in a new environment. So, for instance, they look at what happens when a ship runs on fuel cells or runs it on hydrogen. So, especially using the practical side and the practical applicability of those innovations in daily life. Almost all of our students work on projects that are sold later. Those innovations are further developed with the idea of applying them, certainly not all of them, but a large part, which is of course very nice.
- What does it take to make an innovation a success?	That is a very good question. I think that for a successful innovation it is necessary to connect several aspects and therefore really come up with something new. Usually, when someone comes up with something really clever, where one thinks "oh we should do that", the first question is why don't we all already do that if it is really so genius? And that usually brings you to a lot of points. For example, you can't build it, or it's too expensive, or it simply doesn't work. I think the moment several things come together, for example, certain production techniques will become cheaper, and perhaps the computing power in other areas will be slightly increased. Then, suddenly things become possible that were not possible before and that is innovation. I think having a wild idea is just not an innovation. But the innovation is: actually applying the wild idea and that often requires more than just one thing
- What are common failures while working on an innovative project?	I think that a lot of great ideas will eventually fail when looking at the costs. It has to be paid and I think a lot of things can be done, but it is not yet cost-effective to make them a reality. It is difficult because the question immediately becomes who is going to pay for it.

Questions	Answers
	You see that, for example, with us in the maritime sector that innovations that are about reducing emissions/exhaust gases, the general idea is what I do not burn and I do not have to buy, so it is just fuel cost reduction. These innovations are going quite fast because they are very interesting to explore in terms of financial reasons. While innovations that are purely about being better, for the environment, but that deliver little financial return, you hardly see them getting off the ground. The financial aspect is an important point because I think that a lot is possible in technical terms, but that it does not pay off much. After all, it is still too expensive.
- What do you think of the NEED project itself?	Yes, it is a very wild idea, I think it is technically possible but enormously expensive. I think the question is whether public opinion will ensure whether this is paid or not. I expect the public opinion is going to be very opposed. It will be very much formed by environmental organizations that will say that it is very bad for the North Sea and the climate, etc. and I think that's why a public opinion can eventually be negative and then it becomes very difficult to justify why we have to spend so much money on it. You not only see the polder model in the Netherlands but also Europe, it does not contribute to these types of project. You also see that, if you look at the history, very great things were achieved because there was a strong monopolistic power. The monopolistic power said "we are going to do this now" and it happened. Just look at what they are building in China. Look at Germany in the second world war, what they all build. In the NASA program of the 1960s, in those two front struggles, suddenly materials, and money, and resources could be created. Fortunately, society is no longer like this nowadays, which makes this very difficult.
- What success and failure factors do you think a project like NEED will encounter?	The environment is an important role and I think that it should be looked at carefully. For instance, what is the effect on not only marine life, but also the currents through the North Sea, the tidal currents, our West Frisian Islands, etc. So, we should not only look at the seals and the fish, which is very important as well, but they will find their way again. I mean the IJsselmeer is not dead now either, so that will be replaced by something else, I think. But of course, I think it is important to look at, for example, what the sandbanks do off the Dutch coast, what is the effect of the sand that is there on our dunes, and we may end up weakening our natural barriers by removing that current from there.

Questions	Answers
	I think that would be a really interesting one for me, which I would want to know that answer, first of all, looking at the environment.
- Which factor is the most important and, which is less important?	Yes, that is a very good one. Because I think that the environmental aspect is the least important to me, but it will be perhaps the most important aspect for the public opinion. And over time you see with these kinds of things that the authorities do not make enough effort to propagate and weigh up the importance of the project. And then, at a certain point, public opinion runs off, and then you usually get a less nuanced picture. But I think an important one is going to be, how are you going to manage this, how are you going to sell this, how are you going to demonstrate that NEED is really necessary? That the adverse effect attached to it is worth it. For me, the most important is the technical side and in particular keeping certain parts of NEED open. You are not allowed to close sea trade, so how are we going to approach this, and how are we going to ensure that we can build all those dikes technically? And the question is true to what extent should this actually be a complete dike such as the Afsluitdijk, or can an intermediate form, such as used in Venice, be placed there? I think those are interesting questions, which I think are very important. And I think you have to answer those first before you can make NEED public.
- Do you think that there will be unexpected consequences with NEED?	Yes undoubtedly. The question is, of course, can we predict it or not? I think you will come across things that we had not expected at all, but I do think that when you build a dike of this size you will run into problems with scaling up. If you make everything twice as high twice wide, then it's not all scaling linearly. I think you're going to come across things there, especially in the part before Norway of 300 meters deep. That is good, but what that exactly is, is, of course, difficult. Of course, you cannot say that in advance. At NASA in the 1960s too, we're not afraid of all the thousands of things we know could go wrong. We fear the things we don't even think about where things could go wrong. So, those are things, I also think that can have effects that you may not anticipate in advance. An interesting question is, for example, what will happen to the temperature of the North Sea. That Gulf Stream that runs along up there near Norway, may not come in anymore. However, a lot of glacier water is now coming in. I don't know what that is going to do. Is it getting warmer because it is standing still? And what is that going to do with the climate and the weather around it? Certainly, there are things we cannot fully account for.

Questions	Answers
	I think we will create small innovations, but since, in principle, the solution is less complex. It is just a big dike, I expect that there will be fewer positive side effects. Although I do not immediately want to say that all the effects that it may have will necessarily be negative. But I do think that we are now in a time where we have to think very carefully about what it all means and formulate as many answers as possible. And not like in the last century of fuel for motorcycles. We now go everywhere, but we have of course made some mistakes with ozone, CFCs, fuels, etc. We have to think more carefully before we know this is it.
- To what extent did politics play a role in the implementation/development of NEED?	Yes, a very big role, but politics usually plays what lives among the people. So I think that as a driver of the project, politics should be used in a good way. And that means that you should try not to use them at this stage of the entire project. I think things will go wrong if politics becomes a driver of this idea. What you have to do is you have to go to the audience now and you have to go and say guys we have a huge problem. Because if that sea level is going to rise, and you have to make sure that it is going to live with the public and that they go to politics and guys say you have to solve that for us. And then when that politics comes, after this we can do, then you have some kind of support. If you start this with politics and propagate politics, we have to do this and then because then it goes wrong, you see a lot of those projects, then the public stands on its hind legs and it never goes away want to walk. You see that in all referendums that went wrong, in everything. So I think you have to be very careful with that, who's going to drive this. And you would want public opinion at some point to say we have to do something about this and then politics can act on that and say this is an option and these are other options. We must of course also look at that. But in the end, politics is the one who has to get it done, those are the people who are ultimately going to arrange the large resources and everything because this can never be done privately.
- How can environment/sustainability play a role in the NEED project?	Well, I think the effect on the environment will be very big, I think so. The question is whether all of this is necessarily bad. And that will also have to be evident from what the dike will ultimately look like? What is the rise in salt seawater, what will still come through? So, that is a bit of the question of course, but that it affects, yes absolutely. We now know enough about this with the Delta Works, that even a semi-open connection such as the Oosterschelde barrier has a major effect on the water behind it, say.

Questions	Answers
	So that is something that you will have to accept as people on the North Sea and the Baltic Sea and the Baltic Sea, that it will change.
- How do you think the NEED project will be received in society?	I think NEED is not accepted at the moment. but this is mainly because at the moment the rise of the sea level is hardly on the agenda of the people. And in the Netherlands maybe a little, but the countries around it, which all have effects, I think much less. But even in the Netherlands, it is not so bad at the moment. We had, of course, in the 95s of the last century. A few episodes with those rivers made it very exciting, people who had to be evacuated, and then it was in the spotlight for everyone. And now, other challenges have taken over and that sea-level rise doesn't bother anyone at the moment. As long as that is the case, you can say we have to build a dike, but then no one will agree to that. I'm talking about the Netherlands, but countries around us feel it even less natural.
- What role will openness to society play in the acceptance of the NEED Project?	I think it's very important. I think certainly with this extreme case, you have to come out and indicate this is necessary to turn what is coming our way. Then the first reaction will be, yes nonsense, it all doesn't work out that way, what a ridiculous project and it is most expensive, it will never happen anyway. But then it is there, at a certain point acceptance will arise if you constantly pass on that message. This gives rise to the idea of maybe it is necessary after all and it may well be that we eventually come up with a slightly less drastic variant. I think that openness is very important in this and that people should know this. And I think the first pioneers of the Delta Works will also be crazy. Why build a dike? But that is necessary. You see that in other areas too, but I also bring in space travel. That if people don't keep shouting, in 2040 people will walk on Mars, and people will live and work on Mars, then it won't happen anyway. Of course, the same applies here if this is kept quiet, and nobody says this is necessary, then nobody will eventually accept that it is coming.
- What are similar/alternative solutions to the problem that NEED is trying to solve?	Yes, that's funny because that's what I was thinking about this week. This is a very radical plan, and I thought what the heck, especially responding to the fact that Norway lies three meters higher than for example the Netherlands and their villages are all higher and in England, it is not that bad either. You can, of course, see if you can build a kind of smaller variant of this together with the Netherlands and Germany, and maybe a bit of Denmark, starting in Oostend and building around the German Wadden Islands.

Questions	Answers
	That is all low water; build a dike there that is 40 meters high, at least from the water depth. And just one big dike around the Netherlands, with a few holes than for the harbors of Rotterdam and Vlissingen, etc.. Maybe you could grab a piece of Germany, but then you can finish it with less length. You can finish it much lower and you keep the problem with us. This also means that the effect of the environment on us is great, but the Dutch fishermen can still go sailing and fishing, etc. And that the support we just talked about may already be there in the Netherlands, but in the rest of Europe it is not. That has also been tackled. It is then somewhat local, on the other hand, if that sea-level rise does not stay at one meter, but it goes towards 10 meters, then you probably won't be able to do that either.
- Who should take the lead in working on the NEED Project?	Yes, that is a very good question I think a knowledge group should be. So knowledge institutions preferably from the countries involved that together set up a group that will advise. In doing so, make use of private companies that say what they could do technically. And only later that politics may be added. Because if you are going to bring this through environmental organizations, etc., it will immediately get a stamp of which it is not necessarily good. E.g. Greenpeace also has an opinion about everyone, you have them again, and you shouldn't have that. While you can now see from the whole Covid affair that everyone benefits quite a bit from. We let a group of experts determine what is best for us. The OMT sometimes gets in a bit of contradiction, but they are quite solid in this crisis. And if politicians can listen to that and the public can listen to that, then something will come. And then the private companies step in again, which will eventually save the day. I think it must come from something like this.
- What do you think of the NEED project itself?	Yes, I think it is a very ambitious project, which shows the challenge we face. But I don't think it's going to happen. I think it's too radical. It will eventually meet with too much resistance in society, but with a dam around the Netherlands in itself, you have something. For example; linking islands together with a dike, if it turns out that it is necessary, we will do that. However, then the need has to be there again for a while.

Table 22: Interview with E5 a Civil maritime engineering tutor

Appendix G: Civil hydraulic consultant - interview.

Questions	Answers
- What is your profession?	I call myself hydraulic consultant and hydraulic engineer, I studied hydraulic structures, a Master at XXX. So, the name says it all: hydraulic constructions, with which I help to design them. I've been doing that for a few years now, and it's great fun, especially because we're so good at it in the Netherlands. You probably hear that often, very much to my liking.
- What part plays innovation in your daily life?	I might think even more during my studies, when I looked at the probabilistic calculation of constructions. Determining your optimal construction based on probabilities. And, I am now trying to apply that more and more with us, which is very much related to my work of course. And looking at my day-to-day life. I think we all like it when there's something of innovation, when we can work with technical gadgets. Whether it's our laptop or phone, I think it plays a lot in daily life. I do notice that things are a bit more difficult in business, everyone is working on digitization and automation and we work with various calculation sheets that were drawn up years ago. And to make all this happen a little faster and to transfer it to 3D models, new calculation models, probabilistic calculations, etc.. We are busy with that. Only you see that things are just a bit more difficult in business and there is still more focus on project work where immediate profit is made and less in the background the internal activities such as the innovations.
- What does it take to make an innovation a success?	In order to involve it in our work, it is mainly time that we need. If we get the time to properly research these kinds of innovations, and work them out properly, we will eventually succeed. But the more complicated something is, the more time it takes.
- What are common failures while working on an innovative project?	I think that people are quickly put off by innovations, that there are a lot of bumps in the road, that it either takes a lot of time or a lot of money, or other problems. However, I really think that an innovation costs a lot of time and money in the beginning, and that it will pay for itself later. So, more the fear of an innovation and that people or companies feel too inhibited for an innovation.
- What do you think of the NEED project itself?	I think it's challenging, in any way. I don't want to immediately fall into my own pitfall by burning it down right away, of course. The first thing I immediately think is: Is NEED really necessary?. We are dealing with a relatively low rise of the sea level, which will continue to be the case in the coming years.

Questions	Answers
	But, for example, we now calculate with some sea level rises for the Afsluitdijk, roughly in the 100 years we take into account approximately 60 cm. I can't remember exactly by heart. But, well, in the even longer term, although we are not talking about hundreds of years, but thousands of years, then it might be necessary a little more. So, that's the first thing I think, is it necessary. There are also really quite a few snags. I think that a lot is technically possible, and is also possible. But, of course, there is more than just technology to make this project a success. It's really a worst case scenario as far as sea level is concerned, of course, or whether it could be related in the very long run. In addition, it is also questionable to what extent temperature has an impact on our water level rise? It could also be that it rises a bit more around the equator than with us. How are those currents going to work? The salt flows from the north to the south. There are so many uncertainties in it. But that's why I think it's really cool to be working on this already.
- What success and failure factors do you think a project like NEED will encounter?	The big advantages are that you can regulate the water level in the bay that you actually create, the closed part so to speak. We are also doing this on a small scale in the Netherlands with the Afsluitdijk, in which we mainly have to keep the dike itself water safe. Therefore the surrounding dikes around the countries themselves, along the North Sea and the canal in this case, do not have to. To be less safe, or less high, less strong. So, I think that's a big success factor that you take. Possibly you could still get success from doing something to generate energy, from those water level differences. That is a very general statement, but you can possibly do something with it. I think if the sea level is really going to rise that fast, then I think it could be a success. In that case, the public opinion will see that NEED is actually necessary and we actually have something to do with that, a great need. And if that's just the opposite, then public opinion will eventually turn against you, but that's more in retrospect. In advance, there will be a lot of fuss, especially the ecological damage it can cause, that it's likely to become freshwater. What will happen to the fish stock in the area? The fishing industry? There are a lot of jobs related to it, especially in this area, but shipping also has to go through those dykes. How does it affect the ports of Rotterdam and Antwerp, for example?

Questions	Answers
	Technical feasibility is also a challenge, you see a deep gully along Norway, how are we going to fill it? Looking at politics, what standards are we going to impose on them, who is responsible for maintenance? You name it. So, actually more failure factors than success factors if I quickly mention it.
- Which factor is the most important and, which is less important?	I think public opinion is very important these days. Plans can be made, but if most of Europe turns against this plan, for whatever reasons, economic or environmental, I think there will be so much pressure on politics that it has little chance of going ahead. I hope that the economic factor is less of a factor, but I think it will also play a role. How much will it cost and what will it yield? And I hope that ecology is an important focus. You see that coming back more and more. In the past, less attention was paid to ecology, the impact of the Afsluitdijk on the IJsselmeer. Bas Jonkman has also said, "in this time no more Afsluitdijk would be built", at least not in this way. Many other plans would then have to be devised around it.
- Do you think that there will be unexpected consequences with NEED?	Yes undoubtedly because it is, of course, a work of art and construction that has never been executed on this scale. So, what can we expect? I immediately think of technical challenges, and of how are we going to realize that. We can make a design that complies with that, but that is also a challenge. But, I think, especially the execution of it is something that has never happened in that way before.
- To what extent did politics play a role in the implementation/development of NEED?	I think it plays a major role, especially to get that public opinion on board. In any case, good agreements must be made between them. As I just said, under which standards the standards are applied and who is responsible for maintenance, and so on. But, it will also have to be jointly looked at how we are going to reach public opinion in this, and yet include it in this story in such a way that people get behind it, or at least get a good idea of what the intention is. I'm not a politician, of course, but that comes to mind.
- How can environment/sustainability play a role in the NEED project?	As mentioned, the project has a major impact on the local environment. So, what will it do to the North Sea and the canal when all this is realized? I think mostly it's negative. It's just really hard to maintain the ecology in the area as it is now. that's what people want nowadays, as natural as possible. If human adjustments are made that disrupt that, you no longer have an ecological balance and the whole system will have to develop again until there is a new equilibrium. I think, with this plan in this way, a lot of flora and fauna disappears in the area.

Questions	Answers
	That's just negative. In terms of sustainability, it could also regard it as sustainable by keeping the land safe behind NEED and habitable for a longer period of time in this way. Thus, that in turn, it has a positive impact on the hinterland, even if this is not the only solution, of course
- How do you think the NEED project will be received in society?	I think that people will first give a violent response; that pieces will be written immediately about what impact it all has on the environment and how much it all costs. Who is going to pay for it all, the effect on jobs and the like? However, people always have to get used to change anyway, of course. I think in the beginning it will be a kind of shock. It also depends a bit on how it is presented. I Suppose those plans are once presented in this way, then there will first be a violent reaction, and after, it is important to get public opinion more and more involved. Then the question is to what extent that would be successful. The greater the need, the sooner people are convinced of it, I think.
- What role will openness to society play in the acceptance of the NEED Project?	Yes I think that is very important. I think, if you're not open, there will always be question marks with certain plans. People are more suspicious, certainly if specialists can provide answers on their own. So, that it still ends up in the public via via. Or, if things leak out or if things are disappointing afterwards, you immediately lose confidence. Trust is much more difficult to gain than than to lose, of course. I think, that even though concept plans are being made as to whether it is all feasible or what effect it will all have on the entire European Union, it can be done just fine in the background. But the more you work towards a definitive plan, the more openness is desired.
- What are similar/alternative solutions to the problem that NEED is trying to solve?	I think there are a few options. Continuing as we are doing now, in other words raising the dikes locally, that is all possible, but that costs a lot of money. The question is, of course, whether this will be the most efficient at a given moment, especially if the sea level rises drastically. There is also talk of a national dike ring around the Netherlands, possibly in combination with an airport, there are concept plans for that, but then you actually have the same issues, only on a smaller scale. So, then you have less international political issues, but certainly also national ones. It also still has an impact on ecology and employment opportunities, etc. Furthermore, you have a kind of dike ring from Zeeland to Friesland, with several openings towards the North Sea.

Questions	Answers
	I think it's easier to accept something like that than NEED because NEED involves even more European political issues and I think it's very difficult to get all those countries all noses in the same direction. In the Netherlands, for example, we already have much stricter safety standards than other countries. However, you are not even talking about all the costs that have to be divided and things like that. In the Netherlands we have accepted that we want to keep our country extremely safe against flooding and that is why I think it would be easier to implement, if such a dike ring can actually keep us that safe. We. as the Netherlands. may need such a dike the most. You could also start thinking more rigorously, by moving people around the country. That you really give up the very lowest parts in the country, and let people move to higher parts. This is, of course, also very difficult to achieve, but that is also a solution.
- Who should take the lead in working on the NEED Project?	Yes, the Dutch of course (joking)! I think we can certainly be useful technically, but who should take the lead? That is difficult, is that the European Union? That would be possible. Of course it only concerns a part of countries within the European Union. So, I think there should be some sort of separate committee that represents the countries concerned and that some sort of management follows from this or something.
- What do you think of the NEED project itself?	First, I wonder if NEED is really necessary. That it's not necessarily research related. The first question I ask is if the water level really going to occur so much that NEED is necessary? I don't think so. I do think that if it is going to happen, it is unlikely that it will be implemented on this scale. Because there are so many arguments against it. That's just my gut feeling. It has more negative sides or bumps in the road, that at some point it becomes too big, and an obstacle and then it will stop. That we, as the Netherlands, choose for ourselves and redesign our own water safety system.

Table 23: Interview with E6 a Civil hydraulic consultant.

Appendix H: Project manager - interview

Questions	Answers
- What is your profession?	My profession is manager for an engineering firm that specializes in oil and gas installations, which also includes offshore innovations such as wind farms and the like. So you might think of XXX, for example. I have contributed to the wind farms off the German and Danish coasts. Those were nice projects, only those of the very first wind farms, especially in the German Bight. The biggest problems we had during the innovations, that you clash between the offshore world and the energy world. This means that the energy world, for example, wants to have enough space with such a switch box, while in the offshore world every square decimeter is one, so they want everything as compact and small as possible. That is something small, for example, but has already led to heated discussions.
- What part plays innovation in your daily life?	Quite a lot in my profession, especially if you work at a fairly prominent engineering firm, you always innovation is all around you. For example solar cells and wind farms, etc., also hydrogen factories at the moment and a subsidiary for a company I worked for, which has the patents for the hydrogen and ethylene plants. Some based on that, you're pretty close to all the novelties they're trying to launch right now. My role here was to provide everything with the right supplies, especially in the electrical field, which sometimes required the use of innovative solutions. When I look at daily life I try to be innovative as far as possible within the financial means.
- What does it take to make an innovation a success?	That depends a bit on what it is, in the first instance the opinion of the people is quite important to get a success factor for it. In addition, you need to get the financial world behind the innovation and the technical feasibility. One also has to look at whether one is innovative in such a way that you can now implement it on paper, but there also shouldn't be things or bumps that unexpectedly surface in practice. The latter usually happens. A good example of this is that we have been busy with all those wind farms. The transformers that are normally on four poles in the North Sea, you now also have those that are on one pole. They call them monopiles. To get all those transformers including switches, including compensation transformers and batteries, and banks such on one pole. That was successful at the time. That was a study of almost a year, which we did with several stakeholders. This led to complexity. I must say, it also led to more input, and therefore innovations.

Questions	Answers
	As a result, the components that had to be placed on such a platform also improved, from fire risk to efficiency. It was particularly striking that, for example, batteries were brought in by other stakeholders that are not common in the offshore world, but for example for hotels, I name just a few. However, this does lead to a renewed platform which was also stronger than the previous platforms on certain points. That was only due to the collaboration of the stakeholders. After that, it was finally possible to get everything on the platforms on a two-deck basis, with a relatively low weight. Unfortunately, parties that withdrew from the offshore world, caused the project to fail. However, the research had simply been carried out. One of the major advantages of that project was that it was different from usual and, therefore, there was more room for innovation. However, it also clarified that even now, with such a platform, a lot of profit can be made in the components of such a platform. Another most interesting project is the gas storage in XXX the salt domes. That is, of course, far from this, but that has been a very large project and innovation. The idea here was to temporarily store gas from Russia, instead of importing it continuously. And then, on the seasons, export that around Europe again. That has also been a European project. That was a major project, with the major bottleneck being the cooling of the amount of gas and the number of sources that we would have to connect to get it done. However, at the end that worked out quite well. It was delayed, but it all worked out.At the time, politics also played a role, when the first rumors of earthquakes in Groningen also came around. That also immediately raised question marks for this innovation. They are, of course, rock-hard salt domes, so salt was extracted there in the past. So, there are domes, or, air bubbles, which are so hard that it does not collapse.
- What are common failures while working on an innovative project?	Before your project gets off the ground, finances are of course the bottleneck. However, as long as that has been solved, and you have all parties in the same corner. Then, usually, the pitfall that arises is the communication between all parties, which is what I want to say. That party X provides something different from party Y. That usually lies in the technical field. That is usually an assumed piece of knowledge, or it will work that way, while in principle that involves completely different things. Or that it was misjudged or a little too easy. What I just said, that company XXX wanted to have such a platform on the North Sea, assumed that the switching space must be able to be enormous.

Questions	Answers
	However, every square meter on such a production platform costs quite a bit. In addition to all the steel and resources that you need extra give extra weight to the design, the company XXX really hadn't thought of that. And it was thought too easily in the first place. Also, looking at all the security requirements that are adhered to on those platforms, they are very different from what the company was used to working with, with the result that it suffers from certain limitations and also certainly delayed and made it more expensive than they budgeted. Then you have to think of multiple exceedances at different phases in the project of more than 20%.
- What do you think of the NEED project itself?	The idea itself is quite big, but I would immediately question it. What occurred to me, that the southern part of the project is in a bit of an odd place. On the one hand, I can imagine that this place was chosen because of the traffic flow, but I expected it more between Calais and Dover, so between Great Britain and France. Somehow I think it is politically very difficult to realize this project. technically it is feasible, although the pieces will be near Norway, which is quite deep. A few years ago, my company placed several works of art there. So, those are underwater bridges at a depth of 300 meters, to lay down some cables and pipes. That was successful, but there are a lot of weird aspects to it because of the pressure you have there. So, technically there will still have to be done some research. So, it is feasible, I was once involved in an artificial island for the North Sea, on the territorial border of the Netherlands, England, and Norway, exactly on that three-country point, so to speak. Banks and other parties were involved in this, as well as universities. That artificial island was then put down because it is only 30 meters deep there, so that is quite doable. There would then be an airport and some storage capacities. that whole project just broke down at the time, simply because of politics. And then you're only talking about three countries, and there are still more countries involved. The effects for countries such as Estonia, Lithuania, Denmark, and the Netherlands will of course also make the flow of goods much more difficult. You will have to look at how you are going to solve it. Are these locks that are used, or if you look more at the Delta Works in Zeeland? So, are you going to bake some sort of locks in them, and where will those locks be? That all becomes a bit problematic if you look at the number of ships that normally go through the Calais channel from the Netherlands and Belgium and vice versa. Those are quite large numbers. Or, you should opt for it, as the port of Rotterdam is going to create a Maasland barrier where you keep it open temporarily.

Questions	Answers
	That you will only close it in case of rising or storms or something. If you're going to shoot, I think it's going to be a very difficult story, especially between France and England. Technically everything is solvable, but it will be quite difficult.
- What success and failure factors do you think a project like NEED will encounter?	The project will fail on political grounds and perhaps on financial and/or technical grounds. For the success factors, I think it can ensure the development of new technologies. Just look at what the Dutch have done with the flood defenses in Zeeland and the like, and what techniques have been developed there. Another positive impulse can be fear. The fear of disaster can sail into the project, but I wonder whether you should let it get that far. In the total political consideration, in this case, the European community that you have to get it going there for each other to make it real.
- Which factor is the most important and, which is less important?	The most important factor will be political will. And the least important factor, I think, if you look at the safety of the people, you would say the financial side. When it comes to safety, a lot is possible financially. I also notice that where I come from. Offshore safety is so highly regarded, that you can lose your job if you don't keep your hand on the banister.
- Do you think that there will be unexpected consequences with NEED?	You will have to develop new techniques, which I just mentioned at that depth in Norway, where my company also had to develop new sub-innovations. New devices have also been built, designed, and thought out for this. So, there will be quite a few new things that will come to the fore, but also unexpected consequences considering the climate. Because you lock up the North Sea, that is the Gulf Stream, to only name a few. It can no longer enter the North Sea. That will essentially run on the side of Ireland, causing the North Sea to warm up further, so, you will also influence concerning the climate for here but also the countries behind it. That's something you can feel. The North Sea cools down, normally in winter, but if you lock that in, you get the same effect as you have in the Zuiderzee now. That the temperature remains too high on average. So, some fish species will disappear and maybe others will take their place, and there's a chance it's going to be brackish water.

Questions	Answers
- To what extent did politics play a role in the implementation/development of NEED?	A really big one, especially the current politics in Europe. I think it's moving more to the right block, looking at the Netherlands and Germany. A few years ago, it was generally quite moderate, so, more middle pros. But, you see current politics shifting further and further to the right. This is one of the major threats from that because also the ecological state, and the drive for the environment to improve it, there are going to be very big political tensions. That could have very strange or strange effects, which will make these kinds of projects impossible. Partly due to politics, because there is a big dichotomy in society, both for and against, but also extreme opponents. For example, look at something very simple. If one looks at the plan for a new Feyenoord stadium for the city of Rotterdam; including a group of 20 supporters who do not like the plan. They will try to influence many people through their home address to not let it go through. As a result, it is likely that the effect will now recede through those 20 supporters, but you can also expect the same effect with this project. It is the whole tendency in society that the minority is in charge. The majority of them hardly ever speak or do not make themselves heard.
- How can environment/sustainability play a role in the NEED project?	What I just said, you will appreciate the diversity of the birds, fish you name it, everything that lives there on the North Sea. Of course, you can also turn it positive. You can also consider letting saltwater flow in and out again, you could even generate energy with that. But then you can, for example, engage in fish farming all over the North Sea, provided you keep it clean. Because to be honest, the amount of fossil fuels that are extracted in the North Sea is declining very sharply. Near Norway, there is still a lot of gas there and that is also being extracted at the moment. However, production is almost finished for the rest of the North Sea, so, you can use that for fish farming, for example. Then you have a much larger ecological basin in which you could very easily breed that fish. That could also be a solution to solve food problems. So, you can also give it a positive turn.
- How do you think the NEED project will be received in society?	That's the same story I outlined earlier, planning to build with that island. I think that you will, of course, get negative messages from the environmental side. On the other hand, from people who are concerned with sea-level rise, you will get positive messages from them. However, the masses will take it as it is.

Questions	Answers
	The project has so much depth that it is quite remote from the general citizen. It also does not feel that it is very topical; that the need is high, so to speak. The moment it becomes life-threatening, or, if it is indicated that the polder in which you live is in danger of overflowing, then everyone suddenly becomes active. But if you don't use that as an argument, people will just see this as a nice article in the newspaper.
- What role will openness to society play in the acceptance of the NEED Project?	Openness is much better, just look at the metro XXX. There they were open about things. That has also been delayed for a year and a half because they couldn't get their software program together. However, at some point, that was just accepted by humanity. So, basically, I always say openness, but you have to present it in such a way that it is understandable for the masses. What I recently experienced myself with a high-voltage line to Ameland, from Groningen, a cable was pulled to provide it with energy. Everyone was cheering and the public opinion was that it was a good thing, with some windmills on Ameland. Then the cable was paid for by the company XXX, but it said in the fine print that the cable was being extended to a production platform. And then it was fully accepted, while if you had told it the other way around, the environmental activists, in particular, would have been strongly against it. So, a twist was indicated that the island was saved and that it was good for the windmills etc.. However, the company benefited even more than the people on Ameland. However, it was fully accepted.
- What are similar/alternative solutions to the problem that NEED is trying to solve?	I think I would look at the Netherlands. Can we handle it ourselves? We could raise the dikes in such a way, which is technically feasible and feasible, that you can also protect the hinterland. I would also participate in projects like this parallel to it, but I would still reconsider the dikes and the course of the dikes. You could think of Calais as mentioned before, or on the north side, you could consider lowering the dike, for example from the lowest point from Scotland. And then go straight across to Norway, which makes the area smaller, but the distances are shorter and therefore cheaper. You still have the depth of Norway, but from my mind, it is already a little less deep there than where the plans are now. Or Scotland to Denmark, for example, then you have less trouble politically. For Norway, the need for the dam will also be lower, for Denmark, this is more important because just like the Netherlands, it is fairly flat and is not too high either.

Questions	Answers
- Who should take the lead in working on the NEED Project?	I think the EU should take the lead in this. You're going to have to create something of a committee/ministry like something with all of them. This is quite a huge project, especially if it will take many years to complete. In that case, no country can lead the plan. You have to do that with all of them and the people you have and you will have to put them together in a European context because otherwise, you will never get it off the ground.
- What do you think of the NEED project itself?	In principle, the idea, especially given the current sea rise for the coming decades, is one of the possibilities to solve that problem. The project in itself is feasible, but again, just like that offshore artificial island has also foundered, I expect, when I look at the project, if there's not the need, it's a good idea, but it will stays on the shelf.

Table 24: Interview with E7 a Project manager.