Greenlandic Sand

Examining the Potential of Selling Sand from Greenland

Master Thesis

M.Sc. in International Business

Hand-in date: May 15th 2020

Supervisor: Jens Havmand Mortensen

Silas Schøning-Lyberth

Student no.: 10311

Daniel Jørgensen

Student no.: 124730

Copenhagen Business School

Number of pages: 108

Number of characters: 241292

Executive Summary

This study attempts to determine the potential of extracting sand in Greenland for the purpose of exporting it to foreign countries in the North Atlantic region. Export of sand could have the potential of benefiting the economy of Greenland and cover potential global supply shortages in the future. The study addresses the issue from a business perspective as it is assumed by the authors that these operations must be profitable from a business point of view before exports of sand can benefit the economy of Greenland. An analytical framework is developed for the specific purpose of examining the potential of success for any company that considers to become involved in this project. The framework addresses five factors to assess potential of success: profitability, strengths, weaknesses, opportunities and threats. The five factors are examined individually after which they are combined into a holistic assessment. The study aims to provide a short-term assessment and a long-term assessment of the potential of success.

The research revealed that several issues need further investigation before it can be definitively concluded whether a company can successfully extract and export Greenlandic sand to foreign countries. The most important of these are: (1) A specification of the sand quality available for extraction; (2) An outline of sand products that can be produced from the sand available; (3) Requirements for setup of sustainable equipment and port infrastructure specific to the extraction location; (4) Narrowing down potentially attractive export markets by applying the analytical framework until a thorough understanding of specific regions, competitors and competitor products is obtained.

Despite the fact that a significant amount of issues are yet to be uncovered, the findings of the study indicate that a company might become profitable in one to two decades from now under the conditions that: (1) Sand prices continue to increase with a rate of five to ten percent per year; (2) Costs for a sand operator in Greenland do not significantly change over time; (3) Financial support for setup of port infrastructure is provided; (4) Attractive markets in specific regions can be identified and joined.

Additional key take aways were that size in terms of production capacity and financial capital are essential success parameters for a sand operator. The location of Greenland brings certain advantages. The use of waterborne transport reduces costs per unit significantly compared to in-land competitors. The largest location disadvantage comes with the distances to export

locations which are far exceeding those of competitors. Lastly, the study identified a key success factor to be tightened extraction regulations in other countries, weakening the positions of competitors. The government of Greenland must avoid similar regulations. Instead, it must implement policies that supports a sand business in Greenland in order to make it competitive.

Key Words: *Potential of Success, Sand Operator, Export of Sand, Extraction, Profitable*

Acknowledgements

The process of writing this master thesis can be characterized as unusual due to it coinciding with the corona pandemic. In practice it meant that the entire project was conducted from living rooms and bedrooms. Whereas physical meetings and interviews were made difficult, online correspondences and interviews did to some degree enable interaction with experts and the supervisor of this project. In that respect the authors of this study would like to thank Jens H. Mortensen for excellent guidance and inputs throughout the study. The study will also like to thank Frederik Sørensen from Dansk Kvarts Industri for insightful information of the sand industry. A thanks to Dr. Harald Elsner for valuable insights of the global sand situation. The authors will also like to thank Mike Høegh for essential information on the conditions that a sand business in Greenland will need to consider.

The study would like to give a special thanks to Mette Bendixen for her extraordinary enthusiasm, her vital knowledge regarding the Sermeq Outlet and inputs on the physical properties of sand. Moreover, her initial research was used as a starting point for this study. Her inputs and support were essential for this study to be completed.

Table of Contents

Tables and Figures

Introduction

Climate Change – An Opportunity for Greenland

During the past decades, climate change has been the center of endless discussions with regard to its consequences. It is widely agreed among scientists that its various effects on the world are harming, thus the term is often associated with negative outlooks for the future. One of the alarming consequences of climate change is the increasing pace of melting ice in the world's coldest areas. Among these areas is Greenland. The world's largest island contains masses of ice equivalent to a rise in global sea levels by approximately 7 meters, and during recent years record high amounts of melted ice have been recorded (Promice, n/a). Justly, much attention has been directed towards the negative effects of this phenomenon, not only globally, but also locally. However, recent awareness has been raised about a potentially beneficial effect of Greenland's melting ice. As a result of the melting water streaming out into the Greenlandic fjords faster and in larger amounts, scientists have recognized a substantial increase in sediments being poured out into fjords and bays along with the melting water. At the mouths of melting water rivers, also known as deltas, sediments accumulate and grow into enormous reservoirs of sand and gravel. At the deltas, a natural refining of sediments occurs as grains with larger sizes such as gravel and sand tend to drop closer to land, whereas fine-grained particles e.g. silt are transported further away from the delta. This transportation of sediments from land to sea has created hundreds of sediment reservoirs along the Greenlandic coast line and scientists have estimated it to constitute seven to nine percent of the global river sediment flow into the ocean (Bendixen, 2020). Among all sediment reservoirs, a few are regarded as hotspots as they transport extraordinarily high amounts of sediments to the sea. Depending on shape, size and substance, a share of the sediments might be suitable for various purposes. For instance, sediment particles of a coarse character, are commonly used in the construction industry. It is particularly this type of material of which awareness has been raised as the Greenlandic deltas might hold resources worth significant monetary value. Currently, sand in Greenland is extracted from the sea bottom, and only applied locally on a small scale. If the sand resources from river deltas prove to be obtainable and can be profitably managed and exported on a larger scale, climate change might have presented Greenland a seldomly given benefit (Bendixen et. al., 2019).

Problem Area – Sand

Measured by weight sand and gravel (both referred to as sand from this point) have become the most extracted natural resources in the world, even exceeding oil (Torres et. al., 2017). Sand is a fundamental ingredient for multiple vital parts in infrastructural and production industries such as roads, concrete, glass and electronics. Other important uses for sand are oil and gas extraction, land reclamation and beach renourishment (Torres et. al., 2017). As the world has experienced a boom of urbanization, the demand for sand for above-mentioned purposes has risen rapidly over the past decades. According to the UN, the current global demand for sand has reached 40 to 50 billion tonnes per year. Since the beginning of the new millennium, the global demand has increased three-fold (Laguna, 2019). The UN further states that global sand extraction is far exceeding the rates of natural sand production in river deltas and beaches. The development has had negative impacts on not only ecosystems and biodiversity at several locations, but also on tourism. These consequences have forced governments to implement strict regulations and bans on sand extraction in certain areas. As a result of this and the rapidly increasing demand for sand worldwide, international trade with sand has been steadily growing and is projected to continue to grow 5,5% annually (Laguna, 2019).

China and Singapore are among the top consumers of sand during the last two decades. Between 2011 and 2013, China produced approximately one and a half times as much concrete as the US did in the 20th century (USGS, 2014). Sand and gravel constitute about 60 to 75 percent of concrete (PCA, 2019). During the last 20 years, Singapore imported 517 million tons of sand, which makes the country the largest importer of sand in the world (UNEP, 2014). However, in July 2019, Malaysia, their main supplier, decided to ban all export of sand, which opens opportunities for other sand exporters (Reuters, 2019). Even the United States, which is considered a developed country with regard to infrastructure, saw a 24 percent rise in production of sand for construction purposes between 2015 and 2019. This is explained by a continuous growth in US construction markets (USGS, 2020). The global demand for sand is projected to increase, and will reach a peak in 50 years. Over the next decades shortages of sand supply are expected to become more prevalent (Sverdrup et. al., 2017). If the price of sand is to reflect this development, international trade with sand might become even more prevalent than today.
Despite projections of rises in demand and prices, future prices of sand can still be impacted

by several unknown factors. Even though local shortages of sand around the world will occur, it is widely agreed that global supplies of sand are currently high and will remain high for many decades. However, many sand reserves are protected due to environmental issues or closed off for extraction because urban areas and infrastructure are physically hindering extraction. Germany for instance, have extraordinarily strict regulation on sand mining despite a growing demand for sand and huge unexploited reserves (Book, Handelsblatt, 2018). Although a continuous price increase is expected globally, changes in regulations might halt sand price increases. Other factors might impact sand prices such as new technological inventions leading to, for instance, increased recycling of concrete. Prices of sand can differ by several hundred percent from region to region (Elsner, 2020) and markets which appear attractive on price could suddenly become unattractive overnight. Sand prices are not constant worldwide and much attention must be paid to both local and global developments when considering entrance to international trade with sand.

Research Problem

Although the current level of global sand reserves are sufficient to supply the world's needs, it is important to explore other opportunities as future supply shortages are expected to occur. Current estimates for production of sand are considered undervalued due to a tendency of underreporting in many countries, and therefore, supply shortages might arise even sooner than anticipated. (Miatto et. al., 2016). Whether it being short- or long-term, local and global sand shortages make the Greenlandic sand reservoirs interesting to examine as a potential export opportunity. Being highly dependent on Danish subsidies and their fishing industry, Greenland is looking for other sources of income to strengthen the national economy. Along with other natural resources, sand appears as an interesting source of export. However, as it is the case with any other commodity, extraction and export of sand must be examined as a business case in order to determine its potential as a source of income for Greenland. Before it can benefit Greenland, the entire practice must be profitable from a company's perspective. Therefore, this study will investigate whether a company can successfully extract and export Greenlandic sand or not.

This encompasses all aspects of a potential enterprise including the required capital investment, extraction operations and shipping. In case there is no indication of success for the present time, the study will investigate if the practice could become successful in the

future as well as the requirements for this to happen. The problem and challenge connected to this research is that no concrete model or approach system for this specific issue exists. Nor is any similar study, from which parallels could be drawn, publicly available.*Therefore*, this study will develop an analytical framework for determining a company's potential of success in this practice. Thus, a general analytical framework will be developed allowing any group or company to apply it at any time, if changes should occur in the future.

The paper will develop a framework for determining potential of success, after which it will be tested on present-day conditions and on anticipated future conditions to the extent that data is obtainable. Optimally, a clearer picture will be provided as to whether sand can be extracted and exported profitably from Greenland.

Research Question

As it has been highlighted, Greenlandic sand could have the potential to cover a part of the growing worldwide demand for sand, if not now, then potentially in the future. In addition, it could add a significant source of income to Greenland. But if these scenarios are to be realised, extraction and export of sand in Greenland must constitute a profitable and sustainable business. In order to thoroughly examine the potential of extracting and exporting sand, a comprehensive analytical method must be established. A sand project of this character will face multiple challenges, costs and unforeseen obstacles, however opportunities might also arise. When establishing an analytical method, it is the goal to ensure that all of these factors become uncovered and accounted for. Having accounted for all relevant factors allows the analyst to answer the research question below:

Can a company successfully extract and sell Greenlandic sand to foreign countries?

Approach and Limitations

The research question is broken down into four elements, which need to be defined and limited. Below are shown the authors' definitions as well as the limitations of these. The four elements and their respective definitions and limitations are cornerstones of the study as they set the direction for the research. In addition, it is on basis of these that the research question can be answered towards the end of the paper. Their importance in this regard is explained after they have been defined further below.

A Company

Any company that can fulfill Greenlandic requirements, is granted permission to enter the industry, has sufficient capacity and want to initiate operations will be regarded as a potential entrant. This can be a Greenlandic company, a foreign company or a joint initiative. The study aims to develop an analytical framework that accounts for different company characteristics. Depending on these, chances of success might differ. Furthermore, a company operating in Greenland might have certain strengths and weaknesses related to the location. In this study, the analytical part will not focus on a specific company as it has been out of reach for the authors to identify and collaborate with any group or enterprise that desire to become involved in this specific business within a short timeframe. To compensate for this, it will pursue to identify general traits and key success factors for a company to succeed in this industry.

Successfully

This element is central to the purpose of the study. Success is a relative term that can be assessed differently. The authors of this paper will employ following factors to examine company success: Profitability, strengths, weaknesses, opportunities and threats. Profitability will be regarded as the most critical factor within this element, as a company's thrive and survival depends on its profitability. However, the four remaining factors will also be taken into account as they constitute important indicative factors. For instance, a deficit might appear as non-successful, but if other factors indicate high future profits, the assessment of success might need to be reconsidered. In order to assess these five factors, it is essential to develop a comprehensive analytical framework that accounts for all of them. In the theoretical section, the paper will further explain how the analytical framework is comprised of known theories and models, which in combination address not only the five 'successful' factors, but also the other elements of the research question. Thus, the analytical framework is developed to directly address the five 'successful' factors, but the analysis of these will also yield significant insights of the other elements.
When all relevant data for the five factors have been accounted for and analyzed, a qualitative assessment of "success" can be conducted and assist towards answering the research question.

Greenlandic Sand

As addressed earlier, the Greenlandic deltas contain enormous amounts of sand. A conservative estimate has justified that approximately 15 percent of the sand reserves from Arctic rivers are suitable for the global market (Syvitski and Saito, 2007). This study will adopt this assumption. As it was highlighted earlier, sand particles vary based on shape, size and substance, which implies a broad spectrum of sand quality. Depending on these variables, prices differ. Very few preliminary investigations with regard to substance have been made, which is why a determination of any certain sand quality can not be justified. Therefore, the paper will assume a standard sand quality for construction purposes to be present in the Greenlandic deltas. At a later stage, the paper will review the general potential of the Greenlandic sand, identify a specific extraction location and address the practical circumstances for this location.

Foreign Countries

Any country with a demand for sand is regarded as an interesting export opportunity. However, factors such as geographical distance play an important role and markets might differ from each other in multiple aspects. As the study can not cover all markets in the entire world, a selection of potential export areas will be made. The criteria for this selection is to be elaborated at a further stage in the paper.

Significance of The Four Elements

Throughout the study it will be apparent that the four elements of the research question will serve as indicators for whether a company can successfully extract and sell Greenlandic sand to foreign countries. In order to answer this optimally, the paper will establish an approach that specifies and gives answers to the issues described below. Thus, to the extent data is obtainable, by applying this approach the analyst can expect answers to these issues:
The "*company*" element is supposed to reveal strengths and weaknesses of any company that considers to enter the industry. It will outline location-specific strengths and weaknesses to Greenland as well as key success factors that a company should strive for in the sand industry in general.

The "*successfully*" element will indicate whether operations can be profitable or not. Along with the aforementioned strengths and weaknesses, it also recognizes opportunities and

threats from the external environment which are supporting indicators for success potential.

The "*Greenlandic sand*" element will indicate the potential of the available sand itself. Can it be extracted and is it suitable for export?

The "*foreign countries*" element will look into aspects that indicate how attractive certain areas are currently and aspects that might increase or decrease attractiveness for future potential exports. It is not the goal to identify specific destinations, but to analyze factors that make a regions attractive or unattractive. For this element, it is critical to examine if export to a certain area is realistic from an economical perspective.

The four elements are evidently interrelated and as noted, the analytical framework will indirectly address all of them. It is the aim that this study, through analysis of these four elements, can answer the research question. The findings connected to these might point towards different directions, which is why a holistic assessment is employed, when all elements have been illuminated.

As pointed out earlier, the study will assess potential of success with present-day conditions. Furthermore, a long-term perspective will be provided. The analytical framework to be established will in most parts allow for future outlooks. However, future outlooks will be limited to approximately 50 years from now, and it must be emphasized that any potential future trends or developments addressed in this paper are not regarded as definitive.

Structure

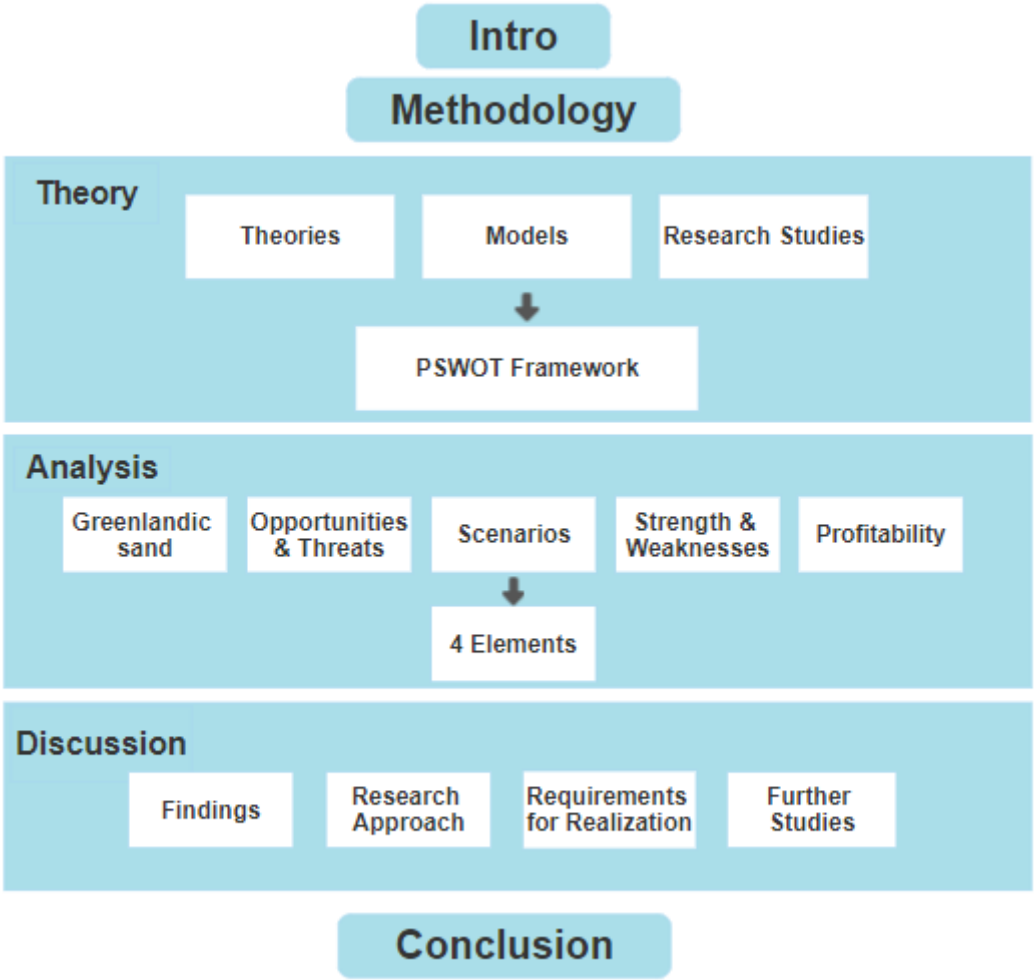

Figure 1 – Thesis structure

Figure 1 illustrates the structure of the paper. The methodology section elucidates the methodological approach of the study. This is followed by the theoretical section in which a research study on future projections on demand for sand is reviewed. In addition to this, the paper will review frameworks and models that enable a comprehensive analyses of the five factors: profitability, strengths, weaknesses, opportunities and threats. Jointly, the tools of reviewed theories will constitute the framework that assesses a company's potential of success of extracting and exporting sand from Greenland. Thus, the purpose of the theoretical section is to establish a thorough understanding of sand and to derive a suitable model based on existing models and frameworks. For the latter part, the study will focus on theories that involve measures for profitability and strategic management. The theoretical section is ended with the formation of the framework that is to be applied in the analytical section.

The analytical section will examine the four research question elements. The ‘Greenlandic sand’ element is addressed first in order to clarify the basic circumstances from which the remaining analysis can continue. The analytical framework is applied to address the three remaining elements. Based on applying the tools of the framework, scenarios are created to outline factors that might influence potential success of a sand business in Greenland. Furthermore, it is to recognize and outline which challenges a company will face and what competencies are required to succeed. In addition, the analytical section will provide estimations using the profitability model, which will indicate potential profitability.

The discussion section will evaluate both the findings of the analytical section and the established framework. The section will assess the findings of each element and discuss potential fields of research and testing that are required to investigate the issue further. In addition, it will be discussed what is required before the project can be realized. The paper will end with a section of concluding words.

Methodology

The methodology section will provide an explanation and justification for the various methods that are applied for reaching an answer regarding the research question conducted. This includes a comprehensive evaluation of the applied research philosophy, how the research method and related strategies are approached. Furthermore, an explanation and justification of the data collected will be presented. Subsequently, an assessment of the research and its validity will be considered through internal and external validity, which also takes into account the trustworthiness of the selected research methodology. The research onion model, which was created by Saunders, Thornhill and Lewis will work as the conceptual framework when establishing the research process.

While there is a multitude of options when it comes to methodology models that would provide a suitable framework for the paper, as for instance the nested model developed by Kaglioglou (1998). The nested model operates quite similarly to the onion model; however, it only contains three layers which are research philosophy, approach and techniques. While it provides a reasonable model that considers the most important aspects of the methodology, the onion model provides a more comprehensive and thorough approach that is more suited for the research being conducted, as it considers additional variables that are important for the research.

Research Philosophy

Research philosophy considers a structure for advancement in knowledge through presumptions related to the topic in question. When conducting a form of research, an increase in knowledge related to the subject is expected, since it relates to assumptions that have been created to answer the research question. These assumptions can be created in relation to human knowledge, how one perceives the realities that accommodates the aforementioned research and to what extent one's own values affect the research development. These assumptions will influence the interpretation of the issues that are being researched (Saunders, Lewis and Thornhill, 2015. Burrell and Morgan, 1979). Within the realm of research philosophies, you are presented with a multitude of methods that will be more suitable depending on the research approach. This paper has chosen to utilize a pragmatic research philosophy on the basis of adopting a range of research methods, which includes both qualitative and quantitative research approaches. One of the requirements for using this approach is establishing a practical application that relates to finding a solution to the problems presented in the research. Pragmatism has established that the research question is the variable that determines which philosophy will be most appropriate for answering the question at hand, and that other approaches might be more suited for exactly that (Saunders, Lewis and Thornhill, 2015).

With an emphasis on finding causal relationships among a plethora of variables that will further establish practical obstacles and solutions for future practice, the pragmatic standpoint seemes the most fitting. The positivist philosophy was also taken into consideration, however on the basis of how the data is collected, mainly through experts with varying forms of expertise in a given field, new theories and methods that complement the newly acquired data made the positivist philosophy less fitting.

This provided the realisation that some of the gathered data will hold both objective and subjective positions. Then again, some of the data collected is not affected by subjective positions, as it follows historical data and formulas that are predetermined, however, since empirical data and research has been affected by potentially subjective opinions to further solve a practical problem, the pragmatism approach seems more appropriate. Due to the fact that a large portion of the empirical data gathered, derives from the conducted interviews for the purposes of this research. Moreover, it is further compared and assessed with data

gathered from more theoretical sources to support or challenge the empirical data made the aforementioned philosophy seem more adequate.

Research Approach and Strategy

When conducting research, the way one establishes how theory shall match the research approach, will determine if an inductive or deductive approach will be put forward (Saunders, Lewis and Thornhill, 2015). The inductive approach considers collection of empirical data to further increase ones' understanding of the subject based on analysis of the gathered data. On the other hand, the deductive approach focuses on finding out if a proposition is correct. This can be done through a case study that focuses on developed theory and research, which is correct for the case study.

For this paper, an inductive approach will be more relied on, as it looks to find an answer based on collected data, expert knowledge and established algorithms. This paper will utilize both newly acquired data as well as established theories and information. As Saunders, Lewis and Thornhill (2015) put forward, one can use theory to conceptualise methods with an inductive approach as well. When it comes to theory and practices regarding export potential on a global scale, there is a lot of data and research available. This includes both previously created models that considers freight rates and global future prognosis of sand prices, as well as theory investigating strengths and weaknesses for global export. Therefore, to understand these, a deductive method will be applied and combined with an inductive method. This is also done, since the deductive approach focuses on the acquisition of knowledge for the researched topic, which is advantageous for this exact purpose. The deductive approach will mainly set the groundwork for the framework to better understand the industry that one is operated within, the product itself as well as geological considerations. Moreover, the inductive approach considers data that has been gathered from interviews or unpublished documents to gain a more updated view on the situation and with this information create a framework that is more suitable for the specific situation regarding the Greenland potential. Furthermore, when investigating potential export locations, routes and timeframe a combination of these two methods will be applied (Saunders, Lewis and Thornhill, 2015).

In order to answer the research question, a consolidation with several experts has been established in the form of interviews and correspondence. These interviews and correspondences were the first step in understanding the broader picture of Greenland's

current situation from a geological standpoint through Mette Bendixen. Furthermore, other interviews were made with experts more closely related to the economic aspect. Doctor Elsner, a professor in the global sand economy gave insight in how the current sand market functions globally. Moreover, through Mette's contribution, a contact with a Greenlandic sand dredger was contacted to better understand current and future potential of the sand market in Greenland. Lastly, Sørensen from Danish Kvarts Industry provided industry specific knowledge. These interviewees contributed to establish a basic understanding of the situation, future prospects, geological and economic challenges, which contributed to the analytical section where the framework was applied.

Other methods to answering the research question came in the form of reports, documents and previous research on similar situations in different areas of the world. These gave further insights into the market in greater detail. After consolidating with the local sand dredger, an understanding of the importance of transport freights became apparent. Through this knowledge, research to find or create a functioning formula for freight rates with the correct independent variables was required to fully understand the economic situation. Fortunately, a functional model was already created, which allowed to adjust variables such as distance and carry weight. Furthermore, the model did not restrict the routes available except for the Scandinavian market. However, it still allowed for more precise routes that are available from Greenland to other continents.

Scenario Approach

When conceptualizing and finding answers to the research question, a scenario-based analysis will be utilized. The basis for this decision derived from the fact that at the moment of writing this paper, very little finite data is available regarding the conditions for extraction and export to foreign countries. Therefore, in order to identify relevant factors that could impact a sand operator in Greenland, two scenarios will be conducted on basis of the framework tools which are to be presented in the theoretical section. This is done to ensure that if Greenland's sand industry becomes ready for the global market, all strengths, weaknesses, opportunities and threats are accounted for and ready to be dealt with to secure a potential business implementation at the most efficient rate.

Two scenarios will be created in this paper, whereby the main variable to be changed is the timeframe. At a later stage in the paper, it will be clear that more scenarios should be

constructed for an optimal analysis. However, a limited access to information of future trends and data makes a creation of additional scenarios difficult. Moreover, fewer scenarios allow more in-depth analyses to be conducted. Other variables that could have been adjusted are sand quality and a broader spectrum of geographical areas.

Data Collection

This paper utilizes primary data and secondary data for the purpose of exploring and finding answers to the research question. The primary data was concentrated on in-depth interviews and was primarily employed for the empirical section of the paper. The fundamental function of primary data is to find answers to the research question, while the secondary data which was initially gathered for other research purposes, has value for the current problem formulation as it can support it or strengthen the method of finding answers (Blumberg, Schindler and Cooper, 2011).

Primary Data: In-depth Interviews

Multiple interviews with different individuals were held to provide significant viewpoints to better understand all variables that were considered as important to answer the research question. Interviewees were experts on their relative field which consisted of geological, economic or logistical expertise, related to the topic. Furthermore, an interview was held with a local that already operates within the sand market in Greenland. He gave a unique perspective, since he had hands on experience with sand dredging within the region. All of the interviewees were contacted via email. Most agreed to take part in the interview, while some liked to have the related questions send to them, and answered them without oral communication. In all instances, prior to the interview, a general list of questions and topics was sent beforehand. Some of the interviewees recommended others to be interviewed, which increased the quality of the data collected.

When the interviews were conducted, the first question that was always asked was if it could be recorded and used for the intended purpose of finding answers to the research question. If some parts of the interview were confidential, an explicit request for them to proclaim so was asked. This was done to ensure that the interviewees statements held ground and that they could stand by their statements to ensure quality and reliability. Most allowed the whole interview to be quoted, however, some asked that parts of the interview remained

confidential, because of either uncertainty of the given information due to it being recently acquired and needed further testing before being published, or it containing sensitive information.

The questions given to the individual interviewee were tailored to fit their respected field of expertise, while some questions remained the same to gain different perspectives on the matter. Since the research is relatively unexplored, more opinions based on different expertise seemed essential to gain a broader picture. This was done to ensure internal validity by presenting questions in a clear way with the intention that they understood that their expertise was the main focus for the question formulation for each of them (Blumberg, Schindler and Cooper, 2011). To ensure that the data collected was unbiased and held reflected answers, open ended questions were asked.

To assure that the interviewees spoke freely about the topic, the interviews were put forward as semi-structured in-depth interviews, where questions were clear in its intent and was made clear to be followed (Saunders, Lewis and Thornhill, 2015). This type of interview method is favourable in exploratory research and an effective means to reach new insights. Furthermore, this interview style helps to better interpret the answers given by the research contributors regarding their field of study. Moreover, this interview method with more open-ended questions was highly relevant since the research being conducted held a lot of unique variables, some that were not obvious initially. Therefore, giving leeway for the participants when answering was important to gain a broader understanding of the situation (Saunders, Lewis and Thornhill, 2015).

The timeframe for how long the interviews lasted varied to a certain degree and lasted between 45 and 65 minutes. These were then transcribed from their initial language to English to maintain a certain amount of fluidity and a full understanding of the gathered data for the researchers. Transcription of the interviews were made for the purpose of better maintaining cohesiveness, which enabled categorisation of the data. Some interviewees were not able to participate in a formal interview, because of time restraints from their part, a compromise was made. This entailed sending the necessary questions to them and have the previously considered interviewees answer them in written form. While this is not considered a traditional vocal interview method, the interviews still served the same purpose, which was to receive answers to something they were specialists in. Therefore, these will be considered as an important correspondence between the interviewees and the researchers in gathering

important information regarding the research problem. The following part will include a description of each of the interviews and correspondence conducted.

Table 1: *List of interviews and correspondents*

Interviewee	Organization	Role in Research	Date	Location	Lenght
Mette Bendixen	Instaar	Researcher	22.01.2020	Skype	65 minutes
Mike Høegh	Masik	Industry professional	05.03.2020	Phone	55 minutes
Doctor Harald Elsner	BGR & DERA	Researcher	22.02.2020	E-mail	Correspondence
Second Interview Mette Bendixen	Instaar	Researcher	15.03.2020	Skype	45 minutes
Frederik Hove Sørensen	Kvarts Industri	Industry professional	30.04.2020	E-mail	Correspondence

Mette Bendixen, Geomorphologist and researcher of climate change effects on Greenlandic landscape for Instaar

As this research investigates the potential of implementing a sand extraction and export business, an understanding of the geological aspects is needed, since it presents itself as an important aspect within the research. An in-depth interview with Mette Bendixen, a PhD graduate from University of Denmark that specializes in geomorphology and is currently conducting research on Greenland. The research is in relation to the effect of climate change on the geological aspects of Greenland. As this was the first interview conducted for the research, it provided information regarding the geological landscape of Greenland and the general potential that is present within the country. Furthermore, Bendixen also functioned as an intermediary between future interviewees as she provided the necessary information to get in contact with these. Moreover, she also provided some crucial reports and publications, which she gave a detailed explanation of what these contained. These publications have presented themselves as an important steppingstone in unravelling important factors that are adjusted for the economical and geological position for the research. As a researcher of Greenland and the effects of climate change, Bendixen's purpose is to unravel the truth within the situation. Therefore, a position of bias is highly unlikely. The data from Mette Bendixen was held over communication platform, Skype.

Mike Høegh, owner of Masik

Mike Høegh is a sand dredger who is located in Greenland. A correspondence between him and the researchers occurred due to a mediation from Bendixen. The interview contained topics related to the current situation Greenland is experiencing regarding sand extraction and the future potential of global sand export. Høegh owns a small-scaled sand dredging company that operates in areas along the coastline not too far away from Nuuk. During the in-depth interview, Høegh gave insight for the future of the industry in Greenland. The Sermeq Outlet, which currently seems to be the most viable option to start a large-scale operation from, will require large financial investments in the Greenlandic infrastructure and required equipment, to accommodate a global competitive market. Furthermore, Mike explains that such an operation will need to be placed close to the natural resource location. Moreover, the currently available industrial port placed in Nuuk is not capable of handling such large scale operations, so instead of further investment into the one in Nuuk, a new port in close vicinity to the Sermeq Outlet will be needed, due to logistical challenges of keeping it in Nuuk. The reasoning for this is to reduce transportation costs, which would have been costly by bringing it from the Sermeq Outlet to Nuuk.

When asked what his plans for future expansion was, the rudimentary answer was an uncertain one. However, Høegh had started to investigate the possibility of entering the North American market. Nonetheless, an exact strategy for their company was not currently developed and the idea of expanding to foreign countries remained as speculations. For this interview, there is a slight chance of bias, as Høegh is very invested into the Greenlandic sand market, and there is a likelihood of him wanting to present it in a better light then what the situation might be in, so there is a likelihood of bias. The interview was conducted over the phone.

Doctor Harald Elsner, Senior Economic Geologist at BGR & DERA

A correspondence between doctor Elsner and the researchers occurred, in relation to questions that were relevant for finding answers for the research question. Doctor Elsner, who is a senior economic geologist for the federal institute for geosciences and natural resources (BGR) and German mineral resources agencies (DERA). One of the questions were in relation to a statement doctor Elsner made in an article, regarding the annual growth rate for sand, where he stated that the sand prices would go up by five to ten percent, based on

several factors. However, he also stated that each nation would experience unique annual growth rate, and further studies would be needed for a specific location. Furthermore, questions related to future locations for sand export was introduced, which was responded with an investigation towards the Asian markets. Moreover, a recommendation to not invest in the European market was given. Some of the information given through the correspondence were answered with quite direct answers, without a significant amount of information given to the reasoning for the responses. There is also a small likelihood for bias, as doctor Elsner is highly invested in the German market, however, he is a researcher primarily, and holds little beneficial exploits for an economic gain. The correspondence occurred through E-mail.

Second interview with Mette Bendixen, Geomorphologist and researcher of climate change effects on Greenlandic landscape

A second interview with Mette Bendixen took place. Some further question related to previously provided information from the first interview was needed. Questions regarding the aforementioned reports provided by Bendixen, as well as answers for some laboratory tests that were in process during the first interview. When the second interview took place, the answers from the laboratory tests had come through. It showed that the sand contained Feldspar which made the sand less durable, compared to standard construction sand. However, only two tests were made from a very specific area in Greenland, which makes them less indicative of the true quality of sand that Greenland possesses. Further test would be conducted in the summer of 2020, to produce a more conclusive image of the sand quality in Greenland. Likewise, to the first interview, the format was a semi-structured interview where questions were prepared beforehand, with leeway for additional questions based on relevancy. Moreover, based on the intent for Bendixen accepting to take part interview was to broader her and others knowledge for the situation and therefore contains a very small likelihood of bias. This interview was also held over the online communication platform, Skype.

Frederik Hove Sørensen, External sales for Dansk Kvarts Industri A/S

Sørensen works for the Danish company called Kvarts, which is one of the leading sand extraction companies in Denmark. Through a correspondence, questions related to exportation and the competitive markets was presented. Furthermore, questions related to the

pricing of sand and future prospects for the financial value of their products was asked as well as direct and indirect costs. The information regarding the price of sand, was that prices vary quite drastically given the quality it contained. Furthermore, the costs that came with taking part in the industry, relates to being close to one-hundred million dkk for a one-time purchase. Moreover, questions were asked in relation to new entrances to the industry, and the answer that was given indicates that while it is possible, it requires a large capital investment and lastly, Sørensen explained that keeping the export industry as close to the place of origin is most beneficial. There might be some bias from Sørensen, as he works with gaining the highest amount of revenue for the company and therefore might produce answers that are more positively driven compared to the reality. The correspondence was given through E-mail.

Secondary Data

While the primary data contained data from interviews, other sets of data was gathered from academic articles, books, reports and formulas that were obtained through different means and affirms itself as the secondary data used for the research. Secondary data covers both quantitative and qualitative data, which can derive from explanatory and descriptive research (Saunders, Lewis and Thornhill, 2015).

Including both empirical data with literature that supports the findings, help create a better conceptualised framework for the research conducted and give more supportive context. When researching viable secondary data for the paper, one has to take into account in some instances the publishing date and original intended usage of the information. Because the data might be outdated in some instances, where updated findings negates the initial findings, or that the data, while useful, needs restructuring to fit the current research being conducted (Saunders, Lewis and Thornhill, 2015).

One essential paper for finding answers to the research came from Bendixen, Overeem and Bjørk’s paper who researched the sand availability and its general potential of benefitting the country of Greenland. The paper takes into account a lot of important variables such as the nation's GDP, current viable markets, geological and economic aspects of Greenland. This paper allowed to conceptualize strengths, weaknesses, opportunities and threats for operating within the nation and laid the basis for the research being conducted. The paper further explores the increase in jobs that would be presented if a larger investment into the sand

market was provided. However, it is recognized that there would be a need to train and educate potential workers within the field, which might hold some difficulties in accomplishing in Greenland itself, regarding work that relates to engineering and geological work. While this report gave an overview and graph over the estimated market price changes, it was originally derived from another study conducted by Sverdrup et. al. (2017).

Sverdrup et. al. (2017)'s paper constructed a model for sand and other earth minerals for global supply that takes into account several factors among which are the global production rate of sand and the market price. Based on different variables, Sverdrup et. al. have created a system dynamics model, the SGS model, that projects the long-term supply, demand and prices of sand. His findings will be taken into consideration when examining the profitability factor later in the paper.

Data Analysis and Implications

The process of conducting an analysis of the data, shall not be taken lightly, it is instead a demanding process. Variables related to the data need to be carefully considered for evaluation and analysis (Yin, 1994). The aforementioned interviews served as the initial and main source for gathering data, which was further used as the most essential tool for the analysis. The data gathered from interviews was categorized and put into a distinct section, where propositions related to the distinct fields were summarized. This was furthermore put together with the data collected from the secondary data sources. The established framework was applied on the data in order to address the research question. When this was accomplished, scenarios were created. By constructing and analyzing these, which were initially build on empirical and secondary data, a clarification for best course of action will be determined in grounded and valid conclusions (Saunders, Lewis and Thornhill, 2015).

Validity and Reliability

To increase validity and diminish the possibility of using misleading data, an assessment of the validity will take place (Saunders, Lewis and Thornhill, 2015). When determining the quality of the research, an assessment of the reliability of the research is required to ensure that the established framework is replicable for future studies and holds consistency throughout (Saunders, Lewis and Thornhill, 2015). There are certain pitfalls that will ensure that reliability is not met and therefore need to be considered. The most relevant of these in

this instance are researcher bias and error, where miscommunication during interviews might occur due to defect hardware or software which provides incomplete data. Another potential risk is that the questions asked might not take into account all variables that are present when conducting the interview, which further produces incomplete data.

To mitigate the potential of errors interviews were recorded. Moreover, the semi-structured interview method also allowed the interviewee to answer questions in a more complete manner and reduced the chances of not accounting for all variables.

Researcher bias might occur if an interviewee holds a position to the subject that might have been affected by their subjective view on the situation. To prevent bias, multiple interviews with specialists on similar fields have been conducted and compared with secondary data that describes data from the same field. (Saunders, Lewis and Thornhill, 2015).

Internal Validity

When a causal relationship is entrenched between multiple variables, an internal validity is present. This can for instance be established when data gathered from the semi-structured interviews corresponds with the findings vested from the framework that is established to answer the research question at hand (Saunders, Lewis and Thornhill, 2015). There are some pitfalls that need to be considered and mitigated when assessing internal validity. One of the most plausible situations that might occur regarding this specific field of study in Greenland is that a interviewee might change perceptions on the situation, since the field of study in that region on a global scale is quite recent, where many factors have not been put into practice. The example of this would be if data gathered from an interviewee becomes obsolete due to changes in the circumstances surrounding it. This can entail changes in political policies, financial situation or sudden geological changes that nullifies the previously gathered data (Saunders, Lewis and Thornhill, 2015). To account for this, the framework that will be established for this research will allow for interchangeable variables to better suit the potential changes that might occur to the aforementioned topics.

External Validity

In regards to a similar topic related to the last mentioned point above, the external validity asks the question if the research conducted may be applicable in other settings or markets (Saunders, Lewis and Thornhill, 2015). The intent for the research is not to consider other

potential research fields. However, due to how the intended framework will be created, a possibility to replicate and replace some variables will potentially allow to configure it to markets with similar goals. This considers markets that focuses on for instance mineral extraction or natural gasses from Greenland, where by changing some variables will allow this framework to work for other markets as well. This is due to the fact that a significant amount of variables only sees an incremental change for it to be correctly adjusted.

Theory and Analytical Framework

Structure of Theoretical Section

Currently, there is no publicly available model, framework or estimation that addresses the potential of sand extraction and export in Greenland from a business perspective. The geomorphologist, Mette Bendixen, and her team of scientists have conducted scientific research related to the geological and geographical aspects of the Greenlandic sand. Furthermore, they have created an overview of how the sand could potentially contribute to the economy of Greenland. As the research does not investigate the potential from a business perspective, the theoretical section of this paper will focus on theories within strategic management and profitability measures combined with selected research studies related to future sand prices and export success. These fields of research and theory will be applied to establish an analytical framework that addresses the five ‘successful’ factors: profitability, strengths, weaknesses, opportunities and threats. As stated in the introduction, the analytical framework will to a high extent indirectly cover the remaining elements: ‘a company’, ‘foreign countries’ and to some extent ‘Greenlandic sand’.

Firstly, the theoretical section will review Sverdrup et. al.’s system dynamics model for global production of sand (2017). Their research is critical to this study as an important criteria for a potentially successful sand business in Greenland might be increasing sand demand and prices.

Subsequently, the theory section will direct the attention towards the specific tools which will form the framework that addresses the five ‘successful’ factors. Beginning with the profitability factor, the paper will review basic theory on profitability estimations and outline general components included in such estimations. In relation to this, the paper aims to discover and incorporate all essential profitability estimation components that are associated

with a setup of a sand extraction and exporting business in Greenland. Additionally, a review of key success factors regarding export performance is included.

After having established an approach for estimating profitability, the theory section will focus on frameworks and models that address a company's strengths, weaknesses, opportunities and threats (SWOT). The SWOT analysis, being a strategic planning framework, allows for flexibility when it comes to research purpose. As the paper conducts a strategic assessment of a business opportunity with numerous multifaceted aspects to consider, SWOT's emphasis on both internal and external factors fits the overall purpose of this study. However, according to Helms and Nixon (2010), the application of SWOT is often oversimplified and with no systemic approach, which results in superficial findings. For a SWOT analysis to be successful, the internal and external analyses must be conducted thoroughly and with consultancy of experts. Therefore, SWOT will not be applied as a single analytical tool, but rather as a summarizing framework for findings derived from in-depth analytical models and expert insights. Instead, the SWOT will be comprised of other models that provide structural and more thorough analyses. These are the Focused Diagnosing SWOT tool for the internal analysis segment, and Porter's Five Forces, PESTEL and Scenario Building for the external analysis segment.

The theory section will culminate in a build-up of the analytical framework containing all essential tools and guidelines that are necessary for a comprehensive analysis of the research question elements.

System Dynamics Model for the Global Production Rate of Sand

Materials intended for construction, infrastructure, technology and conservation of natural areas such as sand aggregates play an essential part in the economy and is considered to be the most active material circulated globally based on weight. As mentioned, it is estimated that approximately 40 to 50 billion tons of sand is used annually for construction work, whereby the largest portion of this is used in China, India, Brazil and USA (USGS, 2014). The system dynamics model for the global production rate of sand (SGS) is compiled to simulate the production and market supply and demand for natural sand. The model also takes into account the market price in a business as usual approach. The model uses market mechanisms whereby the price, population size and maintenance are considered the main factors for demand (Sverdrup et. al., 2017). It is estimated that there are 12 trillion tons of

sand and gravel respectively in total and estimates show a peak in in production rate will be reached roughly around 2065 (Sverdrup et. al., 2017). The objective of the model is to assess the availability and utilization of sand on a long-term perspective by using independent variables which include production and market price as their main data point.

When this research was being conducted, some difficulties in finding the exact and correct input data was present. This includes correct data for the amount of resources available on the global scale and the exact rates of annual mining globally. This is due to a significant amount of the global extraction works which are not being recorded as they are performed in a grey zone or just plainly as illegal activity. On the other hand, some areas that contain the correct material are placed in hard to reach areas, where the right extraction equipment cannot be placed, and therefore provide a lesser picture of all available materials. However, the data that has been compiled for the intended research is usable to gain an understanding over the situation (Sverdrup et. al., 2017). The estimation based on available data, provides an estimation of the amount of sand being extracted at a given time to two to three percent of known global reserves, whereby the total known amount of sand and gravel available on a global basis is estimated to be between eight and 12.5 trillion tonnes (Sverdrup et. al., 2017).

The study performed a multitude of studies, simulating different situations and the potential outcome from a period of 1900 to 2050. With a total of six simulations, the most interesting results are one; the strength of the SGS model and two; what they tell us. This research intended to create an updated model that could be compared to the previously created WORLD6 model, which the same researchers created earlier. The SGS model seems to follow the WORLD6 model relatively close when implemented in the same graph as seen below. It is indicated that the SGS is able to reconstruct a pattern similar to the WORLD6 model.

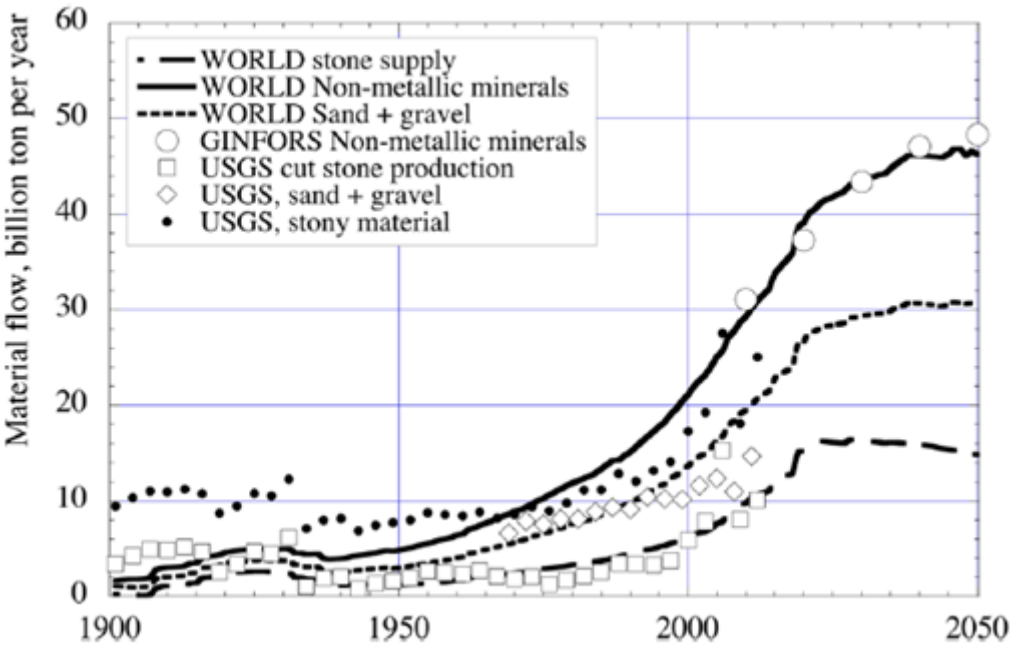

Figure 2 – Comparison of SGS model with observed data (Sverdrup et. al., 2017)

The simulations show a few interesting discoveries. There is a clear abundance of material worldwide, however, some difficulties might become reality in relation to scarcity. The reasoning for this potential occurrence is due to the sand from crushed rocks being limited by future energy expenditure, supply, ability of purchase and availability of long distance transportation (Sverdrup et. al., 2017). This will not occur in ten or fifty years, but might become a reality in the distant future. One solution to this is industrially made sand from crushed rocks, which is available in abundance. This type of sand will be more expensive to produce as an extra step will be required before the final product is ready for usage (Sverdrup et. al., 2017). Another problem is related to the position of the sand. While it is available, it is incredibly difficult to reach, making more precautions and technological advancements required before it can be extracted. Furthermore, an expected price increase for the sand is due to an increasing population, which leads to the need for further infrastructure development and housing, that results in increasing demand. So, going back to the expected peak of sand demands being reached around 2065, is further highly correlated with a peak in population being reached in the same timeframe. Nevertheless, an increase in price of sand will slow down the increasing demand around 2070 (Sverdrup et. al., 2017).

Profitability Model

When establishing the prerequisites for a business, one must look towards the potential profits that the industry and the business can expect. There are certain financial measurements that should be studied and analyzed to evaluate the probability of success of a business. For this study, a Break-Even Point analysis will be conducted. This is done to understand at what stage the profits and cost equals to zero and at what stage one can expected to reach a financial capital surplus (Kampf, 2016). To better understand the Break-Even Point model, it is important to understand what components go into calculating the model. The costs consist of direct and indirect costs for production, alongside the freight costs that come along for exporting the product while income is primarily based on the production that needs to be satisfied to reach the correct level of revenue (Kampf, 2016). An overview of the different components will be presented, followed by the model in its wholeness.

Direct Costs

Direct costs can be defined as expenditure that are based to a specific cost object, in this case the sand dredging industry. These include the equipment, raw material and labor that is required to accomplish a project or the task at hand (Spielman, 2018).The majority of the direct costs are variable costs. These are interlinked with the production rate. Higher output constitutes a higher variable cost and the other way around. The most common variable costs are related to materials required to produce the product, labor costs which is needed to actually create the product and utility costs (CFI, 2020).The varying material amount can for instance be wood, metal or plastic, which are needed to produce the product. Labor costs in essence covers the salaries that the workers producing the products are entitled to, while utility costs covers costs that are for instance related to electricity and water, which are most often a requirement when dealing with certain equipment and keeping the lights in the building running.

Indirect Costs

Indirect cost includes the costs that does not directly associated with the production. For instance, this can be office equipment, utilities and taxes. Indirect costs can likewise direct costs include fixed and variable cost (Spielman, 2018). In contrast to variable cost, fixed

costs do not change when the amount that is produced is increasing or decreasing, it stays constant. This can be the equipment used for production or the cost of rent in where the production is taking place. While the number of workers required to complete a production might vary based on output, salaries often stay constant for the individual and is therefore considered a fixed cost, which is incidentally a direct cost (CFI, 2020).

Net Profit

Net profit takes into account all profit gained from selling their products or services, and has accounted for all cash flows. Net profit is often referred to as the bottom line, as it is the last line on the income statement. (CFI, 2020).

Break-Even Point Model

This model considers the above aforementioned variables and is applied to figure out when an economic surplus can be reached. When investigating the nuances of the model, one can determine when a positive return will be reached by using a graphical model to conduct the analysis (Kampf, 2016):

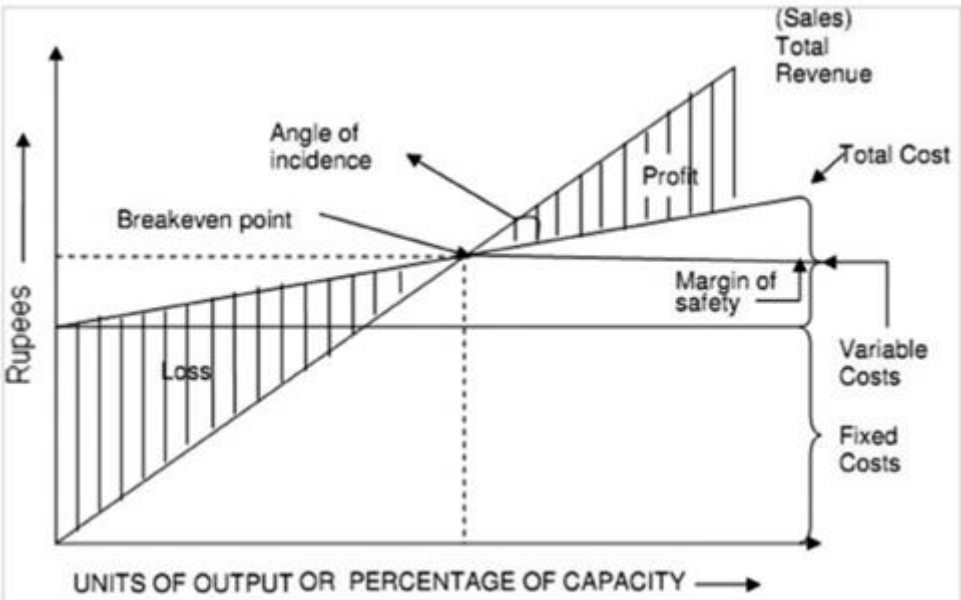

Figure 3 – Illustration of break-even point (Kampf, 2016)

Before reaching an economic surplus, the break-even point must firstly be reached. This is where the revenues and costs are in complete unison and equals zero as seen in the graph above. This is calculated through the equation below (Kampf, 2016):

$$R = p\ x\ q$$

$$C = (DC + IC)\ x\ q$$

$$P = R - C = 0$$

Establishing the Model for the Greenlandic Market

While the basis for the Break-Even Point model has been established, a more specialized model catered for the Greenlandic sand export industry needs to be presented. This revised model will consider both direct and indirect costs that are prominent to establish a global sand extraction and export industry in Greenland and also the freight costs included for exporting. Moreover, a further analysis of what goes into the break-even point model will be presented in regard to expected global sand prices. This readjustment of the model will present a more comprehensive understanding of what is required in terms of investments, however, an exact value will be out of scope for this research, as an expectation of specially tailored equipment, infrastructure for the surrounding area, labor costs, governmental support, geological challenges and exact sand quality data will not be available. A general pricing formulation will be used for the extraction cost components. The general formulation originates from a technical paper that has received certification from ASPE certification board, on behalf of American Society of Professional Estimators for their accurate evaluation of costs that water based extraction operations will accumulate. This paper includes the pricing of labor, material costs, equipment costs and indirect costs, which provides a total picture that encompasses water based mechanical dredging (Jones, 2012). It is important to note that the prices for a Greenlandic operation might be higher due to the harsh conditions.

The freight costs are an essential part of the sand export industry. In order to identify the freight rates costs, the study applied a freight calculator from the world freight rates organization, which is an organization that allows for calculations of the price of shipping. This is based on method of transportation, distance, value of product being shipped, risk of shipping the said product, method of storage, weight and oil prices (Worldfreightrates, 2020). For method of transportation the most prevalent one is break bulk, which is the most common one when transporting large masses of a product, often carrying a heavy weight to the product, which in this instance is correct regarding sand. Since the weight is high, higher consumption of fuel is required for the method of shipping, it is however counterbalanced by

the fact that sand per metric ton is a relatively cheap product. Oil prices are often difficult to predict for the future, since the price can be assumed to be quite volatile, based on several factors and is therefore required to be adjusted for the time of shipping. Due to the nature of sand, it does not require a special container when it comes to temperature control or special precautions for bad weather as it is basically rock that are being transported. Distance might be one of the main factors in determining the freight rates as they are affected by the previously mentioned factors (Worldfreightrates, 2020).

Human labor and utility costs will be affected by the size of operations. Human labor will consist of people with varying amount of education and expertise. There will be a need for engineers for repair and adjustment of equipment, and equipment operators, transporters for both trucks and ships and maintenance. Human labor is sometimes difficult to pinpoint as either fixed or variable cost, as the amount of workers will vary with the season and amount of work available, however, salaries are predicted to remain constant, so a divide is provided. Regarding utility costs, they will mostly consist of electricity expenditure, as all equipment requires power to operate, which will reach a significant scale if operations are intended for large scale exports.

The relevant fixed costs that this industry will be operating with consist of equipment for dredging, refining and sorting of sand, furthermore, a need for storage will also be required on a larger scale. One of the largest investments comes two-fold. Firstly, as Mike presented the requirements for how the industry in Greenland needs to evolve, a seaport will need to be constructed to accommodate larger cargo ships. In close proximity to this, the whole infrastructure of actually operating and extracting the product will need to be developed. There are multiple challenges to this, many regarding price, as such a large operation will carry a large price tag. The other problem is regarding the given location, it is quite remote. So, transport of material to build the infrastructure will be costly as well, as most of it has to come from other areas besides Greenland.

Constructing the infrastructure to a level where it can operate on a global scale will require the largest investment. Furthermore, a question rises if dredging ships will be needed, or if land stationed dredging equipment will produce better results. Considering the area and previously utilized methods, ship dredgers might be the more likely scenario. This if further supported by being the preferred method of dredging currently, as Mike exclaimed. However, the current utilized ships might not support a global enterprise and therefore will require an

investment in larger vessels. It is important to note that currently, there are no price estimates for the total cost of developing the aforementioned infrastructure required in Greenland. Therefore, it will not be taken into consideration when presenting the profitability model, as it is out of scope for this paper.

Besides equipment and infrastructure development, salary expenditure is also a considerable cost. Salaries will vary based on what profession and expertise the workers provide, however, an expectation that the salaries will remain constant given the category the workers go under is expected.

The last part of the equation is by a price estimation provided by . As previously discussed his adjusted SGS model with the WORLD6 model will serve as the basis for the revenue estimates alongside the information provided from Polaris Materials (Koren, 2017) for sand exportation. An adjusted model will be provided to fit further estimations. As the model follows a market price in business as usual approach, the adjustment to reaching the Break-Even Point will be based on the findings of Sverdrup et. al. suggesting that sand prices are estimated to increase with ten percent each year until it peaks around 2065 (Sverdrup et. al., 2017). Doctor Elsner (2020) has also provided an estimation of approximately a five percent annual increase. However, with some reservations for it being closer interlinked with the German market. Therefore, the Break-Even Point model, adjusted for the Greenlandic sand export market will be presented in the form of a readjusted equation:

$$DC = E_D + E_R + S + Sh + HL$$

Direct cost consists of equipment for dredging (E_D), equipment for refinement and cleansing of sand (E_R), human labor (*HL)* Salaries for the workers (*S*) and Ships for dredging and transportation (*Sh*). The more realistic calculation would also include the cost of developing the necessary port infrastructure

$$IC = OS + U$$

Indirect costs contain freight, Office equipment costs (OS) and Utility costs, such as electricity and water costs (*U*). Freight costs goes under its own entity, as it serves as a significant part, but is not directly part of the sand dredging industry, and instead is

considered an export cost. Therefore, freight costs (FC) will be be provided in the final equation.

When applying the Break-Even Point model, a market price development following a business as usual approach suggested by Sverdrup et. al. will be the adopted (2017) as well as Dr. Elsner's estimate. A sand export company named Polaris Materials whom conducts freight transportation to the US has established a price for regular sand used for construction. Their current pricing estimate for sand stands at approximately 20 dollars for a metric ton of sand (Koren, 2017). Establishing an exact pricing for sand for the Greenlandic market is immensely difficult, as there is an inherent amount of variables that are not discovered, such as the exact sand quality available. Furthermore, as Frederik (2020) proclaims, Kvarts prices for sand are varying with large margins due to specific properties in the sand and different processing methods. Therefore it is incredibly difficult to provide a singular price for a standard type of construction sand. Lastly, the price of sand is very varying based on where it is sold to as Elsner explains (2020). Based on these reasons, the price of sand per metric ton provided by Polaris Materials will be used in the calculations put forward in the analysis section. If new developments for the price of sand in Greenland becomes available, the estimated model below allows for changes in the pricing variable to fit more up to date estimations in the future.

$$P = R - (DC + IC + FC) = 0$$

The above-mentioned equation will serve as the basis for calculating and figuring out at which point a break-even point will be reached based on costs and revenue given future prospects. When a break-even point is reached, profit gains in the future can be expected. To assist with finding the expected break-even point a formula that considers Sverdrup et. al.'s (2017) and Doctor Elsner's (2020) assumptions of future price increases will be used. The formula considers an annual growth in sand prices as its base and estimates how many years it will take before a break-even point will be reached. Formula is presented below:

$$TC = CR\ x\ (1 + AG)^y$$

$$\frac{\log \frac{TC}{CR}}{\log(1 + AG)} = Y$$

Total costs (TC) accumulate over time and include all fixed costs and variable costs. The current annual revenue (CR) is multiplied with the expected annual price growth of sand (AG) powered by amount of years (y) it takes to reach a break-even point. The amount of years is calculated by taking the logarithm of total cost, divided by current annual revenue, which again is divided by the logarithm of one plus annual price growth of sand. This provides the estimated amount of years required to reach the break-even point.

Factors for Successful Export Performance

What key factors determines one's success when initiating in export to the global market? Greenland is well known for being a remote country with little influence on the rest of the world. When considering to expand the Greenlandic sand market and pursuing the viability of exporting to foreign countries, one has to gain a better grasp of the situation and discover cases that were in similar positions. Brouthers and Nakos (2009) conducted a study which entailed SME's in smaller countries or regions and explored success factors regarding export involvement. This study focused on Greece and Caribbean nations and put forward statistical analysis to gain a better grasp on which exploratory factors proved significant regarding measures taken when a company in these regions internationalized their ventures (Brouthers & Nakos, 2009). Since it can be argued that Greenland is in a similar position when considering the population size and the average size of companies currently operating in the sand industry in Greenland, an opportunity to explore results from other nations in similar positions seemed highly relevant.

The aforementioned study explored the success chance of multinational endeavors, which is defined as the sum of nations an SME is in business with (Diamntopoulus & Iglis, 1988). Some precaution that was taken for the study, is defining what is considered a successful venture for an SME. The study decided to identify it as the intensity to which the internationalization is obtained, rather than the export performance, as even if they manage to export large quantities, other factors might still result in negative financials (Brouthers &

Nakos, 2009). This research also follows the organizational learning theory (OL) which has given the following hypothesis: SME's that export a significant amount of their total output, manages to have a stronger competitive performance, due to a higher exposure to the international market, which results in more global market knowledge and therefore a competitive advantage. The SME's that do not export on a larger scale, loses the intake of knowledge and are at a disadvantage (Brouthers & Nakos, 2009).

For this statistical analysis 202 companies provided usable samples, where the dependent variables consisted of export performance related to domestic performance, sales and profit contribution to the given company. Furthermore, the independent variables consisted of how diverse the market portfolio was for the given company, at what frequency the exported at, the interaction between the two previously mentioned variables and finally to which degree the company focused on a given market. Moreover, seven control variables were also included that were based on previously conducted studies related to SME export performance. These included the size of a company, previous export ventures and length of time the company have been active with global exporting (Axinn, 1995). Geographic length between the nations in question, difference in nations, as in a dummy variable was created to distinguish the Greek and Caribbean companies and finally a dummy variable that distinguished between currently owned distribution networks and those that did not have these (Brouthers & Nakos, 2009).

The results given by the statistical analysis gave some insightful information, however, some of the variables gave unusable results, most likely due to having an insufficient sample size (Brouthers & Nakos, 2009). The results that produced usable data, however, include information that are of significant value. Firstly, companies that are invested in other nations, by providing their own distribution channels seemed to come on top, as they seem to contain more knowledge of the market they are collaborating with and as a result, performs better globally. In contrast to this, agencies that are independent of the exporting company in question, who only provide the distribution channels are more likely to be less prone to detail and therefore produce lower performance levels (Brouthers & Nakos, 2009).

The second discovery is related to the distance between the exporting nation and the receiver. It shows that approximately sixty percent of Caribbean export companies were distributing to other Caribbean nations, fifteen percent to the US and nine percent to the United Kingdom. This indicates that closer regions to the initial point of origin where the most popular. Similar

results came from Greek companies that are exporting, they also exported to nations in relatively close proximity (Brouthers & Nakos, 2009).

What does this mean for Greenland? Based on the research that was conducted by Brouthers (2009) it gives an indication that two aspects need to be considered when considering global expansion. Firstly, as it is indicated by the study, owning their own distribution channels provides the company with more knowledge of the market one is entering, which further provides a stronger competitive advantage. Secondly, closer proximity for the nations doing business seems like the more popular alternative. This of course holds solid ground, as longer trading routes increases costs and duration for when the goods arrive to the given destination. Therefore, the United States, United Kingdom and parts of Europe seem to be the best option based on the export research that has been conducted.

It is important to note that while this research is conducted on similar conditions regarding the size of the population and development of the region that is being operating from, other important factors are not similar. Most prevalent is the products being exported. The samples used in the study exports a plethora of products such as food, textile and pharmaceuticals, which are all quite far away from being related to the sand export industry. With this in mind, there might be other factors at play that produced the results they obtained regarding the close vicinity and distribution channels being important. Since their study is of a statistical nature, explicit reasonings for their revelations are not provided. Therefore, a cautious approach to their revelations will be put in place for future analysis.

SWOT

The SWOT-analysis has through several decades served as a strategic planning tool for not only companies, but also countries and industries. According to Helms and Nixon (2010), its simple structure for grouping internal and external issues makes it an easily approachable framework regardless of purpose. It allows companies and/or researchers to evaluate the relational ties between a company's competencies and its external environment. The flexibility of SWOT makes it suitable for multiple purposes including strategic evaluation of groups, company functions, companies, industries and even countries. As stated by Helms and Nixon, the use of SWOT has *"focused on analyzing organizations for recommended strategic actions"*. By identifying internal strengths and weaknesses and external opportunities and threats, it provides the user a clear and simple overview of a company's

strategic position. Thus, the framework identifies and examines company-specific characteristics and their fit with factors of the external environment. This approach enables the user to assess what strategic decisions are potentially more suitable for his/her party.

However, as stated by Helms and Nixon (2010), and backed up by Pickton and Wright (1998) SWOT tends to be overly simplistic and often ends up with superficial listing outputs. Therefore, along with thorough analysis and use of expert knowledge, SWOT needs to be combined with or substituted by other tools (Helms and Nixon, 2010). Depending on context and the organization in question, various tools can be applied for both the internal and external analyses. When it comes to choosing appropriate analytical tools, many different aspects within company specifics and the external environment can be considered. Potential focus points within internal analysis are company image, culture, structure, access to natural resources, capacity and efficiency, and financial resources. For the external analysis, fields within political, economic, socio-cultural, technological, environmental and legal aspects are potential factors to address. In addition to this, the competitive environment surrounding a company constitutes an important factor.

For the selection of tools to be included in this study, the above-mentioned potential areas of analysis are to be considered and weighted depending on their relevance to the Greenlandic sand business. Thus, some aspects within both internal and external issues, will be greatly emphasized, whereas others will be given less attention.

Selected tools will substitute SWOT as an analyzing tool, although SWOT will be partially used as a summarizing framework when findings of analyses are to be presented.

Internal Analysis Tools

One of the weaknesses of SWOT is the absence of a systemic methodology to conduct comprehensive analyses of a company's internal and external issues (Coman and Ronan, 2009). Therefore, different solutions are suggested as to how this issue can be addressed. For the internal analysis part, which revolves around identifying a company's strengths and weaknesses, Helms and Nixon (2010) refer to different researchers suggesting tools such as McKinsey's 7S model and the VRIO framework as potential alternatives. McKinsey's 7S model examines the relational harmony between different elements within an organization. The model might be beneficial to apply for any company, however it doesn't explicitly identify strengths and weaknesses for the purpose of being able to evaluate those against the

external environment. Additionally, it has more focus on aligning the elements of an organization, which is important, however not the main purpose for this study. The VRIO framework analyzes the strength of selected competencies of a company relative to the competitive environment. The framework is useful when important competencies have been identified as it helps to investigate whether they provide competitive advantages. Nevertheless, VRIO doesn't address company weaknesses and it can first be applied when certain competences are identified.

Although no companies are yet engaged in sand extraction or export with Greenlandic sand deltas as a source, a comprehensive systematic tool for identifying strengths and weaknesses is still of utmost importance to incorporate into an analytical framework. Should a company begin operations or consider to, it will be crucial to identify and scrutinize internal strengths and weaknesses as it allows the company to deal with those and ultimately enhance competitiveness.

The Focused SWOT Methodology

Coman and Ronan's (2009) focused SWOT methodology addresses the shortcomings of SWOT by using a systemic step-by-step model for diagnosing strengths and weaknesses. The model specializes in strengths and weaknesses only, however Coman and Ronan emphasize the importance of a subsequent analysis of the external environment, in which a company's strengths and weaknesses can be linked to potential opportunities and threats.

According to Coman and Ronan (2009), a large part of SWOT's drawbacks is rooted in its simplicity, which often leads to users ending up with an excessive amount of oversimplified strengths and weaknesses. Based on their analysis of more than 500 executive presentations of international companies, they propose four criteria for a comprehensive evaluation of strengths and weaknesses.

Concise: Lists of strengths and weaknesses should contain no more than four to five items per list as managers will not be able to effectively address too many issues.

Actionable: Strengths and weaknesses to be addressed should be actionable in the sense that goals and tasks are easily defined and ready to be approached. They refer to the example of a frequently listed weakness among companies being 'Asia'. A weakness that is termed in this manner can not readily be addressed through actions.

Significant: Managers should concentrate on items that have substantial impact on the company. Strengths and weaknesses with negligible impact should be excluded.

Authentic: In the fourth criteria, they stress the importance of the lists being realistic rather than wishful thinking. This implies that executives might include items that they wish are present or not present, although they don't fit the reality.

When the internal part of any SWOT analysis is conducted, the list of items must fulfill these criteria for managers to be able to effectively deal with these. Thus, the criteria work as a checklist for strengths and weaknesses after they have been identified.

Coman and Ronan's (2009) focused diagnosing methodology is based on a multi-step model that identifies strengths and weaknesses with origin in value-creating and destructing events. The chosen events are analyzed and distilled into core competencies and core problems. The steps are explained further below.

The Event-Factor Review

The event-factor review rests upon the assumption that a company's strengths and weaknesses are reflected through events. An event with a significantly positive impact on a company is an expression of one or more strengths. On the other hand, an event which impacts the company negatively reflects a weakness within the company. According to Coman and Ronan (2009), such events can be "*winning or losing tenders, meeting technical challenges, influence in standard committees, meaningful market share gains or losses, and substantial profits or losses in a given market segment".* They further stress that events should be analyzed carefully as successes and failures might reveal more than what is obvious. A nuanced review is required because a successful event can reveal significant weaknesses. They bring the example of a won contract with a top tier telecom service provider, which might indicate strong negotiation skills and the ability to offer competitive terms. However, a multi-million dollar loss subsequently occurred due to weak implementation skills. The event-factor review is supposed to generate 8 to 12 strengths and 8 to 12 weaknesses.

Discovering Core Competencies and Core Problems

Coman and Ronan (2009) claim that a number of strengths and weaknesses within a company are rooted in a few core competencies and problems, respectively. Therefore, the next three steps aim to distill the 8 to 12 strengths and weaknesses into core competences and problems. The same steps apply to both.

1) Firstly, the lists of 8 to 12 elements must be pruned by removing *"redundancy, vagueness and irrelevant symptoms"*. Items that do not satisfy the following should therefore be removed.

- The S/W should exist over a certain period of time. Sporadic cases of S/W should not be included. Focus must be on S/W that are constant and add value/cause damage to the company over time.
- The S/W should be expressed in desirable or undesirable terms in order to avoid ambiguity. Coman and Ronan bring the example of a weakness phrased as 'culture'. This needs to be specified to for instance 'lack of individual initiative' or removed if it can't be elaborated further.
- The S/W must be under control or influence of the company. Strengths and weaknesses which can be dealt with by the company are in focus. The company must be able to address them by taking action in one or the other way. A global pandemic or economic upswing are usually not factors that companies can control.

2) Secondly, the reduced lists of strengths and weaknesses are linked through the use of cause-effect logic. This is done by depicting the links between discovered strengths or weaknesses and their eventual effects. An example is demonstrated by Coman and Ronan with 'Lack of innovation' as a weakness, which causes the effects 'a lack of growth' and 'insufficient profits'. This step will help to formulate a leading strength or weakness, which is an essential part of the next step.

3) Lastly, core-competence and core-problem trees are outlined for strengths and weaknesses, respectively. This is done by formulating a leading strength and weakness to which all underlying strengths and weaknesses can be drawn to. 'Firm value is insufficient' is used as an example for a weakness, whereas 'Value was created for the shareholders' is a common leading strength. The leading strength and weakness is to be

depicted in the top of the tree, and subsequently a number of strengths or weaknesses that cause the leading strength or weakness are added underneath it. This same is done with recently added strengths or weaknesses. Eventually, layers of strengths or weaknesses are build until two or three strengths or weaknesses that can not be explained any further constitute the bottom of the tree. These few elements also constitute a company's core competences or core problems. Coman and Ronan's figure below illustrates the reasoning behind this. The underlying assumption behind this strategy is that all strengths and weaknesses are symptoms of a company's core competencies and core problems. Examples of potential core problems provided by Coman and Ronan are 'An excessively centralistic manager', 'Lack of a clear strategy', 'Unstructured processes' and 'Inappropriate performance measures'.

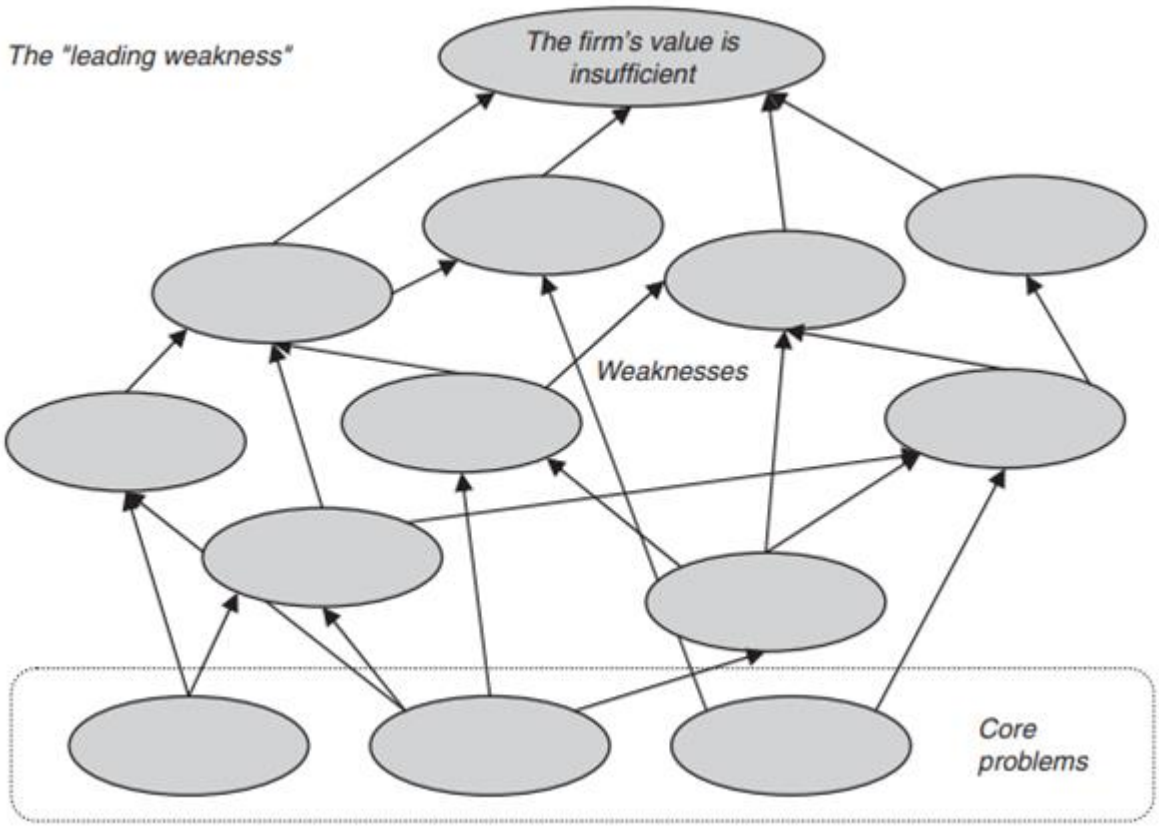

Figure 4 – Core Competencies/Problems tree (Coman and Ronan, 2009)

When core competencies and problems have been identified by using the focused diagnosis methodology, a check can be made to confirm that they satisfy the four criteria *concise, actionable, significant* and *authentic.*

Coman and Ronan's model (2009) offers a systematic method for identifying company strengths and weaknesses. It offsets some of the major drawbacks of SWOT by adding a structured approach for the internal analysis part. However, a drawback that it can not address is the user bias and subjectivity connected to it. The quality of it depends on the skills, knowledge and perceptions of the users. As noted earlier, Helms and Nixon (2010) suggested to use expert knowledge when conducting SWOT analyses. This can be an offsetting factor for the subjectivity issue.

External Analysis Tools

The external analysis of SWOT shares the same weakness as the internal part as it lacks a systematic methodology for identifying a company's opportunities and threats. According to Gürel and Tat (2017), opportunities can be regarded as external elements outside the organization that can benefit an organization. Threats, however, are external elements that can cause trouble for an organization. Harrison and St. John (2004) provide an extended definition for opportunities by arguing that "*opportunities are conditions in the external environment that allow an organization to take advantage of organizational strengths, overcome organizational weaknesses or neutralize threats.*" This supports the view that opportunities and threats are highly dependent on a company's strengths and weaknesses. As indicated by Helms and Nixon (2010), additional tools that either complement or replace SWOT are required for comprehensive internal and external analyses. They have reviewed numerous SWOT studies that applied alternative tools, and the importance of analyzing the competitive environment of an industry seems prevalent. Michael Porter's five forces will therefore be an essential tool to include in the establishment of an analytical framework.

As the tool of Porter's five forces is limited to focus only on factors related to industry competitiveness, there is a need of a tool that addresses opportunities and threats from a perspective that includes a wider spectrum of local and global factors. In addition to this, it must allow for future perspectives as snapshot analyses of current conditions quickly become outdated. Despite its weaknesses, the widely used PESTEL model will be reviewed and incorporated into the analytical model.

Porter's Five Forces

Porter's five forces tool (1979) seeks to analyze the state of competition of an industry by examining the strengths of five influential forces:

- The extent to which competitors are jockeying for position in the industry
- Bargaining power of suppliers
- Bargaining power of customers
- Threat of new entrants
- Threat of substitute products or services

According to Porter (1979), competition does not only revolve around the competing companies within an industry. It goes beyond that as all the above-mentioned forces are part of the underlying economics that shape the competitive state of an industry. The strengths of all forces are to be examined and combined into a collective assessment that indicates the profit potential of a given industry. The collective assessment is qualitative, and the state of competition can vary from being intense, implying small returns on investment, to mild, indicating room for relatively high returns. As explained by Porter, forces are likely to work against each other. Threats of new entrants might be minimal and competitors few, however, a high threat of substitute products makes the industry less attractive to stay in.

By conducting in-depth analyses of each force, strategists will be able to delve below the surfaces of the forces and gain an understanding of how to best defend themselves against external threats or to grasp opportunities. Thus, according to Porter (1979), not only does it enable optimal strategic positioning for companies, it also supports managements by making critical company strengths and weaknesses more apparent.

The five forces model is of great importance to this study as it helps to identify the most important industry-related threats and opportunities that a company must direct attention to in order to gain or sustain competitiveness. Since its invention by Michael Porter, the model has been applied and reviewed frequently by managers and scholars. Therefore, this paper will limit the review of the forces to brief explanations of the forces.

Jockeying for Position

The greater rivalry between existing competitors, the stronger will this force be. This force revolves around the companies that already exist and compete. In an industry with a high degree of rivalry, companies are likely to compete on prices, introduce new products and increase advertising to a higher extent (Porter, 1979). Following factors characterize intensive rivalry:

- A high number of competitors, particularly if they are equal in size and power.
- Slow industry growth, implying intense fights for new market share.
- Limited differentiation of products and services and low switching costs, making it easier or less costly for customers to switch to competitors.
- High fixed costs and perishable products. When demand decreases, these factors are likely to make companies cut prices. This applies in particular to basic materials businesses.
- Large and instant increases in capacity. This often leads to overcapacity and price cuts.
- High exit barriers. This can involve high sunk costs due to expensive and/or specialized equipment. High exit barriers keep poorly run businesses in the market, which harms well run businesses. Porter suggests to ask for governmental support if the industry suffers from overcapacity.
- Diverse strategies among competitors.

Porter (1979) adds to this segment that industries which are mature, often results in deaccelerating or decreasing growth rates, leads to increased jockeying for position and therefore lower returns for most companies.

Threat of New Entrants

If the threat of new entrants is high, the more prevalent is this force, which causes a lower profit potential. The force depends on the entry barriers that are present. High entry barriers reduce the threat of new entrants. Following factors influence entry barriers (Porter, 1979):

- Economies of scale. If new entrants are forced to make large investments in order to compete, it will be less attractive to join the industry.
- Product differentiation. When products or services are already highly differentiated, it becomes difficult for new entrants to stand out and turn customers to their side.
- Capital requirements. The more expensive entry is, the higher entry barriers.

- Cost disadvantages independent of size. This implies that established companies benefit from a number of factors such as experience, access to better resources and better locations.
- Access to distribution channels. If a new entrant cannot easily bring products or services to the market through logistics, the less attractive it will be to join the industry.
- Government policy. Governments can regulate industries by imposing license requirements and limited access to raw materials. Depending on government preferences, some companies might be favored over others. Other regulations might also indirectly affect industries, as for instance, tight control procedures and environmental standards.
- Expected reactions of entrenched companies. If new entrants expect harsh retaliations from entrenched companies, they might be less likely to enter the industry.

Power of Suppliers

Suppliers can use their bargaining power on companies by increasing prices of the products they supply or by reducing the quality of them. This will hurt profitability of companies, especially if they are not able to compensate for this by, for instance, raising prices of the products they sell. The more bargaining power suppliers have, the greater the risk of undesired developments such as those mentioned before (Porter, 1979). The power of suppliers is high if:

- The group of suppliers is small and more concentrated than the industry it supplies.
- Their products are differentiated or unique, thereby being difficult for companies to procure elsewhere. Additionally, high switching costs makes it costly for companies to change supplier.
- They do not compete with other products sold to the industry.
- They can credibly threaten to integrate forward into the industry.
- The industry to which products are supplied is not important for supplier. On the other hand, if the survival of the supplier depends on industry, it becomes vital for the supplier.

Power of Buyers

Buyers can exert power on companies by playing competitors off against each other. They can demand lower prices or higher quality. The greater power of buyers, the lower the profit potential of the industry (Porter, 1979). Following factor make buyers power stronger:

- Buyers group is concentrated which makes the company more dependent on few large buyers. Moreover, if buyers purchase in large volumes, buyers' power will increase. This is particularly the case if companies have high fixed costs e.g. expensive equipment.
- If the company sells undifferentiated products, the buyer can threaten to buy the products elsewhere. This is a way to play competitors off against each other.
- If the product is a component of the buyer's product and represents a large share of buyer's costs, the price sensitivity will be high, thereby incentivizing the buyer to look carefully for alternatives.
- If the buyer is a low-profit business, it will look more thoroughly for cost reductions. Therefore, low-profit businesses are usually more price sensitive than high-profit businesses.
- If the sold products are not important to the quality of buyer's products, buyer's power becomes stronger. Buyers would rather be price sensitive to components that are not affecting the quality of their final products, than to vital components affecting quality a lot.
- If the product sold does not save the buyer money or significantly increase quality of buyer's final product, the buyer will be more price sensitive to the product sold. This relates to the previous point.
- If the buyer can credibly threaten to integrate backwards, its power increases as it can choose to produce the product themselves.

Buyers can be both consumers e.g. supermarket customer, and they can be industrial or commercial buyers, hence B2B trade. In this study, focus will be on the latter due to the nature of the investigated business.

Threat of Substitute Products or Services

The last force involves products or services, which do not originally belong to the industry in focus. Products or services of other industries that can cover the needs of those in question

are regarded as substitute products and services. If customer needs can be fulfilled by substitute products, the profit potential of the industry in focus is limited. Unless industry products can be differentiated or quality raised, industry earnings and growth will be hurt. According to Porter (1979) attention should be paid to substitute products, whose price-performance has the potential to be improved. Moreover, strategists should also focus on substitute products made by companies in high-profit industries, as they might gain sufficient financial capital to enhance their products.

Porter's five forces model will constitute an essential part of the analytical framework as it provides a systematic tool to identify industry-related opportunities and threats. However, it needs to be complemented by an additional tool because it cannot address threats and opportunities outside the sand extraction and exporting industry. This industry is highly dependent on global trends and developments. Furthermore, Porter's five forces tool can quickly become outdated as its main focus is on current conditions (Porter, 1979). The next tool is included in the external analysis part as it can help to address these issues.

P-E-S-T-E-L

Johnson (2015) argue that organizations must consider not only market related aspects, but also non-market aspects, when analyzing the external environment. A wide range of non-market factors could have the potential to affect organizations positively or negatively. Therefore, Johnson suggest to apply the framework of PESTEL, which examines different non-market categories. These are comprised of political, economic, social, technological, ecological and legal aspects. Many of these often prove to be largely interconnected, however, by going through each of them, organizations can gain a broad overview of potential issues that need to be addressed. PESTEL has the advantage that it allows for future perspective analyses. This is essential to the research of this study as a sand business based in Greenland might prove to show greater potential in the future than today. However, as emphasized by Johnson (2015), PESTEL can easily lead to an overwhelming number of issues. This is particularly the case due to the interrelationships between the factors. It is therefore of great importance to identify key drivers for change. These are the factors that have the potential to substantially impact a company positively or negatively over time. Johnson also emphasize that depending on the market or industry in question, some categories will have more importance than others. Therefore, PESTEL allows for flexibility when it comes to how comprehensive each category should be examined. This suits the

research of this study well as it allows for more in-depth analysis of relevant factors and less attention given to irrelevant factors. The disadvantage of this is that the analyses of different factors are highly subjective. Thus, the quality of PESTEL depends on the analyst. Again, this can only be offset by using expert knowledge and comprehensive research, as stated by Helms and Nixon (2010).

Building Scenarios

In order to identify non-market opportunities and treats, Johnson (2015) propose to combine PESTEL with building up potential future scenarios. They argue that business environments characterized by high uncertainty, complexity and/or rapid change are impossible to make forecasts for through a strategic plan containing a single scenario. Multiple scenario analyses should be conducted to allow for different future outcomes. This will help companies to be prepared for different scenarios, hence enable a better strategic positioning. Companies will be able to respond quicker to alternative scenarios. It is suggested to work with three to four distinct scenarios based on the PESTEL framework and the derived key drivers for change. This approach will help companies to develop robust alternative strategies in case that unexpected scenarios occur. Furthermore, Johnson (2015) suggest the following five steps when formulating different scenarios:

- Defining the scope. This refers to the time span and the subject. The subject scope involves limiting the analysis to a certain global industry, market, country or region.
- Identifying key drivers for change. PESTEL is suggested to use as a tool for identifying these. They further state that key drivers should (1) have high potential impact on the company; (2) be uncertain; (3) be mutually independent.
- Develop scenario stories. The chosen key drivers and other factors should be combined into plausible scenarios that have a potential to occur. These scenarios are the ones to be analyzed and from which opportunities and threats are derived.
- Identifying the impacts of developed scenarios. This is the step where opportunities and threats are identified based on the scenario factors.
- Establishing warning systems. Companies should find indicators that can monitor and warn them if any of the scenario characteristics seem to appear.

The research conducted in this study depends numerous factors with origin in several different fields of research. Therefore, the scenario building technique will fit the analytical section as it provides structured guidelines for identifying opportunities and threats. With PESTEL and Porter's five forces, Scenario building will constitute the external analysis tools.

Establishing an Analytical Framework

As clarified in the introductory chapter, the purpose of this study is to develop a framework that can comprehensively assess the potential of success for a sand extraction and exporting company in Greenland. The study focuses on sand that can be extracted from river deltas. The analysis chapter which follows this section will begin with a specification of all practical circumstances involving sand, particularly that of Greenland. The introduction also outlined the factors that this study will apply to measure 'successful', namely profitability, strengths, weaknesses, opportunities and threats. The theoretical section has reviewed models and frameworks that make these factors analyzable through structured step-by-step approaches. This paper will adopt these tools and combine them into a holistic framework that will enable any user to make well-reasoned strategic decisions with regard to potentially investing in this business.

Figure 5 below illustrates the components of the analytical framework that this paper suggests to apply in order to examine the success potential of a sand extracting and exporting business in Greenland.

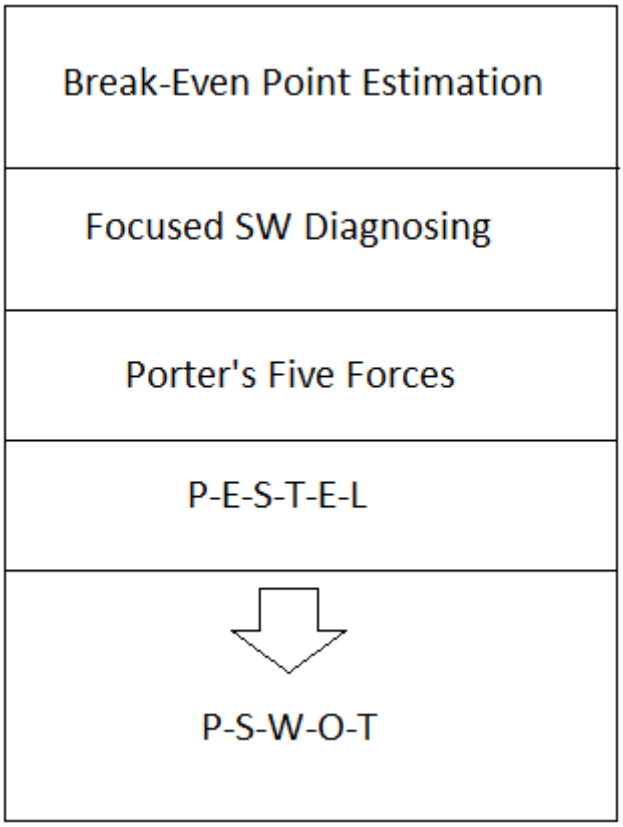

Figure 5 - PSWOT

The first component involves the Break-Even Point Estimation. As emphasized earlier, the break-even point estimation automatically indicates whether the business will be profitable or not. If revenues are higher than variable costs, profits will be generated and eventually a break-even point will be reached. However, if the break-even point is too far out in the future, an investment might not be worth making. In combination, profitability and break-even point comprise the most important factor, when assessing potential of success.

The next highlighted tool is the Focused Strengths and Weaknesses Diagnosing Method, which offers systematic and comprehensive identification of a company's core competencies and core problems. By using cause-effect logic, it can help companies to identify specific competencies and problems, which might offer advantages or disadvantages related to the opportunities and threats found in the external environment analysis. It is apparent that this tool addresses not only the 'successful' element, but also the 'company' element of the research question. However, for the tool to be applied properly, it does require a company with access to its historic events and a certain amount of data.

The next model involves Porter's Five Forces, which will assist in discovering industry-related opportunities and threats. The tool will provide essential insights into how attractive the industry is from a market-based perspective. Porter's five forces deal with both the 'successful' and 'foreign countries' elements.

Lastly, the PESTEL framework enables analysts to flexibly analyze potential non-market opportunities and threats. Two separate PESTEL analyses should be conducted. One for Greenland and one for the potential export areas that are chosen. Along with the findings of Porter's five forces, the tool should be combined with the scenario building approach, where the most relevant potential trends, developments and industry characteristics are selected and analyzed in order to discover how the company might be impacted by these. PESTEL is relevant for 'company', 'successful' and 'foreign countries'. The Greenland version of PESTEL is to some degree relevant for 'Greenlandic sand'

In combination, the reviewed tools will indicate potential success through; profitability (P), strengths (S), weaknesses (W), opportunities (O) and threats (T). Furthermore, they clearly address all of the research question elements with the exception of 'Greenlandic sand'. This element needs to be addressed externally from the analytical framework, but is, however, highly interconnected with the remaining analysis.

It is important to emphasize that the tools of the established framework are not ordered after which should be addressed first, second, third etc. Depending on purpose, it might make most sense to estimate a profitability and break-even point first, if export locations, price of sand, costs etc. are known. However, if export locations have not been decided yet, the five forces and PESTEL seem more appropriate to start with in order to determine potential export locations. This approach is followed in this paper. A third possibility is to begin with the focused diagnosing analysis with the aim of finding out if the company even has the appropriate competences, or has too deeply grounded problems for the type of business in question. The VRIO framework might be a suitable tool to combine with this in order to link identified core competencies to what is required to become competitive in the industry.

The established framework is deliberately flexible of nature as it can be applied fully or partially, by companies or interest groups, by companies considering to expand into this business or companies that are operating already. For the optimal data, the framework must be applied on an entrenched sand extracting and exporting business in Greenland. However,

as no businesses are yet extracting and exporting sand from sand deltas, analyses must to some extent rely on estimates and assumptions. The next section will apply the framework to the extent that information is obtainable after which the findings connected to each element of the research question are presented.

Analyzing the Potential of Sand Extraction and Export from Greenland

Structure of Analysis

This part of the paper will address the four elements of the research question for the purpose of answering the research question: *Can a company successfully extract and sell Greenlandic sand to foreign countries?*. The analysis will begin by examining the element 'Greenlandic sand'. It is important to specify what characteristics make sand suitable for construction purposes, what kind of sand and which quantities are available in Greenland and what are the conditions that a sand operator must deal with in Greenland. In addition, a specific extraction location is selected. The analysis is initiated with this section as it clarifies fundamental conditions which the remaining analysis is depending on. It sets the basic conditions which the established analytical framework can continue from.
As this part of the analysis has been conducted, the analytical framework will be applied to examine the remaining elements. By analyzing the five 'successful' factors PSWOT, the paper expects to gain a profound understanding of 'company', 'successful' and 'foreign countries'. A reversed order of PSWOT will be followed. Opportunities and threats are the first factors to be addressed. This is decided in order to narrow down the scope of the markets to be analyzed and to gain a thorough understanding of these markets. Subsequently, the strengths and weaknesses are addressed, whereafter the profitability factor is analyzed. Underneath, a more detailed approach is described.

In order to assess potential success for a sand extractor and exporter in Greenland, two scenarios will be composed for the purpose of enabling the identification of SWOT-related factors for a company. The two scenarios will differ from each other based on their scopes and on factors derived from the use of the framework analysis tools. At first, the scope of the scenarios are to be determined. As suggested by Johnson (2015) the scopes of the scenarios will be defined based on *timeframe and geography*. The defining process of these is

influenced by certain considerations. These are considerations that take into account expert insights from Mike Høegh, who is operating in the local sand dredging industry in Greenland, Frederik Sørensen from Dansk Kvarts Industri, Mette Bendixen and Doctor Elsner. Thus, their findings and inputs will have an impact on defining the scope. When defining scenario scopes, the quality of sand will be determined and incorporated into the scenarios. After the scenarios scopes have been determined, a further construction of the scenarios stories will take place through the use of the framework tools.

The two scenario stories will be constructed by applying Porter's Five Forces and PESTEL. In the scope definition section, it will become apparent that the first scenario scope involves a short timeframe, whereas the second scope works with a long timeframe. Porter's five forces will predominantly be utilized for the short-term scenario. The reasoning for this is its ability to examine current and short term industry conditions. Porter's model considers the current underlying economic dynamics of an industry. The use of it makes it difficult to conduct a solid analysis for a longer timeframe. However, the model gives a clear view of the current competitive landscape and how attractive the industry appears. Despite its limitations, it will provide a fundamental understanding of the industry, its profit potential and industry-related opportunities and threats.

The PESTEL analysis tool will serve multiple purposes. Firstly, it is applied to conduct a country analysis of Greenland with the aim to provide fundamental contextual knowledge of the country, but most importantly to give an indication of its suitability for a sand extracting and exporting company. Secondly, another PESTEL analysis will be conducted, this time covering the geographical scope that is defined. This version will consider both short-term and long-term developments, thus it covers both scenarios. This PESTEL is essential as it enables identification of key drivers and impacting factors, which are central to formulating scenario stories. Key drivers and impacting factors are found and chosen according to their potential of affecting the sand extraction and exporting industry in Greenland.

It is in the process of constructing the scenario stories that important opportunities and threats are discovered as key drivers and impacting factors reveal what opportunities and threats a company will face. Therefore, the scenario stories to be presented in this paper will outline non-industry as well as industry-related threats and opportunities and explain how these can influence the profit potential of sand extraction and exporting in Greenland.

It has to be mentioned that due to a lack of current companies being applicable to the criteria this paper has set, an initial internal strength and weaknesses analysis will be difficult to implement with regards to the suggested internal analysis method. However, the paper will pursue to outline relevant strengths and weaknesses that a company operating in the sand industry in Greenland will have to deal with. In addition, some key characteristics to success in the general sand business are highlighted.

When the scenarios have been examined profitability estimations for three chosen destinations within the selected geographic area will be presented. This will include the costs and revenue for each of the scenarios, whereby the equations formulated in the literature review will be utilized to calculate the break-even point and in what timeframe this can be expected. When the profitability factor has been analyzed, a discussion of the full analysis will be presented by evaluating each of the four elements of the research question.

Greenlandic Sand

Before applying the established analytical framework, it is important to investigate and clarify the conditions regarding what this study is all about, namely the Greenlandic sand. As the reader will have noticed, sand is not a uniform resource. Its physical properties and substance vary depending on how it has been produced and formed by the nature. The different characteristics of sand play a huge role when it comes to how it can be applied. Sand for construction purposes, which according to the UNEP (2019) accounts for the majority of used sand, is crushed in the nature. This gives the grains sharp edges and different sizes, which are optimal properties for a mixing with cement. Beach sand and particularly desert sand are characterized by being too uniform with its rounded shapes and similar grain sizes. These properties are not suitable for construction purposes, which explains why the world's large deserts can not cover the supply shortages around the world (Sverdrup et. al, 2017). In recent years, a search for new and sustainable extraction locations that meet construction sand property requirements have begun (UNEP, 2019). Bendixen was the first to draw attention to Greenland's unexploited sand resources. Based on observatory research, Bendixen and her team of scientists have described how sand and gravel are accumulating and in fact expanding the landside along the Greenlandic coasts (Bendixen et. al, 2019).

Apart from elucidating the physical circumstances of the Greenlandic sand deltas, their research article provides an overview of the economic benefits that awaits Greenland if a share of the unexploited sand resources can be extracted and exported, and ultimately cover a

part of the increasing worldwide demand. By observing historic aerial photos dating back to world war two, their research has discovered substantial increases of accumulated sand reserves along the coasts. Due to rising temperatures Greenland have seen sediments accumulate faster as greater flows of melting water carry larger loads of sediments. Sand and gravel, which have the geometric properties to be applied for construction purposes, are deposited closer to the land side. Silt, which is small-grained sand particles, is carried further out into the marine delta area (Bendixen et. al, 2019).

According to Bendixen, several hundreds of sand deltas exist along Greenland's coasts, however some are regarded as hotspots because of their substantially large outflows of sand. One of those is the Sermeq Outlet, located in the Sermilik Fjord 100 km south of the capital Nuuk on the west coast. A research study has found that approximately 25 percent of Greenland's total sediment outflow occurs in this location (Overeem et. al., 2017). Whereas the fjord was frozen approximately half of the year decades ago, global warming has reduced this to only 20 days a year, thus allowing for shipping access almost all year (Bendixen et. al., 2017). Being located in the narrow fjord of Sermilik, the sand delta is protected from wave activity from the Davis Strait, which eases potential extraction operations. Assuming a 15 percent usability of the Sermeq sand, Bendixen estimates that 0.33 gigaton, corresponding to 330 million tonnes of sand is available for export annually. To put this into perspective, Bendixen states that this amount covers the yearly demand of the rapidly expanding San Diego County twice. Due to these factors, the Sermeq Outlet has become the center of attention regarding a potential extraction spot, and it will also be the location that this study focuses on.

The coarse sediments, sand and gravel, which accumulate in the inner area of Greenlandic sand deltas appear to be suitable for construction purposes from the perspectives of shape and size. However, as noted earlier, substance does also play a significant role regarding industrial purpose. Along with shape and size, the substance determines the most appropriate use for sand. Depending on the substance, sand might be more or less suitable for construction purposes. Furthermore, the substance might be of a quality that suits more sophisticated purposes than construction, hence increasing the potential selling price (Bendixen, 2020). Prior to this paper, very few preliminary tests of substance have been conducted for the Sermeq sand. The tests, which were sampled and analyzed by Mette Bendixen consist of two samples containing a wide range of different minerals. The two

samples indicate a relatively high presence of feldspar. According to Bendixen, feldspar is a mineral that degrades relatively quickly, making it less suitable for construction purposes. The presence of feldspar might lower the attractiveness of the Sermeq Outlet as an extraction location. However, as stated by Bendixen, determining its potential judged by these samples is not sufficient. The samples are too few and collected at the same spot in the marine delta area. The Sermeq outlet area covers several square kilometers and a comprehensive investigation of the sand needs to be conducted before determining the quality of the sand (Bendixen, 2020).

As stated in the introduction, few small-scaled businesses dredge sand for local purposes in Greenland. However, these do not operate in sand deltas as described in this paper. Sand is dredged from the sea bed at locations with no connection to the sand deltas. Mike Høegh, owner of a small-scaled sand dredging business claims that an expansion of his business to involve extraction from deltas such as the Sermeq Outlet will require huge investments into equipment and infrastructure. According to him, the industrial port of Nuuk is far from being able to manage high scale bulk shipping. As shipping constitutes the highest variable costs, he suggests that infrastructure and equipment will need to be established at the sand extraction location. This includes an industrial port capable of hosting dry bulk ships, but also sand extraction equipment, processing equipment and storage. Extra shipping costs from the Sermeq Outlet to Nuuk will be avoided through this approach.

The surroundings of the Sermeq Outlet is uninhabited and completely unharmed by people. The landscape can be characterized as rocky and sloped. Therefore, many challenges with regard to establishing operations will be present. As stated in Bendixens research (2019), potential environmental impacts will also need to be investigated.

Thus, comprehensive planning and further investigations in many aspects are required before sand extraction operations in the Sermeq Outlet can be initiated. The sand is there in enormous amounts, however difficult and costly to get hold of.

Defining the Scenario Scopes

When defining the scopes of the scenarios, a number of variables and options have been taken into consideration. Due to a tremendous amount of research options regarding exports of Greenlandic sand, certain limitations need to be put forward as the paper cannot cover all

possible markets, areas and scenarios comprehensively. This contradicts Johnson's (2015) suggestion of working with more scenarios, however, it allows the paper to conduct two examples of more in-depth scenarios. The study has chosen to conduct two scenarios that the researchers, based on findings of external analyses, predict will have the highest likelihood of occurring. Certain main variables and professional inputs will be prioritised, both in defining the scope and in later scenario stories.

To begin with, this research has chosen to use the inputs provided by Mike Høegh (2020) based on his knowledge and understanding of the local conditions that a sand operator would have to work under. Høegh provided insights regarding how to approach an operational setup of a sand extracting business in the Sermeq Outlet. As suggested by Mette Bendixen (2020), the location being investigated as a potential starting point for business is the Sermeq Outlet, located in the Sermilik Fjord approximately 100 kilometers away from the capital Nuuk. As pointed out earlier in the paper, Høegh addressed a lack of infrastructure required to handle large-scale bulk shipping in Nuuk. The lack of this requires a setup of an industrial harbour, preferably in the Sermeq Outlet as this will save important shipping expenses between Nuuk and the outlet. In addition, the area must also have the right sand material available. Furthermore, proper extraction and processing solutions that match the harsh physical conditions must be developed by engineers. Thus, all operations from extraction of sand to loading ships for export must be performed in the location.

The research provided by Brouthers and Nakos (2009) gave some interesting insights, which will influence the selection of a geographical focus. One of its key findings to successful export was the importance of exporting to areas within close vicinity. It has, however, been made clear that their research focused on other markets that are not interlinked with the sand industry, which might make their study less suitable for the sand industry. Nevertheless, considering the diverse portfolio of markets that were included in the study, some overlapping factors might be in place, making Brouthers and Nakos findings applicable to the sand industry. Høegh (2020) states that high transport costs make exports challenging from an economical point of view, which is why export locations that are physically closer to the extraction site appear as the most interesting ones to investigate. Therefore, the paper will focus on the geographical area within the north Atlantic, more specifically the northern part of North America, the United Kingdom and the western part of Europe.

The paper has earlier addressed the quality of sand as a key variable for particularly pricing and application purposes. When analyzing the potential of success for a sand operator in Greenland, certain limitations and assumptions will have to be put in place. To limit the scope of the research, this study will focus on what is to be considered as standard construction sand, often extracted from sea-beds or river deltas and typically used for creating cement, asphalt and other construction applications. While the likelihood of Greenland containing this type of sand is still unknown, the initial tests conducted by Bendixen (2020) indicated that the sand from the Sermeq Outlet contains Feldspar, which makes sand less suitable for construction purposes. However, as pointed out earlier, the two samples taken were far from sufficient to determine the general sand quality. The authors of this paper assume that low quality sand will not be a serious candidate for exports to the global market. Therefore, it is prioritized that both scenario scopes work with standard grade construction sand.

An important factor to constrain, is the timeframe for how long into the future, this paper will research. As stated in the earlier, the paper will conduct two scenarios. The first scenario will be limited to a one to five year outlook. This is done to assess the research question from a current perspective. The second scenario is framed to look further out in the future. Based on the research conducted by Sverdrup et. al. (2017), it is estimated that the need for sand used in construction will peek around 2065, and therefore the timeframe scope will be approximately fifty years from now. One of the reasonings for not looking further is because the current data available becomes less reliable the longer into the future one is investigating, and estimations beyond the expected demand boom in 2065 are unclear. With rapid developments constantly occurring on a global level, it becomes increasingly difficult to foresee opportunities and threats for a Greenland based sand operator even 10 and 20 years from now. Therefore, the reliability of the second scenario will be lower as the scenario is constructed based on trends and developments recognized by the authors. Thus, it is qualitative assessments of future developments that are backed up by the findings of the research.

The reasoning behind utilizing scenarios as a main tool for the analysis is not only because an exact prediction of future developments is close to impossible to estimate. It is also because further geological studies need to be conducted to better estimate the sand quality. Other

questions related to environmental impacts from sand extraction in Greenland and challenges specific to the location of Sermeq also need to be investigated.

One of the main measures that will determine when the Greenlandic sand market will be a viable option is the price of sand. Therefore, pricing of sand is determined based on information provided by Polaris Materials (Koren, 2017) and by using a business as usual approach (Sverdrup et. al, 2017). The information regarding the projected annual price growth of sand provided by Sverdrup et. al.'s (2017) and Elsner's (2020) estimates, will be the approach towards estimating a potential break-even points for a Greenlandic sand business.

Analyzing the Competitive Environment with Porter's Five Forces

The research question addresses the potential of a company to successfully extract and export Greenlandic sand. The five forces analysis will regard the sand extraction and exporting industry within the geographical area as stated in the definition of the scope. This is the North-Atlantic area including the northern part of North America, the United Kingdom and Western Europe. Furthermore, the industry involves sand suitable for construction purposes. Thus, rare minerals mining and similar industries are not included.

The five forces model allows for an examination of the profit potential based on the competitive forces that influence the sand industry within the defined scope. Going through all elements of every force will not only provide an indication of the attractiveness of the industry, but also help to outline industry-related threats and opportunities. As stated, the tool is limited to only address current and short-term conditions. When looking further out in the future, it becomes increasingly challenging to analyze the competitive forces of the sand extraction and exporting industry. Therefore, the industry analysis will provide insights that are mainly relevant for short-term investment plans. Hence, it will predominantly address the first scenario that is conducted later in this paper.

Industry Characteristics and Rivalry among Competitors

No companies are extracting sand in Greenland for export purposes, which is why local competition is as low as it can get. Therefore, when assessing the rivalry among competitors, one must direct attention towards international competitors that extract sand and provide it to locations within the North-Atlantic area. According to a US industry report from 2019

(IBISWorld, 2019), the competitive landscapes of the US and Canadian sand industries are characterized by their low level of concentration, implying a high number of equally sized operators. Operators are highly dispersed all over the countries and located as close to their end consumers as possible. The same goes for the European market, comprising approximately 15000 operators among all European member states, where most are SMEs (UEPG, 2020). Between 2014 and 2019 there was a negative industry growth of -2,2 percent in the UK. However, industry growth was expected for the following time period (IBISWorld - UK, 2019). Industry growth in the US market is projected to 1,1% from 2019 to 2024. The Canadian industry growth is projected to be higher, but a large part of this is based on sand for oil fracking, which is not a part of this study. However, these estimates were made before the emergence of the Coronavirus pandemic. According to the UEPG (2020), demand for sand and gravel tends to follow countries' economic well-being. Therefore, it seems likely that industry growth, both in Europe and in North America, are to become stagnant and perhaps even negative during the next five years.

Revenue volatility is considered very high, because the industry depends hugely on its downstream construction and manufacturing markets, and on government activities and regulation. This implies that investments into the industry is associated with high risk (IBISWorld, 2019).

Industry competition is largely based on pricing and the capacity to deliver desired quantities of sand. Thus, there is a low degree of product differentiation. Buyers can easily change sand suppliers without significant switching costs and, in general, the competition within sand industries are considered intense (IBISWorld, 2019). Frederik Sørensen from Dansk Kvarts Industri (2020) states that there is always space for a new player in the market, but a high financial capital investment is required. According to the US industry report (2019) and stated by Mike Høegh (2020), a currently low unit price of sand combined with high transportation costs severely limit the economical prospects of exports. Therefore, the location of sand quarries and extraction sites is essential as the setting of prices highly depends on the distance between sand location and customer. Operators that are located closer to their customers can offer lower unit prices and still enjoy higher profit margins than sand operators with a further distance to the same customer. Therefore, competition among operators are limited to local areas and regions. Large scale supply contracts are usually proposed to local operators. This also explains why exports between the US and Canada only

constitute a small part of total revenues. In 2019, the US sand and gravel consumption reached 980 million tons. Only 5 million tons were imported to the US, whereby the majority came from Canada (USGS(2), 2020).

As mentioned earlier in this paper, tightening regulation and increased restrictions have limited the number of sand extraction sites and forced operators to locate these further away from customers. As truck transport is the most expensive mode of transport, the use of alternative transportation modes such as railroad and ship transport, which are less expensive options, has started to gain greater attention from operators (IBISWorld, 2019).

Larger operators tend to have an advantage over SMEs on a regional level because they offer a wider range of construction materials and processing services as well as better access to distribution channels, marketing and financial capital. In addition, there has been a tendency towards more concentration as larger players have acquired smaller competitors' operations in order to strengthen their regional positions. However, the industry is still considered non-concentrated and mature.

Fixed costs are considered high for the sand industry. Investment requirements for establishing extraction sites as well as extraction equipment, processing equipment etc. are high. In Greenland's case, these will potentially be even higher due to the rocky and challenging nature and not to mention establishing of shipping port infrastructure.

Furthermore, exit barriers are considered high. Sunk costs are high due to high investment requirements. The low level of differentiation and high exit barriers make competition on prices even more prevalent (IBISWorld, 2019).

Based on above-mentioned tendencies, the rivalry among competitors can be considered high and seems to continue within the next five years. However, competition is limited to local and regional areas. Therefore, industry attractiveness is largely depending on local demands and distance to sand extraction locations.

Threat of New Entrants

As mentioned in the previous paragraph, large-scale operators have an advantage over smaller ones. Therefore, new entrants can be forced to make significant investments in order to compete with larger players. According to IBISWorld's industry report (2019), incumbent

companies, particularly the larger ones, are dominating their respective regions and customers might be loyal to these to some degree. On the other side, product differentiation and switching costs are low which is why new entrants should be able to overcome brand loyalty. Obviously, high capital investment requirements pose an obstacle to new entrants. The industry report finds two other major obstacles for new entrants. The first one is related to backward vertical integration of construction material companies. Major consumers of construction sand being construction, manufacturing and materials companies often own or hold interests in sand extracting companies. Entrenched supply relationships between sand operators and sand consumers constitute a significant obstacle to new entrants. The second entrance barrier involves the constantly tightening extraction regulations, both in the North American regions and in Europe. It becomes increasingly difficult to open new extraction locations and expand existing sites. This makes existing sites even more valuable and significantly decreases competitiveness of new entrants. These reasons make entry barriers in all regions high, thus the threat of new entrants is low and according to IBISWorld (2019), the trend of high entry barriers is increasing.

Power of Suppliers

When it comes to the supply chain stage, sand extraction can be regarded as the very initial step towards it ending up in buildings, roads and the like. Therefore, no material or service related to the sand product itself is needed prior to the extraction. However, for the extraction part, providers of equipment, fuel, electricity, chemicals, explosives and cutting blades might be regarded as suppliers. Equipment is a one-off purchase and do not comprise powerful supply figures. The same goes for purchase costs including chemicals, explosives and cutting blades. These comprise a moderate share of industry revenues, approximately 15%, but prices fluctuate little and extraction equipment is considered to have a long life-time. Utilities such as fuel and electricity account for a relatively large part of revenues with 8,7% in average (IBISWorld, 2019). However, as these are basic components, they will not comprise powerful supply groups.

For the exporting segment, sand carriers that transport sand products to consumers can be regarded as a supply group. This involves truck transport, rail road and dry bulk ship transport. According to an industry report developed by Danish Ship Finance (2018), the global marine shipping industry is considered highly competitive. Many operators exist and overcapacity often drives down freight rates. Shipping operators are very dependent on the

presence of companies that produce bulk commodities such as sand. The same pattern applies to the onshore logistics industry, which, in general, is characterized by an intense fight for market share (PwC, 2016). The undifferentiated nature of the transport sector and intense rivalry make this supplier segment less powerful. All things considered, the power of suppliers appears low.

Power of Buyers

The buyer group of sand can be divided into private consumers and public investment. Regardless of it being based on private or public spending, the sand industry is largely dependent on certain sectors. One of those is the activity level of manufacturing. A rise in industrial production increases demand for products, where sand is required. Furthermore, the level of non-residential construction such as establishments of roads, harbors, airports, buildings and other transport-related infrastructure is highly affecting sand industry revenues no matter if it is privately or publicly funded projects. Private home improvement is another segment that influences the sand industry (IBISWorld, 2019).

Based on Porter's (1979) parameters as to what influence the bargaining power of buyers, the power of buyers appear strong. Sand is a major component in construction materials in terms of volume and this requires construction companies to buy sand in large volumes. Moreover, the downstream construction and manufacturing industry life cycles are considered mature or declining leading to higher concentration (IBISWorld, 2019). Construction sand is an undifferentiated product, which means that buyers can easily find other sand suppliers as long as they are located within a relatively short distance. Since sand takes up a large part of construction materials, it also comprises a moderate share of costs making buyers more price-sensitive.

As noted earlier, construction companies do often own or hold interests in sand mining companies. This indicates a relatively high threat of backward integration.

Although the construction industry is also highly dependent on the availability of sand, an assessment of Porter's parameters show that buyers hold a strong bargaining power.

Threat of Substitute Products

The most prevalent rival product to sand is crushed stone. In areas or periods where supply of sand is low, construction companies can crush rocks into desired sizes and use it for similar construction purposes (IBISWorld, 2019). In fact, crushed stone is the dominant choice for construction purposes in the US, especially in densely populated areas. Its geometric shapes are angular and perfect for construction purposes, whereas naturally produced sand and gravel to some degree are more rounded by nature. However, production of stone is more expensive, extensive and only few rock types are suitable for production of crushed stone, where limestone is the prevalent type (USGS, 2020). According to IBISWorld, product substitution of sand is limited and recycling of asphalt and concrete has only minor impacts on the sand industry, although it is slightly increasing.

Competitive Landscape Summary

To sum up the five forces analysis for the sand industry in the scoped area, the individual forces seem to be either strong or low.

- Rivalry among competitors: **Intense**
- Threat of new entrants: **Low**
- Power of suppliers: **Low**
- Power of buyers: **High**
- Threats of substitute products: **Low**

The analysis reveals a very competitive market that has entered its mature life cycle stage. Industry growth is slow and considering the current pandemic, near-future prospects seem negative. As the industry is very volatile, industry-related investments carry high risks.

Companies have only few parameters they can differentiate, those being price and capacity and high sunk costs make unprofitable operators stay in the industry longer. In addition, the largest downstream construction companies can pose a credible threat of backwards integration or block market access by holding interest in competing operators.

A key take-away is the fact that transportation from extraction and processing locations to customers is a major cost component that makes long distance transports inefficient and unprofitable. However, ship transport is a cheaper alternative to onshore logistics that operators have started to investigate as a transport option. Naturally, this only applies to

coastal areas. Still, the high transport costs restricts competition to local regions. Viewing, for instance, the entire US or the entire Europe as one sand market is too broad. In order to identify concrete attractive export locations, multiple region-specific market reports must be conducted in which the competitive landscape and downstream markets are comprehensively analyzed.

PESTEL Analysis of Greenland

The PESTEL framework considers factors that stretches and contains more than just the economic aspects, instead it covers six environmental factors that in unison cover some of the most important aspects of an industry. This form of analysis is crucial to cover for the Greenlandic sand export potential, as there is a significant number of variables that needs to be considered to gain a better grasp of the local situation, as well as the global one. This is in relation to a shorter time perspective and a more futuristic outlook. Therefore, the PESTEL framework provides the paper with an analytical tool that covers the basis for many important aspects that require a more in-depth analysis. This PESTEL analysis will follow an order, where the political aspects will firstly be examined, followed by the economical environment and its implications. Furthermore, the social aspects related to Greenland's culture and demographics will be examined.

Second to last will cover the ecological situation within the country and lastly, the legal regulations that the industry needs to be aware of. This analysis will cover the Greenlandic environment, which will analyze the aforementioned sections, where a descriptive section will firstly be presented for each of the given topics, followed by a future outlook of the potentials and threats.

Political

Greenland is part of the Kingdom of Denmark, however, it resides as its own country with their own given parliament. This means that all local political functions are regulated and covered within the nation of Greenland. Greenland used to be a part Denmark until 1979, where they were declared a home rule. This initiated some restrictions for the Greenlandic nation, as one of their main ways of gaining economic development mainly through fishing was taxed by Denmark. The situation between Greenland and Denmark has been somewhat tense, however, in 2009 the Self-Government act replaced the home rule government. This

gave Greenland their ability to elect their own government and parliament. Thus, they could decide on aspects such education, health, fisheries and have a greater control over their own environment (Naalakkersuisut, 2018). Since the home act was put in place, Greenland has been allowed to participate to some degree in foreign affairs. This includes the possibility to have representatives participate in foreign interests that often are related to economic aspects and trade interests. Greenland is also part of UN, WTO and EU while also being members of Overseas Countries and Territories Association (OCTA) (Naalakkersuisut, 2018).

Since a more independent state occurred in 2009, Greenland has been able to conduct business more suitable to their own needs. Since there is a clear understanding that Greenland also wants to take part in foreign affairs, a higher potential for further future development might be present, as industries such as fishing, oil and mineral extractions might be more politically supported, which might lead to an increase in the export segment for the country. This will in turn potentially increase the likelihood of sand export becoming a real player for the nations GDP.

Economics

Greenland has experienced some economic hardships historically. Based on a report provided by the national bank of Denmark (2016), an overview of the economic landscape for the past ten years has been provided.

To begin with, in 2014 Greenland had an unemployment rate among people within the working age that stood at over ten percent. One of the causes to this can be related to some years in an economic downturn leading to 2014, which subsequently led to a reduction to the population. It is stated in the report that the yearly average emigration corresponds to 600 individuals, which is a lot higher then the annual birth rate (Christensen, 2016). In the same report it is stated that the educational level seems to be subpar as of 2016, whereby the educational programs that supports teachers on the primary and secondary school levels to be lower than the preferred rate. This is due to quality standards not being met when it comes to educational programs, which can have further implications for the future workforce (Christensen, 2016).

When it comes to Greenland's main economic contributions, fisheries are highly represented. This industry has experienced a decent growth in 2016 after some years in a downturn, where the prawn fisheries saw a growth of 40 percent in price that year, whereas cod and halibut

experienced a 20 percent growth in price (Christensen, 2016). Fisheries are currently outmatching any other industry in Greenland, however, precious metals and minerals hold a relevant position in the Greenlandic economy. Unfortunately, in the timeframe between 2016 to 2017, a major decrease in extractions of these aforementioned materials took place. However, some developments occurred, where a union between the Greenlandic and Danish government have started to support the extraction of the materials for use in the military and other avenues such as exports (Christensen, 2016).

The economic council of Greenland released an updated report, which gave some more promising estimates, whereby an expectation of an economic growth rate to go up by four percent in 2020. While this is a positive increase, which has been the case for the past four years, some of it is due to an increase in construction work in Nuuk. A decrease in unemployment has also been a positive factor for the last couple of years. There is, however, some concerns regarding the strategic plan set by the government. It has presented a sustainability and growth plan, which carries some risk as Greenland has recently experienced a slower period as the previous report explained. The country will stand weakly positioned in case of a crisis as the growth plan is reducing the economic buffer (Naalakkersuisut, 2019).

It is indicative that Greenland has experienced some hardships and volatile swings in their economy. The last couple of years have been promising, however, some current strategic plans might hold a lot of risk in case a crisis would occur, whereby the nation will not hold an economic buffer to handle such a situation. The current Greenlandic situations creates both opportunities and challenges. Firstly, although the unemployment rate has decreased in recent years, the unemployment rate still remains quite high. There is a potential for the unemployed to enter the workforce surrounding the sand extraction and export industry. Some challenges related to this are the educational challenges Greenland is dealing with. The workforce available is not qualified for the key positions required in the industry. Therefore, qualified external workforce might be required to facilitate and operate the necessary positions within the industry. Furthermore, since Greenland has experienced some economic challenges and is currently almost without an economic buffer, future capital might take longer to acquire than initially hoped for. Again, foreign investments will most likely be needed when it comes to building the required infrastructure and equipment to operate the sand extraction and export industry.

Recently an article from Berlingske was published that gives a clear indication that the United States have interests in investing in Greenland. Their government has provided Greenland with approximately twelve million dollars. The purpose of this funding is to strengthen and further develop the natural resource industry, tourism and the Greenlandic education system. This financial investment from the US stems to increase and strengthen the relationship between the nations (Berlingske, 2020). As already discussed, all of these sectors requires financial support for the development of Greenland and this stand as an initial contribution for Greenland in becoming a relevant global exporter in the sand industry.

Social

As previously mentioned, the Greenlandic population has experienced some difficulties especially regarding unemployment and emigration out of the country. Currently, there is a slight positive childbirth rate within the country, however, it is countered by the aforementioned emigration. Greenland's current population sits at approximately 56,000 inhabitants making it the 209th populated country in the world (Heritage, 2020). Since there are currently 38,000 inhabitants that serve as the workforce within the country, approximately 33 percent of the population are unemployed, to young or too old for being employed. The current estimations show a future decline in the Greenlandic population, whereby around 2070, it is estimated that the population will fall below 50,000 (Heritage, 2020). Greenland's culture is heavily affected by their Inuit inheritance, however, there is also Scandinavian influence due to their history with Denmark. Greenland also holds a deep history with their nature, hunting and fishing which today are some of their biggest economic providers as Bendixen explains (2020).

The Greenlandic population estimations creates some predicaments for the future of the sand export industry as there will be less of a local workforce available if the trends continue in the same direction as predicted. However, as seen with the reimbursement of potential work that became available in 2018, which caused many locals that were previously unemployed to find jobs. If the sand extraction and export industry manages to obtain a foothold within the country by a reasonable timeframe, it might contribute to an increase in population, as there will be less of a reason to leave the country due to a higher number of job opportunities within Greenland.

Technological

Greenland has started to experience growth in their local infrastructure, as in new buildings being built and airports in surrounding cities are developed and expanded (Naalakkersuisut, 2019). While Greenland has internet service and other modern services as other developed nations have, their biggest challenge when it comes to development still lays in the infrastructure. The only way to reach the different cities within Greenland is by boat or plane as there are no roads that connect them. This is due to the harsh landscape and extraordinarily high investments that are required for a road network. Other difficulties regarding the infrastructure is the availability of ports. There are currently no ship ports that allows for larger scale export procedures. Considering that one of Greenland's largest economic ventures lays in fish and shellfish exports, an advancement within this sector of infrastructure would be highly beneficial for their economic growth.

The sand extraction and export industry require further infrastructure development within Greenland to be able to operate at the scale that would make them globally competitive. There are, however, some challenges related to the financial situation that Greenland is positioned within. Although, if an investment could be provided by an external source, it would firstly increase job opportunities for the local population and when established, infrastructure development could potentially catapult the local economy as access to new opportunities at a larger scale is gained.

Ecological

Greenland is known for their wild nature and practices within hunting and fishing, which are a important parts of their economy and culture. Global warming might have a large negative impact on the nature of Greenland. Nevertheless, it might have created new opportunities for the country. Since a majority of the nation is covered in ice, a lot of resources that were previously unavailable have become more accessible as the temperature has risen.

This phenomenon is one of the main reasons to why this research has taken place. As the ice started to melt, resources that were earlier inaccessible have started to become easier to access, such as sand, as Bendixen proclaims (2020). This created some major opportunities for the future, which relates to the industry in question, that is being examined. Another positive effect that global warming might provide is the opening of the previously inaccessible sea route through the Northwest Passage. Except for Canada, Greenland is the

closest country to the entrance of this passage. As the ice caps melt earlier and faster, the passage has started to open up and is currently already accessible with boats for a couple of months each year. As the global warming continues to progress, the route north of North America will become available, which might offer some positive effects regarding transportation of goods from the Atlantic Ocean to North American west coast and the Pacific Ocean.

Legal

Based on what has been previously discussed, it is clear that Greenland are interested in external support to further develop their nation. However, after many years under another nation, they remain conscious of other nations taking advantage of their land and resources. Therefore, there has been legislations put forward preventing easy access to set up businesses that do not directly benefit Greenland. Going back to the first point, in 2012 Greenland passed a legislation named the Large Scale Act which only allows use of foreign workforce in construction or developmental projects under the condition that those projects cost more than five billion Danish kroner (ITA, 2018). The legislation is tailored for mining and extraction projects. It is intended to incentivize the use of local workforce, whereby providing the local workforce with jobs in such developmental contracts, instead of handing them to external sources (ITA, 2018).

Summary

The PESTEL analysis have given a clearer picture of Greenland's situation. While it is clear that there are some major obstacles the nation is facing, there is also some potentials that can be exploited. Greenland's financial situation needs to be strengthened potentially from external sources before it can provide optimal conditions for the sand industry. The educational system needs to be improved as well as the industrial infrastructure. As for the nation itself, it is abundant in natural resources which are currently not easily accessible, however, they are becoming increasingly accessible due to the global warming by each passing day. A further PESTEL analysis will be conducted to gain better insight in the North Atlantic areas and their likelihood of becoming viable options for the Greenlandic sand export industry.

PESTEL Analysis of the North Atlantic Mainlands

After conducting a PESTEL analysis for Greenland itself, it is important to cover and analyze the part of the world that will induce the lowest transport costs when it comes to importing sand from Greenland. In accordance with the findings of Brouthers research (2009) and Mike Høegh's considerations, the area was chosen for its vicinity to Greenland. When classifying the North Atlantic mainlands it covers parts of North America, more specifically United States and Canada. Furthermore, a closer look into Great Britain will be taking place and lastly, Europe. This PESTEL analysis is conducted to uncover potential threats and opportunities within the given areas. The PESTEL model will have a higher focus on some categories within the model compared to others. This decision comes from the realization that specific categories are more relevant for the intent this analysis has for uncovering opportunities and threats. A higher emphasis will be put on the political, economic, ecological and legal l aspects. This analysis will follow a similar structure to the previously conducted PESTEL analysis, where politics will be presented first, followed by the structure presented within the model. The social aspect of the model will however be exempted, due to the other aspects holding a higher relevance for this analysis.

Political

From a political standpoint, one of the questions that is firstly considered, is the situation regarding the openness of the country's economic markets. An open market is considered a market where buyers and sellers can freely conduct business between borders of neighboring countries or countries that are further apart geographically. This is done without having strict sanction tariffs or regulations that prevent such actions (Nordquist, 2018). The index of economic freedom (2020) have put forward a list of countries and given each of these a ranking between one to one hundred, whereby a ranking between seventy and one hundred is considered as countries with economic free markets. Within the top forty countries we find the United Kingdom, Canada, United States, Germany and France all top the list.

This gives an indication that engaging in business with the aforementioned countries will not hold the risk of not being able to conduct business related to export due to there being political sanctions or similar disruptive measures.

Based on this fact, it can be concluded that each of the countries that are being considered do not hold restrictions that would prevent a company in Greenland from entering these

countries with their sand export business. However, there are some current and potential future situations that might change this fact. For instance, if a global crisis such as the current Corona pandemic was to occur again, borders might become more strict. It could also be occurrences of sanctions preventing different types of jobs to be continued or leading to depreciations in markets that require high amounts of sand such as the construction industry. Also, more specifically for The United Kingdom and their implementation of Brexit might prove itself more difficult to conduct trade agreements between Greenland and the United Kingdom. A report from McKienzie (2017) indicated that an increase in tariffs between Europe and The United Kingdom will present an increase in costs that previously were significantly lower, making it potentially less ideal to prioritize them over other options.

Economy and Technology

To gain a better understanding of the economic situation for the given countries, a macro economic overview will be taking place. Firstly, an examination of the United States will be presented, where a consideration of internal and external economic factors that might impact the Greenlandic sand export industries decision in entering the market. The market report published by IBISWorld (2019) shows how the local sand production industry has been operating. In the timeframe between 2014 and 2019, the United States saw a decrease in the demand for sand, due to experiencing a decrease in the construction rate around the country. This led to a decrease in revenue for this industry by approximately 17.2 billion dollars over the timespan until 2019. However, the future prognosis estimates that the United States will experience a turnaround within this industry, as it is expected that the following years will provide a higher demand for sand. This prognosis is encouraged by an expectation of a rising activity within public and private construction markets, as well as further development of the infrastructure such as roads and bridges (IBISWorld, 2019). A further strengthening of this expected development is based on governmental financial support regarding the aforementioned infrastructure development. The financial support provided by the government creates a form of security, as the construction industry will be supported to a certain extent even during harder times and generally creates more opportunities for the industry (IBISWorld, 2019).

Nonetheless, The American market is volatile and has experienced fluctuations for the construction sand sector in the downstream building and infrastructure avenues. It is predicted that the future annual growth in the private market will increase with 0.3 percent

annually and due to the Fixing America's Surface Transportation Act bill, which put an economic package at 305 billion dollars to further support the infrastructure development within the country over the timeframe from 2015 to 2020. Furthermore, the prognosis for the five upcoming years gives indications that these segments will see an annual increase of 1.1 percent which corresponds to 1.7 billion dollars.
A currently strong US dollar makes imports cheaper for American consumers. However, it is expected that the US dollar will depreciate over the next five years, which will make domestic products relatively cheaper and strengthen US sand operators. A depreciation of the US dollar is therefore assumed to weaken the potential of an exporter from Greenland, thus increasing competition for the Greenlandic sand export industry (IBISWorld, 2019).

Canada has seen investments in the infrastructure amounting to 85.5 billion in 2018, which represents a quarter of the total public financing that does not include residential investments. This means that Canada saw an increase in investments of infrastructure passing eight percent compared to the previous year. While these are promising values, it has to be stated that Canada has experienced some high fluctuations in the investments for infrastructure in prior years (StatCan, 2019). However, there has been a positive trend for the past decade that has accumulated in becoming a potential market if the trend continues. However, a newly published report published by Deloitte shows that Canada is on the brink of reaching a recession, due to the pandemic outbreak and large shifts in the oil prices, which constitutes a large portion of their economy (Alexander, 2020).

In 2018 the government of the United Kingdom released a report for their infrastructure and construction pipeline plans for the upcoming years. This pipeline expresses an investment accumulating to a value of approximately 400 billion pounds, whereby half of this value was to be invested in the following couple of years to further strengthen their infrastructure and provide more opportunities within the construction industry. Projects within the industry will cover large portions of the country, where a focus on using offsite businesses to develop and maintain structures will be set in place, with a hope of utilizing more innovative solutions. There are currently over thousands of projects and contracts in circulation that last until 2028 (Infrastructure and Projects authority, 2018).

This creates some future opportunities for the sand export industry to provide the material to accommodate all of these initiated plans, and if this trend continues, one can predict there to be some further opportunities when looking even further in the future (Infrastructure and

Projects authority, 2018). While the total sum seems like an astounding financial investment, it also covers other parts within what can be considered infrastructure investments. However, the yearly investments are indicative of high potential of requiring raw materials such as sand to accommodate the different projects within the pipeline.

Similarly, to most of the world, Great Britain is experiencing some difficulties within their future GDP development due to the pandemic outbreak. JPMorgan (2020) estimates that the nation's economy will see a 7.5 percent downturn, while Capital Economics (2020) predicts a 24 percent loss, which will have large implications for their economy. It will be difficult to get out of this position and might hinder the infrastructure pipeline plans for the future.

The German forecast for their future GDP Growth seems to remain stable, where an expected dip occurred in 2020 as the GDP went down by approximately one percent, however, it will for the next fifty years slowly rise incrementally to stabilize at 2.5 percent GDP growth annually (Knoema, 2020) Germany has experienced a large increase in infrastructure and construction development all the way since the 1990's and the prognosis states that this trend will continue. Nevertheless, as Elsner (2020) stated, while there is a large portion of projects that are being invested in, Germany most commonly keeps these to the local industry, and seldom outsources internationally. This is due to the fact that Germany already have large deposits of sand and gravel that they utilize for development of the infrastructure and construction industry. This in turn lowers the attractiveness of Germany as a market to enter.

Ecological

Climate changes have not impacted sail routes between locations in the Atlantic area such as Great Britain, the North American east coast and Europe. However, for the northern part of the American continent, it is another matter. As it was mentioned in the previously conducted PESTEL analysis, the global warming effects have created new options for the routes available between Greenland and the North American west coast. The north west passage that previously hindered any passage has now become more open for a two-month period, which is expected to increase in duration as the global warming effects continue. As Bendixen proclaimed, this can provide a solid option for Greenland to enter the west coast of the North American continent as the earlier routes have been inaccessible. Now, this is currently only a viable option for a very short period of the year, however, in the future it will develop into a potentially promising option for Greenland and their sand export industry,

Another valid point that can create new opportunities for Greenlandic sand companies regarding entering other markets are the environmental restrictions towards sand extractions in many of the previously aforementioned countries. North America have imposed regulations and restrictions towards limiting the number of mines that are allowed to operate in certain areas of the country. Some mining sites have been forced to close or move, and opening of new mines has been made substantially more difficult. The implementations of these regulations will increase the transportation costs within the industry, because operators are required to utilize and mine from sites that are further away from the downstream markets (IBISWorld, 2019). The regulations have been put forward to prevent over mining in certain locations and this creates opportunities for Greenland. Greenland is not in a position where over mining is an established risk, nor will it disturb populated areas. Therefore, the North American market might benefit from Greenland's natural sand resources, while preventing their own natural resources from becoming over extracted.

Legal

On a similar note to the legislations that were mentioned above, the European parliament have started to take measures to prevent over extraction and mining of natural resources. These measures are in place to maintain the ecological footprint and reduce the negative impact they often have on the environment (Hamor, 2004). There are frameworks and directives, such as the Council Directive 96/61/EC that takes into account the pollution and measure to prevent them from occurring during high natural resource extraction, such as sand. Furthermore, many of the major companies operating within the European Union have been requested to follow the restrictions put in place to damage the environment (Hamor, 2004). In a similar manner to the regulations put in place within North America, similar constraints are put forward to maintain the ecological footprint and prevent over extraction within the European Union. This puts forward the possibility for companies in Greenland to take action and take advantage of this since there seems to be a lesser likelihood of over extracting sand resources in Greenland.

Summary

The examined nations that surrounds the North Atlantic are all in the category of maintaining a high level of free economic trade. Furthermore, their economic position presents them as having decently high investments regarding infrastructure and construction industries.

However, current implications surrounding the epidemic crisis and oil price drops have made it less of an ideal environment for the near future. Moreover, giving a solid prediction for when this will change is quite difficult, however, if a Greenlandic sand extraction and export industry becomes operational in the future, the world economy might have stabilized. Some of the countries also have a somewhat more strict position regarding opening up for international businesses and instead prefer local industry development such as Germany. Since many of the surrounding parts of the North Atlantic area have implemented regulations and restrictions towards over extraction, it has created opportunities for Greenland regarding their unique position, where they can enter these markets as an external source.

Scenarios

The scenarios section will pursue to provide an overview of key developments and factors that might constitute threats or opportunities to a sand operator that want to extract sand in Greenland with the purpose of exporting it to North Atlantic countries. The time frame for the first scenario is limited to the next five years, whereas the second scenario will address issues that might become opportunities and threats in the next 50 years. It is important to note that all issues being addressed in the two scenarios are opportunities and threats that cannot verify or disprove whether sand extraction and exports from Greenland can be successful or not. Instead, they bring indications as to what factors a potential sand operator in Greenland must pay attention to. As pointed out in the introductory section of this paper, the profitability estimation will be regarded as the main indicator for potential success, however the strengths, weaknesses, opportunities and threats serve as supporting indicators. Thus, the scenarios below will indicate potential of success based on external factors, assuming the suggested developments are realized.

The Short-Term Scenario

It is apparent that major economies will be hugely affected by the current pandemic the next couple of years, and it is assumed that the aftermath will impact not only north Atlantic sand industries, but most sand industries on a global scale. As pointed out earlier, the industry seems to thrive simultaneously with countries' economic growth. Economic prosperity leaves room for infrastructural expansion and maintenance, and construction projects, which all comprise the downstream markets of sand extraction. Even before the emergence of the coronavirus, the world economy was experiencing signs of a slowdown, and indications of a

further slowdown in the next couple of years were present (World Bank Group, 2020). With rising trade barriers, political tensions and not least the addition of the current pandemic, it is assumed that the downstream markets will suffer during the next couple of years. From this perspective, this makes an investment into Greenlandic sand very unattractive as the total demand for sand will shrink, leaving existing operators with less market share to fight for. In a market that is already considered mature, a sand operator in Greenland will have to fight even harder for contracts among intense rivalry. The duration and magnitude of the current crisis' impact on the sand industry remains unclear. However, in case it will impact the economies of the north Atlantic countries even longer than just a couple of years, the economic slowdown is most definitely relevant to include as a substantial threat to not only a sand operator in Greenland, but all sand operators in the north Atlantic.

On the other side, one must not forget that no sand businesses operating in sand deltas have been established yet. Assuming that such establishment, including the setup of all equipment and industrial harbor, takes approximately two years, the current crisis could in theory offer an opportunity to a bold investor, who wants to save a sum on sunk costs. Given that an economic slowdown will reduce international trade activity, demand for marine shipping is likely to decrease as well. The effect of this will create overcapacity among shipping operators, forcing them to drive down shipping rates. The setup of sand extraction operations will surely require a high degree of shipping. If shipping rates prove to remain low or even decrease, an investor might save a significant sum in this regard. Furthermore, given that the downstream markets of sand operators will be hurt as well, a reduced demand for sand might potentially result in a lowered demand for extraction related purchases and equipment. If the lowered demand for these lead to reduced prices, more financial capital can be saved. These speculations are to a high extent based on assumptions and need further investigations on several fields before this sub-scenario can be regarded as a concrete opportunity. Two critical factors that need to be fulfilled for this to be a reliable opportunity is that the downstream markets have stabilized at the time when operations in Greenland are ready to begin, and operations, including extraction and exports, must be economically beneficial. Thus, it is an opportunity that has a high level of risk and uncertainty connected to it.

Turning towards a more industry related issue, the sand mining industry is generally considered mature and despite it having a relatively low concentration, there is a tendency of it becoming more concentrated as larger players have been acquiring smaller sand operators

during the last five years (IBISWorld, 2019). In addition, the degree of vertical integration is high among larger players as they have acquired or hold significant interests in downstream market players. This means that some customers will prefer certain large-scale sand operators merely due to their entrenched relationship. A Greenland based sand operator will have to overcome these ties by offering lower unit prices, which might not be economically sustainable. Thus, increased industry concentration and vertical integration pose a threat to an operator in Greenland not only during the next five years, but also when we reach points further out in the industry life cycle.

The second PESTEL analysis highlighted a trend towards massive public infrastructure investments in multiple nations within the north Atlantic area including the the northern part of North America, the UK and nations in the western part of Europe. However, these plans were agreed upon before the emergence of the pandemic, which is why it is difficult to foresee if they will be realized. Logically, cancellations or postponements of these are not unlikely scenarios. On the other hand, if they are realized, an opportunity might arise for sand operators, including a Greenland based one. If an economic slowdown or even a potential recession forces a high number of companies to go out of business leading to high unemployment levels, governments might be forced to increase government spending at the beginning of a recovery (Balz, 2020). More fiscal stimulus does, of course, not necessarily mean infrastructure investments, but if governments choose this option, not only will unemployment be dealt with, also the construction markets will be stimulated. Demand for sand will be present and therefore, this scenario might offer an opportunity for a sand operator in Greenland.

Global sand supplies are estimated as nearly inexhaustible, meaning that all sand reserves in the world in theory would be able to satisfy global demand for hundreds, perhaps thousands of years. This would be the case if the material was easily extracted and transported everywhere to any destination. As this is not the case, transport of sand is in most cases limited to regional transports. Local and regional sand scarcity has become a growing issue that is projected to intensify in the future. Assuming that a sand operator in Greenland can export sand to only few destinations while making profits, it is left very vulnerable to changes and shocks related to the small group of customers. If, for instance, exports to a specific Canadian region turn out to offer massive profits, and due to high transport costs it is the only market from which the sand operator in Greenland can benefit, the success stands and falls

with this particular market. Disruptions such as societal changes, economic shocks or discovery of easily accessible sand resources in the region could destroy the sand operator's basis of existence overnight. From this perspective, the local or regional limitations of the sand industry constitutes a threat to a sand business in Greenland.

On the other hand, it can also be argued that these geographical limitations offer opportunities. Because competition is limited to regions, it prevents large scale companies from dominating entire global markets as seen in other industries, thereby leaving gaps for other operators in distinct areas. The isolation of markets means that the number of competitors will be kept at a certain maximum and if a new entrant can find a way to gain a competitive advantage through reduced costs, it might be able to steal a share of a regional market. If a sand business in Greenland can discover such markets, where availability of sand is already scarce, it might be able to benefit economically due to the isolation of markets. Thus, the local and regional division of sand markets can be regarded as both a threat and an opportunity.

The Long-Term Scenario

As pointed out earlier, this scenario will be composed of developments of which the probabilities of occurring are difficult to estimate. The further we look out in the future, the more difficult it becomes to foresee what developments the world will face. However, a steady rise in the price of sand seems to be agreed upon and this will strengthen the position of a Greenland based sand operator. According to Sverdrup et. al. (2017) the expected price increase can be explained by different of reasons. When sand and rock reserves close to end consumers are gradually emptied out, operators will have to find new extraction sites possibly located further away. This will result in price increases due to risen transport expenses. In addition, it is expected that energy prices will go up, which will further increase transport costs, particularly in this industry where transportation of large and heavy batches of sand require high amounts of energy. Rising sand prices is an obvious benefit to a sand operator in Greenland, however the benefit becomes even more distinct if the aforementioned cost increases can be circumvented. The paper will return to this issue later.

During the last year, there has been an ever growing attention directed towards Greenland, particularly from the United States who seem to be eager to increase their presence and influence in the Arctic region. Since the beginning of the cold war, Greenland has, due to its

location, been an important strategic military asset to the US. Greenland is located right between the North American continent and the north west part of Russia. The prospect of a warmer climate in the future is expected to make the Arctic region more accessible including opening of sea routes and access to raw materials, which would earlier be blocked by harsh conditions. This expected future trend has not gone unnoticed by the countries that are present in the Arctic. The emergence of these new opportunities will incentivize dominant countries to increase their influence and presence there. The US has made no secret of their interest to increase their involvement in Greenland and lately the Greenlandic self-government accepted a 12 million dollar investment from the US that is intended to strengthen infrastructure, military options, education, tourism and raw materials extraction. Although the amount will not make the greatest impact, it opens up the possibility for a better relationship between the two countries, potentially involving beneficial trade agreements and more future investments in the highlighted fields. Extensions and enhancement of infrastructure, know-how, raw materials mining etc. combined with beneficial trade terms will improve conditions for a sand operator in Greenland. Better trade terms will enhance export opportunities to the US and improvements on the other fields will ease business operations, increase access to employed workforce and know-how and potentially increase local demand for sand as well. Therefore, it seems evident that a strengthened relationship to the United States in the future brings many opportunities to a sand business in Greenland.

An important factor, which is also largely related to the projected future price increases, is the tendency towards tightened extraction regulations. As stated in the PESTEL analysis, countries around the world have made it increasingly difficult for sand operators to open new extraction sites. Environmental consciousness has increased as sand reserves around the world are being over-extracted. Furthermore, noise, pollution and use of substantial space are associated with extraction of sand. Higher prices of mining rights and competition with other land applications combined with stricter regulations means that operators loose competitiveness as they will have to increase prices of sand in order to cover higher costs. As these effects intensify in the future, a Greenland based operator will gradually stand in a better position due to different reasons. Firstly, the transport of sand will predominantly take place via offshore shipping with large-scale dry bulk ships. As the sand dredging part in the Sermeq Outlet is performed in a fjord, no truck transport will be required in the supply chain before the ships reach the ports of a given destination. Later in this paper, it will be apparent that truck transport costs far exceed those of offshore shipping transport comparatively based

on unit cost per distance traveled. A critical factor to this practice is that the market will be limited to coastal and near-coast areas, because shipments requiring too long periods of truck transport result in excessive costs. Another reason for why an operator in Greenland stands well positioned is the extreme amount of sand reserves available. As pointed out earlier, 330 million tons of sand might be available for exports and this is merely from the Sermeq Outlet. The fact that a constant stream of water pours out sediments from the river prevents over-extraction as seen in other locations around the world. If other negative environmental impacts can be avoided, the sand operator is likely to avoid the tightened regulations that competing operators in other countries face. In addition, conflicts involving noise, traffic and space are circumvented as the outlet has no inhabitants. All of these factors provide an opportunity for a sand business in Greenland to gain an advantage over competitors.

However, the opportunity might be vulnerable to a societal and political shift of direction. If shortages of sand become too prevalent in the future, regulations might be eased, which could lead to an increased number of site openings. Environmental consciousness, although it seems unlikely, could begin to be prioritized less by citizens and politicians, perhaps due to disruptive events such as wars or severe pandemics. The world might need to disregard climate change agendas in 40 or 50 years. Therefore, it is with an attached risk that a sand business in Greenland could take advantage of tightened extraction regulations.

Another opportunity, which has already been touched upon briefly involves the climate change effects in the Arctic area. Whereas the Northwest passage has been historically unpredictable when it comes to being covered in ice, the global warming is expected to change this and make it passable throughout a longer period of the year. The passage enables ships from the Atlantic to enter the Pacific Ocean in a significantly shorter time compared to the alternative of the Panama Canal route. The opening of the Northwest passage will give sand operators access to the North American west coast as well as a significantly reduced distance to Asia if markets there become relevant. Except for the Northwest Canadian region, Greenland has the shortest distance to the passage, which could be an advantage against competitors who have similar plans. Thus, the future access through the Northwest passage might be an important opportunity for a sand operator in Greenland if it can find markets that are economically beneficial in these regions.

A final issue that needs to be addressed is the threat of technological inventions or efficiency improving techniques that might threaten the demand for sand. It is widely agreed that

substitute products for sand is crushed stone and recycling of concrete and asphalt. As noted earlier, crushed stone is in fact the predominant choice of construction companies, however it has the same weaknesses as sand because its supply chain processes require huge energy consumptions. Mining and processing operations are demanding, and the similar reasons to those of sand will quickly lead to unaffordability. Recycling of concrete and asphalt are at low levels and currently not regarded as serious threats. However, as in all other industries, technological disruptions can never be ruled out. Inventions of efficient recycling equipment or stone crushing techniques could potentially harm the sand industry market. Focus on recycling is expected to rise when sand prices increase (Sverdrup et. al., 2017). At the same time, it is limited how much concrete and asphalt can be recycled. Similarly, rock reserves still need to be available before technological inventions can process it. Therefore, the threat of technological disruptions appears low, although it should not be neglected.

Strengths and Weaknesses

As this paper has no knowledge of companies that consider pursuing a Greenlandic sand business investment with exports as a goal, the conditions for conducting a focused diagnosing strengths and weaknesses analysis are not present. This section will, however, outline a number of key strengths and weaknesses that a sand operator should strive to gain and avoid. The findings are derived from the analysis parts conducted in this study with support from external expert inputs. It must be mentioned that these findings do not address core competencies and core problems in depth as Coman and Ronan's model (2009) identifies. Instead the findings might be regarded as effects of certain core competencies and core problems. Thus, if they were to be placed in Coman and Ronan's core competences or problems trees, they would fit somewhere in the middle.

Due to the narrow range of options when it comes to differentiating oneself from competitors, sand operators must be excellent in the few options they have. Apart from offering competitive prices, one factor seems to be critical for gaining customers' favor. According to Frederik Sørensen from Dansk Kvartz Industri (2020), operators' capacity and processing of sand must be sufficient, quick and smooth in order to meet customer demands. Customers can swiftly change its sand supplier. Therefore, a new supplier must be able to provide the wished quantities, and this must be done exactly when customers need it. According to Sørensen this is not always the case. A company whose production is not able to keep up with customer

needs has a critical weakness. Naturally, these abilities are to a large extent connected to the volume of sand being available for extraction, and the quality and quantity of equipment. The US sand industry report conducted by IBISWorld (2019) mentions different key success factors for a sand operator. At least two of these factors seem to apply specifically to a potential sand business in Greenland. The first one is long-term access to sand resources. As noted earlier, the rivers in the Sermeq Outlet provide a continuous flow of new reserves to the sand delta. Along with the enormous quantities of sand which are already available, this condition enables long-term access to the reserves. Another key factor is the ability accommodate to environmental requirements. As stated by Bendixen (2020), the environmental impacts of sand extraction in the Sermeq Outlet still need to be uncovered. However, if these prove to be minimal and the Greenlandic self-government will not impose regulations as seen in other countries, then a sand operator will not even have to accommodate to any tightened regulations. Thus, it can be argued that a Greenland based sand business will gain certain location advantages, which can be considered as strengths.

However, the location can also be considered as an obvious weakness. With operations taking place potentially thousands of kilometers away from its downstream markets, the location is certainly a disadvantage, particularly due to the high transport costs. The cost difference between waterborne transport and truck transport is the factor that needs to outweigh this disadvantage for a Greenland based sand operator to become profitable. The profitability section will investigate this issue later.

The US industry report further addresses following key success factor: (1) The ability to vertically integrate with downstream markets; (2) The ability to win contracts while ensuring adequate profit margins; (3) The ability to control supply of a regional market; (4) The ability to expand and reduce operations rapidly in line with market demand (IBISWorld, 2019).

Once again, the location appears as a disadvantage regarding the first and third point. The distance makes it more difficult to network and establish relationships with a region and its downstream market. Therefore, the ability to offer competitive prices and reliable deliveries are characteristics that are critical to pursue for a sand operator in Greenland.

The last issue to be addressed relates to the specific location of the Sermeq Outlet. The rocky conditions of the Greenlandic nature as well as it being located in a fjord require comprehensive investigations and engineering work. The establishment of a setup will be

unique and require substantial financial capital, possibly higher than those competitors must invest. Thus, the unique conditions in the Sermeq Outlet and the need of a setup of shipping infrastructure is a weakness based on the high required sunk costs.

The Profitability Factor

This section will apply the economic model from the theoretical part for the purpose of deepening the knowledge of what constitutes the costs and revenue for the sand dredging and export industry. This part of the paper will examine the economical components, which a sand operator in Greenland will need to consider, while also investigating the potential of reaching the break-even point. Due to certain limitations, accurate values for the profitability components will not be realistic to obtain. This is mainly because of the futuristic nature that this venture constitutes, and because estimating precise costs is difficult, when no such operations currently exist in Greenland. Furthermore, at the time this study was conducted, gathering of some data was complicated by the pandemic restrictions.

To begin with, LA times provided an article which contains information regarding a similar venture, only from the western coast of Canada to the west coast of the United States (2017). Their findings will firstly be examined to assess the cost components and revenues experienced in that case. Based on the information from this venture, a certain recreation will be conducted to create the basis for the rest of this profitability analysis.

The LA Times article (2017) presents the measures a company named Polaris Materials utilizes from extraction of the material to its arrival to the given location. What makes their measures comparable to the potential Greenlandic venture is the origin of their deposits. The sand they extract originates from ancient glaciers that started to melt, which opened deposits of the raw material. From there, the aggregate also known as rock formations are scraped in the quarry pits. Afterwards, it gets cleansed to eliminate irregularities and unwanted materials, after which it is processed into its given category of material. These categories are sand and gravel, which are often distinguished by the size of the pebble. When the sorting process has been conducted, the material is placed on conveyor belts that stretch for almost a mile and is then brought on to large dry-bulk freight ships. These ships can carry up to 75,000 tons of aggregate and a 1,450-mile voyage to the West coast. The last part of the journey requires the need to use trucks to get the aggregate to its final destination (Koren, 2017).

One important measure to take into account when considering the venture from a Greenlandic perspective, is the price difference between the marine freight transport versus truck transportation. The article states that transporting one ton of material over the 1,450-mile voyage costs 7,25 dollars via ship, while a 25-mile trip using trucks costs 8,75 dollars per ton (Koren, 2017). This paper will assume that a sand business in Greenland can utilize a similar practice given the cheaper method of waterborne transportation. Although, the values might not exactly represent those that a Greenlandic business will face, this paper will adopt the unit costs stated by Polaris. It is also important to mention that Polaris' sand pricing stands at twenty dollars per ton. This price will be adopted as well for a rough estimation as the exact sand quality of Greenland is unknown and therefore difficult to give a correct estimation of.

Sand Freight Costs

With the help of information provided by statements of Polaris, a rough estimate regarding the pricing will be put forward. After that the paper will attempt to conduct profitability estimates for three locations that are located in the United States, the United Kingdom and Germany. The three destinations were not selected because they are particularly attractive markets, but because the paper seeks to test if export to these destinations could be profitable in case they prove to be attractive markets. The destinations have also been decided on as they are located within the analyzed geographical area. As stated earlier, a relative proximity to Greenland was the key factor when deciding on the geographical area. These three estimations are also made to better understand the differences in transport costs that come with different export destinations. To conduct the estimates, the freight calculator provided by World Freight Rates will be utilized in combination with the values provided by Polaris Materials.

The variable values that will be used in the estimations are among others the 75,000 metric ton weight for the max break-bulk shipment available, as Polaris (Koren, 2017) described it. Furthermore, their average price per ton of twenty dollars will be included when establishing the variable input for the freight calculator. In order to use the freight calculator, one has to insert the unit price charged for sand. Moreover, the shipment category provided by the calculator will follow the option named minerals and metallurgy as it captures the type of shipment most accurately and destination of origins will be Nuuk, as there are no current ports in the projected location for the extraction area one-hundred kilometers away from the capital. The three specific locations that have been selected for test are Hamburg in Germany,

Plymouth in the UK and Boston, Massachusetts, US. It is important to note that the freight calculator takes into account currently available routes and the currently available infrastructure in Nuuk regarding their ports. The values provided by the freight calculator are also applied in the future profitability estimations of this paper, although these might change.

Firstly, the estimation provided by the freight calculator regarding Hamburg gave an estimated price of transport close to 2.3 million dollars. The assumed price of the sand is 20 dollars per ton, and multiplied with the maximum carry weight of 75,000 tons gives a value of 1.5 million dollars. It is obvious that the given sand price is too low and the freight costs too high, which makes potential export to Hamburg constitute a large deficit. The direct costs and indirect costs for conducting the sand extraction in Greenland have not even been considered yet. A similar result is obtained when investigating the potential of exporting to Plymouth in the United Kingdom. The estimated transport costs are 2.35 million dollars for the break-bulk transportation, which creates an even larger deficit. Perhaps the biggest variation in transport costs came forward when calculating the price of transportation to Boston in the United States. The calculated costs for transport resulted in a price of 18.5 million dollars. This indicates that this is not a realistic option currently, and most likely not in the near future. Whether this is due to tariffs, different infrastructure traits or other factors will need to be investigated further. The sailing distance to Boston is shorter than those to Hamburg and Plymouth (Sea Distances, n/a). Thus, the cost difference is not based on distance. Similar neighboring destinations to Boston yielded similarly high transport costs, making tariffs a likely reason for the high costs. As long as Canadian and American destinations yield such high transport costs, they will not be realistic export options for Greenland. An enhanced relationship between the US and Greenland might ease this issue if beneficial trade agreements can be made.

One must also consider the final stretch of the transportation, where trucks are utilized to reach the final destination for the sand. Polaris Materials have provided a valuation of the costs required for the final 25-mile stretch. This value will be adopted by this paper for the complete calculation of transport costs. This is due to the fact that actual distances are impossible to adjust for given no specific destination is known. With the price of 8.75 dollars per metric ton over a 25-mile stretch and a total weight of 75,000 tons results in an additional 656,250 dollars to transport the sand to its final destination. This additional cost will be incorporated into each estimate, when estimates for future operations are conducted.

Determining Costs

Before establishing a potential break-even point for the two options seeming more suitable from an economical perspective, Hamburg and Plymouth, an examination of the fixed and variable costs needs to be made. As previously mentioned, an accurate cost calculation for Greenland is currently out of scope for this paper, because too many issues still need answering. Therefore, the paper will utilize the ASPE certified valuation of sand dredging expenses, which was introduced earlier. Based on this, the potential fixed and variable costs that a sand dredging operator in Greenland can expect, is determined.

The ASPE certified technical paper considers a dredging operation that extracts 392, 448 cubic yards per month, which corresponds to 588, 672 metric tons per month (Jones, 2012). The output of this paper will be reduced so that it corresponds to two trips back and forth per month between Greenland and Hamburg. This is done to make an estimate relatively conservative. A realized output and selling might be higher, which would benefit the business if operations prove to be profitable in the future. However, two trips between Greenland and Hamburg are considered and each freight can carry 75,000 metric tons, which corresponds to 150, 000 metric tons per month. While the actual capacity for the Sermeq Outlet in theory could be much higher, this basic calculation will serve as the output when a potential break-even point is estimated for future operations.

The required equipment to conduct the sand dredging operation consists of mechanical dredges, which include bucket, clamshell and dragline dredges. Transportation of the dredged material also requires tugs with barges. Regardless of extraction is performed from land or via ships, there will be a need for crew accommodation and survey and a towing vessels are required. Furthermore, labor costs consist of the operator of the dredge, engineers, mate and deckhands, while also requiring operators of the tugs such as the tug master and deckhand.

Total costs for such an operation results in a unit cost for dredging that totals 1.63 dollars per cubic yard (Jones, 2012), which translates to 2.45-unit cost for dredging per metric ton in dollars. For this examination, it is established that 150,000 metric tons will be dredged per month, resulting in a total monthly cost of dredging equaling 366,750 dollars.

Break-Even Point

Direct costs and indirect costs have been established, as well as the transport costs between Nuuk and Hamburg. If one expects that two trips between this route per month will take place, the monthly costs equal 4,6 million dollars in break-bulk costs, 1,3 million dollars in truck expenses, plus the costs of dredging which is close to being 400 thousand dollars per month, gives a total cost of approximately 6,3 million dollars per month. Considering that the expected revenue per month equals 3 million dollars, one can see that a large deficit is reached. Again, it is important to note that the Greenlandic infrastructure for conducting such an operation is not present, which is most likely affecting the transport costs because loading processes are inefficient. Likewise, the price of optimizing the infrastructure has a likelihood of reaching a significant amount that will have a major impact when considering this venture. If a sand operator will have to invest heavily in port infrastructure in the Sermeq Outlet as well, deficits will certainly become even higher. Nevertheless, the estimates conducted in this paper will disregard expenses to this as it is extremely difficult to obtain a reliable estimate on this matter.

Sverdrup et. al. (2017) made a model for the future sand prices using a business as usual pricing model. There he concludes that the expected sand prices will increase with a margin of ten percent annually until the expected growth rate will subside around 2065. With the price of sand provided by Polaris Materials, which stood at twenty dollars per metric ton, and the assumption that 150,000 metric tons will be created and exported each month, one can adjust the revenue and cost to a yearly basis to assist in the calculation. The current values were found to 36,000,000 in annual revenue and 75,600,000 in annual costs. Then the question remains if in a period of fifty years, can a break-even point be reached based on the currently available data? With a yearly increase in sand price that stands at ten percent, a break-even point for the destination of Hamburg can be expected to be reached in eight years. However, due to this being a business as usual calculation, it does not take into account irregularities, which can hinder the expected growth rate, such as a global pandemic or an economic crisis. Elsner (2020) provided an expected growth rate of five percent, which would result in a break-even point being reached in fifteen years from now.

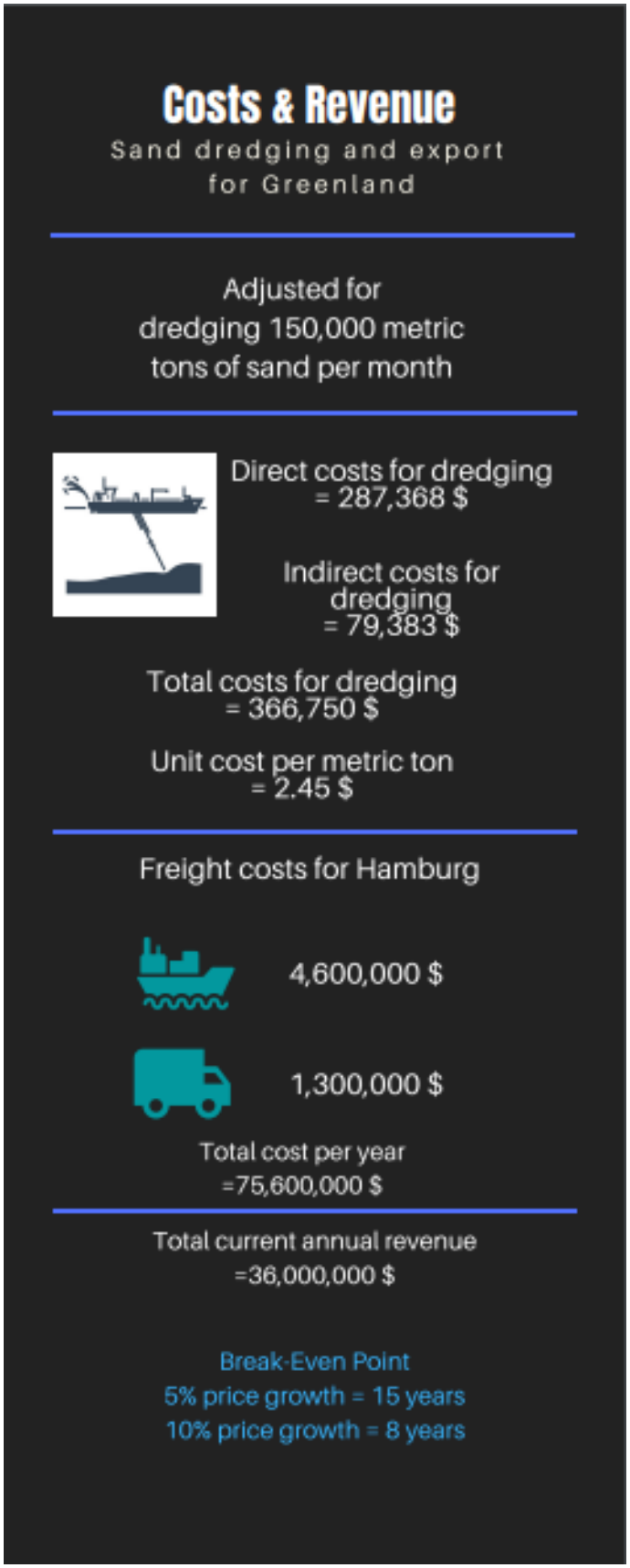

Figure 6 – Costs, Revenue and Break-Even Point for Hamburg

So, in conclusion, it is difficult to exactly predict future price growth of sand, since there are so many factors that needs to be taken into account, while at the same time, being difficult to adjust for future cost component value changes. However, it seems likely that in a decade or two, some profit margins can be reached if Hamburg proves to be an attractive export market. A similar prognosis can be made for Plymouth, adjusted for a few additional years. When it comes to Boston and the rest of the United States, it will require closer to three to five decades before that becomes profitable if transport costs remain the same. To sum up the profitability factor, it seems likely that increases in sand prices can result in profitable margins from approximately ten to twenty years from now if the remaining 'successful' factors indicate potential for profit as well. Thus, from ten to twenty years, increasing profit margins are indicated until 2065 as Sverdrup et. al. (2017) have predicted to be the time when the sand prices will start to stagnate.

Figure 7 – Costs, Revenues and Break-Even Points for Plymouth and Boston

Findings

The findings of the entire analysis section will be presented by evaluating each of the research question elements. The reader will find that a large share of the findings is comprised of the 'successful' factors presented through the PSWOT structure. With exception of 'Greenlandic sand', all findings are derived from the use of the analytical framework developed specifically for this study. With the assessments of the elements it is

the aim to be able to answer the research question: *Can a company successfully extract and export Greenlandic sand to foreign countries?* Based on the findings, a qualitative assessment is employed to answer this question.

Company

This study has not conducted an internal strengths and weaknesses analysis for a specific company. The paper would have taken a different form if the purpose was to assess the potential of success for a particular company. However, some key factors for succeeding in the sand industry, which are related to company characteristics, were recognized. Compared to Coman and Ronan's core competencies and problems (2009), these might appear superficial as they are rather effects of core competencies and problems, but they remain relevant to include. First of all, operators' capacity and processing of sand must be sufficient, quick and smooth in order to meet customer demands. A high capacity is beneficial if customers should need large quantities and being capable of supplying reliably, in other words, delivering the product quickly when it is requested, is essential as well. If a company is not able to live up to these requirements, it holds a significant weakness. These factors imply that long-term access to large quantities of sand as well as sufficient equipment are key factors. This further implies that size plays an important role for success. Other key success factors are (1) The ability to vertically integrate with downstream markets; (2) The ability to win contracts while ensuring adequate profit margins; (3) The ability to control supply of a regional market; (4) The ability to expand and reduce operations rapidly in line with market demand. Another key success factor is the ability to effectively accommodate to environmental requirements. These factors does to a high extent support the view of size and financial capital being essential to success. Thus, small operators with access to less sand resources and less financial capital will have a disadvantage.

A company will possess certain advantages and disadvantages based on the fact that it is located in Greenland and in the Sermilik fjord. Please find the Strengths and Weaknesses parts under the 'successful' element in the next section for a summary of those.

To sum up, if permission is granted to initiate operations in Greenland, a company must strive to achieve above-mentioned success factors, and size in terms of capacity and financial capital seem to be essential here.

Successful

The ‘successful’ factor is evaluated and presented in the structure of PSWOT. As the reader will have noticed, this part will overlap with parts of the other research question elements. Strengths and weaknesses address what makes a ‘company’ ‘successful’, and opportunities and threats examine developments in ‘foreign countries’ that might make a ‘company’ ‘successful’. Thus, the ‘successful’ element is central when it comes to answering the research question, because it addresses almost all elements of it. Five summaries representing the findings of each ‘successful’ factor are found below.

Profitability

The profitability analysis conducted break-even point estimations for export of Greenlandic sand to three randomly chosen destinations within the North Atlantic area. These were Hamburg, Germany; Plymouth, United Kingdom; and Boston, Massachusetts, USA. Based on values of present-time, the estimations of all three locations show that total costs would exceed total income, ultimately leading to deficits. Exports to Hamburg and Plymouth would both result in moderate deficits. Exports to Boston would result in high deficits.

However, in a couple of decades from now, the picture might have changed. Keeping all other variables than price of sand constant, exports to Hamburg and Plymouth could become a profitable practice. The expected price increases might at some point in a decade or two climb enough to make incomes exceed costs. It is important to stress that all variables carry a lot of uncertainty, and expenses for port infrastructure are not included in the estimations. Therefore, an actual break-even point will most likely be reached later than the results show. Nevertheless, the results do indicate that a sand operator in Greenland might become profitable in the future.

Strengths

Although the paper has not been able to utilize Coman and Ronan’s Diagnosing Method (2009), some strengths related to the location of Greenland and the Sermeq Outlet were identified.

Firstly, since the sand is available for extraction in a fjord, not initial use of truck transport is required. The sand can be dredged, processed, stored, loaded on ships and shipped from the setup. In addition, the quantity of available sand and as well as a constant influx provide a

potential sand operator with a long-term source. Over-extraction seems very unlikely and the area is unpopulated which prevent conflicts with other interests. If environmental impacts can be kept at a minimum and strict regulations from the Greenlandic self-government are not imposed, the position of a sand business will be strengthened. This will be in line with the proposed key success criteria of effectively adapting to or circumventing environmental restrictions.

Weaknesses

The weaknesses of a potential sand business in Greenland found in this paper are also location-related. The remote location of Greenland makes transport distances to potential markets extremely long. Although most competitors will have to use truck transportation, their distances to markets are significantly shorter. From a cost perspective, this leaves a Greenland based operator with a huge disadvantage. The distance is also an obstacle to easy networking with participants of downstream markets.

Lastly, the setup of port infrastructure and difficult physical conditions in Greenland require very high investments before a sand business can be realized. Thus, whereas the location provides a potential operator strengths, certain weaknesses will follow.

Opportunities

The opportunities of a business in Greenland can be divided into short-term opportunities and long-term opportunities. The short-term opportunities are limited mainly due to the current pandemic. However, if supply markets of sand, including shipping, purchases and equipment are hit to a point where they must lower their prices, a bold investor might take advantage of this and save significant sunk costs. A short-term scenario that would offer opportunities to all sand industries is if governments increase their spending on infrastructure projects in order to respond to high unemployment rates. This would increase demand for sand and benefit sand operators. Lastly, the regional isolation of markets might offer opportunities to a Greenland based business if it can identify markets that are unreachable to dominating players. This applies not only to a short-term perspective, but also to a long-term perspective.

The long-term scenario highlighted some interesting opportunities that a potential sand business in Greenland might consider. The increased focus on environmental issues will lead to tightened regulations for sand extraction practices in other countries. This reduces

competitors' level of competitiveness, forcing them to increase sand prices. In case a business in Greenland can circumvent these regulations, it will be better positioned than its competitors in this field. The fact that energy prices are expected to rise enhances the situation for the business in Greenland, because competitors will face longer distances than before still using trucks, whereas the distance from Greenland is unchanged and sand is transported using cheaper waterborne shipping.

Another important opportunity is a strengthened relationship between Greenland and the US potentially resulting in beneficial trade agreements and significant US investments into multiple sectors in Greenland that would benefit a sand business in Greenland.

Lastly, stable access through the Northwest passage in the future opens a range of new potential markets in the west.

Threats

As it was the case for short-term opportunities, short-term threats are also related to the current pandemic. The economic slowdown constitutes a significant threat to a setup of a sand business in Greenland. Low trade activity and lack of investments reduce the demand for sand, hence less market share to fight for. Furthermore, a mature market experiencing a trend towards concentration and a high level and risk of vertical integration threaten a business in Greenland. Furthermore, the isolation of markets constitutes a threat. If a Greenland based business relies heavily on few regions or customers, disruptions specific to these could destroy the operators' basis of existence overnight. This applies to a long-term perspective as well.

Threats become increasingly difficult to foresee the further out in the future one looks. Developments that would threaten a business in Greenland are disruptive incidents such as the current pandemic, war or natural disasters. Moreover, a shift of attitude regarding environmental sustainability leading to loosened regulations would give back the advantage to competing operators.

Profitability	▪ Moderate to high short-term deficits are expected ▪ Indications of moderate profits in one or two decades are present
Strengths	<u>Location advantages due to:</u> ▪ No initial need of truck transport ▪ Low risk of over-extraction ▪ Area is unpopulated, hence lower risk of conflicts due to noise and similar issues
Weaknesses	<u>Location disadvantages due to:</u> ▪ Remoteness from markets implying high transport costs and difficult to establish relationships to downstream markets ▪ Lack of port infrastructure and harsh conditions requiring extensive investments

Opportunities	<u>Short-term opportunities:</u> ▪ Potential savings on sunk costs and purchases assuming the supplier market is hit by the current pandemic ▪ Potential increased government spending on infrastructure projects to lower unemployment ▪ Regional isolation of markets might result in pockets with potential <u>Long-term opportunities:</u> ▪ Continuous tightening of extraction regulations in other countries and related factors reducing competitiveness of competitors ▪ Strengthened relationship to the US potentially leading to trade agreements and US investments in important Greenlandic sectors ▪ Opening of the Northwest Passage

Threats	<u>Short-term threats:</u> ▪ Economic slowdown, reduced trade and investments, reduced demand for sand ▪ Market is mature, heading towards concentration and vertical integration is high ▪ Regional isolation, where dependency on narrow markets is high leaves an operator vulnerable to disruptions specific to these markets <u>Long-term threats:</u> ▪ Disruptive events such as wars, pandemics and natural disasters reducing demand for sand ▪ A change of attitude regarding environmental consciousness leading to softened extraction regulations

Figure 8 – PSWOT findings

Greenlandic Sand

This paper has adopted the assumption that 15 percent of the sand available in the Sermeq Outlet is suitable for construction purposes and it is of a standard quality. If this assumption represents real facts, 330 million tons of sand is available for exports annually. However, comprehensive investigations are required to specify the exact quality of sand available. Particularly the substance of the sand is critical to determine as it will impact the selling price of the sand. Due to the current lack of data related to the quality of the sand in the Sermeq Outlet, it is not possible to definitively determine the potential of the sand itself.

As highlighted earlier, there will be massive challenges connected to the setup of extraction operations. Questions as what is practically required for extraction or whether extraction is too complicated to be set up are still open and need engineering-related expertise to be answered.

Foreign Countries

Based on high transport costs, the paper narrowed down the geographical area of focus to include the North American continent and Europe. The profitability analysis indicated that transport costs to the US east coast are far exceeding what is economically reasonable. In a decade or two, exports to European destinations seem more appealing as transport costs are much lower compared to US destinations. This study has covered opportunities and threats that might increase or decrease the attractiveness of exporting sand to destinations within the chosen geographical area. These were outlined in the ‘successful’ element. The paper could not identify specific destinations as being particularly attractive, however it has outlined factors indicating that the European market might become attractive over time. It was beyond the scope of this paper to identify specific locations that will definitely generate profits to a sand operator in Greenland. This will require multiple market reports for specific regions that include analyses of downstream markets as well as thorough analyses of the competitive landscapes. The study has also revealed that export to foreign countries must be destined for coastal locations, because truck transport should be avoided.

Discussion

Answering the Research Question

The findings revealed that a number of questions still need answering before it can be concluded with certainty if a company can successfully extract and sell Greenlandic sand to foreign countries. However, based on the data that is obtainable, the study can conclude that a company can not successfully extract and sell Greenlandic sand to foreign countries within a short timeframe, being 1-5 years. On the assumption that the sand available is of a standard quality for construction purposes, the price will be too low to match the total costs. The transport costs constitute the largest share of these costs. Furthermore, a potential economic slowdown resulting from the current pandemic makes the demand for sand uncertain and therefore extremely risky for an investment in this specific project.

For a timeframe stretching from 10 to 50 years, the outlook seems more appealing for a potential investment. Despite a higher uncertainty for a future outlook, the increasing price of sand seems to result in break-even points in one to two decades from now depending on the actual price increase and with exclusion of port infrastructure expenses. Anticipating total costs to stay constant, continuous increases in sand prices combined with a growing demand and tightening extraction regulations for competitors may hold a positive outlook for the future This study suggests that a company can successfully extract and sell Greenlandic sand to foreign countries if operations start in 10 to 20 years from now, in a best case scenario.

What is required for the Sand Project to be realized?

Because several important aspects still need to be uncovered, the findings should be regarded as indications rather than definitive results. Some vital aspects that still need to be accounted for is everything related to the sand, including its quality, how it should be extracted and the setup of equipment. In order for this project to be realized and to benefit the economy of Greenland, comprehensive investigations of sand quality involving assessment of shape, size and substance must be conducted. The quality will be a key indicator for the potential of the project as a better quality implies a higher selling price, which benefits the prospects of success.

In addition, assessments of how the sand should be extracted must be made. In relation to this, how the setup of equipment can effectively match the harsh conditions of the area so that operations are smooth and capacity is constant throughout the year. All of this requires a

setup specifically designed for the Sermeq Outlet, which is why engineers and special experts must be involved.
The conditions of the Greenlandic nature is likely to make the setup costlier compared to locations with simpler conditions, but it is not the only objective where investments are needed. Port infrastructure must be established as well, and it must be located and designed so that the process from preparing the sand to loading it onto the ships is as smooth as possible. In addition to this, investigations as to whether large scale dry bulk carriers can access the fjord and the port must be conducted. It seems clear that high financial capital investments are required. Naturally, this alone will keep potential investors away. In the likely case of a lack of investors, the only means that would increase the attractiveness is any form of government support. This could be subsidies through tax cuts, government investments in port infrastructure or a third option. Any form of government support seems necessary if the project is to succeed.

Another important aspects involves the issue of environmental restrictions, which seems to be a key factor for a sand business in Greenland to thrive. The environmental restrictions imposed by governments around the world seem to partly explain the expected future price increases of sand. The environmental impacts of a sand extraction setup in the Sermilik fjord are still to be investigated. Potential impacts on local fishing and hunting also need to be considered. The project could depend on these aspects as well. In relation to the previous point, it remains clear that the government of Greenland must support the initiative by providing beneficial terms. Regulations, such as fees and extraction prohibitions as those imposed in other countries must be avoided. At the same time, an operator must strive to run operations with minimal environmental effects. The long distances to potential markets will be a disadvantage to an operator in Greenland, and therefore, the practice will need to differentiate itself on all other parameters that are possible. Along with the key success factors mentioned earlier in the paper, this includes transport via waterborne shipping and beneficial extraction terms through well-functioning collaboration with the government.

Another important aspect that this paper was not able to study in depth is identification of specific promising markets. Because target markets are scattered into smaller regions, detailed market reports are required to assess if an operator in Greenland can win a share of the market in specific regions. Market reports should address the competitive landscapes including mapping of competitors, and PESTEL analyses will be essential for assessments of

non-market related factors. For instance, trade barriers and other export regulations specific to sand might stand as obstacles lowering export attractiveness. Market reports will indicate if a sand business in Greenland stands a chance against competitors and in combination with profitability calculations, they will reveal if exports to specific regions is reasonable. The next section will touch upon this issue as well.

Evaluating the PSWOT Framework

The analytical framework PSWOT was developed to examine the 'successful' element of the research question. By analyzing the five factors profitability, strengths, weaknesses, opportunities and threats, the framework was able to address 'company', 'foreign countries' and parts of 'Greenlandic sand'.

The study was not able to utilize the internal analysis part involving strengths and weaknesses to the fullest as no company living up to the criteria for analysis, was available. Identification of core competencies and core problems through the use of the Diagnosing SWOT methodology would have helped to outline characteristics of a specific company and compare it to key success factors and match them against opportunities and threats from the external environment. However, with the inclusion into this paper, it is ready to be applied and combined with the remaining tools by other parties in the future. As opposed to many other approaches, the tool offers a systematic step by step approach to identify strengths and weaknesses of a company.

The analysis of opportunities and threats followed a scenario based approach, where Porter's five forces and PESTEL were applied to identify industry and non-industry related characteristics, trends and developments. Although they are based on subjective reasoning of the authors, the tools offered a systemic approach to identify different factors that might constitute opportunities and threats. By applying the tools, the analyst will have to examine relevant country conditions, thereby addressing the 'foreign countries' element. The scenario approach allowed the study to narrow down the geographical area which enabled a more focused analysis. However, in retrospect, the geographical area could have been narrowed down even further in order to identify specific attractive export destinations. On the other hand, it can be argued that this study has conducted an analysis of a larger geographic area which can be used to narrow down potential markets further. The PSWOT framework can be applied initially on a broad spectrum of regions. Based on the findings, it can be reused to

analyze a limited area and this process can be repeated until a specific market and its competitors are thoroughly understood. Thus, having discovered that export to European countries is more reasonable from an economical perspective, the next step towards finding more specific attractive destinations would be to apply the framework again on European coastal nations. Thereafter, one or two nations might be selected, and lastly, certain regions within these countries might be recognized as the most attractive export markets.

The scenario approach also allowed for a variation of variables. In this study, the timeframe was the variable to be changed. However, in order to optimally utilize the PSWOT framework, more than two scenarios should be composed, in which different variables are varied. Given that the quality of the sand in the Sermeq Outlet is still to be determined, this remains as an obvious variable to change in different scenarios. As long as the sand quality in the fjord has not been determined, different qualities should be included in further studies. This leads to another issue that was difficult to address with the framework, namely pricing of sand. First of all, there is a wide range of different sand types and qualities, which makes a standard type of sand difficult to determine. In addition, sand is used in almost every single aspect of the construction industry, and depending on the use, the sand will need different processing, making some of it expensive and some less expensive. Furthermore, due to variations in availability of sand, prices across regions vary even for the same type of sand. When sand is more scarce in a certain region compared to another, higher transport costs will increase the selling price. Therefore, it is challenging to specify a standard price of sand and incorporate it into a profitability estimation. Thus, prices vary depending on the availability in regions. As a consequence of this, a more detailed mapping of potential sand products from the Sermeq Outlet must be created so that the following question can be answered: Which specific sand products can be produced in the Sermeq Outlet and what equipment for it is required? When potential products have been outlined, comparisons to competitor prices can be made. When these steps are performed, analysts can apply the profitability part of PSWOT to gain reliable economical overviews. Thus, for the optimal use of PSWOT, a specification of potential sand products and competitor prices must be made.

As pointed out earlier in the paper, the framework is flexible in the sense that no specific order needs to be followed. The approach adopted in this paper was used to assess the export potential within a broad market defined by geographical areas. As pointed out in the theoretical section, SWOT related tools need to be applied comprehensively and with

substantial expert knowledge. The analysis of competitive forces conducted in this paper was affected by a limited access to region-specific data, which is why competition across the chosen regions was generalized. In line with what was addressed earlier, extensive region-specific data is required to optimally apply the framework.

By applying the framework it can be concluded that the reliability and credibility of its findings depends on the availability of accurate information and data, the extent to which expert knowledge is accessible and the subjectivity of the analysts. The more use of expert knowledge, results in more credible findings. Access to accurate data makes findings more reliable. More accurate data and more consultancy with experts will lessen the effect of the author subjectivity.

Therefore, these factors are also essential when it comes to its applicability with regard to answering the research question. The approach of the paper was found to address the correct issues of the research question elements through the use of the established analytical framework. The framework addressed all elements with the exception of 'Greenlandic sand', however the issues within this element can to a high extent be regarded as basic assumptions and a starting point for the analysis. Thus, the internal validity of the framework and approach of the study can be considered high. An aspect that would counter this argument is the fact that no specific export locations could be identified, however this can be explained by a focus on a too large geographical area and limited access to region specific information on competition. The 'company' element can also be questioned as this was only addressed in part.

The external validity of the framework can be considered high with regard to applying the it on potential sand businesses in other parts of the world. The external validity of the findings, however, is low because it addresses multiple issues that are specific to Greenland and the analyzed geographical area.

In conclusion, the degree to which the factors: (1) the availability of precise data and (2) access to substantial expert knowledge are fulfilled determines the applicability of the framework for the research question.

Options for Further Studies

Aside from testing the the analytical framework on an enterprise that genuinely considers to become involved in the Greenlandic sand industry, the authors recognises two relevant issues that this study did not investigate. As it was noted in the introduction, Asian countries such as China and Singapore are large consumers of construction sand. Asia was left out of this study due to the distance from Greenland. However, considering the gradual opening of the Northwest Passage in the future, export to these locations could become interesting to examine based on their extreme consumption of sand. As emphasized in this study, regional shortages of sand is among the reasons for future price increases. A study tailored for these destinations would be a relevant addition to the research of this paper.

A second interesting aspect relates specifically to the melting of ice from the Greenlandic ice cap. As stated in the beginning of this paper, Greenland contains masses of ice equivalent to a seven meters rise of the world oceans. Rising sea levels will have negative impacts on several population rich coast areas. As a response to elevated sea levels, construction of new facades, infrastructure and houses will have to take place. Therefore, it is relevant to analyze what impact this will have on the demand for sand. It is reasonable to believe that demand for sand will increase, but how much and where will the demand be highest? New export opportunities might arise due to this issue, which is interestingly connected directly to Greenland's melting water that pours out massive amounts of sand.

Conclusion

This study was carried out for the purpose of examining whether or not Greenlandic sand can be exported to foreign countries successfully. International attention was drawn to this topic, when scientists proposed the idea of investigating Greenlandic sand resources as a potential source of export. Mette Bendixen proposed that the enormous quantities of Greenlandic sand might help to meet a growing global demand for sand while benefiting the economy of Greenland. This study was based on the premise that the entire practice of extraction and exports must be profitable and sustainable from a business perspective before it can benefit the country of Greenland. Therefore, emphasis was put on examining factors that would make a potential sand business in Greenland successful as well as factors that would make it unsuccessful. Based on the research question, the paper established four key elements that needed to be properly analyzed and answered before an ultimate answer to the research question could be provided. The research revealed that different issues within the four elements still need to be accounted for through further tests and research before a definitive conclusion to the research question can be reached. The most important ones of those are (1) a sure determination of the sand quality in the Sermeq Outlet, (2) an outline of sand products that can be produced from the sand available, (3) requirements for setup of sustainable equipment and port infrastructure specific to the Sermeq fjord and (4) narrowing down potentially attractive export markets by applying the PSWOT framework until a thorough understanding of specific regions, competitors and competitor products is obtained.
The purpose of this paper was also to develop an analytical framework that can comprehensively analyze the potential of success for a sand business in Greenland. It was found that the framework succeeded in addressing the correct issues, however its usability highly depends on availability of specific data, which can be challenging to obtain for specific regions and markets, and also access to expert knowledge.

Despite the fact that certain issues still need further testing and research, the findings of this paper indicate that a company can successfully extract and sell Greenlandic sand to foreign countries. However, at the present point in time, this is not the case, mainly due to the current sand prices being too low. The current pandemic and a potential economic slowdown during the next couple of years create uncertainty about the demand for sand, which makes an investment risky in the short run. It is a different picture if one looks towards one or two decades ahead from now. If average sand prices continue to rise by five to ten percent a year,

total income of a sand business will exceed the costs under the assumption that transport costs for sand business in Greenland remain the same. What is essential for success is that no regulations imposed by the self-government are impeding the course towards profitability. On the contrary, government support is likely to be necessary in order to attract potential investors, because the financial capital requirements will be high.

Bibliography

Alexander, C. (2020). *Canada Pandemic and oil shock trigger deep recession*. Retrieved from https://www.deloitte.com/us/en/insights/economy/americas/canada-economic-outlook.html

Axinn, C. N. (1995). Export intention, beliefs, and behaviors in smaller industrial firms. *Journal of Business Research*, *32*(1), 49–55. https://doi.org/10.1016/0148-2963(94)00009-4

Baker McKenzie. (2017). *The realities of trade after Brexit*. Retrieved from https://www.bakermckenzie.com/-/media/files/insight/publications/brexit_tradeflows.pdf

Balz, D. (2020, April 19). Government is everywhere now. Where does it go next? Retrieved May 5, 2020, from https://www.washingtonpost.com/gdpr-consent/?next_url=https%3a%2f%2fwww.washingtonpost.com%2fgraphics%2f2020%2fpolitics%2fpandemic-government-role%2f

Bendixen, M. (2020, January 22). Skype.

Bendixen, M. (2020, March 15). Skype.

Bendixen, M., Overeem, I., Rosing, M. T., Bjørk, A. A., Kjær, K. H., Kroon, A., … Iversen, L. L. (2019). Promises and perils of sand exploitation in Greenland. *Nature Sustainability*, *2*(2), 98–104. https://doi.org/10.1038/s41893-018-0218-6

Berlingske. (2020, April 23). Torsdag ventes USA at annoncere millioner til Grønland. Retrieved May 6, 2020, from https://www.berlingske.dk/politik/torsdag-ventes-usa-at-annoncere-millioner-til-groenland

Book, S. (2018, November 29). Not on my beach. Retrieved March 8, 2020, from https://www.handelsblatt.com/today/politics/not-on-my-beach-the-great-german-sand-shortage/23582932.html?ticket=ST-2826469-WcSEyGFFkQlLeJMFmQum-ap3

Brouthers, L. E., Nakos, G., Hadjimarcou, J., & Brouthers, K. D. (2009). Key Factors for Successful Export Performance for Small Firms. *Journal of International Marketing*, *17*(3), 21–38. https://doi.org/10.1509/jimk.17.3.21

Burrell, G., & Morgan, G. (1979). *Sociological Paradigms and Organisational Analysis*. Lancaster, England: Ashgate.

Capital Economics. (2020, March 13). Capital Economics – The economic impact of COVID-19. Retrieved April 18, 2020, from https://www.capitaleconomics.com/the-economic-effects-of-the-coronavirus/

Christensen, A. (2016). *CURRENT TRENDS IN THE GREENLANDIC ECONOMY*. Retrieved from https://www.nationalbanken.dk/en/publications/Documents/2016/06/Current_trends_the_greenlandic_economy.pdf

Coman, A., & Ronen, B. (2009). Focused SWOT: diagnosing critical strengths and weaknesses. *International Journal of Production Research*, *47*(20), 5677–5689. https://doi.org/10.1080/00207540802146130

Cooper, D. R., Schindler, P. S., & Blumberg, B. (2011). *Business Research Methods, 11th Edition* (11th ed.). Pensylvania, New York: McGraw-Hill Education.

Corporate Finance Institute. (2019a, November 15). Product Costs. Retrieved April 18, 2020, from https://corporatefinanceinstitute.com/resources/knowledge/accounting/product-costs/

Corporate Finance Institute. (2019b, December 31). Fixed and Variable Costs. Retrieved April 19, 2020, from https://corporatefinanceinstitute.com/resources/knowledge/accounting/fixed-and-variable-costs/

Corporate Finance Institute. (2020, March 15). Variable Costs. Retrieved April 18, 2020, from https://corporatefinanceinstitute.com/resources/knowledge/accounting/variable-costs/

Elsner, H. (2020, February 22). Email.

GÜREL, E. (2017). SWOT ANALYSIS: A THEORETICAL REVIEW. *Journal of International Social Research*, *10*(51), 994–1006. https://doi.org/10.17719/jisr.2017.1832

Hackney, C. R., Darby, S. E., Parsons, D. R., Leyland, J., Best, J. L., Aalto, R., … Houseago, R. C. (2020). River bank instability from unsustainable sand mining in the lower Mekong River. *Nature Sustainability*, *3*(3), 217–225. https://doi.org/10.1038/s41893-019-0455-3

Hamor, T. (2004). Sustainable Mining in the European Union: The Legislative Aspect. *Environmental Management*, *33*(2), 252–261. https://doi.org/10.1007/s00267-003-0081-7

Harrison, J. S., & St. John, C. H. (2010). *Foundations in Strategic Management* (5th ed.). Retrieved from https://books.google.dk/books?id=ybfj2F0oO9EC&pg=PA183&lpg=PA183&dq=%E2%80%9Copportunities+are+conditions+in+the+external+environment+that+allow+an+organization+to+take+advantage&source=bl&ots=e8Fgr2Q1r1&sig=ACfU3U03rcB737I_XjPg2uxjx7AhBpqivw&hl=en&sa=X&ved=2ahUKEwjI-YD_4NboAhXvmIsKHaZ7DcYQ6AEwCnoECA0QKQ#v=onepage&q=%E2%80%9Copportunities%20are%20conditions%20in%20the%20external%20environment%20that%20allow%20an%20organization%20to%20take%20advantage&f=false

Helms, M. M., & Nixon, J. (2010). Exploring SWOT analysis – where are we now? A review of academic research from the last decade. *Emerald Group Publishing Limited*, 215–251. Retrieved from https://www.emerald.com/insight/content/doi/10.1108/17554251011064837/full/html?skipTracking=true

Heritage. (n.d.). Country Rankings: World & Global Economy Rankings on Economic Freedom. Retrieved April 29, 2020, from https://www.heritage.org/index/ranking

How Concrete is Made. (n.d.). Retrieved March 4, 2020, from https://www.cement.org/cement-concrete-applications/how-concrete-is-made

Høegh, M. (2020, March 5). Phone.

IBIS World. (2019). *Gravel, Sand & Clay Extraction in the UK industry trends (2014-2019)*. Retrieved from https://www.ibisworld.com/united-kingdom/market-research-reports/gravel-sand-clay-extraction-industry/

Infrastructure and Projects Authority. (2018). *Analysis of the National Infrastructure and Construction Pipeline*. Retrieved from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/759222/CCS207_CCS1118987248-001_National_Infrastructure_and_Construction_Pipeline_2018_Accessible.pdf

Islam, F. (2020, April 9). Record fall in UK economy forecast. Retrieved April 29, 2020, from https://www.bbc.com/news/business-52232639

ITA. (2019, October 13). Doing Business in Other Areas of Denmark; Greenland | International Trade Administration. Retrieved April 28, 2020, from https://www.trade.gov/knowledge-product/denmark-doing-business-other-areas-denmark-greenland

Johnson, G. (2015). *Fundamentals of Strategy* (3th New edition). London, England: Coronet Books Inc.

Jones, P. (2012). *How to Estimate the Cost of Mechanical Dredging*. Retrieved from https://cdn.ymaws.com/www.aspenational.org/resource/resmgr/Techical_Papers/13_June_TP.pdf

J.P.Morgan. (2020, March 23). Assessing the Fallout From the Coronavirus Pandemic | J.P. Morgan. Retrieved April 18, 2020, from https://www.jpmorgan.com/global/research/coronavirus-impact

Juchem, T. (2020). *UEPG Year report 2019*. Retrieved from http://www.uepg.eu/uploads/Modules/Publications/uepg-annual-review-2018-2019.pdf

Kagioglou, M. (1998). *Generic Design and Construction Process Protocol*. Retrieved from https://researchportal.hw.ac.uk/en/publications/a-generic-guide-to-the-design-and-construction-process-protocol

Kampf, R., Majerčák, P., & Švagr, P. (2016). Primjena Break-Even Point analize. *Naše More*, *63*(3), 126–128. https://doi.org/10.17818/nm/2016/si9

Koren, J. R. (2017, November 19). Why builders of big L.A. projects are making concrete with gravel and sand shipped from Canada. Retrieved May 4, 2020, from https://www.latimes.com/business/la-fi-canadian-gravel-20171104-htmlstory.html

Laguna, A. (2019, May 7). Rising demand for sand calls for resource governance. Retrieved March 3, 2020, from https://www.unenvironment.org/news-and-stories/press-release/rising-demand-sand-calls-resource-governance

Lapitskiy, I. (2019, December 28). Germany GDP Growth Forecast 2019-2024 and up to 2060, Data and Charts. Retrieved May 2, 2020, from https://knoema.com/zhvaheb/germany-gdp-growth-forecast-2019-2024-and-up-to-2060-data-and-charts

Melting ice. (n.d.). Retrieved May 14, 2020, from http://promice.dk/MeltingIce.html

Miatto, A., Schandl, H., Fishman, T., & Tanikawa, H. (2016). *Global Patterns and Trends for Non-Metallic Minerals used for Construction*. Retrieved from https://onlinelibrary-wiley-com.esc-web.lib.cbs.dk:8443/doi/pdfdirect/10.1111/jiec.12471

Moldalieva, J. (2019, January 3). The search for sustainable sand extraction is beginning. Retrieved March 4, 2020, from https://www.unenvironment.org/news-and-stories/story/search-sustainable-sand-extraction-beginning

Nordqvist, C. (2018, July 22). What is an open market? Definition and... Retrieved May 2, 2020, from https://marketbusinessnews.com/financial-glossary/open-market/

Overeem, I., Hudson, B. D., Syvitski, J. P. M., Mikkelsen, A. B., Hasholt, B., van den Broeke, M. R., … Morlighem, M. (2017). Substantial export of suspended sediment to the global oceans from glacial erosion in Greenland. *Nature Geoscience*, *10*(11), 859–863. https://doi.org/10.1038/ngeo3046

Pedersen, B., Berthelsen, J., & Kviesgaard, M. (2019). *Grennland's Economy 2019*. Retrieved from https://naalakkersuisut.gl/~/media/Nanoq/Files/Attached%20Files/Finans/ENG/G%C3%98R%202019%20ENG.pdf

Penduzzi, P. (2014). *Sand, rarer than one thinks*. Retrieved from https://wedocs.unep.org/bitstream/handle/20.500.11822/8665/GEAS_Mar2014_Sand_Mining.pdf?sequence=3

Pickton, D. W., & Wright, S. (1998). What's swot in strategic analysis? *Wiley Online Library*, *7*(2), 101. Retrieved from https://onlinelibrary.wiley.com/doi/abs/10.1002/%28SICI%291099-1697%28199803/04%297%3A2%3C101%3A%3AAID-JSC332%3E3.0.CO%3B2-6

Politics in Greenland - Naalakkersuisut. (2018). Retrieved April 18, 2020, from https://naalakkersuisut.gl/en/About-government-of-greenland/About-Greenland/Politics-in-Greenland

Porter, M. E. (1979). How Competitive Forces Shape Strategy. *Harvard Business Review*, 1. Retrieved from https://hbr.org/1979/03/how-competitive-forces-shape-strategy

PWC. (2016). *Shifting patterns*. Retrieved from https://www.pwc.com/gx/en/transportation-logistics/pdf/the-future-of-the-logistics-industry.pdf

Rex, C. (2018). *Shipping market review*. Retrieved from https://www.shipfinance.dk/media/1817/shipping-market-review-may-2018.pdf

Saudners, M., Lewis, P., & Thornhill, A. (2015). *Research Methods for Business Students* (7th ed.). Harlow, United Kingdom: Pearson Education.

Sea Distances. (n.d.). Sea Distances. Retrieved May 13, 2020, from https://sea-distances.org/

Spielman, E. (2018, April 20). Direct Costs vs. Indirect Costs: Understanding Each. Retrieved May 11, 2020, from https://www.businessnewsdaily.com/5498-direct-costs-indirect-costs.html

Statistics Canada. (2019). *Infrastructure Economic Account, 2018*. Retrieved from https://www.statcan.gc.ca/n1/en/daily-quotidien/190411/dq190411a-eng.pdf?st=oWcJbqCQ

Survey, U. S. G. (2020). *Mineral Commodity Summaries 2020*. Reston, Virginia: Independently Published.

Sverdrup, H. U., Koca, D., & Schlyter, P. (2017). A Simple System Dynamics Model for the Global Production Rate of Sand, Gravel, Crushed Rock and Stone, Market Prices and Long-Term Supply Embedded into the WORLD6 Model. *BioPhysical Economics and Resource Quality*, *2*(2), 1–20. https://doi.org/10.1007/s41247-017-0023-2

Syvitski, J. P. M., & Saito, Y. (2007). Morphodynamics of deltas under the influence of humans. *Global and Planetary Change*, *57*(3–4), 261–282. https://doi.org/10.1016/j.gloplacha.2006.12.001

Sørensen, F. (2020, April 30). Email.

The World Bank. (2020). *Global Economic Prospects Slow Growth, Policy Challenges*. Retrieved from https://www.worldbank.org/en/publication/global-economic-prospects

Thomas, D., Matos, K., & Matos, G. (2014). Historical Statistics for Mineral and Material Commodities in the United States. Retrieved March 4, 2020, from https://www.usgs.gov/centers/nmic/historical-statistics-mineral-and-material-commodities-united-states

Torres, A., Liu, J., Brandt, J., & Lear, K. (2017, September 7). The world is facing a global sand crisis. Retrieved March 3, 2020, from https://theconversation.com/the-world-is-facing-a-global-sand-crisis-83557

UN environment programme. (2019, January 3). The search for sustainable sand extraction is beginning. Retrieved May 2, 2020, from https://www.unenvironment.org/news-and-stories/story/search-sustainable-sand-extraction-beginning

Ungku, F., & Latiff, R. (2019, July 3). Exclusive: In blow to Singapore's expansion, Malaysia bans sea sand exports. Retrieved March 5, 2020, from https://www.reuters.com/article/us-malaysia-singapore-sand-exclusive/exclusive-in-blow-to-singapores-expansion-malaysia-bans-sea-sand-exports-idUSKCN1TY0C4

Willett, J. C. (2020). *SAND AND GRAVEL (CONSTRUCTION)*. Retrieved from https://pubs.usgs.gov/periodicals/mcs2020/mcs2020-sand-gravel-construction.pdf

World Freigh Rates. (n.d.). World Freight Rates: 2020 freight estimates. Retrieved April 6, 2020, from https://worldfreightrates.com/

Yin, R. K. (1994). *Case Study Research: Design and Methods (Applied Social Research Methods)* (1st ed.). Thousand Oaks, California: SAGE Publications, Inc.

Appendices

Appendix 1 – First interview with Mette Bendixen

After an introduction to each other and talks of articles we begin asking Mette questions.

Daniel: "What do you specialize in and what is your research based on?"

Mette: "I have my PHD from the university of Copenhagen, the faculty of science, in physical geography. I am trained as a geomorphologist, which is someone who studies the landscape. I have been working with how the landscape in Greenland changes because of the climate change and I have been focusing on the coast as it is my area of expertise. In the arctic you see an erosion along many parts of the coast. As we know it from the coast in Jutland, the cliffs [in the Artic] are falling into the sea. No one really knew what happened to Greenland. It turns out that Greenland responds completely opposite to climate changes. Instead of an erosion of the coasts, they actually grow bigger, and that is simply because you have so much of the sand coming from the ice sheet. When the ice sheet melts, it runs through hundreds, if not thousands, of rivers throughout Greenland, and these rivers transport sediment, that being sand, gravel and clay particles. When more water melts, you have more energy to transport these materials and that is what is happening. I studied the coasts of Greenland from the Disco Island, the mid western Greenland, down south and all the way up to Tasiilaq on the east coast, a 3000 km stretch, where we identified 120 of deltas."

Daniel: "Could you specify deltas?"

Mette: "You have rivers running out through the landscape and into the sea, which is where they loose their energy, when the meet the waves. When the river transport looses its energy in the sea, it deposits the sediments. You have deltas all over the world and Greenland has hundreds, if not thousands of deltas, and I looked into how those change. Compared to the rest of the Arctic, you might think they would become smaller due to less sea ice allowing for more wave activity, but it was the exact opposite that happened. That is what we published."

Followed by graphical illustrations deltas in Greenland.

Mette: "The delta is where you have all the sand".

Daniel: “So basically, the deltas kind of create new land masses, which causes the expansions?

Mette: “Yes, and when studying this you want different time aspects, because you want to see how they change. We used historical aerial photos taken by the Americans during the second world war. After the war, they handed over aerial photos of Greenland to Denmark, and therefore I have been able to look at what the deltas looked like during the second world war and see how far they extended.”

Another graphical example is shown, illustrating how a delta has expanded since the war.

Silas: “This relates to another one of our questions. Will there be a constant flow of sand running out into the deltas?”

Mette: “Good question. Yes, a river will always transport sediment. The difference here is that you have the melting of the ice sheet, and as you know, the melting happens faster than it did just 20-30 years ago. It means that you have more energy, so more water is transported from the ice sheet to the coast. If climate change is going to continue, which seems likely, then, yes, you will have a continuous input of sediment. I explain it to journalists as a tap pouring out water, but also sediment. If you increase the volume of water coming out from the tap, more sediment will also be transported and the deltas will probably grow bigger.

Daniel: “It seems that this sand that is derived from this is perfect for producing for example cement in building and construction industries and the sand you find in deserts is too fine to be used for that?”

Mette: “It is not too fine, but you are touching upon some right stuff. Desert sand has two issues. Firstly, it is too rounded for building and construction. Imagine building with marbles, these completely round balls. It’s not super useful [for construction]. The other thing is that they have too much of the same size. When building with marbles, you want some small ones that can go in between the bigger ones and they have to be a bit angular so they can adhere better together.”

Silas: “So they sand particles have to vary in size?”

Mette: “Yes”

Mette went on to talk about companies operating with sand in Greenland

Mette: “There are two ships that dredge sand in Greenland at the moment. One is Greenlandic and one is from the Faroe Islands.”

She shows us the NY Times article and points to a ship dredging sand in the middle of a fjord.

Mette: “This is the guy who runs ‘Betoncentralen’ – Concrete central in Nuuk, he is called Nikolaj, he is in contact with the person called Mike, who has the one Greenlandic ship that dredges sand and here is the ship.”

Silas: “Can you tell us the names of the companies?”

Mette: “Yes, I will set you in contact with Mike and if you want, also with Nikolaj who runs the concrete central.”

Silas: “So to be clear, they are the ones who do the local dredging for local demands of sand in Greenland?”

Mette: “Yes, exactly. This is just for local purposes. The question is of how good quality the sand is, now we are talking geology, so some grains are more suitable than others. Do we have a material that is hard, because hard material for construction purposes. It has to be a material that doesn’t decay or erode over 20 years. I took some samples, when I was there, and they are in the lab right now. It will tell us what kind quality we have here.

Daniel: “That is related to one of our other questions, which is what kind of resources are actually available here.”

Mette: “So there is nothing available yet really [sources], it’s an idea we published a year ago and no one has done any work on it. Maybe GEOS, the Danish and geologic survey. They were asked by the Greenlandic government to create a report on the economy of this and the deadline for this was December last year. I can look into who can help with that.”

Silas: “So to get it clear, the applicability of the sand varies depending on where the sand is dredged from?”

Mette: “Yes, some sand is used for construction, concrete, and some is used for asphalt. That does vary. You don’t want to use sand of a too good quality that doesn’t need that good quality.”

Silas: “Do you know anything about the amount of sand used for construction that is potentially present in Greenland? How much is there?”

Mette: “So write that in the article that was published in Nature Sustainability, the one that is the background for the Reuters article you read. The site alone (Shown during the interview on screen), if I remember correctly, it produces as much sand as the entire Denmark uses in their gravel and sand pits, so it is enormous amounts. The Greenland rivers hold up to 10 percent of all sand in the worlds rivers. So it has huge potential.”

Daniel: “Just to move a bit back to the article that you wrote about how sand extraction affect ecosystems in a negative way, do you think the Greenlandic sand has potential to replace sand in the countries where over-extraction take place?”

Mette: “The world is at a point where we use more sand than is available and it means that a lot of the sand that is extracted in many parts of the world is extracted illegally, which has huge consequences for, not only the exact river or beach it is extracted from, but is also has consequences for surrounding areas. We touch a little bit upon it in the article ‘Time is running out for sand’. I have a colleague who just published another paper, which I will sent to you. It is a work he has done in Asia. It really shows the impact of dredging on these places. So yes, the idea was that Greenland could relieve some of the heavy extraction in other areas. It is a controversial subject. It is important for me to say that it is not up to me whether Greenland should do this or not. I am funded by public money, so when I come across this idea, I feel that I am obliged to share it and it is up to Greenland to decide whether they want to do it, and yes concrete is a huge CO2 emission, but we are still at a point where the world is needing concrete, so what are we going to do if we don’t have any substitutes. It is important to know how the Greenlanders feel about the idea and to include their voices too, because extracting sand will absolutely have implications on the environment.

Silas: “How bad are these implications?”

Mette: “Again, we don’t know as there is no research on it. What we published is not a classic scientific article, it was a perspective, an idea to stimulate discussion. As we mention

[in the paper], every natural resource exploitation comes with consequences, and so will sand extraction. It is more a matter of finding out what the consequences are so that people and government can decide if we are willing to take this risk.

Daniel: "While working on this, have you seen companies becoming more active on the matter in Greenland?"

Mette: "No, you have to obtain a license in order to extract the sand. You want to check with the guy from the concrete central, Nikolaj Mogensen, how that works. I would assume that he has to obtain licenses and then have the ships dredging for sand."

Silas: The consequences are yet to be discovered, right?

Mette: Yes.

Silas: What Daniel and I was talking about and what we have seen, is that draining beaches for sand may have a lot of consequences for the environment in other regions, however, the constant flow of sand which is pushed out to the fjords, will that result in a lesser likelihood in damaging the fjord in Greenland? Because you're taking something that is being replaced.

Mette: "That is a good question. Going back to the analogy of the tap of water, it will resupply, yes. The thing is that, this specific fjord that I showed you, which we were sailing through, I know that the surrounding areas are a very popular hunting ground. So, the constant flow of ships moving back and forth will have a damaging impact on that industry. So the consequences are not only environmental, in the sense of damaging fish in the area, it will also have an impact on industries that are active in the close vicinity (tourism, hunting and so forth). On the other hand, it is a field that Greenlanders have accumulated great skills in managing the dredging industry. It does not require that many people, but it requires maritime skills, which the Greenlanders have had for decades."

Daniel: "We saw similar effects in Norway, when the fishing industry became more prevalent and started to take up a lot of space in surrounding fjords."

Mette: "I think that is a valid point, I keep saying that there is no research which might make your research for the paper a little difficult, so an idea would be to use that as a comparison.

Since the case is somewhat similar between Norway and Greenland. Norway is just further ahead in time, it's of course a different type of extraction, but the complications are somewhat similar."

Silas: "at the end it is all about weighing up the benefits against the consequences."

Mette: "Exactly, and again we can't make that decision before we have all the data, which I guess you guys are trying to shine a light on from the aspects of economics, shipping and trade. Which I have very little experience within."

Daniel: "As we already discussed, there will be a constant flow of raw material that will reach the fjords, however, I have a feeling that in similar regards to fossil fuel, there will be an end to the stream at some point. I'm guessing that there is a limited timeframe for how long the sand flow will last. So in relation to the sand extraction industry, there will be over extraction at some point?"

Mette: "Well yes, but all the sand that flows down from the glacier is deposited in hotspots, which delivers enormous amounts of cement, which means that the sand extraction industry will not have to reach out to all of the areas where sand extraction is available, because reaching out to every spot for small sand extraction will not be feasible at all. There are locations that contains so much sand that the extraction industry should focus on a few places, so that you won't have sand dredging industries in all of Greenland. Therefore, the sand dredging industry won't impact that many areas of Greenland. You do however have a lot of limitations, there is ice on the water sometimes, where approximately twenty days throughout the year where you can't work because of it. Another limitation is the water depth is very shallow, so a question of how big ships can you actually get close to the sand deposits. Another limitation is that you want way bigger boats to achieve the level of extraction that is potentially possible and since the upper level of material is not usable, since you want courser grains of sand, which sets a limit to if you can do it or not in relation to technology and the area of extraction.

In regard to time limitation, sand might not be as valuable today, as it might be in 10 to 20 to 30 years. Since sand is a cheap commodity today. However, as the demand rises in the future, so will the price. Therefore, it might not be wise to establish an industry today, instead maybe in three or five years or even further in the future."

Silas: “That’s exactly what we will look at.”

Daniel: “When we looking into the company that focused on the extraction and creating of titanium and other minerals, I only wondered if these types of material might also be available in the sand hotspots we were talking about?”

Mette: “We will know more when the results from the test samples arrive which are currently in the lab. These samples looked what kind of mineralogy the sand consists of. If the sand contains a lot of valuable minerals, that you don’t want to use it in concrete making and instead extract the minerals and use them to create computers or other tech, which is a lot more valuable, since the computer industry uses sand as well. So it really comes down to what kind of quality the sand holds, and where can we utilize it most efficiently.”

Appendix 2 – Correspondence with Dr. Harald Elsner

In regards to the article, we have a couple of questions related to some of your statements. The first question is in relation to "Elsner believes that in the future, too, the price for sand and gravel will rise by 5% to 10% annually" Do you have a more concrete estimation to when you believe this will occur?

We have just prepared a short report (not published yet) on gravel production in Germany and also checked for current prices. All companies and organisations told us that the prices have risen and are rising 5 – 10 %pa. However, keep in mind that there is nor average price for sand or gravel in Germany or Denmark, but that prices may differ several 100 % from region to region!

The second question is in relation to this statement: "There are some problems in some regions in Africa and Asia," Do you have any insights of the potential for Greenland or other nations further away from these continents regarding the export of sand and gravel to these areas when considering further infrastructure development? Would it be profitable for nations such as Greenland to reach out to these markets in the future or will the distance always be an issue?

I know of these discussions of export possibilities of sand and gravel from e.g. Greenland to other markets. I was very skeptical in the past, but prices in other regions may be much higher than in Europe. I was told that sand in Singapore is about 100 USD/t. So why not exporting sand from Greenland to Singapore – but only if you can stand the pressure of the (international) environmentalists and believe me, you cannot in a democracy!

Our last question in relation to the article is related to: "It's no longer like in the old days when you would get enough sand and gravel for your building project just like that, says Elsner, pointing out that nowadays you can easily wait for several weeks until you get the amount you need." It is estimated that it would take two weeks for a ship to reach Germany from Greenland. Do you believe there is some potential for the Greenland industry to have an effect on the European market?

No, the European building material markets are totally independent from any potential new supply from Greenland!

Appendix 3 - Interview with Mike Høegh - Audio file attached

Appendix 4 – Second interview with Mette Bendixen

Daniel: “Thank you again for the research papers that you provided us; they have been of great help.”

Mette: I am glad that you found them useful and I hope they will be of further use, when you guys have come further along with the research.”

Daniel: “Regarding the paper named “Promises and perils of sand exploitation in Greenland” we saw that there is a couple of graphs presented on page 5. Do you remember what those are based on?”

Mette: “Do you mean what their source is?”

Daniel: “Yes.”

Mette: “I think the source should be provided, but if I remember correctly, it is a study done by Sverdrup. You fill find the full source in the references section of the paper.”

Daniel: “Okay, thank you.”

Silas: “Yes, again, thank you so much for the papers you provided. I also remember from our last meeting you mentioned some test you did on the sand quality. Have you received the results from them?”

Mette: “Yes, they just recently came back from the laboratory. They showed some interesting results, some that might not be to promising for what you guys are trying to research. The samples seem to contain a significant amount of Feldspar.

Silas: “I’m not sure what Feldspar is.”

Mette: “Yeah, that is understandable. Feldspar is a material sometimes found in rock formations that has a more rapid degrading property compared to other types of rocks. This means it is not very well suited for construction purposes. It is important to note that only 2 test where done from one specific delta. So further research needs to be done before a definite answer can be provided.”

Silas: “That is less promising, but as you said, more samples needs to be taken. Is there any kind of use for Feldspar? I mean, can it be used in other markets?”

Mette: “Yes, while it is not optimal for construction due to it reducing the potential lifespan of the structures, it can be used for renurshishment of beaches for instance. Which means that it can provide structural integrity to foundations of the beaches, if they are experiencing damages from environmental shocks.”

Daniel: “Alright. We were also looking into the fracking industry; do you think that type of sand could be used for that purpose?”

Mette: “No, the fracking industry uses sand that is more shock resisted and durable. Where the pebbles are more rounded in their form and are of similar sizes. The sand that has been discovered in Greenland has so far been shown to be rugged in their form and are of different sizes as well. So, based on the findings that has been done so far, it seems that the sand that Greenland contains will not be suitable for fracking.”

Daniel: “Okay, so I guess it should not be a priority to consider fracking a viable option for further research?”

Mette: “Well, the current research that we have done, shows that it is not a viable option, so perhaps focus on other avenues.”

Silas: “Yes, I do not think it was our main priority to begin with either, but have you experiences other findings for the sand that is available in Greenland?”

Mette: Yes, due to our partnership with Mike Høegh has provided us with some interesting insight. It seems that the deeper you go in the sea bedding, the larger the sand grain. You could say that on the top of the sea bed, you find Silt, followed by smaller rocks and then larger rocks. This is basically following the laws of physics.”

Daniel: “That makes sense.”

Silas: “I think that was all the questions we had, do you have anything to add, Daniel?”

Daniel: “No, I believe that was all. Thank you so much for taking another meeting with us Mette”

Silas: “Yes, thank you, it has been very insightful!”

Mette: “I am glad that it was helpful. If you guys have any further questions, you are more then welcome to send me them on E-mail”.

Appendix 5 – Correspondence with Frederik Sørensen from Dansk Kvarts Industri

Silas:

Hej Frederik,

Som lovet kommer her nogle spørgsmål, som vi håber du kan hjælpe med.

Som sagt undersøger vi potentialet for at indvinde sand i Grønland og eksportere det til udlandet. Typen af sand vi fokuserer på er sand til infrastruktur og konstruktion osv. Grundet de høje omkostninger til fragt har vi indskærpet vores fokusområde til Nordatlanten, dvs. den Nordamerikanske østkyst og Europa. En afgørende faktor er konkurrence-niveauet i de områder. I eksporterer jo selv sand med skibsfragt som mulighed. Derfor tænker vi at I nok har kendskab til den konkurrence, der er, i hvert fald i det Europæiske område. Har du et bud på nedenstående spørgsmål?

Meget teoretisk set, findes der 2 slags sand/grus grave – den billige og den dyre.

Den ene fodrer en power screener, som grov sortere 3-5 forskellige størrelses intervaller. Disse bliver som realt købt i bulk – hele læs, dette er ”den billige” .

Den anden starter med at fodre en power screener som sortere sten fra, sender sandet videre til et vaskeri, som vasker alt organisk materiale af. Videre til en tørre tromle, derefter ned i en køle tromle. Herefter bliver det fin sorteret. Herefter sækket op, fyldt i bigbags eller i silo biler. Dette bliver købt som stykgods op til hele læs ”Den dyre”.

Hvordan ser det ’competitive’ landskab ud i Europa og hvis du har kendskab til det, i det Nordatlantiske område? Er der forholdsvis mange udbydere til den ’market share’ der er, og er virksomhederne forholdsvis ens i størrelse eller er der få store virksomheder, der dominerer?

Frederik: Jeg vil mene det er konkurrence dygtigt, da grusgrave er meget ”lokalt” på europæisk plan. Når mineralet er så billigt som det er, bliver det ikke importeret eller exporteret lang vejs fra.
I Danmark er vi 3 virksomheder, som sælger det vi kalder kvartssand, der er vasket og ovntørret. Dansk Kvarts Industri A/S, Dansand A/S og NCC. Dansand er de største. Men hvordan andelen er fordelt, kan jeg ikke svare på. Herudover er der mange mindre grusgrave.
I Europa måske også verden er den største spiller Sibelco, en belgisk koncern. Som har en finger i stort set alt i Europa i alle brancher der har med sand at gøre.

Silas: Er ’the market share’ hurtigt voksende i områderne og er der efter din vurdering plads til ’new entrants’ (nye virksomheder)? Eller vil nye virksomheder hurtigt blive fejet til side? Prøver virksomheder i høj grad at differentiere sig fra hinanden?

Frederik: Market Share, har været voksende de seneste år i Danmark, men andelene af market share tror jeg er fordelt i forhold til størrelserne af virksomhederne.
Der er altid plads til en ny spiller, dog er det et marked der er svært at bryde komme ind i, da det kræver noget startkapital – jord, maskiner osv., og samtidig skal finde kunder i meget konservativt marked – ”der vil have, hvad de plejer at få” der mange gange er etableret et sted, derfor loyale til et punkt.
Virksomhederne er ens på mange punkter, de eneste differencepunkter jeg kan se i forhold til byggeindustrien er: priser, fleksibiliteten omkring produkterne, produktionstid.

Silas: I forhold til jeres kunder, hvordan vil du vurdere deres ’power’ ift. sandudbydere? Er der mange kunder eller få, måske store? Hvor vigtige er I for dem ift. hvor vigtige de er for jer? Det handler lidt om hvem der har den største ’magt’ her. Vil de hurtigt kunne skifte udbyder, hvis prisen ændrer sig en smule?

Frederik: Der er rigtig mange kunder, fra helt små, til mellem størrelse og op til stor. Vi er vigtige for hinanden, kunderne har behov for sand og vi har behov for at sælge vores vare. Kunderne har ”altid magten”, når der eksisterer andre leverandører.
Ja, kunderne kan hurtigt skifte leverandør, men det kommer dog an på størrelsen af kunden, den nye leverandør skal kunne producere til deres behov, og det er ikke altid en realitet.

Silas: Det var vores spørgsmål omkring konkurrencen. Som sagt undersøger vi også nogle andre faktorer, deriblandt styrker og svagheder, som en virksomhed skal have/undgå. I forhold til det, hvilke kompetencer for en virksomhed ser du som kritiske for succes som sand 'extracter' og 'exporter'? Er der nogen specifikke egenskaber du mener giver en 'competitive advantage'?

Frederik: Konkurrencedygtige priser, produktion der skal kunne følge med efterspørgslen, fleksibilitet i produktionen. Vigtigst nok- varerne skal sælges.

Silas: På samme måde, hvilke svagheder/problemer er vigtigst at undgå?

Frederik: Produktionen – hvis ikke den kan følge med. Have styr på grave regler osv.

Silas: Det kan også være adgang til logistik eller adgang til specielle resurser.
Til sidst undersøger vi også en model for at estimere et potentielt 'break-even point' for en mulig investering. Vi har ret godt styr på hvilken slags investeringer i udstyr og lignende der kræves, samt variable omkostninger. Vores problem er hvad disse vil løbe op til. Har du et bud på hvad såkaldte 'fixed costs' og 'variable costs' vil være? Det skal naturligvis ikke være en kompliceret udregning for dig. Det er mere hvis du på stående fod har et bud på om det vil blive 1, 5, 10, 50 eller 100 mio. kr for fixed costs. Det vigtigste er de variable omkostninger til løn osv. Har du et nogenlunde overslag på det?
Vi forstår naturligvis hvis det er umuligt at lave en realistisk vurdering af disse.

Frederik: Alt det udstyr i skal bruge, render hurtigt op i 100 mil . Ydermere er lokationen meget hård ved maskineriet både i form af salt fra vandet – vind og vejr. Men samtidig kulen, som vil gør det meget dyrt at tørre sandet.

Silas: Vores sidste spørgsmål vedrører priserne på sand som I og konkurrenter sælger til. Er der en platform eller en side, hvor disse kan findes? Eller er der en nogenlunde standardpris på sand til konstruktion og infrastruktur, som du kan anbefale os at bruge?

Frederik: Der findes ikke nogen platform jeg kender til. Vi ligger i den dyre ende, da sandet er bearbejdet, og vi har et højt indhold af kvarts.

Ligger mellem 250-500 kr. pr. ton løs, dette kommer an på korn størrelserne. Det knap så forarbejdet sand, kan købes helt ned til 50 kr. pr. ton løs.

Det er svært at specificere en standard pris, da sand næsten bliver brugt i alle dele af byggerier – fundamentet, beton/mørtel, fugerne, sandblæsning osv.

Min vurdering i forhold til hvad vi sælger vil ligge omkring en 300-400 dkk pr. ton eksklusiv alt.

Appendix 6 – Profitability estimations in excel

	cy per $	percent	mt per $	Greenland	
Direct cost	709453,3	78 %	1064180	287367,4749	
Indirect cost	195979,71	22 %	293969,6	79382,5251	
Total cost	905433,01	100 %	1358150	366750	
unit cost	1,63		2,45		
per month	Hamburg	Plymouth	Boston		
Freight cost	4600000	4700000	37000000		
Truck cost	1300000	1300000	1300000		
			Hamburg	Plymouth	Boston
	Years	5% growth	15,2067	16,1354	47,3487
		10% growth	7,78445	8,6241	27,4518