Master's degree thesis

LOG950 Logistics

Salfjord AS: A qualitative case study about the competitive advantages from Tjeldbergodden

Anders Eielsen & Sharmila Thapa Magar

Number of pages including this page: 96

Molde, 24.05.2019

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Acknowledgements

On the outset of this thesis, we would like to express our gratitude towards all the personage who has helped us by providing guidance, cooperation and encouragement to complete it.

We would also like to convey our gratitude to our supervisor prof. Åsmund Olstad for his keen interest, unfailing support, feedback, guidance and patience to accomplish this thesis.

We are also thankful for the cooperation from the general manager of *Salfjord AS* for providing the required information required to complete this thesis.
Last but not the least we would like to thank everyone who along the way believed in us and assisted us in any way, shape or form.

ABSTRACT

The aim of this thesis is to give an overview of Salfjord AS current situation, their competitive advantages, their goals, plans and ambitions for the future. This study uses logistics, supply-chain management and marketing theories to argue and discuss the options and possibilities available to Salfjord while using research methodology theories to ground or study and give it validity. This study also includes estimates, projections and cost analyses to quantify Salfjord's advantages and make examples to represent their values. The study touches on topics like sustainable aquaculture, the benefits and drawbacks of Landbased closed containment systems, RAS technology and ocean based ONP fish farming. The study then concludes by summarizing the analyses done throughout the study and lists the different cost-reductions and value generated by Salfjord's clever choice of establishing themselves at Tjeldbergodden.

ABBREVIATION GUIDE

BMP	Best Management Practice
CC	Closed containment (A farming method where the pens are closed off from the surrounding environment
CEO	Chief executive officer. (Person in charge of company.)
GWh	Gigawatt hours. (A unit of energy. Equal to 1000 mWh or 1 000 000 kWh.)
FAO	Food and agriculture organization
HOG	Head-on-gutted (A state in which the fish has been processed and readied for end-customer consumption. This reduces the total biomass of the product by roughly 20% after it has been processed.)
kWh	Kilowatt hours (A basic unit of energy.)
LB	Land based. (A fish farming method conducted on land instead of in the ocean.)
MT	Metric tons. (A unit of measuring weight. Equal to 1000 kg.)
Mwh	Megawatt hours. (A unit of energy. Equal to 1000 kWh.)
ONP	Open net pen (The traditional method of farming fish in the ocean with nets and pens.)
RAS	Recirculation aquaculture systems. (Reuse up to 98% of water, reduces reliance on access to fresh water sources.)
RQ	Research question.
SSB	Norwegian bureau of statistics. (A collection of empirical data gathered in Norway)
TBU	Tjeldbergodden Development (Owners and managers of Tjeldbergodden.)
TWh	Terawatt hours (Unit of energy. Equal to 1000 GWh or 1 000 000 000 kWh.)

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1.0 Introduction

1.1 Background of the research

"Aquaculture can be defined as human cultivation of sea organisms. This can be done at various levels of intensity. In intensive farming, such as of salmon, fish are reared in pens and cages and the farmer controls factors of production such as farm size, stocking and feeding of fish." (T. Bjorndal, 2002)

Salfjord AS is an ongoing project which is designing and building an oceanfront salmon farm next to Equinor methanol plant at Tjeldbergodden. Before moving on to Salfjord we will be discussing little about the history of fish farming in Norway.

The fish farming industry in Norway started in the 1960s and have its roots as a supplementary action to increase the availability and ease of access to Salmon. Norway's sheltered fjords, stable environments and hardy species of Salmon coupled with investments and support from the Norwegian government can all be attributed to the success and growth of the fish farming industry in Norway. The industry itself has been expanding and flourished since its inception and have had a steady growth rate ever since. According to a source on aquaculture industry (T.Bjorndal, 2002) the average annual growth rate was as high as 47% during the period of 1980-1990.

On a global scale, wild fish capture started stagnating in the 1990s hitting a ceiling value of **93 million** MT of fish captured annually while aquaculture production have seen a steady growth since the 1970s. Aquaculture production produced 42 million tons of fish worldwide in 2004 and have since doubled with a reported 80 million tons in 2016 with a prognostication that aquaculture production will generate more fish than wild fish capture as early as 2020 according to the (FAO)Food and Agriculture Organization of the UN.

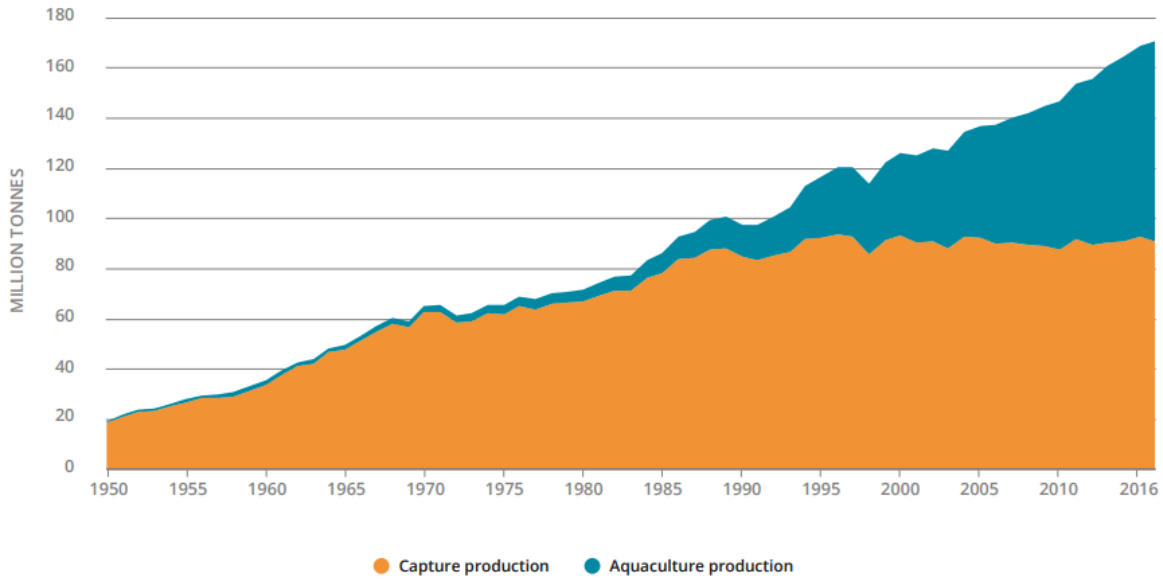

Figure 1: Global rate of wild fish capture and aquaculture production. (DNB, 2017)

Shown in the graph above is the aquaculture production contrasted with wild capture production in the period between 1950 and 2016. One can observe from the graph that the aquaculture production is increasing at a steady pace without any hints of slowing down as opposed to wild capture production which have been stable since 1995. A notable factor in the steady increase in aquaculture production is the increased production from the China. China experienced their consumption rate of fish increase to 35,1 kg per capita in 2010 which led to a sharp increase in demand that spurred on increased investment in the Chinese aquaculture production (Tvete, 2016). China is a global powerhouse in the aquaculture market and is responsible for roughly 62% of the global aquaculture production of finfish and shellfish. (Manci, 2014) Norway is the world's leading producer of Atlantic salmon and one of the largest seafood exporters in the world. (Eurofish, 2018)

"Today, the aquaculture industry has reached the size and maturity where business can no longer be run efficiently merely by employing the ways and means that have been successful in the past. Moreover, during the last couple of years the Norwegian world market share have diminished, in large part due to competition from other countries like Chile, which has a strong and expanding aquaculture industry. The industry is confronted with a series of new challenges. The strong demand experienced by the industry since its inception is no longer outpacing supply. The firms are increasingly exposed to price

pressures. At the same time, customer demands are becoming more differentiated, and not easily addressed by all aquaculture firms" (Aslesen, H.W, 2007)

The business side of fish farming is now more relevant than ever and it is going to be even more so going forward, with customer demands becoming more complex and multi-faceted. For a business to thrive in such a market it is important for them to adapt and to focus on properly managing their supply chain as well as their choice in strategy.

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1.2 The importance of the research

As a newly founded company, Salfjord AS which is the focus of our case study, is in a position to become Norway's biggest land based fish farm with a current expected maximum annual production of 36 500 MT of salmon annually. Salfjord is going to have to leverage their supply chain, their strategies and the competitive advantages they possess with great care if they are to succeed in penetrating the competitive global market.
Being successful in generating value is something that is more relevant than ever due to the ever-increasing difficulty as an intruder on the global market in regards to already well-established competition and customer demands. A motivating factor for our thesis is our wish to research Salfjord's unique situation while applying supply chain management, marketing and logistics theories to explain their position, their choices and the options available to them going forward. It is within our aspirations that other researchers might use our thesis as a stepping stone for providing practical examples of logistics, marketing and supply chain management concepts as well as first-hand examples of concrete competitive advantages. The goal of our thesis is to give the reader a comprehensive understanding of Salfjord's goals, strategies, ambitions and an overview of their situation.

1.3 Problem formulation

The purpose of our study is to provide a better understanding of Salfjord's situation and how it plans to succeed in the coming future. Thus, the main research questions for our master's thesis is:

What is Salfjord's AS general strategies?
What unique competitive advantages do Salfjord AS possess?
How does Salfjord's supply chain generate value?
Is Salfjord's operations ethical?

These research questions are further detailed in Research Methodology in the next chapter.

1.4 Limitations

Our monograph is deliberately limited to focusing on one company at one geographical area in order to limit the scope as much as possible. This was done to make our thesis as specialized as possible in order to keep things simple and interesting.

Salfjord AS was chosen as they have presented themselves as an object of study to Molde University College. Salfjord AS is a newly started company that is still in the planning phase of development with their entire operation being based on estimates, market research, projections and partnerships. Money have been invested into land development where the fish farm is going to be located and work is ongoing to make the farm operational by 2023 at the earliest estimate. Due to fish farm not being built yet we don't have access to historical data from Salfjord AS and thus the numbers within our study will be based on their estimates, projections and their calculated values given to us by the company owner upon request. Averages used in comparative situations are mostly taken from other research papers and the Norwegian bureau of statistics (SSB).

As the facilities doesn't exist yet we haven't had the chance to visit the farm itself but we've had interviews with the general manager of Salfjord AS, a similar company known as Salmon evolution, with AGA whom is positioned to be Salfjord AS' oxygen supplier and Skretting whom is one of many potential feed suppliers. Our study is also limited by the fact that the general manager of Salfjord AS has invested a non-negligible sum of

finances into market research as a part of their project and as such isn't comfortable divulging specific numbers as the information itself has market value. We came to an agreement to instead give us ballpark numbers, projections and estimates to work with. We acknowledge that this reduces both our ability to do quantitative analyses and reduces the accuracy of our data and findings somewhat.

2.0 Research Methodology

Research methodology simply refers to the different methods of performing research and this chapter will describe the methodologies commonly used and those utilized in our master's thesis.

2.1 Research objective

Wacker (1998) describes two objectives of research which changes based on the goals of said research. The first is to gather and compile facts while categorizing data accordingly and the second objective is theory building where the objective is to search for systematic similarities between data and data-points with the intent to connect them. The first objective is research that uses data as evidence to make theoretical predictions while the second objective focuses on making predictions before evidence is gathered through the use of similarities in already existing or proven data and data-points.

2.1.1 Research Strategy

Bryman and Bell (2015) outlines two different strategies for researching; Quantitative and qualitative research, the former includes quantification in the collection and analysis of data while the latter strategy is more concerned with descriptive details and explanations.

In addition to the two strategies there are two ways of approaching the relationship between research and theory; deductive and inductive research. Deductive research, as the namesake implies, is about deducing theoretical hypotheses and testing them through empirical means as a way of doing research. Inductive research is about taking the researcher's findings and observations and making them the groundwork for creating new theories and hypotheses. (Bryman and Bell, 2015)

Our thesis is predominantly a qualitative one as our numbers are limited as described in chapter 1.4: Limitations.
Our master's thesis was originally meant to be a quantitative one when we started our venture into the research. It was within our scope to gather data from several sources, compare them against each other to create observations to analyze but there were several setbacks which stopped our research from getting off the ground.

After interviewing several different fish farms, we found ourselves lacking in data and information due to the problematic and restrictive nature of requesting private market research and information from private corporations and companies. We were optimistic at first due to some companies we contacted being both helpful and optimistic to our cause, which we described as a master's thesis about land based fish farming, but due to several delays and setbacks on the companies' side we never got concrete empirical data to analyze. We were left with little first-hand data and so we slowly shifted our thesis focus from a quantitative perspective to a qualitative one. During the process of shifting the content of our master's thesis we also decided to narrow down our focus and scope as much as possibly in order to lessen our workload while making relevant data-gathering much simpler. As a result of narrowing our scope, the goal of our master's thesis changed alongside and can now be described as; "research Salfjord AS' advantages and situation and make theories and hypotheses from the data we can get from them."
This falls in line with the theory described earlier and makes our thesis qualify as a qualitative and inductive.

2.1.2 Research Design

"Colloquially, a research design is an action plan for getting from here to there, where here may be defined as the initial set of questions to be answered, and there is some set of conclusions (answers) about these questions." Yin (2003)

There are several different types of research designs outlined by Bryman and Bell (2015) with the emphasis on 5 different types that are commonly used in social research;

- Experimental design
- Cross-sectional design
- Longitudinal design
- Case study design

- Competitive design

For the purpose of our thesis we decided that the path for us would be to choose a case study design for our research in the spirit of simplifying our master's thesis. Thus, we found it prudent to go a bit more into detail on our choice of research design; the case study.

Case study

"What can you learn from a case, given it is just one case?" (Morgan, 2018)

There are several complications and barriers to conducting a case study as a method of research; it takes a large amount of time, it puts a big requirement of skill from the ones conducting the research, it requires first-hand information and the carefulness to not generalize and reduce the specificity of data as you most only have a few cases to work with. As our case is a significantly small one with only 1 person in charge of all of Salfjord's activities and decisions, it will be easier for us to get a complete overview of Salfjord AS's situation, including goals, strategies, resources and ambitions. While the opinions and insights we might glean from our interviews with Salfjord might be subject to small sample size bias, we still believe them to be highly relevant as they belong to the leading figure of the company and thus decides the company's direction going forward.

An important distinction when designing case studies is between single- and multiple-case designs.

Single case study

A single-case study involves a detailed and rigorous analysis of a single case. A case can be a single organization, a single location, a single person or even as small as a single event. (Bryman and Bell 2015) If the case study analyzes the case on a global scale it is called *a holistic case study.* On the other hand, if the same case study includes more than one unit of analysis and the focus is shifted to subunits, the research design would be called *embedded case study.* Bryman and Bell (2015) mentioned that one of the major pitfalls with embedded case studies happens when the study focuses on the subunit level and forgets to include the larger unit of analysis.

Multiple-case study

Multiple-case studies, as the name suggests, contains more than a singular case. This form of research-design has many challenges and benefits associated with it compared to the single-case studies. The amount of data from multiple sources are often considered more decisive as evidence and the overall case analysis is considered stronger than the single-case brethren. One of the challenges associated with a multiple-case study design however is the tremendous amount of time and resources that needs to be invested. A very important way to define a multiple-case study is to treat them as multiple experiments that follow a *replication* logic. That is to say that once one of the cases yield a result, steps are taken to achieve the same result by the same means in other cases as well in order to prove correlation or the lack thereof. Once data has been gathered from all the different cases involved in the multiple-case study, an individual report is made for each of the cases and compared in order to draw conclusions across all the cases. (Yin 2003)

2.1.3 Research Method

A research method is a collection of techniques and methods for gathering data and information through documentation, archives, interviews, observations or physical artifacts. (Yin, 2003) In our thesis the main source of information and data comes from interviews with Salfjord's general manager and founder. As mentioned in Patton (1990) having most of your data come from a single source and method might create some data triangulation challenges. Patton (1990) discusses four different types of triangulations when evaluating data, triangulation being the act of gathering data based on comparisons between research and existing data-points. Data triangulation is the method of using multiple sources of data to support a conclusion or finding, similarly investigator-, theory- and methodological triangulation is similar in the sense that one uses multiple sources of investigators, theories or even multiple methods to support a conclusion.
Our main source of evidence and data all comes from interviews with **[**one person within a single company / Interviews with Salfjord and Salmon evolution**]** which reduces the strength and validity of the data as proof, but wherever possible we also use external sources of evidence, represented by articles, reports, studies and statistical archives to triangulate data as best as possible.

2.1.4 Interview design

Gall, Gall and Borg (2003) mentions that the most important source of case study information is the interview method. Case study interviews are often open-ended by nature which allows for the researcher and the source to communicate more than just data. Interviews are often flexible and can give access to facts as well as personal opinions and insights that might otherwise not fall within the scope of the more rigorous methods of data-gathering.

Gall et al. (2003) as well as McNamara (2009) specifies four formats for interview design:

Informal conversational interview

In the informal conversational Interview, the researcher generally does not ask specific types of questions, but rather uses spontaneous generation of questions and interacts with the participant by responding and reacting to their answers, often with the intent to guide the interview process.

Semi-structured Interview

The semi-structured interview is more structured than the informal design but it still leaves a bit of flexibility since the researcher is allowed to ask- or change questions based on participant response. The purpose of this interview design is to make sure that the general areas of data are gathered from each interviewee. It provides a more focused angle to the casual conversational approach while still allowing freedom and adaptability in data gathering.

Standardized Open-ended interview

Standardized interviews ensure that all participants in the interview are asked identical questions to ensure all participants have the same framework for answering, but the questions itself are often worded in a way so that the responses themselves can be flexible and open-ended.
This interview design is the most popular one often seen in formal environments and research studies because of the open-ended factor that allows participants to express themselves freely. While being standardized, the open-ended nature gives the researcher some challenges when it comes to code the data from the answers for triangulation purposes.

Closed fixed-response Interview

The closed fixed-response interview is the least flexible design choice in where all interviewees are asked the same questions and asked to choose from among a predetermined set of answers to represent them or their stance on a topic.

According to information presented in Gall et al. (2003) and McNamara (2009) we believe the most appropriate type of interview to our single-case study is the informal conversational interview design. We chose this design due to the easygoing nature of the interview target coupled with the lack of sample size to interview. While a structured interview would be a strength while interviewing a large sample size as it would ensure coherency and reduce potential variance in answers, the restrictive nature would be a weakness when faced with the smaller sample sizes as it might make the interviewee feel less obliged to talk about out-of-topic data and opinions. The informal conversational interviews we have had with Salfjord has given us much insight into Salfjords ambitions, opinions, goals and general stance on challenges in today's aquaculture stage, which might have been lost had we chosen to go with a more rigid interview guide.

The usage of the informal conversational interview allows for a better flow of conversation to happen more organically and might uncover problems not necessarily considered by the researchers beforehand.

2.2 Research Problem and Research questions

Yin (2003) outlines that the arguably most important part of a research study is to define and conceptualize the research questions. These questions are required to have both substance (The topic of the study) and form (The "who", "where", "how", or "why"). Together the research questions should result in an answer to the research problem statements.

The research question themselves pose as the core reasons behind what questions are being asked and what information are being sought after. A natural cause of action is to gradually change the questions, either by reformulating them, removing them or adding

new ones as new data is being discovered, which either opens up new tangents to the topic or reduces the scope of the study by making it more focused. (Bryman and Bell, 2015)

After two interviews our final problem statements for our master's thesis were this:

What differentiates Salfjord AS from its competition and how do they intend to generate value from their supply-chain management?

To answer the problem statement, we formulated a few questions that will help us:

Research question 1 (RQ1): What strategies are available to Salfjord?
Research question 2 (RQ2): What unique competitive advantages do Salfjord AS possess?
Research question 3 (RQ3): How does Salfjord's supply chain generate value?
Research question 4 (RQ4): Is Salfjord's operations considered ethical?

2.3 Data gathering

Mentioned earlier in chapter 2 is that we gathered our data predominantly through interviews with Salfjord's general manager. In this chapter we will elaborate further on the details regarding this.

2.3.1 Phone and email contact

The beginning of our contact with Salfjord started with our proposal, which have since changed completely, where Salfjord had volunteered to provide information and a few example proposal topics for the interested. We contacted them via email on October 22th to get a rough overview of their situation and information on their feed plans so far and we got invited to sit in on a meeting between them and Skretting, their feed provider. After a back and forth email chain with the general manager of Salfjord, he made it clear that he preferred to discuss information over the phone whenever possible, a request that we decided to honor to the best of our abilities, and so most of our interviews are recorded during phone conversations.

The first major interview with Salfjord was held over the phone on March 13th. The interview guide can be found in **Appendix B** and includes the general line of questions that we had planned to ask of the respondent to get a more in depth understanding of Salfjord as a whole. After that we mocked up interview guides for the other interviews as we planned them.
Questions included topics like investments, costs, products, suppliers, partners, proactive plans, reactive plans, ambitions going forward, possibilities of integration and their stance on certain topics in the aquaculture field. As we performed the interview in an informal conversational manner as described in chapter 2.1.4, we got a lot more insights and opinions than we thought we would at the start of the interview as Salfjord's general manager was eager to help us to the best of his abilities within reason. The informal nature however caused us to deviate a lot from the interview guide we planned, and caused us to spend a lot of our time talking, discussing and responding to information outside the planned questions presented in the interview guide found in Appendix B.

2.3.2 Recording and transcribing

By utilizing tools like ACR, a call recording app, we were able to ensure that we wouldn't lose any parts of the interview due to common errors while multitasking. We asked if we were allowed to record the interview to which the Salfjord's general manager had no objections and gave his permission. He was however hesitant to give out any finer details and data with market value as he has not decided to sign any confidentiality agreements between us and the Molde community college. Salfjord's general manager asked us if he could be allowed to read our thesis before publishing it in order to ensure we were representing them fairly and without error, and we agreed to those terms.

As touched upon earlier, there are many advantages to recording and transcribing interviews as it reduces the pressure and strain on the interviewer.
It allows for less energy and mental capacity to be spent on remembering content and context and it allows for more focus to be spent on examining what is being said and replying to the interviewee's information, reactions and insights. (Bryman and Bell, 2015)
As reviewers we also agree that reducing the stress during an interview and allowing us to

give the interviewee our undivided attention would allow us to conduct the interview at a better quality than if we had to take notes manually.

This was the first time any of us ever had to write a transcript from an extended interview and we were both surprised at how much time and energy the transcription process required. Roulston, Lewis and deMarrais (2003) have conducted research on the topic of transcriptions citing that first-time interviewers often underestimate the sheer amount of work that is needed. As the entirety of all our interviews were conducted in Norwegian because our interviewees were more comfortable talking in his native tongue, it also fell on us to translate the entirety of the transcript to English. It is recommended by Bryman and Bell (2005) to allocate six hours of time to transcribe an hour of speech, something we found agreeable as all of our interviews were transcribed and translated by us by hand.

2.4 Limitations

We conducted the majority of our interviews over the phone during the course of this study. There are five challenges associated when one conducts the first interview(s) according to Roulston, et al. (2003) and we found ourselves challenged by quite a few of them. We observed that it was hard to follow the structured line of questioning with the informal method of interviewing, we found some of our questions that we had deemed relevant prior to the interview, show that they were in fact irrelevant during our review of our findings and we found a few contradictions after reviewing the records of the interviews which made us require follow-up interviews to clarify.

Conducting the interview over the phone also comes with its own sets of challenges as we got to observe; Frequent communication disruptions caused by both interviewer and interviewee talking at the same time unintentionally due to lack of non-verbal and visual cues to indicate the intention to speak. There were periods of low reception where the quality of conversation could drop suddenly and significantly. It was observed that both interviewer and interviewee were more prone to distractions and it was hard to indicate and signal when it was appropriate for the other part to stop talking.

There are also a few limitations in regards to the transcription. As noted earlier, the entirety of the interview was held in Norwegian and then transcribed to English for the

ease of use. Since none of us are native English speakers there might be errors in the translation or in the transcription process.

2.5 Statistics about the scope of the study

We performed in total 6 interviews across 4 different companies which includes Salfjord AS, AGA industrial gas supplier, Salmon evolution and Istad Kraft whom are a power supplier company in Møre og Romsdal.
Our interviews were entirely in Norwegian and we spent roughly 5 hours transcribing and translating the different conversations and interviews by hand. With roughly 7 pages of summarized transcript which we used as a basis for our information.

Figure 2: Interview statistics

2.6 Research Validity

In order to ensure that the study have scientific value, we will use the research design criteria summarized by Yin (2003).
Yin summarizes the research design criteria into 4 parts; Construct validity, internal validity, external validity and reliability.

2.6.1 Construct validity

The role of construct validity is to make sure proper measures are being implemented for the concepts that are being studied. Case studies is considered somewhat problematic due to researchers often failing to implement the right measures as well as the biased nature of a researchers' subjective judgement when collecting data. (Yin, 2003)
Yin proposes three strategies to increase construct validity; Use multiple sources of evidence, establish a chain of evidence and have a neutral third party review the case study report to avoid bias.

2.6.2 Internal validity

Internal validity seeks to establish casual relationships in information. This can be achieved by analyzing information given by multiple sources in order to make comparisons. The more sources that can give you the same or similar information, the higher the internal validity is.

2.6.3 External validity

External validity seeks to establish the findings of the study and see if the results are similar in other external cases. The more similar cases which can replicate similar results or findings to your study, the higher the degree of external validity.

2.6.4 Reliability

The goal of reliability is simply to produce the same result after performing an action repeatedly. If a study's result can be replicated by another researcher doing the same procedures detailed in your study, then you have a study with a high degree of reliability.

2.7 Research summary

Objective:	Exploratory study being a combination of fact finding and theory building.
Strategy:	Qualitative and Inductive in regards to findings and the theories they support.
Research Design:	Embedded single-case study
Process:	Linear but iterative.
Method:	Small series of Informal Conversational Interviews.
Validity:	**Construct Validity**; few sources of evidence, empirical data is summarized, supervisor is reviewing the study. **Internal Validity**; Little internal validity. Only 1 main source of information. **Esternal Validity**; Findings and numbers are similar to those reported by competitors and close to those reported on average from other studies. **Reliability**; Conversation recordings and transcripts are saved if needed in later date.

Table 1: Research summary

3.0 Literature review

3.1 Generic strategies

Competitive Advantage

According to Dash and Das (2010), a firm's probability of success depends whether its business strengths not only match the key success requirements for operating in the target market, but also exceed those of its competitors. Existing demand and capacity do not always guarantee maximum profitability. Certain analyses are to be studied that can be beneficial to the manufacturers to optimize their product mix, prioritize their sales or marketing efforts to reduce risk and maximize profitability in long run. Analyses could be done on current as well as foreseeable business scenarios, on balances against capacity, on capability and investments. (Aswini, 2013)

A competitive advantage exists when a target market customer perceive that a firm has a product or services better than that of its competitors. (Dess, Lumpkin et al. 2007)

Competitive advantage is an advantage gained over competitors by providing great values to the customers which can be done by either implying lower price or providing more prominent benefits and services that justifies higher prices (Porter 1985).

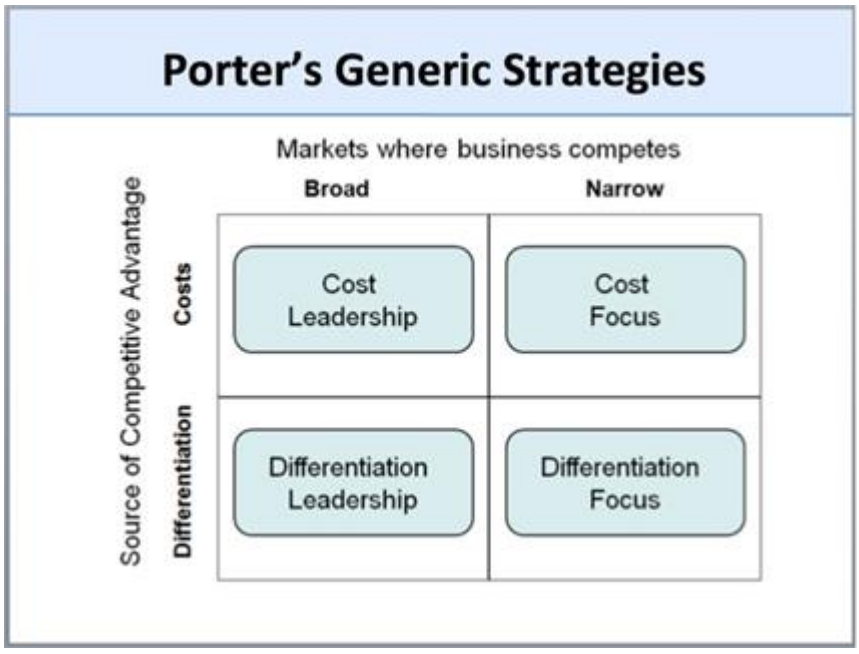


Figure 3: Porter's generic strategies

Porter have suggested three main generic business strategies which are defined by the methods a company can use to establish and gain competitive advantage:

1. **Cost Leadership:** Cost leadership can be achieved when a firm is able to increase its profits by reducing the costs of producing products to a broad specrum of customers and still charge average prices. (Hales and Mclarney, 2017)

2. **Differentiation**: Differentiation strategy can be achieved when a firm involves in distinguishing itself from other competitors by providing unique products or services that deliver superior value to a broad spectrum of customers. Differentiated firms can have the benefit of charging higher prices and earn higher returns to outperform the competition. (Hales and Mclarney, 2017; Miller, 1987; & Miller,1988) distinguishes the differentiation advantage into two different parts; innovation differentiation and market differentiation. The former utilizing new technology to pursue differentiation and the latter utilizing differences in product to generate market shares.

3. **Focus**: This strategy can be achieved when a firm chooses to focus on specific groups of customers or industry segments within a narrow scope. This strategy works best when a buyer has certain demands of a product which is currently not available in the market. This strategy is generally split into two different focuses which are both targeting a narrow buyer segment.
    - **Cost Focus:** In this position the targeted customers are provided their desired product or services at a lower cost relative to the competition.
    - **Differentiation Focus:** In this position customers are provided with unique or different product or services that delivers superior value relative to the competition. (Hales and Mclarney, 2017)

"The essence of strategic positioning is to choose activities that are different from rivals and a strategic position is not sustainable unless there are trade-offs with other positions" (Porter, 1996). Porter believes that competitive strategy is about becoming different in a market by creating or holding a unique and valuable position within that market.

According to Porter (1996) a firm can 'stuck in the middle' when if it doesn't have enough power to make a decision and follow a strategy, a position he describes as the "inherent contractions of different strategies." Such firms have a chance to lose out on cost advantages or superior differentiation from competitors.

3.2 Vertical Integration

The term vertical integration first emerged in early as 1930's in the economics literature. According to Coase (1937) in his famous article, *the nature of the Firm* where he described vertical integration as the "*coordination of the various factors of production normally carried out without the intervention of the price mechanism*". In the 1980's Porter (1980) made a thorough definition of vertical integration where he defined it as "*the combination of technologically distinct production, distribution, selling, and/or other economic processes within the confines of a single firm. As such, it represents a decision by the firm to utilize internal or administrative transactions rather than market transactions to accomplish its economic purposes.*" With this definition Porter describes vertical integration as an organization's ownership and control of various functions in the value chain, therefore relating to organization's make-or-buy decisions (Lehtinen, 2010). However it is more than a make-or-buy decisions because some decisions to integrate upstream (or downstream) require firms to acquire capabilities far beyond the basic strengths of their core business (Harrigan, 1984). According to her '*Vertical Integration' involves upstream (or downstream) arrangements between sister business units to provide raw materials or semi processed materials, components or services to (or purchase outputs from or act as distributors for) each other".* With the definition of vertical integration Porter (1980) has also defined the most specific concepts of forward and backward integration. By forward integration Porter means integrating vertically downstream towards the market to be served and conversely, by backward integration Porter means integrating vertically upstream toward the supporting business such as suppliers.

Therefore in the terms of control by ownership sense, a vertically integrated organization can be defined as a single firm where either several or all the functions in the value chain are performed internally. (Fergusson, 1993)

Regarding this definition, the number of functions that are performed internally determines the degree of vertical integration. (Balakrishnan & Wernerfelt, 1986)

The overall concept of vertical integration according to Porter (1980) definition is illustrated below:

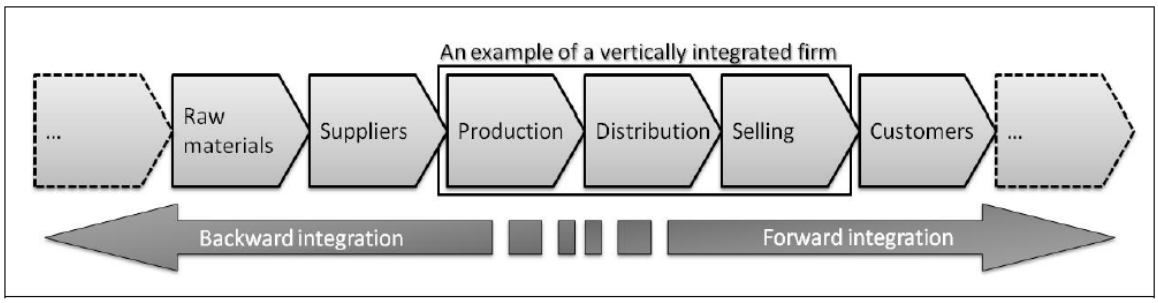


Figure 4: The concept of vertical integration (Adapted from Porter 1980)

While some of the scholar like (Adelman, 1949; Blair & Kaserman, 1978; Comanor, 1967; Dennison, 1939) and few other fail to find the reason behind the vertical integration like technological leadership, to secure access to raw materials, or competitive pre-emption nor the diversity of ways where vertical integration strategies might be formed few other economic scholars like (Bork, 1954; McGee & Bassett, 1976; Porter, 1980) have recognized the ways in which vertical integration could make industries more competitive (rather than less so). Most economic scholars have held one view on vertical integration, a view based heavily on the convenient assumption of a monopolist, instead of considering how firms might use this strategy differently (Harrigan, 1984).

Harrigan (1984) defines four degrees of vertical integration which are (1) *non-integration*, (2) *quasi-integration*, (3) *taper integration*, and (4) *full integration*. *Non-integration* means incorporating only one function in the value chain and buying everything from the market. *Quasi-integration* means that different functions in the value chain are integrated through joint ventures, franchises, minority equity investments, loan guarantees etc. *Taper integration* means the situation where some of the inputs and outputs are bought and sold outside of the firm and the rest in-house. Finally, *full integration* means that everything is transferred in-house. (Harrigan, 1984) Mahoney (1992) calls full integration vertical financial ownership.(Lehtinen, 2010).

The table below describes some of the advantages and disadvantages of vertical integration (Harrigan, 1984)

Advantages	Disadvantages
Internal benefits • Integration economies reduce costs by eliminating steps, reducing duplicate overhead and cutting costs (technology dependent) • Improved coordination of activities reduces inventorying and other costs. • Avoid time consuming tasks, such as price shopping, communication design details, or negotiating contracts **Competitive benefits** • Avoid foreclosure to inputs, services or markets • Improved marketing or technological intelligence • Opportunity to create product differentiation (increased value added) • Superior control of firm's economic environment (market power) • Create credibility for new products • Synergies could be created by coordinating vertical activities skillfully.	**Internal costs** • Need for overhead to coordinate vertical integration increased costs • Burden of excess capacity from unevenly scales plants (technology dependent) • Poorly organized vertically integrated firms do not enjoy synergies that compensate for higher costs **Competitive dangers** • Obsolete processes may be perpetuated • Creates mobility (or exit) business • Links firm to sick adjacent business • Lose access to information from suppliers or distributors • Synergies created through vertical integration may be overrated • Managers integrated before thinking the most appropriate way to do so

Table 2: Advantages and disadvantages of vertical integration. (Harrigan, 1984)

3.3 Competing on global scale

Today many industries are changed or very different from what it has been in the sense of international competition. Competing on a global scale is not an easy task. A company or a firm has to think deeply on different aspects before going into the international market. In order to compete globally and successfully it is necessary for an industry to differentiate their products or services from their competitors. A company must be much more innovative and always look for ways to improve the products and services to distinguish themselves in the tough competition in the global market. To sustain in the market a company has to compete with various domestic competitor that allows individual subsidiaries to compete in different domestic markets on their own. Therefore, to enter into an international market first of all an international company have to change from being a multi-domestic competitor to a global organization, which sets its entire world-wide system of product and market position against the competition (Hout, Porter et al. 1982).There are a lot of benefits to going on a global market but it poses a lot of risks too. The companies will require major policy and operating changes and acceptance of numerous unconventional approaches to manage multinational business to compete globally and according to (Hout, Porter et al. 1982) those approaches could be:

- Major investment projects with zero or even negative ROI
- Financial performance targets that vary widely among foreign subsidiaries
- Product lines deliberately overdesigned or underprices in some markets
- A view of country-by-country market positions as interdependent and not as independent elements of a worldwide portfolio to be increased or decreased depending on profitability
- Construction of production facilities in both high and low labor-cost countries

A company has to make a decision if it has the perfect or right characteristics to enter into the global arena. It is essential to take a cautious examination of the economies of the business that benefits the global competition. A global competition is considered success when the significant benefits are achieved from worldwide volume that's could be either in terms of reducing unit costs or superior reputation or service are greater than the additional costs of serving that volume (Hout, Porter et al. 1982).

Efficient logistics network and higher volume of distribution networks play very important role in taking advantage of the global competition. A high level of research and development are important alongside the knowledge of transportation cost and needs to be considered to be able to enter into global competition. (Hout, Porter et al. 1982)
Technology is one of the main supporters of globalization, and it is in the company's best interest to be in pace with the new technologies and adapt to new consumer trends as required. Global integrations that are supported by free trade agreements, new interaction in communication systems, flexible manufacturing processes, consumer preferences, transport optimization which are all based on the latest economic trend worldwide helps in assisting globalization (Nicolae, Florin et al. 2013).
Today the new triad in international trade is based on relations between western and eastern Europe, the U.S with Mexico and Canada and last but not least Japan and the pacific countries, holding 86% of global trade (Pop, Dabija et al. 2011).

Hout et al. (1982) further explain that a company should have a potential for altering changing competitive interaction in its favor so as to trigger a shift from multi-domestic to global competition. Since there is not guarantee of success after becoming global, the company must be willing to do the heavy investment required for global competition. When the company realizes it's potential to go for global competition but not yet so must ask itself whether it can innovate effectively and must understand its impact on the competition to find the best answers to these three questions:

- What kind of strategic innovation might trigger global competition?
- Is it in the best position among all competitors to establish and defend the advantages of global strategy?
- What kind of resources-over how long a period will be required to establish the leading position?

There is no any guaranteed formula that can lead success to a firm in international business market. Competitive benefits are determined by powerful strategy of a firm that is applied in both international and domestic business. Therefore, the managers who can think in unique way are the one who are able to sustain the global market else it would be a problem for a company to identify the nature of the competition, justify the necessary investments or adopt the changes in behavior of the firm and if the company is able to

implement the global strategy successfully it can be a successful international companies (Hout, Porter et al. 1982)

3.4 Value-adding activities

For every business entity the primary goal is the value creation. The main reason to create value is to help sell customers products and services in the market and for shareholders it is to increase the value of stock price, ensuring the future availability of investment capital to fund operations (Ramu, 2017). The fundamental idea to understand the business markets is to implement the abstract idea of value. According to (J. Anderson & Narus, 1999) the value is regarded as "the cornerstone of business market management because of the predominant role that functionality or performance plays in business markets".

3.4.1 Value creating and delivery

When the fundamental nature of value is given in the business market, it is critical for firms to comprehend the mechanism and means of value creation. (Biong, Wathne, & Parvatiyar, 1997; Flint, Woodruff, & Gardial, 1997) regard value as a tradeoff between benefits and sacrifice. In order to create value in any business, firms should focus on their service to the customer. The real value of the product is recognized through the ways of servicing customers. Talking about the value it has been defined in two forms. Some define value in business markets monetarily (J. Anderson & Narus, 1999; J. C. Anderson, Jain, & Chintagunta, 1992). However, others use a broader definition that also includes non-monetary revenues, such as market position, competence, and social rewards (Biong et al., 1997; Wilson, 1995; Wilson & Jantrania, 1994).

Therefore, value creation is an essential part in every business market. Strategies need to be developed to create those values in the market. In order to develop a value creation strategy, a firm must identify the points of value their potential customers seek and next to do is to develop a pre-emptive strategy to provide those benefits (O'Cass & Ngo, 2011). Various dimensions have to be focused while developing value creating strategies along with the customers perceive value. According to (Ulaga, 2003) there are eight dimensions of value creation in a business-to-business context and they are:

- Product quality
- Service support
- Delivery performance
- Supplier know-how

· Time-to-market
· Personal interaction
· Price
· Process costs

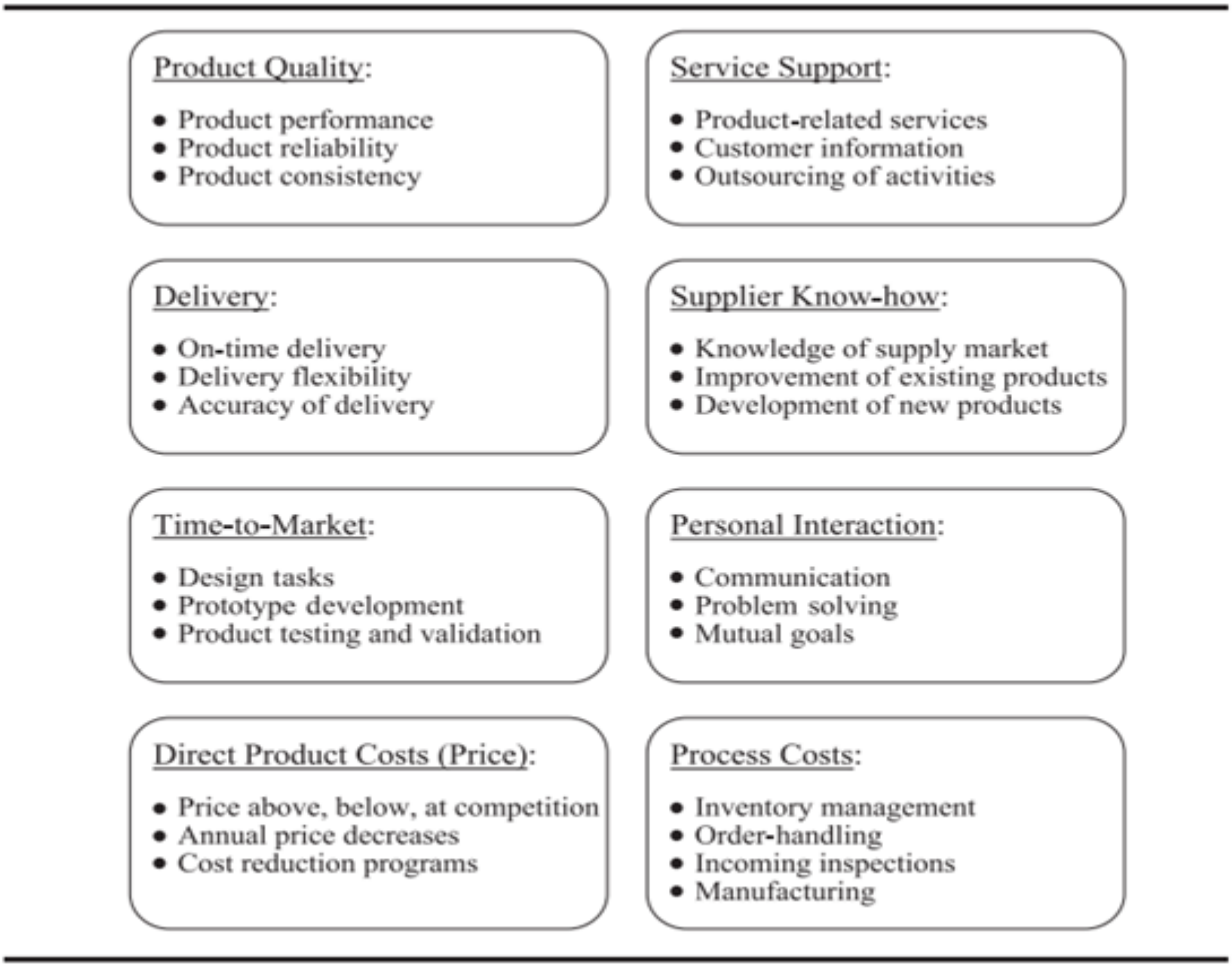


Figure 5: Relationship value drivers

(Smith & Colgate, 2007) proposed a customer- value creation framework which identifies four main types of value any organizations can create:

1. **Functional/instrumental value**: the attributes of the products itself: the degree in which the products satisfy the customer's desired goal.
2. **Experiential/hedonic value:** the degree in which the customers can have appropriate experience, feelings and emotions with the products.
3. **Symbolic/expressive value:** the degree in which the product can have associated psychological meaning with the customer
4. **Cost/sacrifice value:** the degree that is associated with the utilization of the products.

However, if the value creation is only targeted to an individual, smith and Colgate's value creation framework might not apply as the framework must be adopted when the source of value identified have to be appropriate and applicable to the context in which they are used. For example, in the context of open source software which is most attractive to business and expert users, such as universities and hobbyist programmers, the value is created by providing software at lower prices. But an experiential value creates more of an individual assessment rather than s firm-level assessment. According to (O'Cass & Ngo, 2011), the following values are the comprised to create a firm's pre-emptive value creation strategy:

1. **Performance Value:** the product attributes and attribute performance identify the performance value
2. **Pricing Value:** this value is created when the customer believes they are paying the fair prices for the services or the products. The value price refers to a price that justifies the benefits of purchasing a product.
3. **Relationship value:** the value that is created with the smooth relationship with the customer through the efforts of creating and delivering a hassle-free purchase and consumption.
4. **Co-creation Value:** the value that is created by co-creating or co-producing when the customer gets influence or take advantage from the various parts of the business system.

Delivering Customer value

Satisfying customers is the ultimate goal of any logistic system. However, the capability of a firm to deliver customer value in its chosen markets determines the success or failure of any business firm. Customer value is simply defined as the difference between the perceived benefits through purchase or relationship and the total cost of ownership. Mathematically, it can be expressed as:

$$\text{Customer value} = \frac{perceptions\ of\ benefits}{Total\ cost\ of\ ownership}$$

Here 'total cost of ownership' is used rather than the cost or the price because TOC includes both the purchasing cost as well as the other operating cost. Competitive advantage can be enjoyed when a firm successfully deliver more customer value than their competitors. Logistic management have an unique ability to impact both the numerator and the denominator of the customer value ratio which can be make clearer by expanding the ratio as:

$$\text{Customer value} = \frac{Quality\ X\ service}{Cost\ X\ Time}$$

Source: (Johansson, 1993)

The four elements are defined as:

Quality: the functionality, performance and technical specification of the offer.

Service: the availability, support and commitment provided to the customer.

Cost: the customer's transaction costs including price and life cycle costs.

Time: the time taken to respond to customer requirements e.g. delivery lead time

All these four elements are to be executed continuously on the basis of improvement, innovation and investment in order to ensure continued competitive advantage (Christopher, 2016)

3.4.2 Customer Service

Providing the ‘time and place utility’ while transferring the products and services between the buyer and suppler is the ultimate role of customer service. In other word value is not created until and unless the product or service is in the hand of the customer or consumer. Therefore ‘Availability’ is an important factor which together constitute a customer service. There are several factors are to be interacted which impacts the process of making products and services available to the buyer or customer determines the whole customer service. Due to multivariate nature of the customer and also widely differing requirements of specific markets, it is important for any business to have a clearly defined policy towards customer service (Christopher, 2016)

Even though the cost reduction is a worthy goal as long as it achieved through value creation, low-cost strategy may provide effective logistic however, not an effective logistics. Moreover, the customer service not only have its impacts on the ultimate end user but also on intermediate customers like distributors.

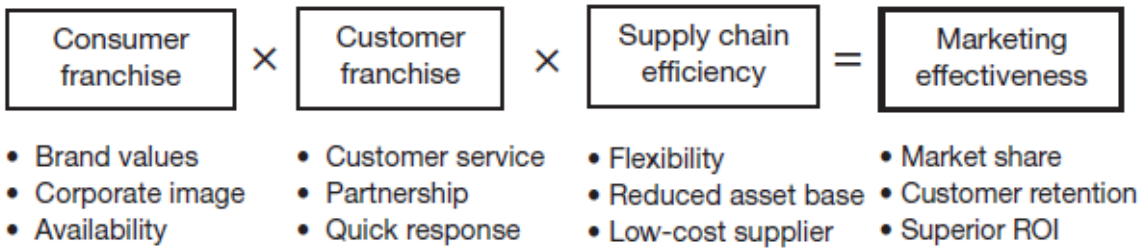


Figure 6: The Impact of logistics and customer service on marketing

Through the supplier’s efficient logistics system, the improvement in the impact in both the consumer franchise and customer franchise can be possible. Only by maintaining all these three components can help to maximize the effectiveness of the marketing. (Christopher, 2016)

3.4.3 Customer service and customer retention

According to Theodore Levitt ‘people don’t buy products; they buy benefits which has an idea that it is the totality of the ‘offer’ that delivers the customer value. For example: The value for a finished product might be different when it’s in warehouse and in the hand of the customer even though it possesses the same value. Here distribution plays an important role as a source of added value.

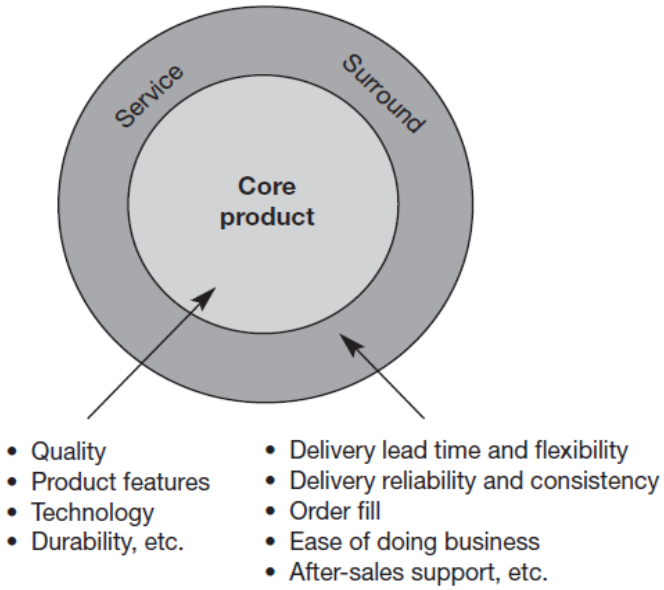


Figure 7: Using service to augment the core product

In the figure, core product represents the basic product. The outer layer consists of service and the logistic activity which represents all the added value. As we can see clearly that there are other factors like advertising, branding and packaging that enhance the perceived value to the customer besides customer service and logistic activity. This idea emphasis on creating strategies that focus on ‘servitisation’ i.e. converting a product into service. Improving customer retention is the ultimate objective of any customer service. It helps not only gaining the new customer but is also the most potent weapon to keep the customers. Moreover, through relationship marketing, organization can continue develop their marketing strategies to maintain and strengthen customer loyalty (Christopher, 2016).

3.4.4 Market-driven supply chains

The goal of becoming a 'low-cost producer' could be achieved through traditional supply chain where the internal operations of the supply company is optimized which enables the production efficiencies to the maximum level. This approach is fine from the manufacturing perspective whereas its nowhere close to being 'customer-centric' as a matter of designing supply chain regarding the requirement of the customers. So, in order to focus on customer, the challenge has been risen to design the supply chain from the 'customer backward'. In this new perspective the customer is not seen at the end of supply chain rather at its start. Its moreover called as 'demand chain management'(Christopher, 2016).

"managing demand chains is fundamentally different to managing supply chains. It requires timing the supply chain on its head, and taking the end user as the organization's point to departure and not its final destination."(Baker, 2004)

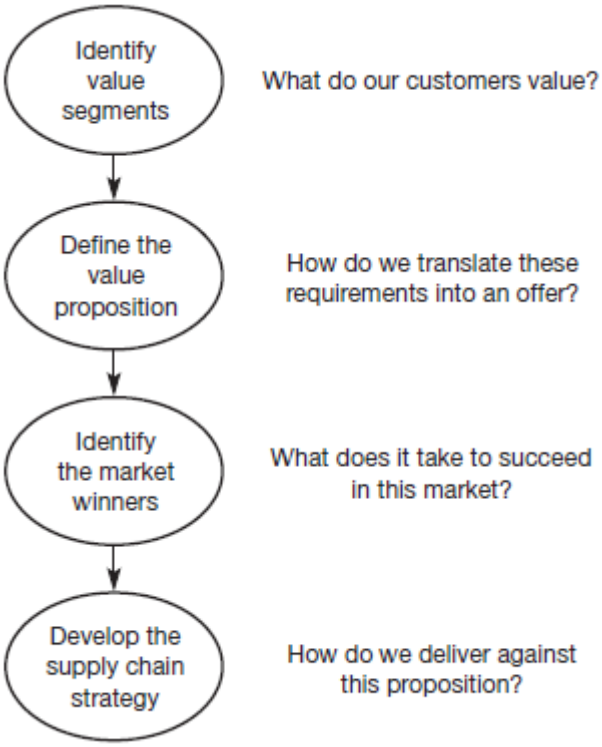


Figure 8: Linking customer value to supply chain strategy.

The figure suggests the appropriate sequence of actions to create a market driven supply chain where it begins with the knowledge of the customer value that the customer demands in the market for which the company competes. This customer demand will help market to identify the real market segmentation (Christopher, 2016)

Designing a supply chain to market-driven companies operating in global markets means first:

1. Giving the company an adequate system of forecasting and monitoring of the applications,
2. Building an information network that can quickly disseminate information on the application to allow rapid adjustment of the supply chain or network to change
3. Quickly reconfiguring and redesigning the network to capitalize on the immediate, and perhaps only temporarily, the nascent market opportunities
4. Continually reviewing the various drivers that guide the design choices (Faraoni & Petretto, 2009)

Defining customer service objectives

The whole aim of the supply chain management and logistic is to provide the customer satisfaction with the level and quality of service that they deserve with low cost to the total supply chain. With the concept of *perfect order*, the definition of service objective can be made clear. The perfect order is fulfilled when the customer service is achieved in full. Although the definition is specific to individual customer, it's possible to apply to group customers into segments. The perfect order is measured when the service is 'on-time, in full and error-free' (Christopher, 2016).

3.5 Aquaculture and Environmental Impact

3.5.1 Sustainable aquaculture

As the demand for the seafood is increasing, the overfishing has been exploited to its limits. As a solution aquaculture has been the only way to contribute the demand for fisheries. However, in course of fulfilling the demand for seafood, the aquaculture industry has been encountering numerous of criticism regarding the negative environmental impacts and their lack of sustainability. On the other hand, the criticism can be taken into consideration so as to develop the better management in the aquaculture techniques so that it leads to the improvement in the aquaculture with more production yield efficiently and also the negative ecological or the environmental impacts can be minimized which is possible through the

application of sound scientific principles to improve production methods and environmental management (Boyd and Schmittou 1999).

According to (Pillay 1992), the most frequently and used concept of sustainable development and aquaculture is the one provided by FAO which follows as: “Sustainable development is the management and conservation of the natural resource base and the orientation of technological and institutional change in such a manner as to ensure the attainment and continued satisfaction of human needs for present and future generations. Such sustainable development (in agriculture, forestry, fisheries sectors) conserves land, water, plant, and animal resources, is environmentally non-degrading, technically appropriate, economically viable, and socially acceptable.’’

Although the term sustainable is unclear and not fully understood when it comes with the other terms as “sustainable agriculture” or “sustainable development” or “sustainable ecosystem”, just the general concept of sustainable development is simple and important.

According to (Frankic and Hershner 2003) the following consideration should be given at least in order to assess the sustainability in any enterprise or technology:

- the sustainability (or continuity) of supply, and quality of inputs;
- the social, environmental and economic costs of providing the inputs (e.g., depletion of resources elsewhere);
- the long-term continuity (or sustainability) of production;
- financial viability;
- social impact and equity;
- environmental impact;
- efficiency of conversion of resources into useful product

Sustainability is achieved only when there is an appropriate and maintained environmental conditions which can include ecological, socio-anthropological and economic aspects of environment. Therefore, in order to attain sustainable resource management, the following six general steps should be included for any activity that are used or practiced (Frankic and Hershner 2001).

Environmental resource assessment:

The very first necessary step for the successful management program is to choose the suitable available resources which can be helpful to make a decision about long term goals. It is necessary to know the selected site vulnerability to various activity impacts. Environmental resource assessment has to include a long term and profundity research, studies of organisms that are being cultured or are intended for culture, as well as understanding of utilized ecosystems, their bio-complexity and how they function at a healthy state. (Frankic and Hershner, 2003)

Environmental impact assessment

It is the analysis and evaluation of possible environmental impacts caused due to proposed decision or activities which is likely to cause significant effects on the environment. It is very essential to provide a clear information regarding the impact identification of the aquaculture on the environment. The aquaculture development project should include the best available knowledge and information or options about the mitigation of impacts and environmentally sound management (Frankic and Hershner 2003). The most important development in the environmental decision process in the last decade has been the inclusion of environmental impact assessments by regulatory managers (Power and Adams 1997).

Policy framework and regulatory measures

International policies are vital to ensuring that marine resources are properly managed and protected due to the transboundary nature of ocean issues (McGinn and Peterson 1999). According to Norwegian Ministry of Fisheries and coastal affairs the policy objective is stated as "The Fisheries policy shall contribute to establish a sound basis for an economically viable development of the fisheries industry. A sustainable management of the living marine resources is pre-conditional. Through marked orientation and increased value adding, the fisheries sector shall contribute to good employment and living opportunities in the coastal communities". The basic approach is to review and analyze existing institutional and legal mechanisms (including regulation and enforcement) for integrated coastal and marine management and aquaculture development potential. Accordingly, the country should propose a generic institutional and legislative framework to address the environmental issue and encourage integrating aquaculture management. (Frankic and Hershner 2003)

The potential benefit of traditional tenure and management systems should be recognized by the comprehensive policies and institutional legal framework and ensure that they are incorporated into rules and regulations wherever significant for conservation and sustainable use (McGinn and Peterson 1999). A well-regulated system in aquaculture not only positively affects the environment but also helps to boost the economy as well.

Socio-cultural and economic assessment

Socio-cultural and economic evaluations provide an economic framework from which differing adaptation strategies or solution can be studied. In an assessment of alternatives, any aquaculture company should be provided a necessary information on how each option compares in respect to the relative costs and benefits for each aquaculture impact (Sorensen and West 1992). Effective choice of reasonable areas for aquaculture and long-term maintenance of site suitability acquires precise assessment of both existing conditions and plausible trends in environmental, economic and social variables (Frankic and Hershner 2003).

Implementation

The success of the aquaculture management program can be recognized through the country or the industries' ability to implement the established sustainable program effectively and how it has helped to manage the natural resources. The basic question of an implementation strategy is how to apply science and execute the best management practice (BMP) for aquaculture? Comprehensive BMP should become a `living document`, open to revisions and expansion (Frankic 1998). Established BMP provides constant monitoring and control, strengthening environmental protection and sustainable aquaculture development.

Monitoring and evaluation

The purpose of monitoring is to ensure that the knowledge has been used to convert collected data into useful information. The purpose of monitoring implementation of aquaculture practices is to make sure that the major established policies (goals, comprehensive plans, and agency authorities) are implemented in proper and efficient way. Monitoring helps in evaluating the total impacts of changes after the implementation of BMP and policies and

assure that management program elements for aquaculture are upgraded to reflect changing needs and circumstances consistence with its basic requirements. This approach will provide a premise for a common assessment of the aquaculture success of failure in achieving objectives of balanced development and resource protection or conservation (Frankic and Hershner 2003)

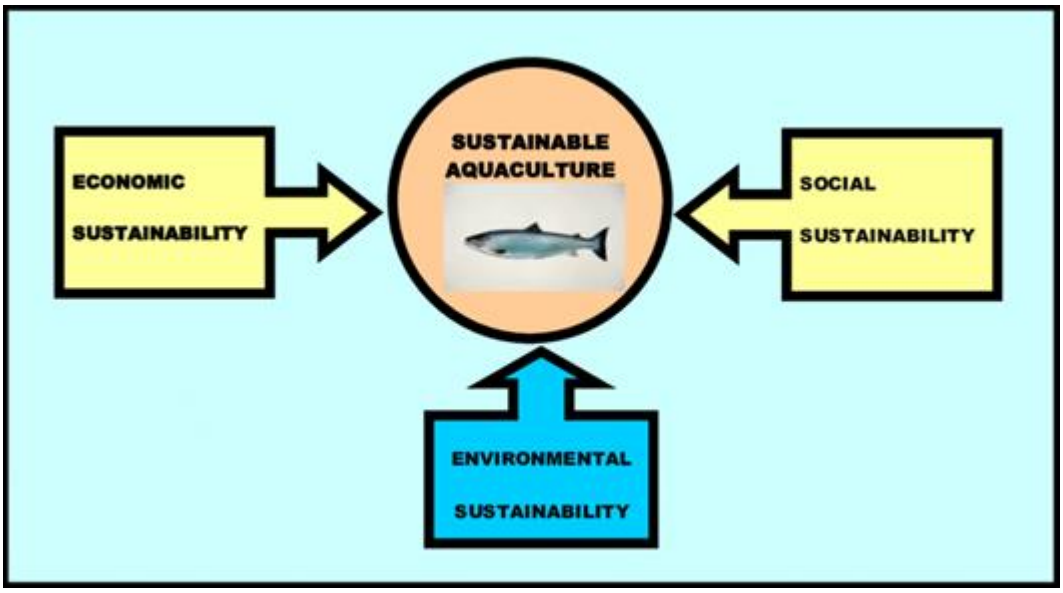


Figure 9: The three components necessary for sustainable aquaculture (Marine conservation society, 2007)

3.5.2 Fish welfare

Today the concern have been raised regarding the welfare not only in the farm animals but also in fish in aquaculture and capture fisheries (Huntingford, Adams et al. 2006, Diggles, Cooke et al. 2011). Traditionally the concept of animal welfare has been implied to those animals which are considered to have an ability to experience pain, fear and suffering or the species which have the higher level of cognition when compared to fish. This statement has cause debate among the researchers considering the ability of fish whether it can experience pain and fear (Ashley 2007).

According to (Verheijen and Flight 1992) recent researchers has found not only the fish react on stressing environment but they have also concluded that fish can feel pain and experience fair. Though some researchers have disagreements about the topic on whether fish is in fact able to feel pain or fear despite having the brain needed to recognize those emotions, they still acknowledge that the fish shows ‘robust, non-conscious stress responses to noxious stimuli’ (Rose, 2002). Despite the debate among the researchers, it is

required for the fishery workers to deal with the fish slaughter in an appropriate and humane manner (e.g. anesthetic overdose and/or cerebral maceration) (Beaumont, Taylor et al. 2002). The various definition of animal welfare leads to the key point that poor welfare is associates with exceeding the coping capacity of animals resulting into chronic stress-related physiology and behavior, pathology and increased mortality (Veldhuizen, Berentsen et al. 2018).

Different species have different biological and environmental requirements and response accordingly to the aquaculture conditions. So, there still remains much of a research to be done, specially focusing on the growth in the aquaculture species like cod, halibut and tuna (Ashley 2007).

It is difficult to measure the welfare. Most of the definitions of animal welfare are either 'function-based' or 'feeling-based' where in function-based definitions , the fundamental assumption of the welfare is correlated with biological functioning including physiological stress response (Duncan 2005) while in feeling based definition, the welfare is more or less equals the current emotional state of the animal (Duncan and Dawkins 1983). According to (Spruijt, van den Bos et al. 2001) it is "the balance between positive(reward, satisfaction) and negative(stress, aversion) experiences of affective states. The state of this balance may range from positive (good welfare) to negative (bad welfare)". Therefore, welfare of farmed fish is determined by the degree of a limitation a fish can adjust to the rearing conditions and find them rewarding (Kristiansen and Juell 2002).

A good production comes from good welfare, as proved in numerous other terrestrial meat animals. The quality of the fish changes heavily depending on how the pre-slaughter procedures management and the slaughter methods are carried out. It even effects during the final storage of the product. It means if the slaughter process are carried out without the care to avoid the stress conditions to the animal, the quality of the product have negative effect than the one where the slaughter process is carried out considering the welfare of the animal. This ethic aspect also has the same reflexes on fish quality (Poli, Parisi et al. 2005)

According to (Poli, Parisi et al. 2005) during the slaughter time (severity of the pre-slaughter and slaughter stresses) and storage (handling and storage temperature), many

quality traits can be changed or affected. Following are the relative quality changes that can be indicated:

1. Fish and fillet appearance (physical injuries, flesh gaping and color);
2. Technological properties of the fish and fillet [rigor evolution, texture (firmness, cohesiveness, elasticity), water holding capacity and fillet shrinkage], rigor mortis onset and texture in particular are important for flesh processing;
3. Freshness indicators, such as dielectric properties or impedance, K value, and spoilage indicators such as *biogenic* amines, lipid oxidation products such as malonaldehyde;
4. Sensory qualities of raw fish (appearance of skin, rigor status, eye, gills color, smell, mucus, condition of flesh), the shelf life and, even if less frequent, the differences in some sensory traits of cooked fillets as texture, taste, flavor, odour.

After analyzing various method of fish slaughter (Poli, Parisi et al. 2005) have come to the conclusion that pre-slaughter and slaughter stressful practices can leave and effect on the flesh quality in fish that are in a similar fashion to mammals and poultry. Some of the general trends found are as follows:

1. less stressful pre-slaughter practices and killing methods produce less intense physical exercise in fish and minimize the stress response, in this way minimizing changes in the normal post mortem processes and the quality traits development and involution;
2. slaughter methods have an effect on the physical properties of flesh;
3. Stressful pre-slaughter and killing methods exhaust muscular energies, produce lactic acid, reduce muscular pH and increase the rate of rigor mortis onset. In this way they can have significant negative effects on flesh quality, and in particular on keeping quality of fish;
4. with reduced pre-slaughter stress and activity, fish will take longer to go into rigor, giving the possibility of handling the fish while processing and packing before they enter into rigor, increasing fillets yield and reducing damage of flesh;
5. severe stress due to the pre-slaughter practices can be so aversive to the fish that it masks the benefits of good slaughter practices;
6. differences in sensory evaluation on cooked fish are less frequently found than physiological measures

Therefore, it is important to choose the best slaughter process that avoids or minimizes stress, pain or suffering because fish welfare even at death is closely related to the quality of the final products.

3.6 Land and Sea based aquaculture

Traditionally fish farming has been separated into 3 broad methods of farming the fish with two different methods of containing them. The traditional method is to either procure or produce the smolt and simply raise them in specialized open ocean-bound pens or nets, sporadically changing the nets they live in when their size demands it until they're ready to be harvested. This is the simplest method and requires the least amount if investment in regards to costs and technology which is an important factor for a lot of start-up companies.

The second method is called post-smolt where they procure salmonids already at the smolt stage and raise them in their own tanks, usually on land, until they hit a desired size of 1kg, in which they transfer them to open pens and nets. The land-based cages require the use of recirculating aquaculture systems to recirculate and recycle the water and to monitor and keep it in optimal conditions all year round. This is a firm middle-ground to the first and last method of farming fish as the RAS only needs to sustain fish up to 1kg and thus require less investment in space and technology to operate on a commercial level.

The third and increasingly more popular method is to invest into an entirely land based facilities which is more reliant on advanced technology to function but allows a greater degree of control over the fish's health and growth. While it requires a significant amount of investment in regards to space, technology and costs, the technology is being improved constantly and according to DNB (2017) will soon see a better cost-efficiency than the traditional method.

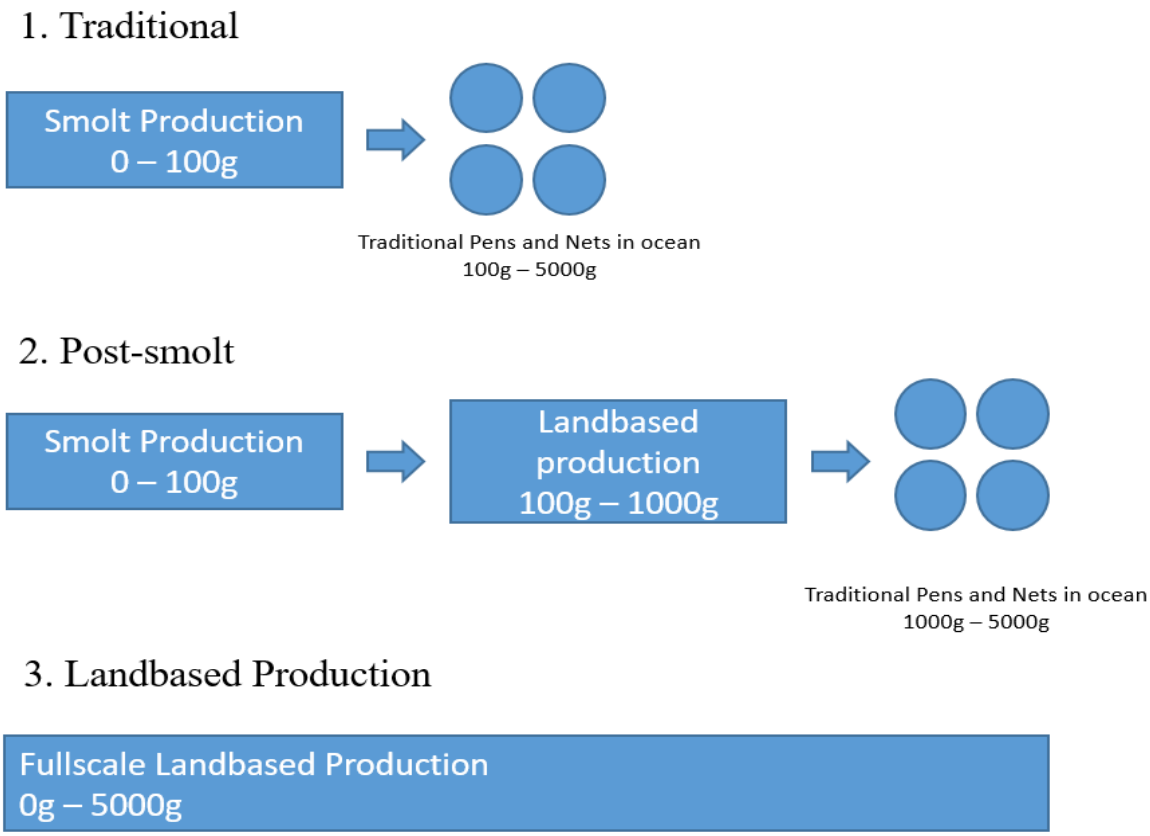


Figure 10: The different links in the supply chain of traditional, post-smolt and landbased production farms.

The three methods are depicted in the figure above and each of them comes with different levels of investments required, their own costs of upkeep and maintenance and their own challenges and advantages which will be elaborated on later in the chapter.

Fish farming exists to address a fundamental problem in our consumer-driven society. The demand for fish is exponentially increasing alongside the population and the number of available wild fish simply isn't. One of the core principles of economics is that if demand is increasing but supply is not, its value and associated costs will rise until it becomes unavailable to most. Stopping this reality is arguably one of the biggest advantages of fish farming.

3.6.1 Advantages and challenges of the ONP method

Challenges of Open Net systems

Blöcher (2015) describes biofouling as an accumulation of unwanted growths and organisms, such as algae or mussels, on the fish-pens nets. It is described as a multifaceted problem and it is especially challenging since the Norwegian salmon industry relies on cleaner fish to reduce the number of lice on the product. On facet of this problem is the increased growth of salmon lice in areas with high degrees of biofouling as the fish prefers to consume the biofouling more so than lice which leads to a steady accumulation of lice which are otherwise consumed. This have a lethal effect on the salmonids.

"Krkošek and colleagues' analysis of 142 populations of pink salmon shows that wild stocks adjacent to fish farms have suffered dramatic increases in mortality of juvenile fish owing to infestation by sea lice." (Rosenberg, 2008)

Advantages of ONP method

A financial evaluation was made between the two commercial-scale fish farming systems for Atlantic salmon, a LBCC-RAS farm of USA and an ONP farm in Norway. Assumption was made to produce the total production of 4000MT net weight which is equivalent to 3300MT of head-on gutted weight. The study found out that the capital cost of the LBCC-RAS is 80% higher than ONP given the same production capacity making ONP cheaper to start at the first place.
The comparison is shown below:

ONP system cost components	Cost (US$)
Licences	23,571,429
Floating rings	1,834,286
Nets	857,143
Moorings	342,857
Boats	1,285,714
Feed barges	1,371,429
Camera systems	214,286
Feed distributors	34,114
Power systems	188,571
Total	29,699,829

LBCC-RAS system cost components	Cost (US$)
RAS Systems	26,640,557
Effluent treatment	3,487,500
Water supply	675,000
Processing	2,112,030
Building	9,426,413
Engineering	5,080,980
Construction management	1,058,538
Bond	254,049
Contingency (10%)	4,848,102
Total	53,583,169

Figure 11: Commercial 3300 MT LBCC and ONP system comparison

When comparing the operating cost, LBCC-RAS is 10% higher which shows both farms are relatively similar while still making ONP slightly cheaper.

Cost item	ONP system		LBCC-RAS system	
	Cost (US$)	Cost (NOK)	Cost (US$)	Cost (NOK)
Feed	2.05	14.34	1.90	13.33
Smolt	0.47	3.30	–	–
Egg	–	–	0.12	0.86
Labor	0.31	2.15	0.52	3.65
Well boat	0.18	1.23	–	–
Health	0.03	0.18	–	–
Electricity	–	–	0.33	2.32
Oxygen	–	–	0.15	1.07
Water treatment	–	–	0.09	0.62
Insurance	0.02	0.16	0.18	1.27
Primary processing	0.43	3.03	0.12	0.83
Transportation	0.25	1.58	–	–
Sales & marketing	0.09	0.60	–	–
Maintenance	0.14	0.99	0.47	3.26
Interest	0.60	4.21	0.65	4.52
Depreciations	0.18	1.28	0.58	4.09
Others	0.33	2.32	0.49	3.45
Total	5.08	35.37	5.60	39.27

Figure 12: operational costs and input factor cost comparisons of ONP and LBCC-RAS system

ONP can take an advantage of ocean current to deliver oxygen to their fishes it causes no cost to the industry. Since ONP are installed in the ocean they use the natural water which saves money used for water treatment.

In summary, the ONP farming method is cheaper to operate, less investment for a start-up company, easier to operate, require less manpower and consumes less electricity.

3.6.2 Advantages and challenges of Land based fish farming

production types and Advantages of LBCC

"Land-based closed-containment systems can increase farmed fish production in systems that practically eliminate water pollution, minimize water use, improve freshness and safety, reduce business risk, and are economically competitive with other established fish production technologies. In addition, land-based closed-containment systems use water recirculation technologies that can meet point-source effluent discharge regulations and reclaim the nutrients that would normally be wasted. The ability to site these facilities in many locations means they can provide a fresh product, reduce shipping costs, and capitalize on cheap electricity when such locations are available." (Summerfelt, 2014)

The land base fish farming refers to the production of fish in a large land base tank system. Raceways and ponds can be used as well for such fish farming. Very high water throughput is required which can be done by pumping water directly or via using a closed systems called RAS that recirculate the used water which are cleared or clean up through biological processes. The different factors of the environment are carefully controlled in an advanced closed- containment system resulting the fish to grow mature twice as fast and much healthier than in sea base fish farming (Shore 2012). According to FAO (The Food and Agriculture Organization of the U.N), over 600 oceanic species are produced worldwide in an assortment of aquaculture frameworks utilizing freshwater, brackish water or saltwater.

Typical Production system used in land-based aquaculture:

Recirculating aquaculture system (RAS)

It is a tank based closed system for farming fish and other aquatic organisms by reusing the water in the production in which the water is processed using mechanical and biological filters in order to remove the suspended remaining like solids and nutrients and reuse again. Recirculation systems are gaining popularity all over the world for many

different species. It permits a very high degree of water Re-use due to its high level of technology. Global market for the sea food has been increasing rapidly while the sea based aquaculture can't hold up longer as it is coming to its limit. So, in such scenario recirculating aquaculture has been an emerging to meet the global market demand.

Flow through systems (FTS):

Flow through system also known as raceway is one of the procedures used for land base aquaculture which is most often in rectangular channel and equipped with supply and exit end. The canal size matters a lot in this system where the length to width ratio is given more importance in order to prevent the buildup of debris in the Centre caused by the fish stock swimming in circular movements. Usually the water quality controls the length of a unit or by the amount it can hold for the convenience for the management. In order to maintain the flow through system by gravity, the landscape should be sloped to one or two percent (Aquatext Dictionary, 2019). To make the flow uniform the shape of the raceway should not be curved (Pillay and Kutty 2005). Usually the raceway for freshwater is made with multiple parallel lines, with each stripes of 15 to 20 or more serial sections with their own drainage channel in order to avoid and isolate any diseases percent (Aquatext Dictionary, 2019). In this system the rate of the water flow should be significantly high so as to fulfill the respiratory requirements of the species and also to wash away the metabolic wastes, especially ammonia (Stickney 1994). Raceways are to be cleaned frequently in most of the cases. Pumps are used to remove the accumulated solid wastes from the bottom race. Generally, this kind of system is used to produce trout fish. However, other species can be produce using this system.

Ponds Systems

Pond system aquaculture is one of the very popular and traditional method of producing fish and other aquatic species cultivated in ponds. Ponds can be built whenever the required factors like soil, shape of the land and water supply are right (Chakroff and Druben 1976).

Audun Iversen, a scientist at Nofima, says that "Land-based technology could see a paradigm shift in aquaculture worldwide." Iversen isn't the only one who sees land-based technology effecting change in the aquaculture industry. Steven Summerfelt of the

Freshwater Institute in the US believes that the US is set to experience growth of recirculating aquaculture systems (RAS) fish production (Bentoli 2019)

RAS is a series of technologies that allows for the re-use of water in aquaculture production. The ability to re-use water will reduce the amount of fresh water required to operate the fish farm, which enables farms to be established on sites and geographical locations where the amount of water is a limiting factor. On the other hand, RAS technologies can also allow for increased production without increasing the amount new water required. (Lekang, 2007)

According to FS (2018) The recent advance in technology has made fish farming possible to be practiced in land with number of benefits of controlling factors, resulting in a healthier, safer method of growing fish and meeting the world's demand for seafood. With an advantage of controlling environments within the onshore farms, it eliminates the concern about environment breaching and contaminants spreading through the ecosystem.

Aquaculture escapees are considered an ecological disaster as escaped farm fish starts competing with wild population while simultaneously spreading hyper-competitive strains of lice and diseases which the local aquaculture wildlife have no defense for. (Heller, 2017)

The most interesting fact is that the limited use of water gives a huge benefit to the production inside the fish farm. According to Steve Summerfelt (2014) traditional fish farming are based upon the external conditions like water temperature of the river, water cleanliness, oxygen levels in water, weeds and leaves drifting downstream and blocking the inlet screen etc. These external factors can be controlled and partly or completely eliminated in a recirculated system, depending upon the degree of recirculation and the construction of the plant. Since the controlled parameters will result in a better and more controlled rate of growth in fish it could also help increasing the accuracy in future predictions. This would help farmer predicting fish sizes at certain stages of production. This feature provides the major advantage of preparing precise production plans where the exact time the fish will be ready for sale can be predicted. (Bregnballe, 2010).

Steve Summerfelt has agreed on number of preferences over net pen farming using land-based systems which grow salmon to maturity. According to him light and temperature in land based can be controlled which accelerate the growth in salmon faster than in net-pen farming.The effluent and solid waste used in fish farming can be managed which leads to the protection of marine environment. The nutrients that are recovered can be used to

produce fertilizer. There will be no need to worry about the bad weather and diseases or from other predation with the control of growing environment in land based system. It will eliminate the cost of buying pesticides and antibiotics (Shore 2012).

Challenges of Land based fish farming

Monitoring the quality of water continuously gives the RAS benefits by decreasing the risk of disease or its spreading which also eliminates or reduces the need for antibiotics. This however is also a double-edged sword as if the monitoring is below the required level of vigilance it could lead to the development of sludge. (Badiola, et Al, 2012) Badiola also outlines other know issues with RAS systems, namely development of nitrification in the water and an earthy off-flavor in the product.

The technology used to manage the waste products allows for effective waste control and also helps to recycle those waste products as fertilizer. This way the wastes don't end up as ocean floor sediments. Regarding water utilization the RAS used in onshore fish farms used 100 times less water per kilo of fish then traditional land-based system, sporting a water retention rate of 90-98%. (Summerfelt, 2014.)

A problem with RAS-produced fish is the accumulation of byproducts and solids that slowly accumulates over time as the water is getting recycled and not completely purified. This leads to unexpected side-effects like the one presented in Summerfelt.

"Two presentations described technologies and practices to eliminate earthy/musty off-flavors sometimes encountered in RAS-produced fish." (Summerfelt, 2014)

The process of purifying the water of lice, biowaste, nutrients and other substances is called depuration. Biofilters and biofilm are used during the depuration process and causes off-flavor in the fish living in the purified water due to bacteria and compounds which are associated with the biofilters. (Summerfelt, 2014)

3.6.3 Advantages of closed containment fish farming.

Land based closed containment systems refer to fish farms stationed on land without a direct connection to the ocean or the other pens in the farm, which is from where the name closed containment stems. A major advantage inherent to closed containment fish farming is that not having a direct connection to the ocean reduces or eliminates entirely the threat of both fish escaping into the wild in the event of an accident, environmental hazard or mechanical complications and for fish to be exposed to lice or seaborne diseases.
Costs of keeping salmon lice-free is several times higher than the value it provides according to Pedersen (2016). Land-based facilities don't expose their Salmonids to outside sources of bacteria and lice at a comparable degree to that of the sea-farmed salmonids and thus have to invest a noticeable amount less in ways of inoculation and delousing while at the same time not acting as a vector for more diseases to the surrounding area. This makes land based aquacultural farming a better option for both environmental and costs associated with brand reputation.

Pedersen (2016) explains in great details how the current export value of farmed salmon actually exceeds the value of wild Salmon. Pedersen (2016) also mentions how farms invest more into antibiotic treatments on trout, at a ratio of 6 times the economic damage done by sea lice. An example of this would be that a salmon farm might invest up to 1.2 million NOK into antibiotic treatment to prevent a disease that would kill salmon with a combined commercial value of NOK 200 000. This is done to avoid the possibility of negative brand association with parasites, mortality and fish of low quality. Such investments are paradoxically required by ocean based ONP fish farms as their fish are in direct contact with the local environment. Avoiding such 'unnecessary' costs is one of the many benefits of a CC system.

Having a closed system also allows for far greater control over variables and factors affecting the water used to grow the product. (Salmon Evolution, 2019)

"InSEAS new, replicate state-of-the-art water recirculating systems can be operated in a nearly closed-manner at various temperatures and salinities." (Summerfelt, 2014)
Fish performance indicators can be significantly improved when Atlantic salmon smolt are cultured to 1 kg at salinities of 12 ppt when compared to full-strength seawater"

Average seawater has salinity of 35 ppt or parts per thousand. Optimal conditions for raising salmon can be artificially created in closed-containment systems as it allows the aquacultural farming facilities to precisely tune the different variables and factors affecting the fish unlike open environments commonly found in sea-based farms. (Summerfelt, 2014)

A few solutions presented at the summit described in Summerfelt (2014) described technology that were being developed which lessens the water quality issues of denitrification and microbiology within land-based closed-containment systems; including different forms of anaerobic treatments to remove nitrate, phosphates, biosolids and off-taste compounds without having to add more water from outside sources, a so-called Zero-flushing treatment. There are several known challenges with closed containment RAS technologies and science is continuously applying force to reduce those challenges and thus improving the quality and yield of the closed containment farms. (Summerfelt, 2014).

"Iceland has the strongest penalties for the failure to comply with escape-related regulations (possible loss of license), and producers without contingency plans in Norway face fines. Fines for major escape events are also levied in British Columbia, particularly if the events are not reported promptly, although such fines are rarely sufficient to induce a change in practice. Overall, the evidence indicates that where penalties for escapes exist, they generally provide an insufficient incentive to prevent escapes and are incommensurate with the ecological and socioeconomic risks." (Naylor, 2016)

A fish farm in the state of Washington faced fines as high as 2.8 Million NOK for damage caused by human negligence which allowed between 243,000 and 263,000 units of Atlantic salmon to escape according to Times Colonist. (Times, 2018) This is classified as a major outbreak and is considered to be an environmental disaster. (Capiello, 2019)
"The Atlantic salmon bring with them pollution, virus and parasite amplification, and all that harms Pacific salmon and our waters of Washington." (Capiello, 2019)

4.0 Case Description

Introduction to Salfjord

Salfjord AS is a new actor on the scene of oceanfront arctic salmon farming and was established in **2017** with the ambitions to vertically integrate several links in the supply chain as they grow as a company. (Salfjord Interview, 2019). They chose their location at Tjeldbergodden as it was logistically optimal and it gives them easy access to live fish carriers, harvesting vessels and feed carriers as well as already established infrastructure. The site is also qualified for long-term production while also retaining the ability to upscale the operation should it be needed in the future. Fully developed, the farm is expected to produce 36 500 tons of salmonids per year making it theoretically the biggest land-based salmon farm in Norway at the time of writing. (salfjord.com)
Their public resources state that Salfjord is developing 115 000 m^2 of land but they have since decided to expand that area to 170 000 m^2.

As of today Salfjord AS has currently invested a bit over 4 million NOK (23.04.2019) into permits, licenses, land renovations, handling fees, ecological- and market research with the expected capital cost to be in the level of 1 billion NOK by the time the first module is up and running. Salfjord initially expected to have modules producing 3 000 Metric Tons (MT) but have since abandoned this idea after doing rigorous cost-efficiency analyses. They have now decided to change their technological modules into ones with a production capacity of 7300 MT of HOG salmon instead, citing that the cost-efficiency have increased drastically. While being hesitant to divulge their exact capital costs breakdown, citing investment of time and financial costs of doing market and industrial research, they've told us that the new 7 300 MT salmon modules have a modest projected 20% increase in capital costs while boasting a 2.4 times increase in production capacity according to Salfjord. (Salfjord Interview, 2019) This a perfect example of economy of scale.

Salfjord's long-time plan is split into several phases. In the initial phase Salfjord's goal is to get 1 out of their planned 5 modules operational and running at full capacity.
After the initial phase Salfjord is going to construct their hatchery module to allow them to integrate the activities of their smolt-suppliers in an effort to reduce costs and supply chain complexity.

When both the hatchery module and the salmon farming module is operational, Salfjord will move on to the 4 last steps of their long-term construction plan which involves getting the remaining 4 planned salmon farming modules running at full capacity.

In this initial phase they have divulged that they're importing smolt from some of their investors as an opportunity, but that is a temporary measure until their roe hatchery module is running at capacity at which point they will start importing salmon roe from commercial vendors. (Salfjord Interview 2, 2019)

Salfjord AS also has ambitions to integrate the other end of their supply chain, with current wishes to establish a subsidiary company of Salfjord AS which as of now is unnamed. This company's primary function will be to sell Salfjord AS's fish on the global market alongside all the challenges and benefits associated with that. This however is more of a far-away ambition and as such is not Salfjord's current priority. (Salfjord Interview, 2019)

As part of their recurring annual costs Salfjord expects their feed- and electricity costs to be their highest source of expenditure if we disregard the annual depreciation of value of their equipment once purchased and operational. Through their location at Tjeldbergodden Salfjord is seeking dialogue with Equinor and TBU in order to reach an agreement in where Salfjord gets to use the cooling water from the methane plant in order to heat the water used in their fish farming operations.

Heidrun is an oilfield that is directly connected to Tjeldbergodden through a gaspipe connection called the Haltenpipe. (SNL, Haltenbanken - Petroleumsvirksomhet)
A competitive advantage given to those who operate at Tjeldbergodden is the proximity of the liquid natural gas (LNG) development plant that is receiving the LNGs from the Heidrun field. Salfjord has divulged that they need upwards of 20 000 MT of liquid oxygen annually to which is to be supplied by the Tjeldbergodden LNG plant in order to cut transportation costs to a minimum as the infrastructure at Tjeldbergodden is already established. Salfjord is currently in contact with the LNG plant in order to discuss the potential of a partnership and vertical integration to reduce transportation- inventory- and recurring costs of oxygen.

Skretting is one of the bigger fish feed suppliers in the area and Salfjord have been in dialogue with them about the possibilities of a future possibility of a feed supplier relationship, but nothing has been finalized yet.

Salfjord as a fish farming company is planning to utilize a land based closed containment (LBCC) system to farm adult salmon without resorting to recirculating aquaculture systems (RAS) as is more common for land based farms that doesn't have access to a nearby water supply. Salfjord has instead chosen to go with a more traditional method of pumping water directly from the fjord, from a depth around 60-70m below surface, and having it go through a series of filters that purifies it of miscellaneous organic materials so the water can be safely used to farm salmon in a controlled environment.
The depth of 60-70m is significant as that is below the depth at which algae and lice have a presence. The pumping of water is a continuously ongoing process that replaces old water in the modules which is then going through another set of filters and purifiers before being reintroduced to the fjord.
(Salfjord Interview 1, 2019)

One of the differences between a RAS and Salfjord's planned recirculating method is that the RAS commonly retains up to 98% of its water while depending on biofilters and bacterial cultures to denitrify and scrub the water for prolonged use while Salfjord's planned method have estimated a 66% water retention while the remaining 33% is continuously being replaced with fresh fjord water. (Salfjord Interview 1, 2019)
The higher the % of water retention, the higher the cost of maintenance and value depreciation of their pumping equipment.

The choice to not rely on RAS methods is one made decisively by Salfjord as they state they do not wish to be a research farm but rather a commercial one. While they have interests in being innovative, they do not want to be a test-pilot of expensive and at times fickle technology. LBCC-RAS fish farms still have several challenges and hurdles associated with it, with unexplained high mortality rates of fish and suspicions of hydrosulfide development as examples. The consequence of hydrosulfide development is associated with a high to total mortality rate of the product without any known methods of avoiding it with current technologies according to Salfjord. (Salfjord Interview 1, 2019)

One of Salfjord's concerns with biofilters is that you have to keep an eye on both fish and bacterial development as they form a co-dependent relationship where both would die without the other. This represents an increase in variables in the inter-module eco-system and also an increase in variance which in turn increases the risk of something eventually going wrong somewhere. If not properly cared for the bacterial cultures could also produce sludge that in turn is associated with the development of hydrogen sulfide. There has also been reports of bio-filters infusing the salmon with an earthy off-taste due to substances known as Kiamin that is part of the bio-filter, which reduces the quality of the fish as a product. (Salfjord Interview 1, 2019)
These are concerns and challenges which Salfjord has decided to preemptively avoid by utilizing the same technology found in Salmon Evolution which is also a LBCC salmon farm whose farming methods and principles are aligned with the core of Salfjords ideals. (Salfjord Interview 1, 2019)

What Salfjord is trying to achieve is to merge the tried and true methods of traditional Norwegian salmon farming with the benefits of a land based closed containment system, getting the best of both worlds in terms of salmon safety, welfare and health. While it is not a perfect system Salfjord has invested heavily in environmental technology and states that the filters they'll employ can remove up to 64% of all organic materials from the used water before it is reintroduced into the fjord, reducing the resulting pollution and contamination significantly. (Salfjord Interview 1, 2019)

Salfjord can market themselves that they utilize the competitive advantage that is the clean, nutritious and plentiful Norwegian ocean- and fjord water coupled with rich coastal areas inherent to Norway. All of this combined with the hinterland connections and high quality maritime routes for product and supply transport which as a whole can't be copied by actors in the US or china, as they have to use RAS technologies to achieve similar operations which comes at a much steeper cost in terms of capital investments, challenges and hurdles.

5.0 Data and discussion

In this section we're going to answer the research questions and ultimately the problem statement that were addressed in chapter 2: Research methodology. To answer the problem statement, we'll use the basis of the theoretical framework outlined earlier combined by discussing our four different research questions.
The problem statement went as following:

What differentiates Salfjord AS from its competition and
how do they intend to generate value from their supply-chain management?

To answer this statement, we produced the four following research questions:

RQ1: What strategies are available to Salfjord?
RQ2: What unique competitive advantages do Salfjord AS possess?
RQ3: How does Salfjord's supply chain generate value?
RQ4: Is Salfjord's operations considered ethical?

And we will start by discussing the research questions in turn:

To answer the research question (RQ1) we need to take a look on how the logistics and supply chain management theories coincide with Salfjord's situation and ambitions. Salfjord seems to be going for a general cost leadership strategy with all their geographical and social advantages mixed with differentiation strategy without using customer specific focuses.

5.1 RQ 1: What strategies are available to Salfjord

As mentioned in chapter 3.1, Porter (1996) outlines the 3 generic business strategies which can be utilized to establish and maintain competitive advantages over their competition. The first thing to be discussed is the strategies available to Salfjord, more specifically what resources Salfjord has to become either cost leaders or differentiation leaders in their field. Salfjord has a lot of advantages due to their strategic choice of placing their fish farm at Tjeldbergodden, as the location gives them access to important resources at lower costs, to

established maritime transportation routes and the ability to run an efficient operation on land.
The first strategy this study will delve into is cost leadership. Cost leadership as defined by Hales and Mclarney (2017) is achieved by either increasing profits by increasing production volume or reducing costs on a broad spectrum without changing prices.

5.1.1 Cost-leadership Strategy

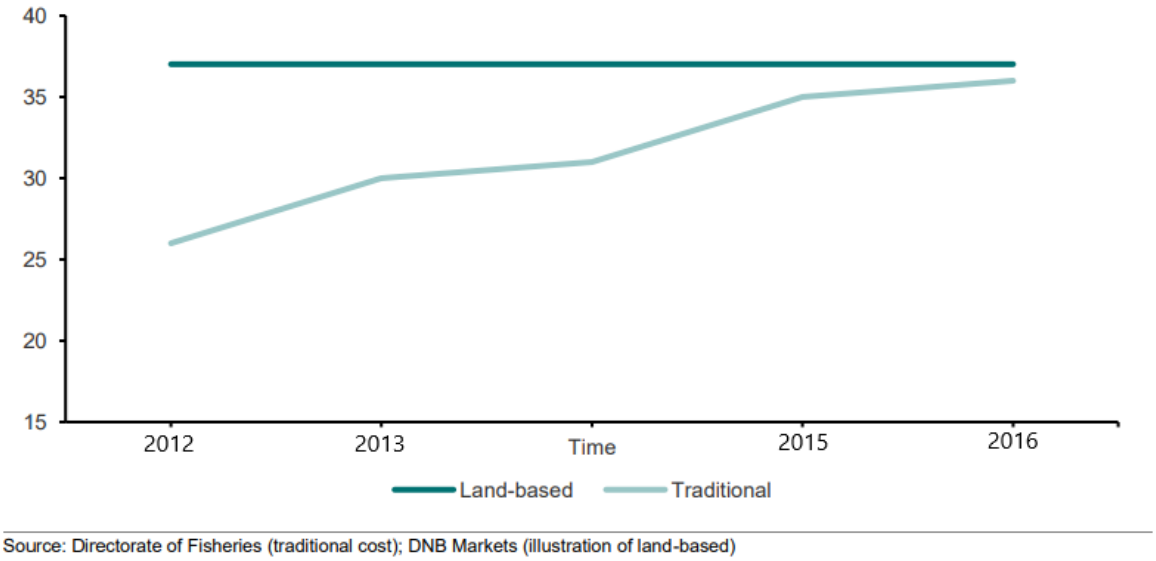
One of Salfjord's key advantages that reduces their costs are their choice of geographical position (Tjeldbergodden) and the potential partners (Equinor, AGA & TBU) that inhabit that area. These partners can offer Salfjord greatly reduced costs in form of cheap energy, already established infrastructure, easy access to required resources (Oxygen, electricity), buy-back value on land renovations and almost non-existent transportation costs on oxygen or electricity which are both important resources to Salfjord.

Being a land based facility also carries with it the benefit of not being subjected to the maximum limit of biomass allowed as defined by the Norwegian directorate of fishing (2016) and stated in the Aquaculture Operation Regulation. (Lovdata, 2008). The Biomass regulation states that the maximum amount of biomass allowed in the ocean is usually 780 MT per license for one particular farm with the exception of Troms and Finnmark whose license are up to 945 MT per license. Each license allows a farm to contain and produce their allotted biomass in fish of up to its limit and a farm can apply to have several licenses at once in order to increase the total amount of biomass they're allowed to contain and produce. As mentioned earlier, the important part of this restriction is that this specific limit only applies to ocean based fish farms which gives land based fish farms a definitive competitive edge in regards to area utilization (they're allowed and capable to house more fish within equally sized areas), reduced costs of licenses and reduced complexity of operations.
Land based fish farms still need to apply for a license to determine the amount of biomass they're allowed to produce annually but that doesn't follow traditional values and is decided on a case to case basis where the LB fish farm itself applies for a single license for the amount of biomass they are going to produce. Due to the strictly controlled environment of the fish in a closed containment farm, the increased fish welfare and the lower mortality; land based fish farms often have a trend of having a better area utilization compared with their ocean based competitors. (Salmond Evolution, 2019)

It is important to note that Salfjord AS is going to be a land based fish farm and thus it would make sense to assume that their competitors in the Atlantic salmon market would be other land based fish farms as well. The truth is that Atlantic salmon is predominantly supplied by sea based ONP fish farms which means that they have to compare themselves to the cheaper and more readily accessible alternative of fish farming. Ocean based farms as discussed earlier in chapter 3, have quite a few benefits by being easier to operate than land based farms due to them having more streamlined routines, less complex machinery, less need for scrutiny and constant vigilance and cheaper operating costs in terms of necessary auxiliary resources like oxygen and manpower. While Salfjord has a lot of advantages that reduces their costs, which would put them ahead of other land based farms and facilities or other ocean based facilities outside Norway, it might not give them enough of an advantage to put them ahead of traditional Norwegian ONP farms in terms of operating costs alone.

One important point to mention however is that traditional ONP farms are facing ever-increasing costs of production due to the increasing importance of vaccination, increased antibiotic treatments, increased pesticide treatments and higher mortality rates due to decreased fish welfare. (DNB, 2017)

Depicted below is a graph showing production costs of land based vs. ocean based fish farming.



Source: Directorate of Fisheries (traditional cost); DNB Markets (illustration of land-based)

Figure 13: Cost of production per kg HOG salmon

Salfjord and Salmon evolution can both report a projected cost of production roughly around NOK 40 when accounting for inflation in 2023 which coincides with the graph showing an average cost of production of NOK 37 for land based fish farms in 2017.
It is yet unsure whether cost-leadership might be a feasible strategy for Salfjord or not despite their cost-reducing advantages.
The specific data and information on exactly how much their advantages are worth is discussed in more in-depth in research question 2 and chapter 6: Findings.

5.1.2 Differentiation strategy

Differentiation strategies are based on distinguishing oneself from the competition, usually by means of providing unique products or services which hold superior value to a broad spectrum of customers according to Hales and Mclarney (2017).

It is important to note that a product that is perceived to be of higher quality or produced by a 'superior' brand increases the customers' willingness to pay higher prices for those specific products according to Akaichi, F. Glenk, K and Revoredo-Giha, C (2019).
A core part of the differentiation strategy is to generate more revenue from your product by marketing its value in how it is different from your competitors' products. The higher revenue generated by a higher price and a higher willingness to pay can excuse higher costs of production. (Porter, 1996)

Salfjord has chosen to differentiate themselves from the majority of its direct competition by utilizing a land based closed containment facility to perform what is essentially the traditional open net pen method of farming fish. This way they get to reap all the benefits of being LBCC and ONP without having to suffer many of the common pitfalls that is the difficulties and challenges present in RAS facilities and sea-based environments. (Salfjord Interview, 2019) Having all the benefits of a closed containment farm however gives them some very important differential advantages over their direct competition; quicker product growth, healthier product, reduced costs of medicinal treatment, reduced mortality rates and increased environmental friendliness as mentioned by Salmon Evolution (2019).

Due to the highly controlled nature of LBCC fish farms, they have a much more precise control over the fish's nutritional intake, their exposure to hazards like parasites, viruses and lice, the fish's stress levels and other factors that might affect product quality.
The survival rate of salmon is 95% in land based farming facilities as opposed to their ocean based counterparts which on average have a survival rate of 80%. (Salmon Evolution, 2019)

"Production on land have 30% better license utilization than with traditional open net pen farming in the ocean. The main factor for this is higher productivity, a more controllable environment and low mortality. The efficiency on land lends itself to cost saving." (Salmon Evolution, 2019)

"A highly controlled production environment, the water's quality parameters and an optimal and stable water temperature reduces the production time by 30% from 16 months in the ocean to 12 months on land. This gives a high yield of returns over time." (Salmon Evolution, 2019)

While all of these factors work in conjunction to either reduce costs or increase production which would fall under cost leadership theory, they also increase the overall quality of the product; ensuring it is disease free, lice free, not subjected to other parasites and other hazards in the ocean which affect fish welfare and quality. As a comparison, RAS technologies often utilized by other countries in which coastal areas are less abundant have disconcerting side-effects which generally is associated with reducing the quality of the product, something Salfjord has deliberately chosen to distance themselves from. (Salfjord Interview, 2019)

We believe that Salfjord has the opportunity to market the advantages of LBCC farmed salmon in order to differentiate themselves from their competition with a product that is perceived as more organic, more natural and more healthy compared to their ocean-raised counterparts whom are steadily being subjected to vaccines and antibiotics at a larger degree. (DNB, 2017)

Having a product that is marketable for its increased freshness, better health and better nutritional values than its competing products could be the future of salmon marketing as it opens up the possibility of Salfjord penetrating and competing on a global scale with a differentiation strategy.

These arguments all make a compelling case for Salfjord to be aim for becoming differentiation leaders in their market, instead of becoming cost leaders.

5.2 RQ 2: What unique competitive advantages do Salfjord AS possess?

In order to look at Salfjord's unique advantages as a business we have to discuss how Salfjord differentiates themselves from their competitors through the resources available to them, which is not available to their competition. This comes in the shape of availability of resources, reduction of costs and the ease or elimination of resource transportation.

5.2.1 Geographical advantages

The Salfjord general manager and founder were very particular in their choice of location for their farm, he wanted to maximize possible benefits.
The choice of location is arguably the biggest source of competitive advantages that Salfjord has access to as it gives them the potential to save hundreds of million in land renovation costs and tens of million in recurring annual costs.

Land development

Salfjord has bought land at Tjeldbergodden and is currently renovating it with the intent to use it for salmon farming as early as 2023. Their current plan is to develop 170 000 m^2 of developed land to house their 5 planned modules for adult fish and one module for hatching and raising juvenile fish into post-smolt and they still have a considerable amount of spare area for associated industry and potential partners. The geographical situation of Tjeldbergodden, with its unused land and open landscape, makes it ideal for Salfjord to

expand further should they need or want to upscale their operations further at a later date which is also enabled by their choice of farming methodology and technology.
(Salfjord Interview 1, 2019)

Salfjord states that their 170 000 m^2 of land contains as much as 6,000,000 m^3 of rocks and mountain that needs to be processed and renovated. To give a frame of reference 1 m^3 of mountainous rock found at Tjeldbergodden weighs 2.7 MT with its high density. The rock from the mountain/ground at Tjeldbergodden have a high quality compared to regular rocks and are really valuable in the asphalt production industry which have strict requirements and regulations with regards to their requirement to rock hardness, density and durability. The rocks at Tjeldbergodden is allegedly among the best in the region.

While one would regularly have to pay someone to remove the 16.2 million MT of rock, Salfjord has an agreement with a partner whom buys and transports the excavated rocks for them. The revenue generated from the transaction of rocks is used to finance the land development and as such is presented as a cost reduction element to the land development costs which are discussed in more details in chapter 6: Findings.

Liquid oxygen

One of Salfjord's goals is to come to an agreement with the LNG plant at Tjeldbergodden with regards to vertical integration and oxygen pricing. After a brief interview with both Salfjord and their oxygen supplier AGA we believe we have a good understanding of their situation. There has been no formal agreement yet as it is still between 3 to 4 years until Salfjord is operational and a lot of things can change in the meantime.
In regards to resource requirements Salfjord needs 4 000 MT of liquid oxygen for their initial phase and 20 000 MT of liquid oxygen when operating at full intended capacity of 36 500 MT HOG salmon in their final phase.

The agreement between AGA and Salfjord could include both unique and competitively priced oxygen and the possibility of vertical integration in the shape of a direct pipeline between the salmon farm and the LNG plant. If they manage to agree to a direct pipeline, they will virtually eliminate the cost of oxygen transport and storage which would translate to an average sum of NOK 5 600 000 per year while operating at full production capacity.

Børndal and Tusvik (2017) models the average costs of oxygen storage tanks to be around NOK 150,000 annually varying from NOK 100,000 to NOK 200,000. Børndal and Tusvik (2017) also models the average consumption to 0.5 kg of oxygen to each 1 kg of HOG salmon produced which coincides perfectly with Salfjord's estimate from our interview with them.

Bjørndal and Tusvik (2017) presents an annual requirement of 2,817 MT oxygen required annually at a price of 2.5 NOK per kg Salmon produced while Salfjord reports their annual demand as 20,000 MT oxygen. Salfjord has stated explicitly that they prefer their cost of oxygen to remain undisclosed, we will however make the assumption that their offered prices of oxygen will be more competitive than the average market price given their level of direct integration and partnership with their supplier. Børndal and Tusvik (2017) also models the average costs of oxygen storage tanks to be around NOK 150,000,- which presents another potential advantage that Salfjord possesses as they are working out the possibilities of a direct pipe-line to the LNG plant processing and delivering liquid oxygen. This might give them the opportunity to bypass the need for oxygen as inventory and thus all the costs associated with the storage and transportation of liquid oxygen, which is a decisively strong advantage in terms of costs.

Cheap energy

Salfjord has an immense advantage in the form of cost reduction on their electrical consumption due to a potential agreement with TBU. This will be explained more in-depth later.

Equinor have a methane plant on Tjeldbergodden which uses methane from the Haltan Pipe and converts it into ethanol, a process which infuses the water used to cool the system with a massive amount of energy. The process of the methane plant creates a very valuable waste-product called cooling water. The water is used to prevent the methane plant from overheating and as it absorbs the heat energy the water's temperature increases from 6 to 18 degrees as it is imbued with energy equal to 200 MW or 1.6 TWh of energy annually. This is approximately 1% of Norways' total annual electricity production. (Biopark, 2019)

Usually the heated water is of little value as it gradually loses the infused energy by means of dissipation and was mostly dumped back in the ocean to prevent costs to arise from stockpiling and transporting water.

Tjeldbergodden Utvikling AS (TBU) is the owner of the industrial area called the Biopark which as of now is utilizing the heated water for aquaculture production purposes, paying only a formal tariff to make use of the infrastructure necessary to transport and handle the water. The heat-infused water itself is given away free of charge and it is within Salfjord's ambitions and future strategy to be also be able to utilize cooling water from the methane plant in their aquaculture production. (Salfjord Interview, 2019)

Salfjord is currently in an ongoing negotiation of a partnership with Tjeldbergodden Development (TBU) which if concluded positively would give them immense cost reduction in the shape of cheap energy-infused water which will be used by the fish farm to keep their water at an optimal temperature. The energy of the water that would be available to Salfjord is estimated to roughly 26 Gigawatt hours annually.

Adjusting water temperature to optimal levels is one of the biggest cost items in terms of recurring costs for land based fish farms worldwide. If Salfjord manages to achieve their partnership strategy with TBU, they would have successfully covered at least half of the electrical costs of their first and initial building phase, as well as getting a significant recurring cost-reduction to electricity costs in the long run.

SSB, the Norwegian bureau of statistics places the mean consumption of electricity to an average household to be just a touch above 20 000 kWh back in 2012. This number have since increased to somewhere between 30- to 35 000 kWh per annualy in 2019 according to an employee of Istad Kraft AS, a power supply company in Møre og Romsdal. (Istad kraft interview, 2019)

In 2018 the annual mean price of electricity was 0.548 NOK per kWh not accounting for tax or network rent, (SSB Electricity prices, 2019) according to a brief interview with an employee at Istad Kraft AS he could however inform us that the they use a rule of thumb

for estimating the cost of electricity to an average user which is roughly 1 NOK per kWh if one take into account both taxes and network rent. (Istad Interview, 2019)

Salfjord estimates their installed power in regards to their pumping and emergency systems to be 75 MWhs for a fully operational facility and 80 MWhs annually when they include their hatchery module. The emergency- and pumping systems alone comes out to around twice the annual consumption of the average household. Bjørndal and Tusvik (2017) did a cost analysis on land based farming of Salmon and made a rough estimate outlining the electricity consumption of farms producing 5 MT of salmon. It is important to note here however that this model doesn't account for the salmon being HOG, which according to Salfjord's estimates skews the cost by roughly 20% downwards due to less processing. (Salfjord interview 2, 2019).
Their model predicted a cost of 4 kWh per produced kg of salmon. If we account for the addition processing to make the salmon HOG, the realistic consumption would increase to 4.2 kWh which is a stark contrast to Salfjord's 9 kWh consumed per kg of produced HOG salmon. Salmon Evolution estimates a firm middle-ground with an energy consumption of 6.7 kWh per kg of produced HOG salmon.
An important note is that Salfjord acknowledges that the price per salmon is pessimistic and not necessarily entirely accurate as they decided to go for a safer approach to forecasting by making sure they err on the side of caution instead of predicting a more favorable outcome.

Bjørndal and Tusvik also made the estimate of a 5 MT capacity farm to consume 20 million kWh annual. Bjørndal and Tusvik (2017) also outlines a rough 4,000 kWh consumption per MT of salmon production.

$$Estimated\ cost\ of\ production\ in\ kWh\ \cdot Maximum\ module\ capacity = Estimated\ consumption\ of\ energy\ in\ production$$

If we try to make it comparable to Salfjord's estimate by accounting for the 20% increase due to lost biomass in the HOG process and upscaling it to 7300 MT we end up at an expected value of 35,040,000 kWh or 35.04 Gigawatt hours annually per module. If we go by the Istad Kraft's rule of thumb each of Salfjord's 5 planned modules would cost them 35,04 million if we account for taxes and network rent.

$$9\ kWh/kg\ \cdot 7300\ Metric\ Tons\ annualy = 65\ 700\ 000\ kWh\ per\ Module\ annually$$

Using Salfjord's own estimated cost of production however, it becomes 9kWh multiplied by their module production of 7,300 MT of salmon or 7,300 000 kg which comes out to a production cost of 65,700,000 kWh or 65,7 GWh. If we multiply that by the number of modules, we get 328.5 GWh of consumption annually.
We could make two assumptions here; (1) we could assume that the reality of the cost of production fell somewhere between the provided value of 9 kWh per kg HOG salmon estimate and the modeled average of 4.2 kWh which would be between 35 GWh and 65 GWh and (2) we could assume that electricity used in the adult salmon modules make up their entire electrical consumption. Salfjord has given us their total annual power consumption which comes out to 400 000MWh or 400 GWh, which is higher than our expected 328.5 GWh and for all intents and purposes we will use the provided number on electrical consumption going forward.

A comparison that could be made to give context to how much 400 GWh of power is would be to compare it to how much an average household consumes.
Salfjord's fish farm operating at full size and capacity, using Salfjord's provided values, is comparable in electrical consumption to 12 307 average Norwegian households.
In practical numbers Salfjord's fully operational LBCC fish farm would cost somewhere around NOK 400 000 000 in electricity annually.

$$\frac{Energy\ imbued\ in\ purchased\ water}{Average\ expected\ power\ consumption}\ \cdot 100\% = Cost\ reduction\ in\ percentages$$

$$\frac{26\ 000\ 000\ kWh}{400\ 000\ 000\ kWh}\ \cdot 100\% = 6.5\%$$

During their first construction phase they would still get 26 GWh of energy but they would only have an expected consumption of 50 GWh, thus the percentage of covered costs becomes bigger:

$$\frac{26\ 000\ 000\ kWh}{65\ 700\ 000\ kWh}\ \cdot 100\% = 39.6\%$$

Salfjord, if we make the assumption that they come to an agreement with Equinor and TBU, have estimated the cooling water to cover 26 GWh of energy consumption annually which otherwise would have had to be heated with their own heating pump technology. This is very significant because this could reduce Salfjord's total expected electrical costs by up to 6.5% when they are operating at full capacity or it could cover 39.6% of the annual electrical consumption of their salmon producing modules in their first construction phase.

5.3 RQ 3: How does Salfjord's supply chain generate value?

Christoper (2016) outlines 3 different components that work together to create market shares, customer retention and return-on-interest; namely Supply chain efficiency, customer franchise and consumer franchise. To discuss how Salfjord's supply chain generates value outside their already established competitive advantages we have to touch upon their potential for marketing.

Salfjord has informed us of several steps they're taking to optimizing their supply chain as mentioned earlier in chapter 4. Their plans in the start is to import smolt from their investors until their hatchery module is running in a stable state at which point they will vertically integrate their smolt-importing link in their supply-chain to increase flexibility and reduce supplier costs. They will then import salmon roe (eggs) from commercial suppliers which is cheaper and less complex to purchase and transport than live fish.

On their buyer side of their supply chain, the Customer franchise, they haven't made any definitive decisions yet, but they have ambitions to create their own subsidiary company to be an intermediary between the farm and the global market. Outsourcing the transactional activities to a Salfjord-owned company reduces the workload and paperwork associated with the farm itself while still maintaining a quick response-time and flexibility that is hard to achieve with third parties that isn't in a mutual partnership.
Salfjord has also show interest in the newly created Norwegian Gannet, the world's first slaughtering boat which is a vessel that combines processing, transportation and sorting into one and thus circumvents several links in the supply chain while simultaneously increasing fish welfare, reducing wastage, reducing lead-times and increasing profitability.

(skipsrevyen, 2018) We will go more in-depth on this in the 'Vertical Integration' subchapter.

The benefit of integrating the links of the supply chain is compounded by the amount of links that this slaughtering boat integrates. It does the job of a well-boat, containing and transporting the fish. It is its own processing facility so there is no need for the shipment to be transported to a slaughtering facility or a holding pen which reduces both product lead-time and transportation costs and finally it takes the fish directly to the retailer or customers that bought the product from the fish farm.
This allows for the fish to be slaughtered on the hour leading up to the actual delivery of goods and thus retain its freshness and quality for much longer. Skipsrevyen (2018) puts this number to a 30% increase in fish longevity or quality retention.
It is proven in Poli et al. (2005) that the stress put on the product during transportation, storage, pre-slaughtering and the slaughtering itself can have severe negative effects on the product quality.

The product has been proven to be able to change for the worse in regards to both appearance and properties when exposed to stress. The changes to properties include changes in texture, firmness, elasticity, shrinkage, rigor mortis onset, nutritional values, K values and spoilage indicators. In regards to appearances a fish under duress will exhibit degradation in skin, eyes, gill colouration, smells and mucus membranes which in turn can greatly hurt their commercial shelf life.

On the consumer side Salfjord has stated that they're very conscious about their brand identity. They're prioritizing a clean, environmentally friendly operation and puts emphasis on increasing fish welfare as it is an important factor in competing on a global scale. (Salfjord Interview 1, 2019) Marketing your operations as both environmentally conscious and focused on animal welfare have proved to be a consumer-welcome alternative to an industry that is often perceived as profit-driven and uncaring. As discussed in the journal by Akaichi, F. et al (2019) it shows that some consumers are showing an increased willingness to pay more for products which originates from companies or brands which is perceived to exhibit priorities the customer deem ethical; including humane treatment of animals, animal welfare, a focused on preserving the environment and producing meat that is considered organic. Salfjord is an environmentally

conscious business with a strong focus on performing sustainable aquaculture and their product are considered more organic than their competitors' due to being raised in a LBCC farm without excessive vaccinations and antibiotic treatments. This is one area of focus that Salfjord might want to consider marketing if they want to pursue a differentiation strategy on the global market as they already fulfill the criteria that is associated with increasing customer's willingness to pay for a differentiated product. All these factors and components brought together holds the potential to provide value for Salfjord as a part of their supply chain in the shape of increased market shares in the future, improving customer retention, improving brand reputation and increasing brand value.

5.3.1 Water pumping

Salfjord has the luxury of ocean water readily available due to their strategic choice of location. This gives them the advantage that they can utilize the water directly through pumping systems which makes them able to farm salmon without utilizing RAS-technology. Salfjord utilizes a mechanical pond system of farming that constantly pumps and filters fresh water from the ocean while filtering and re-introducing used water back into the ocean. Their pumping technology operates at a 66% water retention rate with an installed power of 75 MWh.

5.3.2 Vertical Integration

In the initial start-up phase Salfjord plans to build a module capable of producing 7 300 MT of head-on-gutted (HOG) salmon. This module however is only intended to produce adult Salmonids at an average size of 5.5 KG from post-smolt weighing 600-1000g. Since Salfjord has no means of producing post-smolt themselves at this stage, they're going to have to import their post-smolt from someone else. Salfjord has discussed arrangements with their investors for them to supply post-smolt until they have developed their hatchery module and made it run in a stable state at capacity.

Salfjord has made the decision to perform an upstream integration of their smolt-supplier in order to ensure access to raw materials and to reduce costs in ways of transportation, transactional costs and complexity according to Porter (1980) and Fergusson (1993). After their first initial salmon producing module is able to run at capacity, their immediate next

step is to integrate their supply-side link by getting a smaller module intended for hatching eggs and growing baby salmonids to smolt size in different tanks. (Salfjord Interview, 2019)
By Harrigan's (1984) definition, Salfjord has a desire to do a full integration of their immediate closest supplier in order to eliminate steps in their supply chain and to reduce costs. It also carries with it the competitive benefits of giving Salfjord greater control of the company's economic environment and market power as well as making coordinating activities in that same link easier.

The ambition to integrate their immediate supply-links is not entirely without challenges or dangers. The integration offers Salfjord greater control over their activities in regards to post-smolt, but it also creates a need for coordinated activities where there before were none which could become a cost in both time and manpower.
It also carries with it the risk of producing products at excess or below capacity due to unevenly scaled operations, which could lead to bottlenecks or unexpected costs downstream in the supply chain.

While this constructing a hatchery module would eliminate the need for a direct smolt supplier, Salfjord is not planning to integrate the supply-side in its entirety as they still plan to purchase salmon roe for hatching purposes from commercial sources.
On the other side of their supply chain, Salfjord has ambitions to create a subsidiary company to function as an intermediary between Salfjord and the global market. This will reduce the workload for Salfjord and allow them to focus on core activities instead.

Salfjord also has wishes to involve innovative technology such as the world's first slaughter-boat named Norwegian Gannet in their operations. This a move that would integrate several links in their supply chain as it would reduce or eliminate their need for well-boats, transportation to processing plants or holding pens, transportation to the customer and the need to contract a processing plant to process their salmon into a consumer-ready product. As the slaughter-boat is one of a kind it is considered highly innovative and it brings along the benefit of increasing product quality by way of increasing product longevity, product freshness and reduced lead-time by circumventing traditional links in the supply chain which produces value for the end customer. (Skipsrevyen, 2018)

Slaughter boat

According to skipsrevyen (2018) the Norgwegian Gannet was christened in late 2018 and have a transport capacity of a thousand tons of fish while being able to process roughly a hundred tons an hour. The Norwegian gannet uses a hybrid engine for environmental reasons and their thousand tons transportation capacity is can to equivalent work of 50 to 150 semi-trailers of fish per weekend while emitting only half the carbon footprint of the trailers.

The slaughter boat can be a boon in aquaculture field as it helps in eliminating some issues that arises during transportation and harvesting of fish, which could save millions in terms of costs. The slaughter boat is a new and innovative method of transportation and slaughtering where the fish is received straight from the tanks and pens, for them to then be supplied to the market directly.

In 2018, the world's first and the largest slaughter boat named 'Norwegian Gannet' was created. The boat was constructed in Spain in 1921 by traditional Spanish yard Balenciaga Astilleros and is the largest boat the Spanish yard have made till date. (Skipsrevyen 2018) The vessel has been registered in Norway and has a homeport in Bergen. The shipping company Hav Gruppen AS owned the boat with a shareholders from the Haugland and Sekkingstad families. The boat is 94 meters long and 18 meters wide while being powered by a diesel electric hybrid engine. According to the site (Skipsrevyen, 2018) the boat is equipped with state of the art technology and conveniences including a bridge, cabins, a cafeteria, a cinema, a gym and a cutting edge slaughterhouse on board.
The Norwegian Gannet ensures the crew have the highest quality of recreational activities available in order to ensure high morale and crew satisfaction, which is believed to be reflected in an increase to workplace morale, increased quality of work and an increase to processed product quality.

According to Carl-Erik Arnesen, Hav Line's CEO, the boat provides various benefits in during fish harvesting and processing. Some of the benefits are described as following:

- The fish is taken directly from the fish farm via slaughter boat, processed inside the onboard slaughterhouse and transported directly to the market, reducing lead-times while increasing product quality and reducing costs.
- The boat has a processing capacity of about 100 tons per hour and it has carrying capacity of 1000 tons, which equals the transportation capacity 50 to 150 road-based trailers.
- The slaughter boat produces around half the carbon footprint of the abovementioned 150 transportation trucks and thus represent a boon to the environment and a consideration to those who focuses on performing sustainable aquaculture.
- Provides advantages of better fish welfare, better fish health and freshness, less shrinkage and longer shelf lifetime.

There has been made a case for which toxic algae and its potential for blooms presented in water often have a negative impact on the development of aquaculture (Shumway 1990). The algae flourishes quickly and it is a time-consuming process to clear the algae through traditional methods. A slaughter boat can be of great assistance as it can function as a well boat by temporarily storing fish from sea based ONP farms by quickly getting the fish out of the contaminated pens within few hours when there are outbreaks of algae in sea-based farms. This can in a pinch help save the value of farmed fish along the Norwegian coast.

5.4 Research question 4: Are Salfjord's operations ethical?

To answer this research question, we first have to discuss the definition of what it means to be 'ethical' in the context of aquaculture. Huntingford et al. (2006) and Diggles et al. (2011) defines ethical treatment as the implementation of activities and guidelines that increase the welfare of both farm animals and fish in aquaculture. Frankic and Hershner (2003) describes sustainable aquaculture as a whole to be part of ethical practices.

Salfjord's stance on the topic of sustainable aquaculture is that the environmental sustainability takes priority as far as the economic sustainability allows. Salfjord actually manages to address some of the important social and socio-cultural challenges like effective choice of areas for aquaculture and the long term maintenance of site suitability.

Salfjord which decided to go with a land based farm have situated themselves in very sustainable area that through their placement of the farm have secured themselves both access to resources and logistics routes ensuring they have a long-term continuity of production. The controlled nature of a LBCC farm increases their expected efficiency of converting resources into useful product (adult salmon) while also being very easily maintained without disrupting the nearby ecology and minimizing environmental impact with the future expansions and additions of modules planned by Salfjord. Salfjord has stated the wish to brand themselves as an environmentally conscious company and have a wish to have their corporate image being that of one capable and willing to make their operations sustainable. To achieve this Salfjord has invested a lot into purifying and filtering technology, boasting the ability to reduce the solids in their used water by up to 60% before it being reintroduced to the ocean. As a part of the environmentally friendly image we would imagine it being a good move for Salfjord as a corporation to also put a strong emphasis on fish welfare as it is known for decreasing costs and simultaneously improve public perception of the aquaculture industry.

6.0 FINDINGS

Here we will sort some of the numbers we have uncovered and make cost comparisons. If Salfjord were positioned at another location they would not benefit from the reduced annual costs with regards to oxygen prices, oxygen transportation, cheap energy and the reduced price of the required investment in land renovation. We used the municipality of Averøy as an example of another possible location for fish farming and how the same costs associated with land renovation, oxygen transport and oxygen pricing and electricity consumption changes for that location.

6.1 Land development

First, we will look at the land development situation which is a part of the unique costs associated with their choice of locations and completive advantages from Tjeldbergodden. Salfjord are currently in the process of renovating 170 000 m^2 of the land they own at Tjeldbergodden. (Salfjord Interview 3, 2019)
The rock from the mountainous area and the ground at Tjeldbergodden are of a high quality. The rock mined from Tjeldbergodden during the landscaping process have been reported to possess the hardness, density and durability required to be regarded as the best in the region in terms of fulfilling the requirements for being used in producing asphalt. One of Salfjord's partners have come to an agreement with Salfjord to buy their rocks as they are mined and excavated during the landscaping process which is currently ongoing at Tjeldbergodden. Salfjord is using the earnings from the partner to finance the renovation process itself, which greatly impacts and reduces the cost of current and future land renovations. (Salfjord Interview 3, 2019)

Right now, land renovation is estimated to cost between 450 NOK and 800 NOK per m^2 to be processed along the coast of Norway. The price is dependent on various factors and variables which we will not describe in this thesis. Taking into account the earnings from the agreement with the third party, Salfjord pays roughly 20-30 NOK per m^2 of land renovated which is a substantial difference in regards to costs. If we use an optimistic pricing of 600 NOK per m^2 in renovation costs, Salfjord would have had to pay NOK 97 750 000 more in required one-time financial investments should they have chosen so to locate their farm in Averøy instead their chosen location at Tjeldbergodden.

6.2 Oxygen

An important factor is Salfjord's possibility of getting direct pipe-lines to the gas plant at Tjeldbergodden which would reduce or outright eliminate transportation and inventory costs related to oxygen. They are also in a partnership position to be offered unique rates on oxygen that cannot be matched should they have chosen to locate themselves elsewhere, the lack of integration possibilities being cited as a reason.
(AGA interview, 2019)

As stated earlier Salfjord has a need for 4 000 MT of oxygen for their initial set-up and 20 000 MT of oxygen when their salmon farm is working at full capacity.
Bjørndal and Tusvik (2017) estimates the average price of oxygen at NOK 2.50 per kg which translates to NOK 10 000 000 annually at the first stage of production or NOK 50 000 000 at full capacity. This is contrasted by the information given to us by AGA in which they describe the potential for giving Salfjord rates as low as NOK 0.10 per kg of oxygen purchased should they manage to find an agreeable partnership. This advantage generates a cost reduction of NOK 2.4 per kg of oxygen purchased. The partnership rates translate oxygen to costs of NOK 400 000 in the initial phase and NOK 2 000 000 when working at full capacity. That is a differential in costs of up to NOK 48 000 000 annually.

When it comes to the transportation of oxygen it involves a several step process; oxygen has to be loaded into tanks, the tanks have to be loaded on board a transport vehicle, the vehicle have to pass different barriers (tollbooths and ferries for ground vehicles), the vehicle have physically transport the product and both distance and carry capacity is a factor here. The semi-trucks frequently used by Salfjord's oxygen supplier AGA have a transport capacity of up to 28 MT of oxygen per vehicle.
With a total requirement of 20 000 MT of oxygen with 5 modules, each of them requiring 4 000 MT of oxygen each, the price and transportation costs of oxygen becomes an important factor as well as the logistical challenges of transporting 715 truckloads of oxygen annually.

AGA puts the cost of transportation to NOK 0.25 per kg of oxygen for the transportation route from Tjeldbergodden in the municipality of Aure to the municipality of Averøy

which spans 110 km. Transportation of 4 000 MT of oxygen across the 110km would come out to NOK 1 000 000 annually or NOK 5 000 000 at full capacity.
Bjørndal and Tusvik (2017) puts the price of oxygen inventory at NOK 150 000 per 5 000 MT annually due to investment in oxygen tank equipment and tank value depreciation.
If Salfjord were to put its salmon farm in Averøy instead of their chosen location at Tjeldbergodden they would have to pay for oxygen transportation, market value oxygen costs and cost of oxygen storage which collectively comes out to NOK 11 150 000 in their initial phase and NOK 55 600 000 annually at full capacity excluding the logistical costs involved in planning and handling the routing for 715 semi-trucks annually.

6.3 Electricity

The last major geographical advantage Salford could benefit from with its strategic location at Tjeldbergodden is the energy-imbued water they could get from the Tjeldbergodden Methane plant which as mentioned earlier could save them upwards of 26 GWh in electricity which comes out to a total of NOK 26 000 000 in value which is subtracted from the expected value of NOK 250 000 000.

6.4 Costs Summarized

This table shows the relevant costs based on location at full production capacity to showcase the impact of Salfjord's geographical competitive advantages acquired by their choice of location.
The investment costs are converted to annual costs by spreading them out over 20 years of production without accounting for inflation or interest as it would add unnecessary complexity to the equation. 20 years were decided on as a realistic lifespan of a project.

Costs	Tjeldbergodden	NOK	Averøy municipality	NOK
Oxygen costs	NOK 0.10 per kg	2 000 000	NOK 2.5 per kg	50 000 000
Oxygen transport	-	0	NOK 0.25 per kg	5 000 000
Oxygen storage	-	0	Tanks of 5 MT of oxygen (NOK 150 000 ea.)	600 000
Electricity consumption	65,7 GWh per module (5 modules) + Other.	400 000 000	65,7 GWh per module (5 modules) + Other.	400 000 000
Methane plant agreement	26 GWh provided	-26 000 000	-	0
Total annual costs w/u investments		**376 000 000**		**455 600 000**
Land renovation	NOK 25 per m^2	4 250 000	NOK 600 per m^2	102 000 000
	Divided by 20 years	212 500	Divided by 20 years	5 100 000
Total Annual costs:		**376 212 500**		**460 700 000**

Table 3: Region specific costs of Oxygen, electricity and renovation.

If Salfjord decided to build their operation in another part of Norway, without the competitive advantages offered by Tjeldbergodden and their partners, they would have to invest 97.75 million NOK more in land development and pay 79.6 million NOK more in electrical and oxygen related costs every year.

If we translate the renovation costs into increased annual costs evenly spread across 20 years we can see that Salfjord's competitive advantages amounts to a recurring total value of NOK 84 497 500 annually.

An interesting fact about their competitive advantage being valued at NOK 84 497 500 annually is that this is will eventually be reflected in Salfjord's costs of production.
As of now Salfjord has estimated their costs of production to around NOK 40 per kg of HOG salmon produced accounting for their competitive advantages.

$$\frac{The\ cost\ settling\ elsewhere\ annually}{Salmon\ produced\ in\ kg\ annually} = value\ of\ competitive\ advantage$$

$$\frac{84\ 497\ 500\ NOK}{36\ 500\ 000\ salmon\ produced} \approx 2{,}31\ NOK\ per\ kg\ salmon\ produced$$

From these numbers we can see that if Salfjord had chosen to place their operations in Averøy municipality, without all of Tjeldbergodden's advantages and assuming Averøy does not introduce its own unique advantages, the associated increase in cost at 84.53m NOK annually translates to an increase in production cost of NOK 2.31 per kg HOG salmon produced.

As of the moment of writing the export prices of salmon is NOK 65.48 per kg according to SSB. At an expected production cost of NOK 40 per kg of HOG salmon produced there is an expected profit of NOK 25.48 per kg of exported salmon. An increase in production costs of NOK 3.31 translates directly to a decrease in expected profits by the same amount which comes out to an expected profit of NOK 22.15 per kg of HOG salmon sold.

From this we can see that a farm placed at Tjeldbergodden has an expected profit of 15% more than an identical farm placed in Averøy per kg of exported salmon when accounting for increased costs of production.

7.0 CONCLUSIONS

To conclude our analysis of Salfjord's situation we find it proper to start with our problem statement:

What differentiates Salfjord AS from its competition and
how do they intend to generate value from their supply-chain management?

To answer the problem statement, we will summarize the topics addressed in chapter 5 and 6. Salfjord is a LBCC farm whose main competition is traditional Norwegian ONP farms. Salfjord's strategic advantages is built on their careful selection of the location to build their fish farm whose advantages includes neighbors that is open to partnerships, a highly suited area that is effective both for the purpose of land development and aquaculture.

The area is suited to aquaculture by enabling long term maintenance and continuity of production, availability of resources at a reduced cost and the ability vertically integrate parts of their supply chain to increase the value it generates. It is also suited to land development due to the rocks found in the ground and the mountainous areas being of a high quality to the point where they can be sold for a profit to a third party in order to almost entirely finance the land development itself.

This is in addition to all the strategic advantages Salfjord benefits from by investing in LBCC technology which makes them very suitable for pursuing a differentiation strategy when trying to penetrate the global market.

The controlled and precise nature of being a LBCC farm allows them a high degree of tailoring the product's environment and by extension its quality. This increases fish welfare by reducing mortality, decreasing stress, decreasing exposure to environmental hazards, parasites, diseases and threats.

The increased wish welfare can lead to a higher quality of product which is can conceivably be considered differentiated enough to be marketed and sold as a high-class product in the future and thus allow for Salfjord to differentiate themselves from the competition and for the successful execution of a differentiation strategy in the global market.

Salfjord's main focus is to perform sustainable aquaculture which comes with its own benefits to both brand name, fish welfare and the environment.

Outside the qualitative advantages that is gained from Salfjord's choice in location it has also given them quantitative advantages which is realized in immediate potential reductions in investment- and recurring annual costs.

If Salfjord decided to place their salmon farm at a place without their partners within close proximity, the high quality soil and the option for cheap electricity it would have costed Salfjord roughly 98.6 million NOK extra in land development investments to clear out the 170 000 m^2 area and 79.6 million NOK annually in extra electrical costs and the transportation, storage and purchasing of oxygen.

If you spread out the cost of land development evenly across 20 years in order to make them an annual cost, the differential annual costs rise from 79.6 million NOK to 84.50 million NOK. Translating the annual costs into increased costs of production shows that one can summarize the competitive advantages of Tjeldbergodden into an increased estimated profit of NOK 2.32 per kg of produced HOG salmon or a 15% increase in estimated profit from an identical operation not located at Tjeldbergodden.

These are all factors and variables that differentiates Salfjord from their competition and Salfjord intends to generate value from their supply chain by integrating activities where at all feasible, by increasing customer satisfaction and reducing lead-times with the deliveries of a high quality product and from investing in innovative technologies and options like the Norwegian Gannet which could very well be the future of global fish transportation.

8.0 APPENDICES

8.1 Appendix A – References

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8.2 Appendix B – Interview guides

Salfjord Interview 1 (2019)

Duration in minutes	Task
10	**Introduction**
2	Introduce ourselves and our goal.
2	Ask permission to record conversation.
6	Ask the general manager to introduce himself and the possibility to share information and data.
34	**Interview Questions**
11	Questions about investments
8	Questions about production
15	Questions about resources (Oxygen, Electricity, Feed)
24	**Discussions**
5	Salfjord's goals
6	Potential partnerships
13	Being a land based fish farm (Pros and Cons)
5	**Conclusion**
2	Verify resource numbers
1	Ask permission for further contact
1	Discussion about future means of contact
1	Thank company representative for their time.
TOTAL TIME IN MINUTES	
73	

Salfjord Interview 2 (2019)

Duration in minutes	Task
1	**Introduction**
1	Introduce ourselves.
13	**Interview Questions**
8	Questions about Vertical Integration plans
2	Questions about Ownership
3	Questions about production clarifications
10	**Discussions**
10	Discuss Vertical Integration
3	**Conclusion**
2	Verify numbers
1	Thank company representative for their time.
TOTAL TIME IN MINUTES	
37	

Salfjord Interview 3 (2019)

Duration in minutes	Task
1	**Introduction**
1	Introduce ourselves.
17	**Interview Questions**
10	Ask questions about personal opinion on competetive advantages
7	Clarifactions on land ownership
10	**Discussions**
15	Discuss renovations
3	**Conclusion**
2	Summarize numbers.
1	Thank company representative for their time.
TOTAL TIME IN MINUTES	
31	

Istad Interview (2019)

Duration in minutes	Task
2	**Introduction**
2	Introduce ourselves and our goal.
5	**Interview Questions**
5	Ask about average power consumption and prices.
5	**Discussions**
5	Discuss possible options for discounts on energy.
3	**Conclusion**
2	Summarize numbers.
1	Thank company representative for their time.
TOTAL TIME IN MINUTES	
15	

AGA Interview (2019)

Duration in minutes	Task
5	**Introduction**
5	Introduce ourselves and our goal.
30	**Interview Questions**
5	Questions about oxygen pricing
15	Questions about oxygen transportation. (Provide example for clarification)
5	Questions about oxygen storage.
15	**Discussions**
15	Discuss potential differences in prices: Tjeldbergodden and Averøy
4	**Conclusion**
3	Summarize numbers.
1	Thank company representative for their time.
TOTAL TIME IN MINUTES	
54	