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An investigation in Norwegian seafood air cargo operations

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# An investigation in Norwegian seafood air cargo operations

A cross-sectional study of Oslo Airport Gardermoen

Master of Science in Business

Major in Logistics, Supply Chain Management and Operations

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## List of abbreviations

3PL	Third-Party Logistics
ANS	Air Navigation Services
CCL	Cold Chain Logistics
COVID-19	Coronavirus Disease
CTK	Cargo Tonne-Kilometres
GDPR	General Data Protection Regulations
GPC	Gardermoen Perishable Center
IATA	The International Air Transport Association
ICAO	International Civil Aviation Organization
IT	Information Technology
NHO	Confederation of Norwegian Enterprise / Næringslivets Hovedorganisasjon
OSCC	Oslo Seafood & Cargo Center
OSL	Oslo Airport Gardermoen
RFID	Radio Frequency IDentification
SSB	Statistics Norway / Statistisk Sentralbyrå
TTI	Time-Temperature Indicator
ULD	Unit Load Device

## IATA 3 - Letter Codes of Airports

*40 largest export airports from OSL. Sorted alphabetically.*

*Used in Figure 8. Total shipment weight with destination over the last 3 years.*

BEY	Beirut
BKK	Bangkok
BOS	Boston
CAN	Guangzhou
CGK	Jakarta
CPT	Cape Town
DMM	Dammam
DOH	Doha
DXB	Dubai
EWR	New York City
FLL	Fort Lauderdale
FUK	Fukuoka
HAN	Tokyo
HKG	Hong Kong
ICN	Seoul
JED	Jeddah
JFK	New York City
JNB	Johannesburg
KIX	Osaka

KUL	Kuala Lumpur,
KWI	Kuwait
LAS	Las Vegas
LAX	Los Angeles
MIA	Miami
NRT	Tokyo
OAK	Oakland
ORD	Orlando
PEK	Beijing
PVG	Shanghai
RUH	Riyadh
SAN	San Diego
SEA	Seattle
SFO	San Francisco
SGN	Ho Chi Minh City
SIN	Singapore
SJC	San Jose
TLV	Tel Aviv
TPE	Taipei
YUL	Montreal
YYZ	Toronto

## Abstract

Seafood is the third largest export product in Norway, after oil and gas. Sea fishing and aquaculture activities produced approximately 930 thousand tons of seafood for the industry in 2019. Markets outside Europe require air transportation in order to get the fresh commodities to market on time. This investigation looks at the structure and efficiency related to the shipment of these goods that go through Oslo Airport Gardermoen (OSL).

We present and investigate the research questions “*What are the key dynamics, challenges and opportunities of seafood export handling at Oslo Airport Gardermoen?*”.

Theoretical relevance to support our investigation and study is found in our comprehensive literature review. We have analysed literature regarding air cargo operations, relationship management, cold chain logistics and terminal requirements in efficiency planning.

We have utilised a qualitative strategy with a cross-sectional design. Semi-structured interviews have been conducted with Avinor, airport forwarder and terminal owners at OSL. These focused on current challenges, future potential, and requirements to be achieved for a successful capture of the expected increase in market demand.

Our investigation and findings show that there is potential for improvements surrounding information flow between actors in the value chain, where much of the uncertainty and volatility is found. Opportunities exist to improve capacity utilization through better coordination and infrastructure planning. Air cargo operators at OSL are aware of the underlying problems and opportunities that exist, but struggle to coordinate their efforts. Operators at OSL could not only improve current operations, but also to capture a greater market share by proactively preparing for the future market demand.

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# 1.0 Introduction

In a world of increasing competition, a clear strategy for meeting expected demand is crucial and more important than ever before. In the air cargo facilities of the future, humans and machines work in harmony to offer both higher efficiency and superior customer service. According to the International Air Transport Association (IATA), the total air cargo industry is expected to grow at a rate of 4.1% during the forecast period 2020–2027, even with the current effects of the global pandemic (IATA, 2018; Kim et al., 2020). Norway is the world's second largest exporter of fish and seafood, and the industry is expected to further increase its contribution to the national economy (Johansen et al., 2019). Additionally, the farming of Atlantic Salmon has the potential to grow by a factor of five by the end of 2050 (Fossheim & Gabrielsen, 2012). These prospects in the growing need for air cargo services provide great opportunities for the export of fresh fish to the fastest growing markets outside Europe from OSL.

Airlines, dedicated freighters and changing market powers affect the dynamics that could potentially be an impediment for future growth in seafood export from OSL. The airport, freight forwarders, terminal owners and airlines all benefit from an increased export, thus all share an interest in improving their services to attract new customers (Van Asch et al., 2019). Due to the extensive supply chain found in transport of fish, the dependency on each contributor is high. Consequently, this demands greater emphasis on how to efficiently mitigate existing issues found within the value chain in addition to preparing for the coming decades by all participants.

## 1.1 The Norwegian seafood logistics

The seafood industry makes up a substantial part of Norwegian exports. In 2019 sea fishing and aquaculture activities produced approximately 930 thousand tons of seafood for the industry. 23,7% of this was then exported by planes to markets outside Europe (Nerdal, 2020). However, most of the air cargo does not

go through Oslo Airport. According to the previous CEO of Avinor, Dag Falk-Petersen, only 30% of this went through the airport. The remaining percentage end up on trucks before being transported out of major hubs in Europe such as Schiphol Airport in Amsterdam and Heathrow in London. These major hubs serve as a connection for a vast number of airlines and freighters to bring the commodities onwards to abroad markets.

With this dynamic in mind, investigating how the seafood supply chain operates at OSL, which is the main export facility for Norwegian seafood exports, is imperative. The natural resource is produced along the whole Norwegian coastline, and as of 2019 there were 1100 fish farms spread along the whole coast. According to Miljødirektoratet (2020), these farms produced close to 1,4 million tonnes of seafood in 2019 alone, where over 50% of the world's demand for Atlantic Salmon can be found. Most of the commodities are transported to larger slaughterhouses before being transported to market. Fish and other by-products of the harvest are processed, packed or frozen before it is moved. The products are then driven directly to market or another consolidation facility where it is then repackaged and then shipped towards the end consumer (Transportutvikling AS, 2020).

The seafood that ends up at Oslo Airport is then handled by one of the two seafood terminals, namely Gardermoen Perishable Goods and Oslo Seafood & Cargo Center, henceforth referred to as GPC and OSCC, respectively. These are both private corporations who handle full-freighter aircraft, ensuring that all shipments are handled in compliance with IATA regulations (Avinor, GPC & OSCC, 2021). The exported goods are mainly shipped towards markets in Asia, North America, Middle East and to a lesser extent the African market from OSL.

It is worth noting that the seafood shipment is physically transported first by a trucking company and then an airline company. However, the logistical operation is usually organized by a freight forwarder that coordinates the operation between the seller and the buyer. These companies typically do not own the transportation assets but only rent the service in order to get the product to market.

## 1.2 Oslo Airport Gardermoen (OSL)

Oslo Airport is Norway's largest airport, located 35 km northeast of Oslo. It is a major passenger hub and home to airlines such as Widerøe, Norwegian Air Shuttle and Scandinavian Airlines. It is also a connection point for 26 domestic and 158 international destinations. The airport is operated by Avinor, a government owned stock company, and boosted to NOK 8,2 billion in operating income for 2020.

For years, the commercial focus of OSL has been primarily centered around passenger traffic, with efforts to boost cargo transportation taking a backseat. The fierce competition between airports to attract airlines has created a greater need to facilitate other income streams as well. Transporting cargo in the belly of passenger planes is a good example of how airline companies can profit from both passenger and cargo traffic.

Avinor is a major operator of airports in Norway and the owner of 45 airports located around the country. Even though the company is owned by the state it operates very similarly to a private company. Its operations are financed through income from operation fees from the airlines (46%), commercial rent revenue and direct sales to passengers (54%), (Avinor Annual Report, 2020). Avinor also collects some revenue from other actors such as the Norwegian Air Force. The financing model for the Norwegian airport network operates in such a way that the big and profitable airports such as Oslo Airport, finance the smaller and less profitable airports. Because of the drastic fall in revenue from the pandemic, Avinor last year received a capital injection from the Department of Transportation (Avinor Annual Report, 2020).

Oslo Airport faces strong competition in terms of seafood air transportation from airports such as Helsinki, Copenhagen, and Schiphol. For a lot of the fisheries located in the north of Norway, it is closer to drive to Helsinki Airport instead of OSL. The low barrier of entry for transporting seafood also means that there is always a risk that other airports will join in on the action if the

margins suddenly start to grow. This puts a constant downward price pressure on the airport and terminal operators.

### 1.3 Motivation

2020 was a dramatic year for Norwegian and international aviation. The COVID-19 pandemic caused a drastic reduction in the number of passengers. Oslo Airport saw its passenger volume reduced by 63% compared to 2019. This included a 36,7% drop in the number of total landings and take-offs, as well as a 53,7% reduction in international flights (Avinor Annual Report, 2020). All of this illustrated the vulnerability of our current aviation-based supply chains, as well as the overall aviation industry.

The air cargo market was however less affected by the pandemic than passenger transport. Even though this market is traditionally dependent on passenger flight, especially for intercontinental flights, the market has been relatively stable. This has been partly due to a strong shift towards dedicated cargo planes, and the swift decision from operators to adjust their fleet in the current pandemic. This has allowed OSL to maintain most of its cargo capacity. This stands in contrast to a lot of other airports which have seen significant reduction in their capacities.

### 1.4 Problem statement and research question

This master thesis aims to explore the challenges surrounding logistics of seafood export from OSL. This includes looking into potential inefficiencies of the seafood export operations. The thesis also explores how these actors interact with their downstream and upstream partners. They receive seafood primarily from trucks which are then repacked before being loaded onto the belly of passenger planes or dedicated cargo planes. However, with the increased volume there is growing pressure on the capacity of the infrastructure. This situation is summed up in the following research question:

*What are the key dynamics, challenges, and opportunities of seafood export handling at Oslo Airport Gardermoen?*

To investigate this, we have conducted a cross sectional design. This allows us to take the assumption that the nature of the relationships between the actors can change over time. However, this can make it more difficult for the study to prove its validity for different time periods. Through semi-structured interviews with the relevant industry actors, the cross-sectional study explores the situation of the current supply chain network. It looks at the diverging and common interest of the players, and their thoughts on how the current situation can be improved, as well as what the main challenges are. It also incorporates data collected from seafood brokers to analyse trends and patterns of seafood exports from OSL.

### 1.5 Value of the research

The purpose of the research is to contribute to the knowledge around aerial logistics of seafood. There seem to be less documentation and literature on this type of focus area compared to regular passenger transportation. Through this paper we hope to strengthen the academic foundation of air cargo operations, and especially for perishable goods such as fresh fish. Given the strong growth in the sector and potential capacity problems in the industry, the relevance of investigating how to increase efficiency in its operations is arguably of great importance. By investigating the viewpoint of the various actors operating at OSL we hope to highlight aligning interests, problems, and opportunities, and try to present the findings in this paper.

Additionally, given the massive impact of the pandemic it is clear that air cargo supply chains are vulnerable to global disruptions. The current situation has resulted in the grounding of entire airline fleets and induced great costs upon all actors in both passenger and cargo operations. This has given understanding and motivation as to why it is important to continue and add upon the lacking literature surrounding air freight logistics.

We hope that this research can be useful for OSL, terminal operators, seafood forwarders, and the airline companies operating to and from OSL. Potentially, this research could help alleviate certain problems the seafood transportation is

currently dealing with. As the pressure to export increasingly more quantities of seafood increases, we believe it will become ever more important to have efficient supply chain systems related to these products. By highlighting inefficient logistics, we aim to uncover hidden costs or opportunities for missed revenues. This can however be quite challenging when the supply chains become very complex and there is low transparency. The research can also prove valuable when considering the effects of increased transparency between the actors within the industry.

## 1.6 Thesis Structure

This thesis is divided into several differentiated sections. Firstly, we give a general introduction to the industry, situation, and problem. Secondly, we look at the relevant literature, which includes topics related to seafood handling and transportation, aviation, and air freight. Thirdly, we go through the methodology of the thesis. Next comes a situational analysis based on multiple interviews conducted with relevant industry actors. The situational analysis looks at dynamics of the terminal setup and seafood exports operations. To accomplish this however, it is important to get a good picture of all the different actors and stakeholders involved in the process. By examining the driving forces involved in seafood export through air freight we can uncover critical dynamics that are essential to understand the current system.

Our findings, discussion and conclusion which builds on a combination of collected literature, interviews with industry insiders and export data collected from freight forwarders and brokers will conclude the paper. Additionally, suggestions for future research as well as a limitation of the study is found here.

## 2.0 Literature review

Following our problem statement, this literature review has been methodologically used to find and investigate research undertaken within the air cargo operations industry and used as a base for our study. The objective of air transport is to provide mobility to passengers and/or cargo, through the services from one place to another. As this research is dedicated to cargo transport and terminal operations, we will focus on these aspects and leave aside passenger transportation.

Three main categories were identified to extract relevant information: air cargo operations as an overview, transportation of perishable goods and terminal requirements. The study will advance knowledge within the different categories by investigating factors that could affect the efficiency, quality, and sustainability within each. The categories are closely linked to each other, but it is evident that there exists knowledge gaps or lack of literature within most of the air cargo operations aspect of found literature. However, it must be noted that following the ongoing pandemic, there has been a massive increase in literature surrounding the uncertainty and volatility within the air freight services.

### 2.1 Market expectation

Norway's export revenue has always been dependent upon the resources that could be found along the coastline (Johansen et al., 2019). It can be said that the seafood industry is important for the national economy in two ways. Firstly, as a direct export and revenue generation. Secondly, as employment and value creation along the coastline, and especially in Northern Norway. The Norwegian seafood industry is expected to increase and remain a stable contribution to the national economy. The expectations and potential are high for the industry to increase in both direct volume and greater utilization of the circular economy. Additionally, the supplier industry associated with the fish value chain is also growing in pace with the overall export. The potential for exporting Atlantic Salmon has the potential to grow by a factor of five by 2050,



and is expected to be a main objective in terms of future marine and national strategies for the economy (Fossheim & Gabrielsen, 2012; NHO, 2016). It is important to be aware that the fisheries and aquaculture are both government-regulated in Norway.

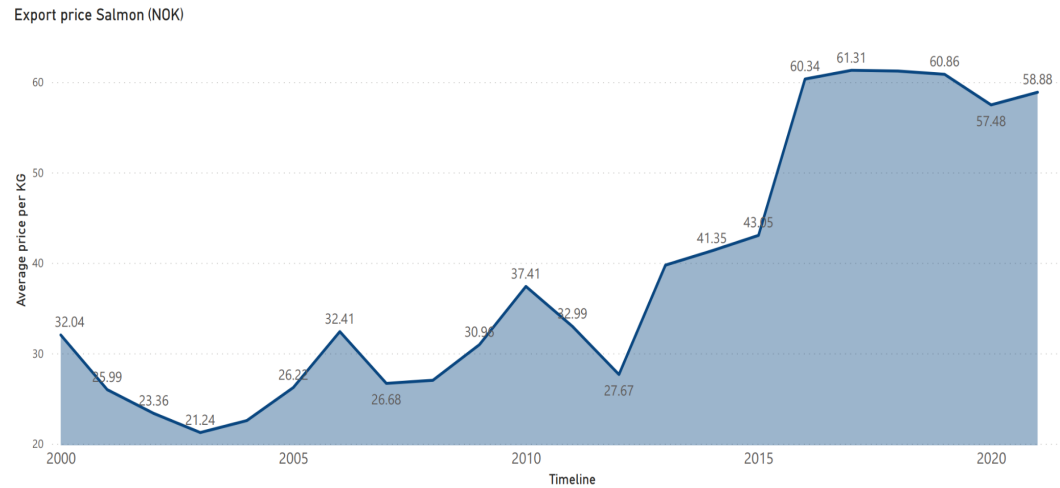


Figure 1. Export prices per year (SSB, 2021)

As presented above we see the historical, average prices of salmon export from Norway which has clearly increased over the last 10 years. However, as the current pandemic greatly impacts the export of fresh fish by air cargo, the growth is expected to be relatively marginal during 2021 (Kim et al., 2020; Poulsen, 2020).

## 2.1 Definition of value chain

Before addressing the air cargo operations literature, we define what a value chain is, and certain terminology used throughout the thesis. As defined by Schmitt & Gollnick (2016, p3) “air transport, by nature, is an abstract service, performed by various contributing stakeholders, like the airline, the airport, the air navigation services (ANS), and the aircraft and its manufacturer respectively”. Furthermore, air transport services can be divided into separate groups. These two groups are upstream and downstream segments (Tretheway & Markhvida, 2014). The upstream sector consists of manufacturers, leasing firms, infrastructure (airports, terminals, storage), and other suppliers of

necessary services for daily operation. The downstream sector consists of passengers and cargo (forwarders, cargo operators, terminal operations).

Furthermore, air cargo transport consists of a series of services from origination to planned destination. These services are moving cargo through a shipper, a forwarder, road transport, an airline (or carrier), and a consignee (Derigs et al., 2009). The sender, or shipper, requires a certain service level and price for the commodity. The forwarder, or broker, acts as a negotiator for the sender and desired cargo airline. The road transport carries goods both before and after the air cargo transport. At the other end, the consignee receives the shipment. Figure 2. depicts the general process of air cargo transportation.

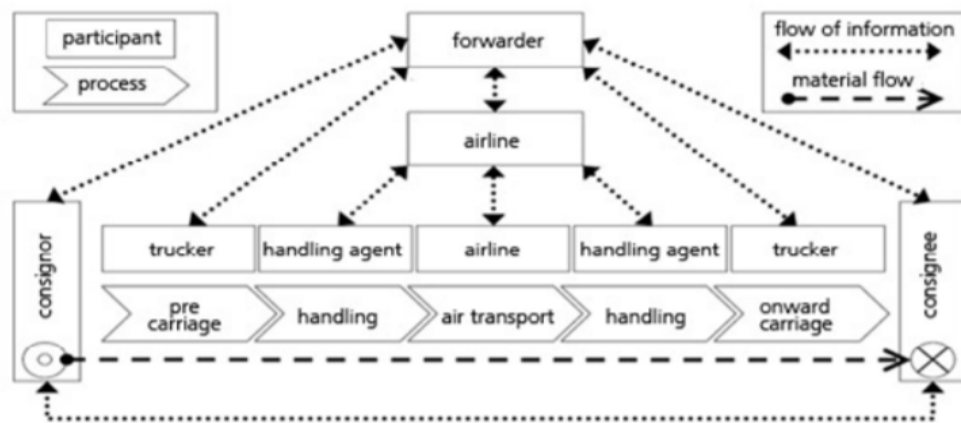


Figure 2. Air cargo transportation process (Clausen et al., 2013)

The objective of air transport is to provide mobility to passengers and/or cargo, through the service of a flight from one destination to another. As this research is dedicated to cargo and storage operations, we will focus on the flow of the same, leaving aside passenger transportation other than combined passenger and cargo transportation.

Because it involves more players, sophisticated processes, varied weight and volume, network processes and priority services, air cargo transport is much more complex than passenger transport. The differences have been discussed thoroughly in numerous articles, but it can be summarized in three main categories (Bartodziej et al., 2009; Leung et al., 2009; Y. Li et al., 2009; Wong et al., 2009).

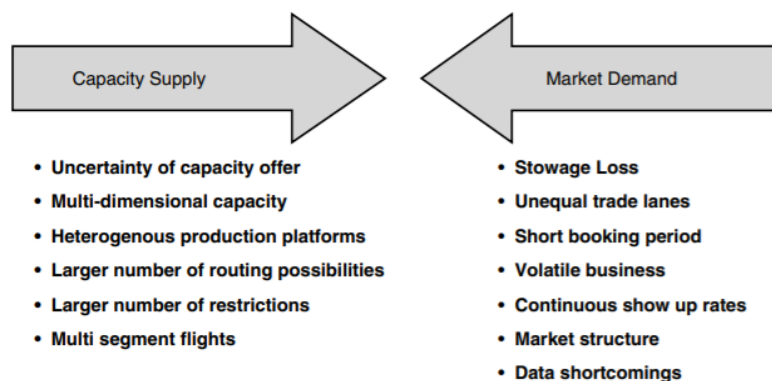
### Uncertainty

The capacity for cargo is volatile and uncertain until the time and date of departure (Becker & Dill, 2007). Freight forwarders must pledge to the use of capacity on their booked flights, and often a substantial amount of time beforehand. This can range from weeks, to even a year beforehand (Amaruchkul et al., 2011). Amaruchkul also states that freight forwarders usually do not have to pay for unused capacity, giving the incentive to book more flights than the required capacity. This can also present immoral competition. These conditions give air cargo transport greater uncertainty than passenger transport when you consider available capacity. Petersen (2007) further adds to these claims stating that the booking process is presented with considerable volatility.

### Complexity

Air cargo operations depend on something called unit load devices (ULDs), and not passenger fixed capacity forecasting as normal flights. Multiple dimensions must be considered when transporting by air. Some key elements are (in addition to the load unit size itself) weight, temperature, centre of gravity of the aircraft, type of goods etc. (Leung et al., 2009). Being within the parameters of weight and volume are rarely enough for a successful loading ...

Becker & Dill (2007) defines the complexity drivers in air cargo management into supply (capacity offer) and demand (shipment, customer, and market structure) based complexity.



*Figure 3. Demand- and supply-driven drivers of ACRM (Becker & Dill, 2007)*

Additionally, cargo airlines however lack competitor information to act accordingly. This is due to mainly two reasons: Firstly, the multitude of different tariffs, rates, long-term agreements, and other pricing tools. Secondly, a larger number of bookings is made on spot markets, where prices are formed on an ad hoc basis. Meaning directly between forwarder and airline representative when needed for a particular purpose (Becker & Dill, 2007).

### Flexibility

Unlike passenger airline markets, the air cargo operations already inherit a certain degree of flexibility, and especially within the parameters of changes in contracts (Gupta, 2008). These contract changes usually concern shipment increase, change in charge due to lack of cargo space and pre allocations to increase overall sales as forwards benefit from selling as much of their allocated cargo space as possible (Thuermer, 2005). Generally, major airlines operate so-called hub-and-spoke networks. This means that both passenger and cargo are transported from different destinations and origins to several smaller hubs before they are consolidated and transported to other hubs by using wide-body aircraft. Having too many stops, and transit connections would be unacceptable for regular passenger transport, but for cargo the measure is delivery time which is not directly impacted by the number of transits (Amaruchkul et al., 2011).

## 2.2 Air Cargo Operations

In recent years, there has been an increasing trend of cargo being shipped by air. With products' life cycles getting shorter and more economies moving toward globalization, there is now a greater need to move products to their markets expediently (Chew et al., 2006).

Air cargo transports have increased massively and currently trades for a value of 6\$ trillion worth of goods each year (IATA 2021), for approximately 35% of the total world trade market. In comparison to passenger transport, cargo operations have grown about 50% faster in the period between 1995 and 2004 (Wong, Zhang, et al., 2009), and are continuously expected to have an annual general growth of 4% each year until 2050 (Boeing, 2020). This has created new combinations of transport, where a bigger share of the on-board cargo is now

added to freight goods to capture a bigger value from the market. Earlier forecasts suggest that the air cargo market will grow by 4.7% per year and triple in revenue by 2033. However, due to the COVID-19 pandemic in 2020 the industry-wide global cargo tonne-kilometres (CTKs) fell 10.6%, which is the largest decline since its beginning in 1990 (David, 2020 (IATA)). It is expected that the air cargo market will return to normal operations within a year, but the ongoing pandemic shows both the vulnerability and possibilities in such a market where air cargo has become a greater means of income for all airlines (Sun et al., 2021).

The value chain provided by the air transport can be said to be an abstract service consisting of a great number of actors from order to delivery. Tretheway & Markhvida (2014) presented Commercial Aviation Value Chain, where it is divided into segments of upstream and downstream divisions. Where the upstream consists of the producers of used aircraft (Boeing, Airbus, General Electric etc.), infrastructure (airports, communication services) and service providers (ground services at the airport, insurance). The downstream division explains the actors using the services of the airlines, which is where you find the freight forwarders which will be further explained later in this literature review.

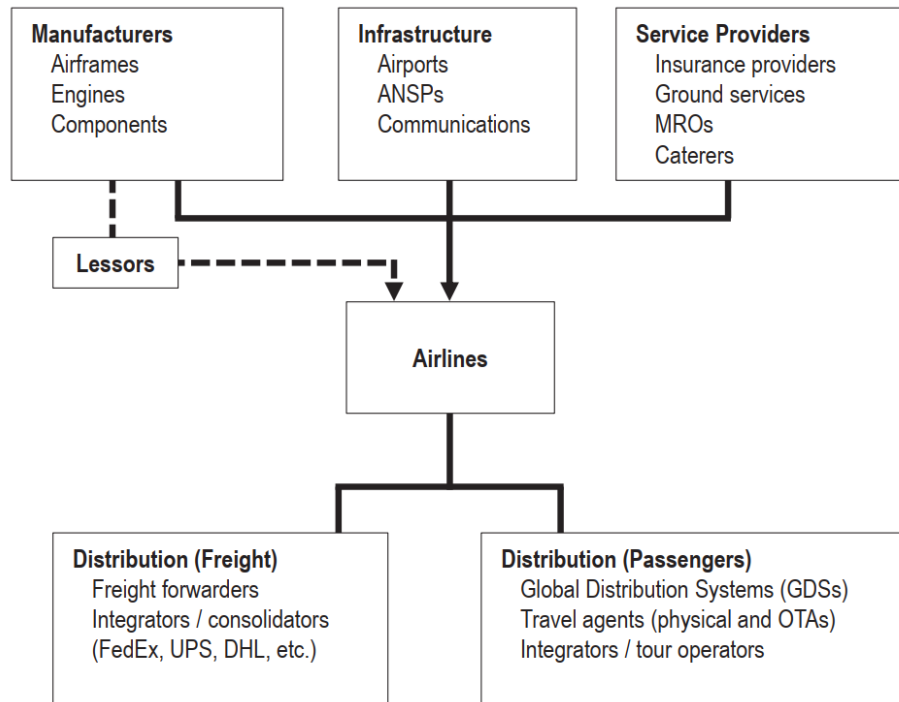


Figure 4. Commercial Aviation Value Chain (Tretheway & Markhvida, 2014)

The biggest drivers in the general rise of air cargo transportation attributes to the rapid expansion in the Asian markets. Most prominently, the high demand for fast and timely deliveries and keeping a low inventory throughout frequent replenishments has given rise to the explosive growth (Li et al., 2009).

When investigating the Norwegian seafood exports, 2.4 million tons were delivered to abroad markets in 2019. Approximately half of these deliveries were red fish consisting of salmon and trout from fish farms throughout Norway. 220.000 tons was transported to markets outside Europe, where approximately 67% was delivered to Asian markets. A massive 99% of all seafood exported to these Asian markets consists of red fish, where the remaining 1% is mainly king crab and halibut (SSB, 2020).

Costs are the main driver for choosing airports and starting air cargo operations, and an economically sustainable industry must cover the cost of operations and provide returns on investment so that capital can be renewed. When considering financial sustainability within an air cargo value chain, this must be achieved not only by the value chain as a whole, but also by each sector of the value chain individually (Tretheway & Markhvida, 2014). Lacking or disrupted

performance in parts of the aviation value chain could impair the sustainability of the entire system. These will be explored for the air cargo services at OSL later in this paper.

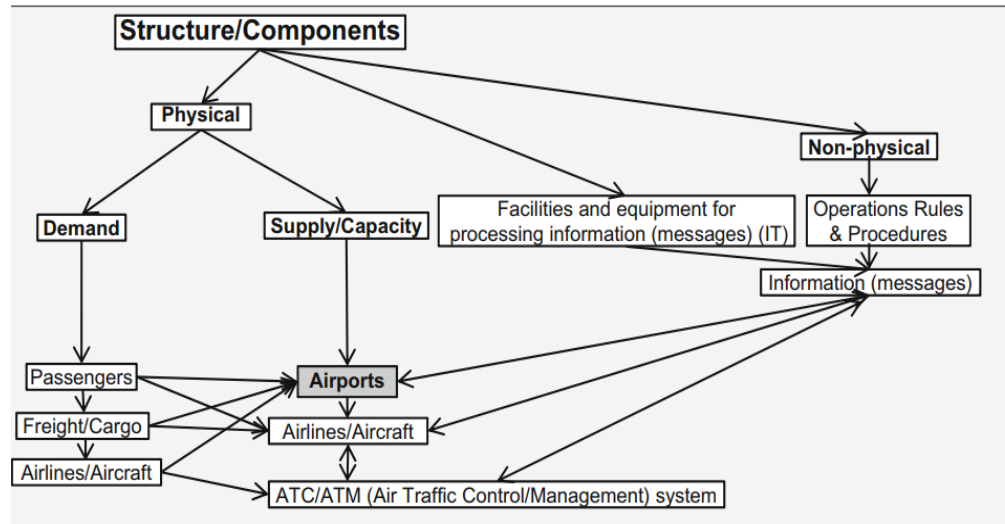


Figure 5. Structure and components of air cargo transportation (Janić, 2019)

### 2.2.1 Main components of the air cargo systems

Transporting goods using air freighters can be done in several ways and through different means of booking services, from personal agreements to the use of third-party logistics providers. In a more explanatory way, from (Derigs et al., 2009) we see that air cargo transport involves a series of services from origins to destinations to move cargo through a shipper, a forwarder, a road transporter, an airline, and a consignee. These actors make up the overall chain of events in the delivery of goods from producer to customer. However, these supply chains may be longer or shorter depending on the market they operate in. As explained in the figure 6 below, the routing landscape options can be significantly shorter for some areas than others (Brandt & Nickel, 2019; Derigs et al., 2009; Derigs & Friederichs, 2013; Feng et al., 2015).

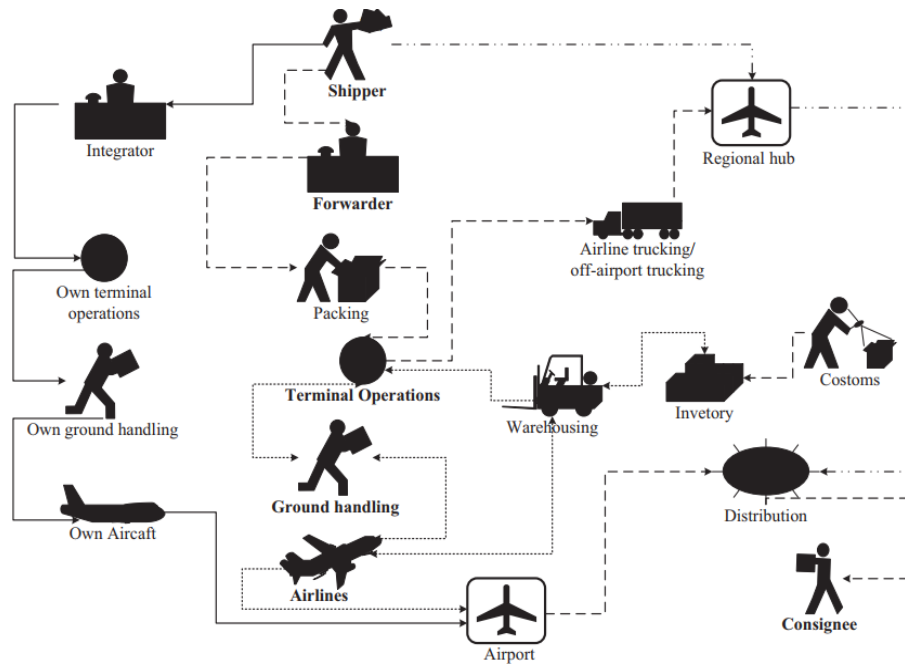


Figure 6. Landscape of air cargo operations (R. G. Kasilingam, 1997).

Next follows a description of the different parties involved in the distribution line of perishable goods such as seafood:

### *Shipper*

In all deliveries there is an order, a shipper in the air cargo operations. The shipper needs the commodity to be sent anywhere in the world at a low cost and at the required service level for the given item.

### *Forwarder*

The air cargo operations of freight forwarders include specific decision problems, such as capacity booking, supply strategies for airlines, container loading, integration and consolidation strategies, and truck routing and scheduling. Stated simply, the forwarder acts as the “middleman” between the shipper and the airlines (Feng et al., 2015).

### *Road transporter*

Ground transportation services before and after air transport are handled by the road transporters. These may include trucks, vans and other transportation equipment needed to safely store and transport the commodity.



### *Airline*

For the cargo operations the airline receives, stores, transfers, tracks, loads and unloads cargo, and assigns and manages capacity. Airlines appear to be the dominant players in the air cargo industry and their importance on the aviation value chain (Budd & Ison, 2017) since they are the providers of this main service from origin to destination . Airlines sell the majority of air cargo capacity to forwarders in the long-term, medium-term, and spot markets.

### *Consignee*

Recipient of the shipment (R. Kasilingam, 2003). This can be understood as the final receiver of the good.

## 2.2.2 Relationship between forwarder and airline

Air cargo forwarders act as intermediary in the supply chain where they buy cargo space from different airlines, and offer additional services combined with the available cargo space. Buyers or shippers have three reasons as to why they use forwarders and their services, namely time sensitivity, costs and their knowledge or know-how (Sales, 2013). Forwarders have a multi-product portfolio, meaning that they offer much more than just their booked cargo space for a given date and time. Their extensive market knowledge and ability to bring customers and shipments to the correct facilities adds to their value for both forwarder and airport.

<b>Income generation, forwarder at an airport</b>
Margins on shipments
Warehousing/Fulfilment
Customs declarations
Agency commissions
Market knowledge

*Table 1. Airport forwarder income generation*

For the general understanding, the potential of air cargo development may not be entirely clear to operators and airports due to the fact that cargo operations usually represent a minor part of an airport's revenues (Feng et al., 2015). Nonetheless, if we look beyond the direct financial value, airports are wise to maintain a good relationship with all actors, forwarders especially, as it presents a great strategic value to both customers and stakeholders. Air cargo generates economic value outside the airport, towards the airport's region or country. This is exemplified by the increase in Norwegian seafood export prognosis (Johansen et al., 2019). By enabling trade both locally, regionally and internationally and attracting valuable companies and partners, this shows the importance of the airport and its terminals working together with all trade representatives found surrounding the airport (Diana, 2012; Forsyth et al., 2010; Gardiner, Ison, et al., 2005; He et al., 2019).

Brandt & Nickel (2019) explains that there is a great imbalance when comparing passenger flow to cargo flow. However, air cargo is a fast and safe way of transport, but at the cost of a higher price. Because of this higher price, goods transported by air have at least these properties; *urgent, perishable, valuable or dangerous*. The air cargo operations of freight forwarders include specific decision problems, such as capacity booking, supply strategies for airlines, container loading, integration and consolidation strategies, and truck routing and scheduling (Amaruchkul & Lorchirachoonkul, 2011; He et al., 2019; Z. Li et al., 2012).

Forwarders, and other third party logistics providers (3PL's), have proven to be on its most effective when they can provide these capabilities to their customers (Chu et al., 2016; Lieb & Lieb, 2010; Singh et al., 2018):

- Provide visibility.
- Measure performance.
- Create a low-cost network.
- Offer multimodal options.
- Develop internal and industry rate benchmarks.
- Conduct constraint-based bids.
- Establish reliable transit times.

Given the necessary capabilities to operate at its most efficient, airports and its terminals play a dominant role in its users to obtain these qualities. As Gardiner et al., (2005) mentions, the performance of forwarders in the proximity of an airport can greatly impact the air freight operators' choice of airport. This enables both airport and forwarder to generate value and revenue based on each other's performance and relationships with available actors. Subsequently, if either of these has a drop in performance or activities it would most likely have a negative impact on revenue for both, creating an interdependency between them (He et al., 2019).

### 2.2.3 Air cargo revenue management

Revenue management within air cargo operations is differentiated from passenger revenue management due to distinct characteristics in the variety of goods transported. These variables contain capacity estimations, capacity booking behaviour as well as network capacity allocation (Feng et al., 2015). Factors which are heavily researched consist of overbooking in different environments (R. G. Kasilingam, 1997; Popescu et al., 2006; Y.-J. Wang & Kao, 2008), accepting or rejecting air cargo operations (Amaruchkul & Lorchorchoonkul, 2011; D. L. Han et al., 2010), contracting the capacity demand (Amaruchkul et al., 2011; Gupta, 2008; Hellermann et al., 2013) as well as forecasting the demand (Totamane et al., 2014).

Author	Overbooking	Accept/reject	Contracting demand	Capacity demand	Forecasting demand	Profit/Costs
Amaruchkul et al., 2011		X		X		X
Han et al., 2010		X		X	X	X
Hellermann et al., 2013			X	X		
Gupta, 2008		X	X			
Totamane et al., 2014				X	X	
Popescu et al., 2006		X		X		
R. G. Kasilingam, 1997	X				X	X
Amaruchkul & Lorchirachoonkul, 2011		X				
Wang & Kao, 2008	X			X		X

*Table 2. Air cargo revenue management literature*

#### 2.2.4 Capacity management on cargo planning

The freight forwarder executes revenue management through capacity booking and supply strategies for different airlines. Capacity booking determines the capacity allocation between a long-term contract and dynamic capacity booking in view of a random market demand, and it is used to update the weight and cargo type for a scheduled flight for arrived consignments (Chew et al., 2006). Capacity planning is found to be difficult for both shippers, forwarders and warehouses as the booking process functions today (Yan et al., 2006; Yang et al., 2015). Time schedules are fixed months ahead of time due to large investments. As a result, forwarders and storage are planned and fixed accordingly far ahead. These are mostly based on contracts.

As the production is a pull system, demand and quantity shipped can vary greatly from month to month, or even week from week. Adding to this uncertainty, the degradation of goods can have a major impact on the quality of delivered produce if capacities are pushed beyond their limits. We see from literature that nearly all major publications mention or study the impact and necessity of the number of trips for a product, but also minimizing total costs, which can be said to be the driving force of choosing a departure airport (Derigs et al., 2009; Derigs & Friederichs, 2013; Z. Li et al., 2012; Lin & Chen, 2003; Yan et al., 2006; Yang et al., 2015). Thus, building upon the importance of information flow, capacity management and efficiency throughout the chain.

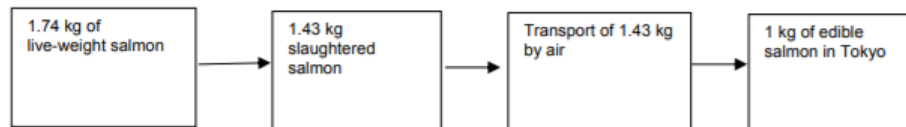
Author	Uncertainty cost	Transportation costs	Maximization cargo profit	Minimizing total costs	Network profit	Number of trips management	Cargo flow
(Lin & Chen, 2003)		x			x	x	
(Yan et al., 2006)	x			x		x	
(Z. Li et al., 2012)			x	x	x	x	
(Yang et al., 2015)				x		x	x
Tang et al	x			x		x	
(Derigs & Friederichs, 2013)				x			x
(Derigs et al., 2009)			x		x	x	
(Chew et al., 2006)	x		x	x	x	x	x
(Azadian et al., 2012)	x					x	

Table 3. Capacity management on cargo planning literature

Adding upon the capacity management, it is also important to understand the weight changes of transported goods throughout the chain. As explained by SINTEF, 1.74kg of captured salmon in Norway is in reality 1.43 kg of transported goods, which again results in 1kg of edible product for the end-consumer. Also explained is that the difference between fresh and frozen goods in terms of edible weight is the same.

**Chain 4: Fresh gutted salmon to Tokyo**

Chain identical to Chain 2, but then air freighted from Oslo to Tokyo (8380 km).



**Chain 5: Frozen gutted salmon to Shanghai**

Chain identical to Chain 1 up to slaughter. The salmon is then frozen in a processing plant in Norway, packed in cardboard boxes, stored for three months and then taken to Rotterdam (1350 km) and from Rotterdam to Shanghai (19500 km) by refrigerated container transport.

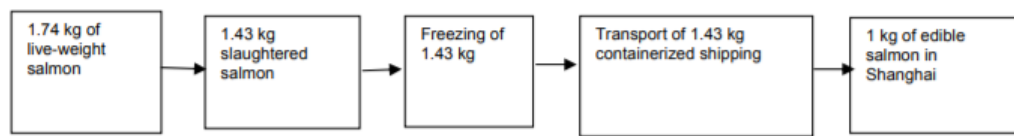


Figure 7: Weight decrease in transport (SINTEF)

Definition of air transport network

The air transport networks depend heavily on the strategic choice an airline wants to follow, which refers directly to the destinations it intends to serve and how it will connect these services among the points chosen (Cook & Billig, 2017). Nevertheless, depending on the strategy the airline decides to pursue, an airport also needs to be taken into consideration to align their planning and usage of the facilities to this strategy (Burghouwt, 2007).

## 2.3 Commodity transport

The literature addresses two main issues when considering transportation of perishable goods such as fresh fish in the supply chain. These are cold chain temperature monitoring and cold chain logistics. For commodities that are perishable, subject to quick obsolescence, or required on short notice, the speed of air transportation becomes advantageous (Wensveen, 2015).

### 2.3.1 Cold Chain Logistics (CCL)

We see from Akdemir, 2008; James & James, 2010; Kuo & Chen, 2010 that cold chain logistics can be explained in three processes. Firstly, cold processing (initial processing and cooling of product). Secondly, cold storage warehouses or other facilities that provide a temperate environment. And thirdly, transportation and distribution of goods within a given timeframe. This paper focuses mainly on the second and third process, thus excluding literature surrounding initial processing.

Cold chain logistics (CCL) of fresh agricultural products refers to the food supply logistics chain that maintains a suitable temperature and humidity environment for the transported goods (J.-W. Han et al., 2021). Furthermore, it can be explained as a concept that is a system extracted from specific needs for the transformation and distribution of temperature-sensitive products (Kuo & Chen, 2010). According to Christopher et al., (2011), effective logistics management ensures that the requirement from customers is satisfied from the whole systems' point of view, by employing methods like good material flow coordination, information flows. When considering the logistics behind the transport of perishable goods, the equipment used to process and the information system management used to protect temperate and frozen foods are referred to as cold chain logistics, or CCL (Montanari, 2008). Wu et al., (2018) states simply that in a cold chain, freshness is a primary concern for customers when buying a perishable product. When investigating the literature and discussing implementation and operations of a cold supply chain, we find that there are several important measures to take before an efficient incorporation of cold chain logistics can take place. Firstly, it is complex and requires a large



investment for the construction of the system. Secondly, a high implementation into the different co-organisations that will be part of the supply chain. And lastly there needs to be sufficient control of operation costs as it can, without sufficient observation and control, fluctuate drastically (Chaudhuri et al., 2018).

Transparency, information flow and traceability are thoroughly mentioned throughout most literature found concerning the efficiency and quality of a cold supply chain (Bogataj et al., 2005, 2005; Chaudhuri et al., 2018; Montanari, 2008; Singh et al., 2018). Traceability has become a means for the cold chain to be able to 'certify' food safety of the product to the end customer. This has increased the possibility to take responsibility and effectively recall a good along a specific part of the supply chain if necessary. As mentioned above by Chaudhuri et al., (2018), such a system is complex and expensive, but presents several advantages in terms of safety, efficiency and increased strategic competitiveness in a cost focused market. Adding to this, Montanari (2008) states that data tracking, temperature monitoring and implementation of monitoring in real time is of prime importance for an efficient and safe cold chain.

### 2.3.2 Cold Chain Temperature

Temperature is the single most important environmental factor affecting the deterioration rate and postharvest lifetime (J.-W. Han et al., 2018). Furthermore, the ability to maintain the required storage temperature for perishable foodstuffs is mentioned as a key factor in preventing risks which can affect food safety and food quality throughout the literature (Chaudhuri et al., 2018; Esmizadeh et al., 2021; J.-W. Han et al., 2018; James & James, 2010; Ji & Guo, 2009; Montanari, 2008). Fresh fish is a highly perishable food which needs proper handling and preservation to retain a desirable quality as well as a high nutritional value. It is therefore crucial for OSL and its terminals to facilitate proper storage and environment. Additionally, air freight operations are becoming more and more valuable for airlines, especially since they tend to grow faster in this business and cargo sector than in passenger traffic (Choi & Park, 2020; Kim et al., 2020).

In perishable food industries, improper logistics can be the cause of up to one-third of spoilage (Rockefeller Foundation, 2013). The most important determining factor for quality is found to be the change in temperature conditions during transport throughout the supply chain (Chen & Shaw, 2011). Temperature tracking in cold chains has been an important issue for a long time, but a vast number of solutions have been tried and implemented to adhere to the challenge. This includes data trackers, time-temperature-indicators, simple colour changing labels adjusting to temperature or more RFID tags with temperature sensors (Baxter & Kourousis, 2015; Chen & Shaw, 2011; Mercier et al., 2017). Where the lastly mentioned RFID, or Radio Frequency Identification, has a great potential in improving its traceability across the chain to mitigate risks (Marucheck et al., 2011; Raab et al., 2011; Ringsberg, 2014). RFID is a form of wireless communication that allows the users to uniquely identify an object, animal or even person by using electronic radio frequency emitters from tags on the given object. One main advantage of such a system within an area of vast amounts of containers is the possibility to identify from a distance, compared to the optical and close scans of a barcode. Giving immediate updates to all participants within the system of both whereabouts, temperature, and extensive logs throughout its transport.

Applications of such technologies as RFID has shown great potential to increase flexibility, reduce volatility, properly manage cost fluctuations and thus leading to making better decision within the cold chain (Chu et al., 2016; Nakandala et al., 2014; Shi et al., 2010; L. Wang et al., 2010). Regardless of which data technology that is adopted, a good temperature monitoring and control mechanism is vastly documented as a necessity for a cold chain's quality and risk mitigation.

### **Time and degradation of product**

Temperature has a massive impact on the freshness and quality of products such as fresh salmon (Hansen et al., 2009; Mercier et al., 2017). Generally, when storing salmon, the expected freshness can last for up to 12 days when stored at 0 degrees. However, if somewhere along the cold chain the temperature increases to between 8-10 degrees Celsius, the quality can degrade to lower than

needed levels within two days of capture. Transportation time varies in valuation for air freight and for passengers. Additionally, Boonekamp & Burghouwt (2017) expands upon that the quality decreases with total shipping time.

## 2.4 Terminal requirements

Throughout the literature, airport competitiveness with respect to cargo operations is a very specific research area and limited amounts of academic research can be found (Van Asch et al., 2019). However, throughout exciting literature it is found that the arguably most important components are found in differentiated factors throughout the market, and not necessarily from the location itself.

### 2.4.1 Cargo marketplace

This component relates to the actors present within the delivery supply chain. Firstly, freight forwarders control a large share of the supply chain related to the different actors within the air cargo management, which is further backed by Kupfer et al., (2016) which emphasises their important role in their respective markets. Additionally, their presence at or close to an airport is appreciated by other actors within the total transport chain. Secondly, we have fully established integrators. Having an integrator present at the airport can play a crucial role in attracting airlines to operate to and from your terminal (Gardiner & Ison, 2008). Airports with cargo activities and operations which are well-established are more competitive when attracting new cargo services.

### 2.4.2 Terminal product differentiation

By offering specialized structural advantages, terminals, warehouses, equipment and so forth to customers, airports efforts to attract cargo operations will be significantly easier. Differentiation comes in a variety of services, but we will firstly touch upon reputation, secondly specialized structure and thirdly business development.

Passenger transport and cargo operations touch upon many of the same qualities required for attracting new customers, where good reputation regarding the

services around air cargo being prominent for both cases. A good reputation can be said to be subjective, however throughout the literature it seems that it plays a big role in catching market shares. This has been proved throughout the years, from earlier literature (Murphy et al., 1989) to newer research (Budd & Ison, 2017; Gardiner, Ison, et al., 2005; Gardiner & Ison, 2008; Hwang & Shiao, 2011; Kupfer et al., 2016).

A key focus for relevant literature is that they all have an increased focus on the overall quality for the air cargo operations. The mentions of customs handling tend to be included when discussing other services the terminal provides, thus being excluded from being stated as a direct differentiation factor in the literature. As a result, differentiated factors from the air cargo operation impacts the overall reputation of the airport, which in turn is crucial to maintain and attract new cargo operators, airlines, and passengers for revenue creation.

Author	Customs	Ground handling	Quality of air cargo operations	Collaboration airport/airline	Presence of forwarders	Airport quality
Murphy et al., 1989			X	X		
Budd & Ison, 2017		X	X	X		X
Gardiner, Humphreys, et al., 2005	X	X	X			X
Gardiner & Ison, 2008			X	X	X	
Hwang & Shiau, 2011			X	X		
Kupfer et al., 2016			X		X	

Table 4. Terminal product differentiation literature

### 2.4.3 Warehouse operations

Structural qualities in warehouses, specialized trade or storage areas are key factors when discussing the positive impact for an airport. Following Forsyth et al., (2010) the importance of provision of cargo facilities for air freight forwarders is of specific interest, and especially important when considering terminal operations of salmon from OSL. More specifically airport cargo terminals with adequate temperature-controlled environments from unloading by arriving trucks to departure by chosen airline.

By maintaining a constant and unbroken temperature-controlled supply chain, the longevity of fresh products can be expanded is of critical importance in ensuring that the products being shipped in the supply chain remain fresh. The cold chain is a temperature-controlled supply chain used to help extend and ensure the shelf-life of products being shipped (Coyle, 2011). IATA's Perishable Cargo Regulations book particularly and specifically addresses the temperature control management issues in the industry.

When freeze storing fish (Dawson et al., 2018) the effects can be shown in various areas. These consist of weight loss, colour, water saturation, texture, and general stability of the meat. If not stored properly, these will have negative impacts on the properties of the fish. The high quality and highly desirable commodity demand adequate warehousing properties. Importantly, defining good information systems is discussed as one of the biggest success factors for proper warehouse operations (Coyle, 2011; Page, 2003; Zhang & Zhang, 2002). Naturally loading and transfer capabilities are found here (Coyle, 2011; Gardiner, Humphreys, et al., 2005; Page, 2003), but also the enhanced capabilities of customs handling (Elliott & Bonsignori, 2019; Kasarda & Green, 2005; Zhang & Zhang, 2002)

Author	Customs	Loading and transfer	Sustainability	Communication	Terminal capacity	Facilities for freight forwarders
(Graham, 2014)		X	X			
(Coyle, 2011)		X		X	X	
(Page, 2003)		X		X	X	
(Zhang & Zhang, 2002)	X			X		
(Elliott & Bonsignori, 2019)	X					
(Kasarda & Green, 2005)	X					
(Gardiner, Humphreys, et al., 2005)		X	X		X	
(Forsyth et al., 2010)						X

Table 5. Warehousing literature overview

#### 2.4.4 Location and capacity

When comparing air cargo transport to other forms of transport, speed and reliability are the two main components. Time-sensitive and perishable goods such as fresh fish are therefore natural users of air cargo to international markets. Zhang (2003) can be quoted stating “*all other factors equal, the ideal hub location is one that minimizes the total flight kilometres within a network and allows services with larger aircraft*”. However, when adding in the factor of fish production location it is important to understand the ideal location of a hub depends on the markets one wants to serve (Dennis, 1994). Evidently, airports with a favourable location will have a great competitive advantage over competitors. Nonetheless, choosing such a favourable location will always depend on the activities and products distributed from the airport (Van Asch et al., 2019).

In a growing market, the potential for expansion at an airport can be highly relevant for the air cargo segment (Magalhães et al., 2015), which can be said to be especially important for the expected salmon supply from the Norwegian market (Johansen et al., 2019). Additionally, the value of added employment to the economy should be noted (Neiberger, 2008). Additionally, adding to the capacity constraints of fish transport, terminal storage and handling capacity is crucial to be able to maintain the desired quality of the fresh products. By not being able to properly receive, store and manage the commodities, the quality could deteriorate at an alarming pace (Dawson et al., 2018).

#### 2.4.5 Airport operations

As previously mentioned, air cargo operations are unique in terms of its speed and reliability (Dewulf et al., 2019; Lange, 2019). Airport operations consist of the necessities for a time-efficient and quick handling of cargo. These operations can be divided into subgroups consisting of operating hours, costs, network connectivity and accessibility. To serve an international market the value of having the possibility to operate at night is classified as either important or a



necessity (Kupfer et al., 2016), which is especially apparent for time sensitive deliveries between Asia and Europe. These claims are further backed and explained by (Gardiner, Humphreys, et al., 2005; Shaw, 1993) stating that airports should have unrestricted night-time activities to attract cargo. It is a general claim that airports closed at night are far less attractive for cargo operations.

If we look at costs at operating to and from an airport, it can be divided into strictly aeronautical costs for operating the aircraft and respective services, and the more general non-aeronautical costs (Fichert & Klophaus, 2011). We have mentioned that custom services are one of the most important factors when cargo operators look into establishing new cargo routes, and this is further backed up by Kupfer et al., (2011) in regards to costs. Increase of operating costs will decrease the cargo output an airport can generate (Yuen et al., 2017).

Boonekamp & Burghouwt 2017) sheds light upon the importance of international connectivity and its crucial effect on both regional and economic development. International connectivity is especially marked as a key factor when choosing an airport for air cargo operations. This is further backed up by (Chung & Han, 2013) which states that flight frequency and connectivity is found in close to all research regarding airport choices for cargo operations.

Airport connections are most often supplemented or incorporated with road transport both to and from terminals (Budd & Ison, 2017; Hall, 2001; R. G. Kasilingam, 1997; Kupfer et al., 2016), which expands upon the importance of having efficient terminals, loading areas and handling. This is especially apparent when transporting salmon as its requirements for proper temperature consistency and quality degradation over short amounts of time is always present (Dawson et al., 2018). Adding to its importance of terminal efficiency, its price volatility can also be affected by improper handling (Oglend & Sikveland, 2008)

Author	Extended operating hours, frequency, night-time operations	Costs - Passenger services	Costs - Cargo services	Costs - Commercial services	Route restrictions (wide body compatibility, connectivity)	Road cargo transportability	Ease of access to terminal, warehouse, storage
(Gardiner, Ison, et al., 2005)	x				x		
(Kupfer et al., 2016)	x				x		
(Kupfer et al., 2017)		x	x	x			
(Shaw, 1993)	x						
Fichert and Klophaus (2011)		x	x	x			
Adenigbo (2016)			x				x
(Boonekamp & Burghouwt, 2017)					x		x
(Chung & Han, 2013)	x				x		x
(Hall, 2001)					x	x	x
Yuen et al. (2017)	x		x	x			

Table 6: Airport operations literature

## 2.5 Terminal planning

### 2.5.1 Air cargo facility design standards

To determine the facility requirements for the future to ensure efficiency, Biggs et al., (2009) stresses the importance of collection of data to create sufficient forecasts. They divided the necessary data collection into six categories:

- Weight or volume of cargo and mail
- Ultimate origin and destination
- Times at origin and destination
- Commodity type or value
- Flight information
- Truck trip characteristics

These types of information are of great value and importance by shippers and forwarders. However, this information is rarely distributed openly as they may be reluctant to distribute detailed information on air cargo shipments, air cargo traffic and commodity types at their facility.

Throughout the literature it is shown that the design and development of air cargo facilities should be flexible to consider any modifications of design parameters due to changes in demand and technology.

### 2.5.2 Financial considerations

Assessments of financial feasibility is essentially to determine if the project can generate revenue to make it attractive as an investment for potential users of an improved terminal. Today, the sharp growth in shipping volume has led to the rise of integrated service providers and bigger 3PL providers. With that structural change in the market, financial instruments for greater investment capacity have presented themselves (Kleindorfer & Visvikis, 2009).

In the past years, the efficiency of air cargo logistics has continuously improved due to advances in IT and communication (Hertwig & Rau, 2010). However, as previously stated, implementation of an efficient cold chain is expensive and complex. These factors will impact the financial consideration of upgrades or changes to existing terminals, thus manifesting the importance of assessing attractiveness to current and future partners (Petersen, 2007).

### 2.5.3 Operational issues

Kiso & Deljanin (2009) explains that air-freight markets are shifting as the economic growth pattern accelerates past that of the already established industrialized economies. Operational rates and characteristics vary heavily on volume, density and weight of shipments, commodity type, routing, season, regularity of shipments, imports or exports and priority or speed of delivery. Additional complexities must be considered when evaluating consolidation of shipments or other limited or exclusive agreements (Alamdari & Mason, 2006; Oum et al., 2004.)

### 2.5.4 Security considerations

Security issues affect all airline operations as well as the airport facilities utilized by air cargo carriers. Now, cargo screening is a mandatory requirement for all cargo loaded onto passenger aircraft (Transportation Research Board, 2015). For aviation security purposes, screening is the *“application of technical or other means which are intended to identify and/or detect weapons, explosives or other dangerous devices, articles or substances which may be used to commit an act of unlawful interference”* (ICAO, 2020).

There have not been statutory or regulatory requirements for screening all-cargo operations. However, effective from June 30, 2021, international standards will require that all international air cargo carried by commercial aircraft operators (both cargo and passenger airlines) must be screened or received from an earlier airport which has already screened or confirmed its cargo (DHS, 2020; ICAO, 2020).

### 2.5.5 Environmental issues

Noise certification standards for aircraft have been established by the ICAO. In addition to modernising fleets to utilize quieter aircraft, air cargo operations in proximity to more densely populated areas and communities are bound by procedures to minimize noise exposure. Night curfews and/or restricted night operations are found at many airports, particularly in Europe. At OSL air movements restrictions apply from 11PM to 6AM, although permitted if landing from and taking off to the north (Bredal, 1998). Air cargo transportation is disproportionately affected by night-time restrictions as scheduled flights during night-time usually are the most effective and efficient (Elliff, 2021).

Environmental considerations in terms of contracts provide considerable customer interest in discussing sustainability issues. However, by proving the effect of environmental interest in contracts, it has not yet been considered a major role in either the selection or the retention process of service providers (Budiarto et al., 2018; Lieb & Lieb, 2010; McCann et al., 2005). However, there are strong incentives planned for future regulations by the international governing organisations (IATA, 2018)

## 3.0 Research methodology

This section goes over the methodological approach used in this thesis. This includes a description of the research strategy and design, before going over the data collection process and analysis. Lastly, follows a section on our process for quality checking the data to ensure that the quality is up to the expected standard.

### 3.1 Research Strategy

The research design gives an overview of the approach that is used for the thesis. It characterizes the way the information or data regarding a topic is identified, selected, processed, and analysed. This includes different strategic methods such as qualitative and quantitative.

Qualitative research is the method where one gathers data using interviews with open-ended questions or other first-hand observations such as questionnaires or other related activities. One of the highlights of this method is that it helps uncover not only what the subject thinks, but also investigates why. The information gathered in this approach is typically non-numerical. Quantitative research on the other hand, is used to systematically quantify and analyse data. This typically involves tools such as computational analysis, mathematics, and statistics. This is a great way for testing hypotheses and theories (Bryman & Bell, 2011).

The last method is a mixed method approach. The benefit of this approach is that it can potentially give results that cannot be uncovered by only one method (Bryman & Bell, 2011). The original approach for this thesis was to divide into both qualitative and quantitative sections, but after obtaining data from the industry, we found that we could improve the impact of our study by focusing on the qualitative dimension. Therefore, this thesis is based on a qualitative approach with a cross sectional design. By building our approach around the input from the industry representatives, we will be better equipped to analyse the dynamics of seafood transportation.

For our approach, we have interviewed industry representatives to get a better view of the markets and industries' views on the challenges and opportunities within seafood export, especially directly related to logistics around terminal and warehouse operations at Oslo Gardermoen Airport. Through semi-structured interviews we have gathered data on industry sentiment regarding the prospects and implementation challenges of seafood cargo operations. This includes input from key actors in this value chain such as airport operators, terminal owners, and seafood brokers.

The analysis builds on data collected from seafood brokers and airport operators through conducted interviews and additional transportation data. This includes shipping data, but also information regarding offload time at the airport. Variables like freight weight, frequency, and destination are part of this analysis. Data and reports collected from public sites such as SSB (Statistisk Sentralbyrå) and other relevant sources are also included. Given the projected increase in Norwegian seafood export it is potentially useful to investigate how the system could handle more cargo and how operators can mediate this pressure. For this we try to examine both short term and long-term aspects of seafood export operations at OSL, which could help facilitate continued growth of the Norwegian seafood sector.

This thesis follows a deductive approach. This means that the theory guides the research, as in contrast to an inductive approach where the theory is the outcome of research (Bryman & Bell, 2011). Through this method we will review relevant theories that will then be used to come up with a hypothesis. Next, we will explore this through observations, which in this case involves data collection through interviews and material collected from related stakeholders. Finally, we will build our confirmation based on discoveries in the previous sections (Bryman & Bell, 2011).

The rest of the methodological description will explore the qualitative approach to establish a solid theoretical framework.

### 3.2 Research Design

The research design part gives an overview of the overall strategy for how the research will be conducted. This entails an explanation of how the research question will be answered. This is typically through various ways of collecting, interpreting, and analysing data, usually followed by a discussion.

There are various ways of designing the research, but the five primary ways are cross-sectional design, comparative design, longitudinal design, case study design, and experimental design (Bryman & Bell, 2011).

The cross-sectional design can be a powerful way to answer complex questions. It has at times been neglected because of lack of understanding by reviewers and researchers (Tetnowski, 2015). One of the key benefits of a cross-sectional design approach is that it incorporates theoretical knowledge and at same time allows for testing through other design approaches. Given that this thesis will be conducted using a mixed method approach we have concluded that this design will be the most suitable for this study.

According to *Business Research Methods* by Brymann and Bell (2009), a cross-sectional design can often centre around a single location, organization, person or event. The core idea of this concept is an intensive exploration or examination of a specific setting. This study revolves around seafood exports from Oslo Airport.

One of the key benefits of cross-sectional design is that it is useful to uncover variation, especially when working with more than one case. This can be variation in terms of organizations, companies, or various other cases. The crucial point is that one needs multiple cases to discover and establish the variation. Ideally, one wants many cases to uncover the varieties in the variables that are being explored. That is why it is also beneficial to have a large number, since that will help make finer distinctions (Bryman & Bell, 2011).



It is important to have proper research design criteria in mind when one designs a cross-sectional design study. The relative importance of each one will vary according to each case, but overall, it is crucial to validate the study. Following is a general category of criteria, measurement validity, external validity, internal validity, ecological validity, replicability, and reliability. The objective of the intrinsic cross-sectional design is to analyse and understand a particular situation or dynamic.

### 3.3 Data collection

#### 3.3.1 Qualitative sampling approach

Our sampling has been a mix of structured interviews and data collection from the industry representatives that have responsibility within the fields that are relevant to our topic of investigation. Through communication with Avinor and freight forwarders such as Salmosped AS we gathered valuable data collections.

Through a preliminary inquiry we collected information from these companies and organizations that led us to the more relevant contacts within this sector. We expected that it would be quite challenging to contact the right people, so when contact was established, the most relevant approach was a semi-structured interview, not a survey or questionnaire. The reason why we had a semi-structured interview was to be able to discuss and reflect upon relevant problems that could arise from the questions asked. This could for instance be minor details that could impact implementations, or factors that we might have to exclude from the paper itself. Given the complex nature of the topic, it would be difficult to come up with a fully structured approach. It would also leave little room for flexibility in the interview setting. The fact that most interviews went over Zoom and other similar platforms did not change this aspect with any noteworthy degree. In fact, the possibility to easily record the meeting potentially improved the accuracy of the research.

### 3.3.2 Interview planning

To extract the maximum amount of information from the interviews, we had to be well prepared and have the necessary routines in place. This meant doing a trial run before the actual interview to uncover any hidden obstacles or technical glitches. For any potential face-to-face interviews, it was important to make clear in advance if the subject objected to the conversation being recorded. This proved to not be relevant given the situation caused by the pandemic. Nevertheless, without a recording of the conversation it is very important that the notetaking is meticulous and detailed.

### 3.3.3 Data utilization

Part of our analysis is based on shipping data collected from a central seafood broker. This data includes shipping records of gross weight, number of boxes, airline, date of departure, departure location, arrival location and name of the terminal operator for the respective shipment. The data includes about 70.000 shipping entries and stretches from 2018 to 2020. This paper utilizes PowerBI to structure this data. However, the data had to be processed before it could be imported into PowerBI. This included making the date format into a recognisable form in dd/mm/yy format. After this the data was loaded into PowerBI. This allowed us to get a good view of how the shipments were distributed. Specifically, how much weight was transported to the different destination over a three-year period from 2018 to 2020. We also calculated the aggregate year-on-year shipping weight, before breaking it further down into a month-on-month basis. Finally, we also looked at the different traffic shares of the two main terminal handlers, namely GPC and OSCC. This gave insight into the size and market power of the two operators.

The data collection process also included interviews with several key actors in the industry. For this we first developed an interview guide which included the questions we were going to ask the participants which were conducted over Zoom or Teams due to the current restrictions. This was done with recording of the conversation, which was crucial since we then moved on to transcript the

conversations. These documents were then meticulously studied before being implemented into our findings and discussion.

#### 3.2.4 How to achieve access

Using contacts in the industry we made direct contact with representatives, either in person, or through phone and email. At times we had an initial meeting to achieve a mutual understanding of both information flow and the process we intend to use. The time spent on these meetings was helpful to prepare for the official interview. It was important to keep these conversations on the topic since time may be short both for us and the corporations. As stated by Frey (2004) *“The length of a telephone interview is unlikely to be sustainable beyond 20–25 minutes, whereas personal interviews can be much longer than this”*. This agrees with what we expected from the data sampling processes and scheduling.

#### 3.3.4 Incentives of relevant parties

It was very important for us to consider the incentives of the people we interviewed. Some of the participants likely had vested interest in promoting certain perspectives or solutions and downplaying others. It was important to keep this in mind since it could mean that the contact was less willing to disclose negative information relating to the topic. This potentially also meant that some actors had an interest in conserving the status quo and would therefore be overly negative to potential changes in the current system.

#### 3.3.5 Issues of ongoing access and cooperation

There was also the possibility that we would experience a problem with a lack of response or no response from the people we are trying to contact. With the ongoing COVID-19 crisis and its heavy impact on the aviation industry, there was a risk that contacting industry representatives would become very difficult. With so much stress on the industry it was not unlikely that inquiries from students would be downplayed or postponed. Ultimately this proved not to be the case. The technological capacities to conduct digital meetings proved to lower the bar for conducting conversations and interviews with the industry.

Another potential issue was that the actors we contacted would be concerned about information leakage to industry rivals and competitors. This could possibly lead to a restriction in what data and information we could get access to, as well as interview objectives being restrictive in our conversations. To mitigate this, we took the necessary steps and precautions to ensure that trust was established. An example of this that did not prove to be necessary was a non-disclosure agreement to prevent the spreading of the underlying data and information that is not meant for distribution. Interviews with public companies such as Avinor should be less exposed to those concerns given the need for openness and transparency in state-owned or partially state-owned companies.

### 3.3.6 Data management

Who owns the data and under what circumstances should it be used and by whom? If applicable, different countries may have different legislation regarding data safety and storage. General Data Protection Regulations (GDPR) induce heavy fines for firms not complying with regulation. We mitigated this by:

1. Drafting an outline of the processing operations so that legality could be addressed in advance.
2. Decide who is in control of the data and which legislation applies to the study. Depends on where data protection will be carried out.
3. Prior to data processing, define who the data subjects are and take precautions to respect their rights in relation to data privacy.

It can be hard to anonymize records and report findings in a way that allows individuals and companies to stay anonymous. This is particularly true regarding large and distinctive firms, such as IBM in Hofstede's research (Hofstede, 1984) where a pseudonym was used. As the quantitative data collected predominantly was not sensitive, we expect the avoidance of harm to be manageable in this context, but that does not mean it should be prioritized less. A great challenge in qualitative research is to ensure confidentiality and anonymity. Great care must be taken to protect the identification and sensitive

data. Failure to protect individual anonymity can damage reputation (M. Parker 2000:238).

### **Informed consent**

The ESRC Framework for Research Ethics states that “Informed consent entails giving sufficient information about the research and ensuring there is no explicit or implicit coercion.” Homan (1991:73) states that it is easier said than done.

Three major points:

1. Hard to present absolutely all information that might be required to make an informed decision about their involvement. Time management: too little time to be able to extract all information.
2. Disruptive in everyday context to provide and ensure informed consent.
3. Further complicated if collected in a public place or using public information about people or organizations. It may not be practical to see informed consent from all here.

### **Additional guidelines**

Market Research Society (MRS) Code of Conduct (2014): “the researcher must take all reasonable precautions to ensure that respondents are in no way directly harmed or adversely affected as a result of their participation in a marketing research project”. Should be particularly careful if sample sizes are very small.

AOM Code of Ethics: “if confidentiality or anonymity is requested, this must be honored”. Security, anonymity and privacy of research subjects and informants should be respected rigorously, in both quantitative and qualitative research.

The SRA, Ethical Guidelines (2003:27) gives a good guideline with recommendations to ‘treat each case sensitively and individually, giving respondents a genuine opportunity to withdraw’.

### 3.4 Quality of Research

By evaluating business research certain criteria must be taken into consideration. Bryman & Bell (2011) names three criteria that have been identified as being crucial when carrying out this type of research, namely reliability, replicability, and validity. Additionally, and comparatively, Lincoln & Guba (1985) researched the same consideration and expressed the need of identifying four criteria: credibility, transferability, dependability, and confirmability. These criteria are found to be similar and overlapping, the focus in this paper will be on Bryman & Bell for our evaluation of research, but with inputs from earlier research by Lincoln & Guba.

#### 3.4.1 Reliability

Bryman & Bell (2011) states that reliability is whether the results are *repeatable and stable over time*. Likewise, when considering Lincoln & Guba (1985) ensuring dependability by adopting an auditing approach or audit trail is a good strategy. Our dependability in this study is guaranteed by descriptions and clear processes from the beginning to the end of the project. Databases, academic articles, interview transcripts and other documentation used throughout this paper is stored and secured in an accessible manner.

#### 3.4.2 Replicability

Continuing with the criteria stated by Bryman & Bell (2011), replicability is referred to as *whether the procedure employed in a study is detailed enough in case other researchers choose to recreate the study in other contexts*. This can be achieved by thorough and dense description of the conducted research, thus building upon the transferability explained by Lincoln & Guba (1985). This has been achieved in our paper by thorough description on where and when relevant articles and papers used in the literature review have been used, and the logic behind our theoretical framework. As a result, if other researchers were to recreate and utilise the same data and information, the result would be replicable.

### 3.4.3 Validity

Continuing the last criteria, validity refers to integrity that *can be considered in the truth of the findings and results the research generates* Bryman & Bell (2011). Persistent observations, engagement over a substantial amount of time and other factors giving a sustained overview can help ensure the validity of the given research (Lincoln & Guba, 1985). However, not all strategies can be applied to all studies. Therefore, the researchers will have to find and conclude which would be beneficial and supportive of the research validity (Korstjens & Moser, 2017).

Throughout our research a substantial amount of literature from different sources has been used to guarantee the validity of the literature researched. Building upon the criteria and explanations by Lincoln & Guba (1985) and Bryman & Bell (2011), information and interpretation validity can increase with the use of different data sources. Throughout our process a combination of approaches and material has been utilised. This consists of the extensive literature review, conducted interviews with participants of air cargo services at OSL and a visit to OSL to better understand the facilities and their placement and operations. Only reliable sources have been used for the literature review, where citations, publication dates and journals have been analysed before use. Interviews have been conducted in a safe and thorough manner digitally due to the inability to meet in person due to the pandemic. Safe storage of transcriptions and video has been in place from the start and all stored data has been approved before conducting interviews with the relevant actors. Additionally, these were checked separately by each of the researchers to further increase the validity of the study (Bryman & Bell, 2015).

Conclusively we will make a remark on generalisability, which is *the concern regarding whether to which extent the results of the research can be generalized outside the context of that study, or other situations* (Bryman & Bell, 2011). This study can be utilised by other airports, air cargo facilitators or other participants in a supply or cold chain to see the impacts and possible measures to be taken to increase both efficiency and operations within a chain of individual actors.

## 4.0 Situational analysis

This section will describe the situation as it is for the cargo facilities and operations at OSL today, with emphasis on efficiency between the different actors in the supply chain. We will explain and visualise airline operations, receiving countries, terminal operations, and an overview of current operations in general. These numbers and visualisations will be used to highlight and exemplify inefficiencies.

Our approach led us to further investigate the efficiency of the cargo logistics at OSL. As previously mentioned in the literature review, the factors affecting cargo efficiency are vast and may be difficult to navigate and implement. Hence giving the motivation to further analysis of factors which could benefit OSL. Within this part of the thesis the details and overviews are provided from interviews conducted with relevant actors throughout the supply chain of the air cargo operations at OSL as well as numerical data visualisation traffic and destinations.

### 4.1 Background

Through our investigations we have found that there is a lot of activity that happens at the terminal that does not necessarily need that level of proximity to the airport. A potential solution to this problem, which was mentioned by our interview subjects, was to move some of this activity further out. Putting the non-essential activities that are currently conducted on the airport terminal to a new facility 15 to 20 minutes outside the airport has the potential to free up more space for the critical activities.

This was a natural direction to take for our investigation, since all our interview subjects described issues surrounding capacity. From what we uncovered it also seemed that there was a substantial amount of activity that took place at the terminals that did not need to be done there. Given that the focus was going to be on seafood export by air, Oslo airport was an obvious focus point. It is the largest airport in Norway and already has substantial seafood export activities.



Norway is also in a special situation since we have a lot of seafood exports going to markets in the United States, Middle East, and Asia, but not so much returning cargo. Specifically, consolidation of cargo that was to be transported further with trucks. These consolidation operations merely take advantage of the fact that the infrastructure and labour is already set up. However, if capacity for truck to air cargo is squeezed, this is a natural space to reorganize to free up more space.

## 4.2 Fish cargo attributes

A crucial factor for seafood cargo is temperature regulation of the product. The fish is transported frozen from when it leaves the slaughterhouses. This requires the operators to make sure that the temperature of the cargo does not rise above certain temperatures. These can vary between the different types of seafood, but the concept still stays the same. It requires either refrigerated systems or the use of ice to make sure the temperature stays at the requisite level. Both methods are expensive to operate. Refrigeration systems need to be installed, maintained, and require constant electricity. Ice takes up both volume and weight that could be otherwise used to transport more cargo. The importance of temperature control also varies with the seasons. Norwegian climate is characterised by cold winters and relatively warm summers. This means that the need to keep the seafood cold is greater in the summer. For air cargo there are also very rigid requirements in terms of having the cargo ready at the tarmac hours before the plane is set to departure. As a result, the seafood cargo could potentially risk standing in the baking summer sun for hours before the plane arrives, especially if the plane is running late. This means that the amount of ice will have to be increased, making the transport more expensive. This is however not a big problem during the winter when temperatures often naturally are at the right level.

The transporting of fresh goods demands a higher attention to temperate and efficient warehouses, transportation methods and information flow. The overall goal for the supply chain should therefore be to ensure that all factors needed to keep the commodity fresh for as long as possible. Additionally, keeping the

sustainability aspect of air cargo operations and the product's importance to the national economy at high importance (Bogataj et al., 2005; Johansen et al., 2019; Ziegler et al., 2013). The global demand for fish is expected to increase in the following years, which puts a great importance on OSL's capability to adjust to the increased demand in the market. However, the impact of costs on air cargo operations as well as operators' choice of airports are a major concern to further development of new areas and warehouses.

The seafood market has been characterized by good profit margins for the seafood exporters, but the margins for the companies further out in the value chain do not necessarily see the same margins. The market is very price sensitive which leads to a very low degree of loyalty between the actors. Building new terminals, new warehouses or developing new systems may not be justified as a slight increase in cost per kilogram delivered goods may give incentives to operators choosing other cargo airports. The current pandemic has also shed new light into the change of market power and sustainability within the sector from both products delivered and the market powers affecting air cargo (Choi & Park, 2020).

#### 4.3 Characteristics of the Norwegian market

Geographically, the Norwegian market and Oslo Airport have certain attributes that distinguish it from other markets. The northern location of Oslo Airport has made it challenging to establish the airport as a hub in the same way Schiphol and Frankfurt have accomplished. The freight balance of the Norwegian market also makes it difficult to achieve an optimal cargo flow balance. The high volume and weight of the outgoing seafood export makes it challenging to fill the planes on their return voyage. This often leads to flights going in a triangular pattern. The flight leaves from Oslo to the Asian market loaded with seafood. The plane then flies to Central Europe where it unloads cargo for the European market. Finally, it flies back up to Norway, but often with excess capacity since the demand for products is somewhat limited.

#### 4.4 Impact of pandemic

As the pandemic progressed, 40–60% fewer flight movements were recorded in late March with international flights affected the most. By April 2020, over 80% flight movements were restricted across all regions. The incredible impact of COVID-19 also had a dramatic effect on the rest of global aviation. This had a dramatic effect on air cargo, with prices rising from \$0.80 per kg for transatlantic cargoes to \$2.50–4 per kg. During normal cargo operation, i.e., not under a pandemic, most of the seafood cargo is transported as extra cargo in passenger planes. Specifically, it is stored in the belly of the plane under the passenger level. This makes freight prices very dependent on passenger traffic. But as oil prices kept falling there opened a new opportunity, airlines could now make money converting passenger planes to full cargo planes (Flight Global, 2020). This was crucial because airlines were haemorrhaging money and, in an attempt, to improve cash flow some airlines started to shift towards more seafood transportation. This included Qatar Airways who opened a direct flight from Evenes Airport to Doha International Airport. A biweekly round trip of a Boeing 777 (B777) continues to ensure a fresh supply of Norwegian Salmon to the Middle Eastern market. Earlier in 2021 a B777 flight set the record for the most amount of food transported with a B777 with a cargo of 68.944 kilo of salmon.

#### 4.5 Terminals

Terminal operations are operated by two individual operators at OSL, namely OPC and OSCC as mentioned throughout the thesis. Both strive to be an effective terminal and warehouse within the value chain and are the last stop before entering the freighters taking them abroad. Throughout interviews with both terminals, it is evident that they share most of the same issues and constraints and shares the same prospects for the future in terms of positive economic impacts of increased export.

Trucks from all regions of Norway deliver their fresh commodities directly to the terminals themselves, which stores and prepares the packages for future transportation either by air cargo or new trucks down to Europe. As this thesis

is primarily focusing on OSL, the trucks delivering to the terminals for cargo consolidation before further shipment by trucks were excluded.

While discussing ongoing halts in efficiency and possible storage problems at each terminal, what occurred most often was capacity constraints on peak delivery days for scheduled deliveries. Part of this seemed to stem from a lack of even distribution of delivered cargo. While they know that a truck from a given fish farm is underway, there is little to no information found exactly when it arrives. As a result of this information impairment, workers can find themselves working night shifts with nothing to do until the shipment arrives. When the shipment finally arrives, there might be multiple trucks arriving in a very short time interval which further complicates the situation. If a shipment is delayed there are few automatic ways of letting the next step in the supply chain know. This can potentially result in further delays and increased costs for downstream activity.

As both actors have ongoing issues in terms of information flow and capacity constraints on peak delivery days, a better way of distributing information and a better overview was thoroughly discussed. There were found to be both short term solutions and long-term solutions which could both potentially benefit operations on each terminal, however the question regarding costs and the implication it may have on operation and product cost is unavoidable. Whereas short term solutions as a “cooling hotel” may greatly impact capacity constraints in the warehouses, long term solutions such as permanent additions to storage areas are found to be equally important when discussed and when looking at the future prognosis of expected demand on the global market. Both actors see the possibility and advantages of centralization but emphasise on the importance and healthiness of the competition that resides at OSL today.

#### 4.6 Analysis of shipment data

Through data collection from one of the key seafood brokers, we have done an analysis of the shipment through the two main seafood terminals at OSL. This data looks at shipments from 2018 to 2020, and from our analysis we can

extrapolate that the pandemic had a serious effect on the total quantities shipped. However, as we found out through the interviews, the airport handlers and organizers were able to reorganize the shipment methods so that seafood could be continued to be transported, even at the height of the pandemic.

The data relates to how much freight was transported between different global locations. This included 17 departure locations and more than 50 final destinations. Additionally, the data covered more than 59 different airline companies. Because of the limitations of the study, we have chosen to focus on the freight that was sent from OSL through the terminals of GPC and OSCC. The shipments are sent in 5 different box sizes which include the following sizes: 10l, 30l, 40l, 80l and 250l. Outside of this, the data also includes the total weight of the shipment and the date of departure. In total our analysis is based on more than 70.000 shipping records. The data was then first processed and cleaned in Excel. This was necessary to get the right format so the data could then be analysed using PowerBI. Through PowerBI we were able to see trends and the overall direction of the shipment flows. Following is some of the key takeaways from the quantitative analysis:

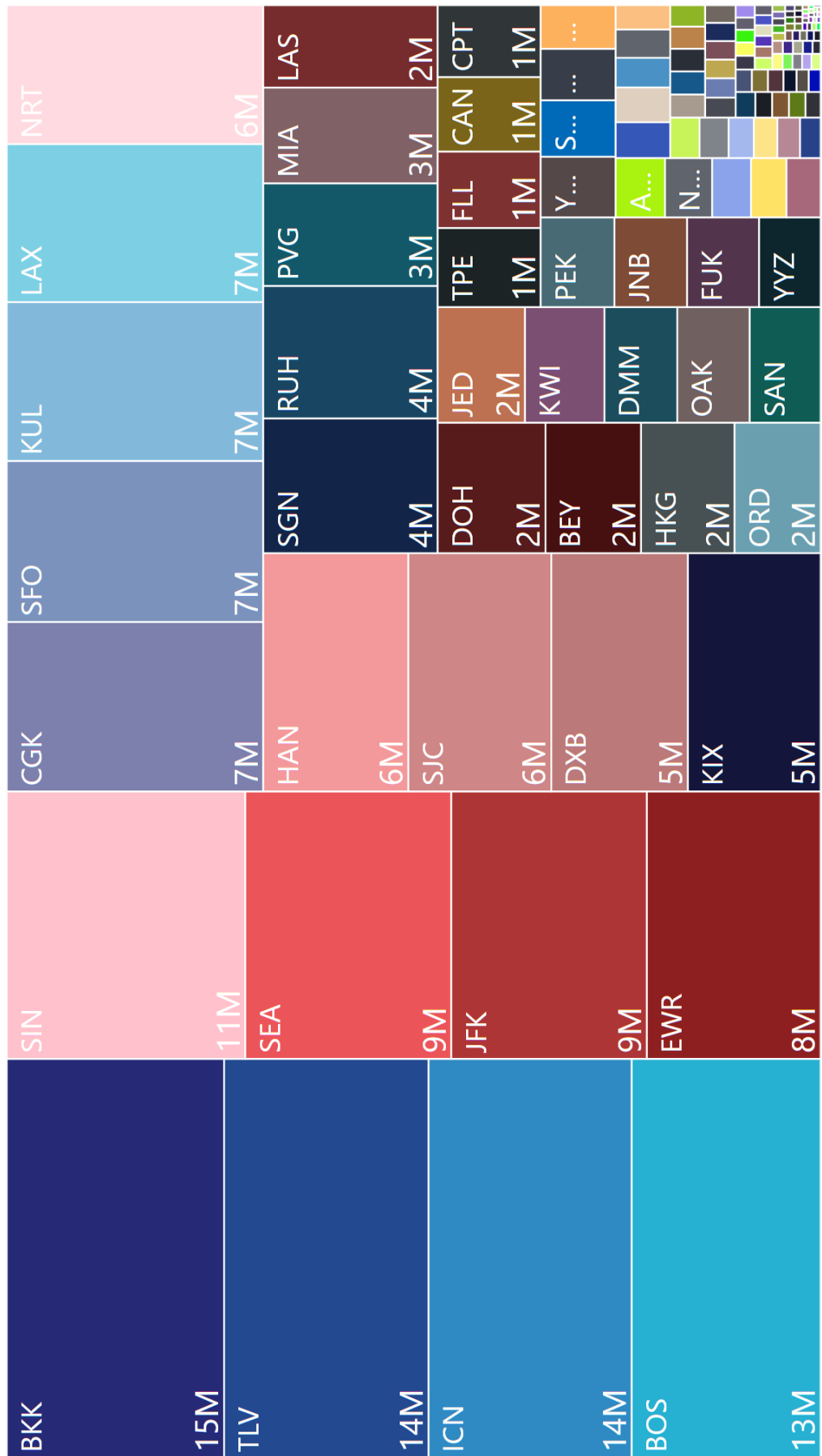
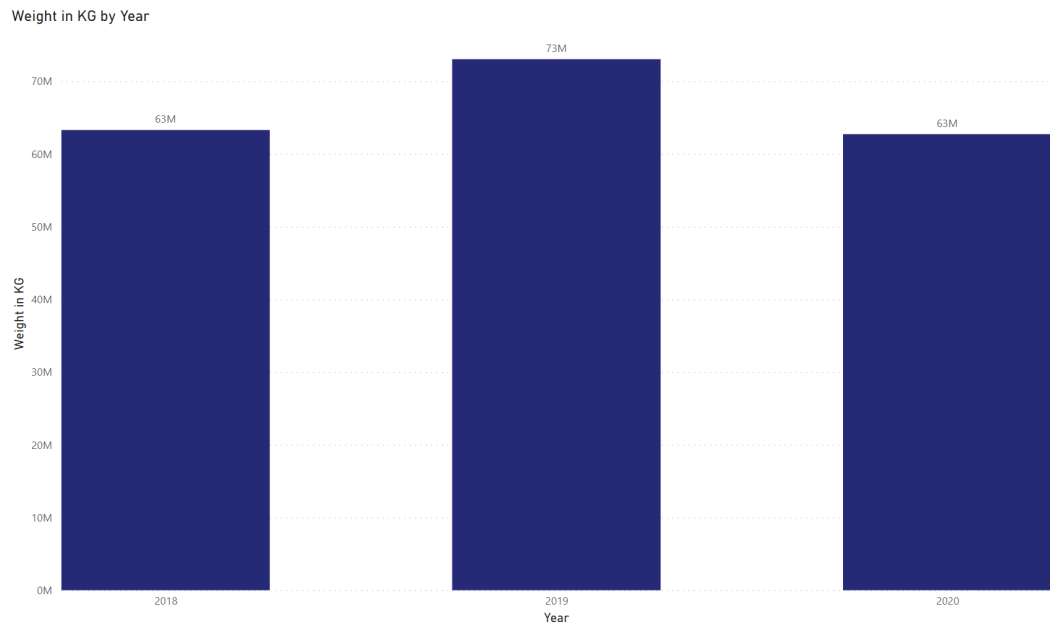


Figure 8. Total shipment weight with destination over the last 3 years

This chart illustrates the cumulative shipments calculated after weight to the different destinations. The weight is stated in million kilograms. This means 150 000 tons were exported to Bangkok over this three-year period. This was the biggest destination, closely followed by Tel Aviv, Seoul, and Boston. Also, worth noting is that US cities count five of the top ten biggest destinations. Generally, we can see that Norwegian seafood is transported to all over the world, and quite distributed in terms of end destinations with no single destination clearly outweighing the others.



*Figure 9. Annual shipment weight over the last 3 years*

As we can see on the total weight transported out of OSL, there is a clear reduction from 2019 to 2020. The projected growth rates expected at least the same volume as 2019, and probably continued growth. However, from the analysis we can see that there was a 10 million kg cut in exports from 2019 to 2020.

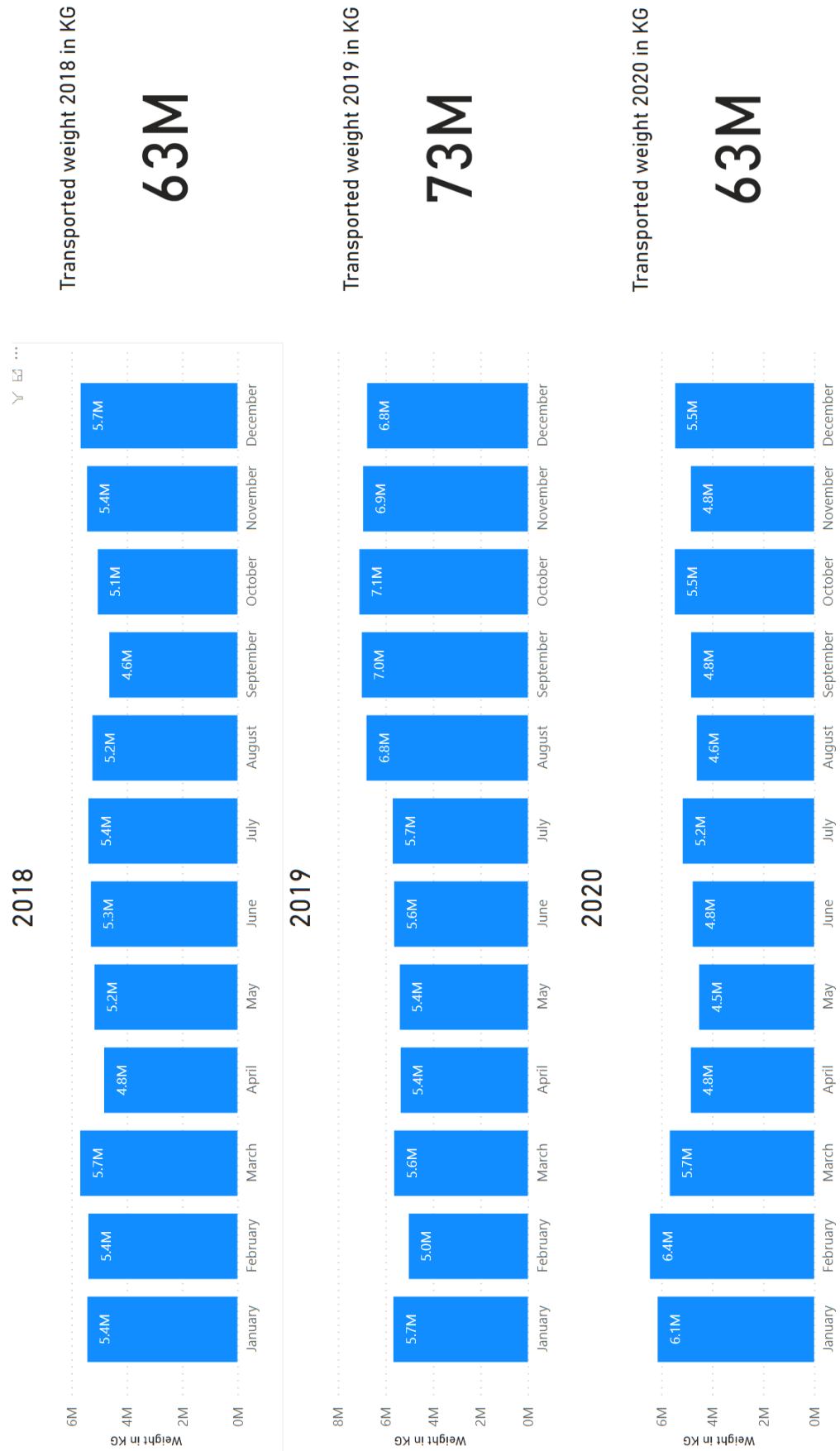


Figure 10. Monthly shipment weight over the last 3 years



This chart shows the monthly development of freight from OSL. From this we see that there started a downward trend from February 2020. However, by October the same year the volume started to climb back towards pre-pandemic levels. From the monthly overview we can also observe seasonal changes in the shipping levels. The winter season seems to be the time when there is an increased level of export.

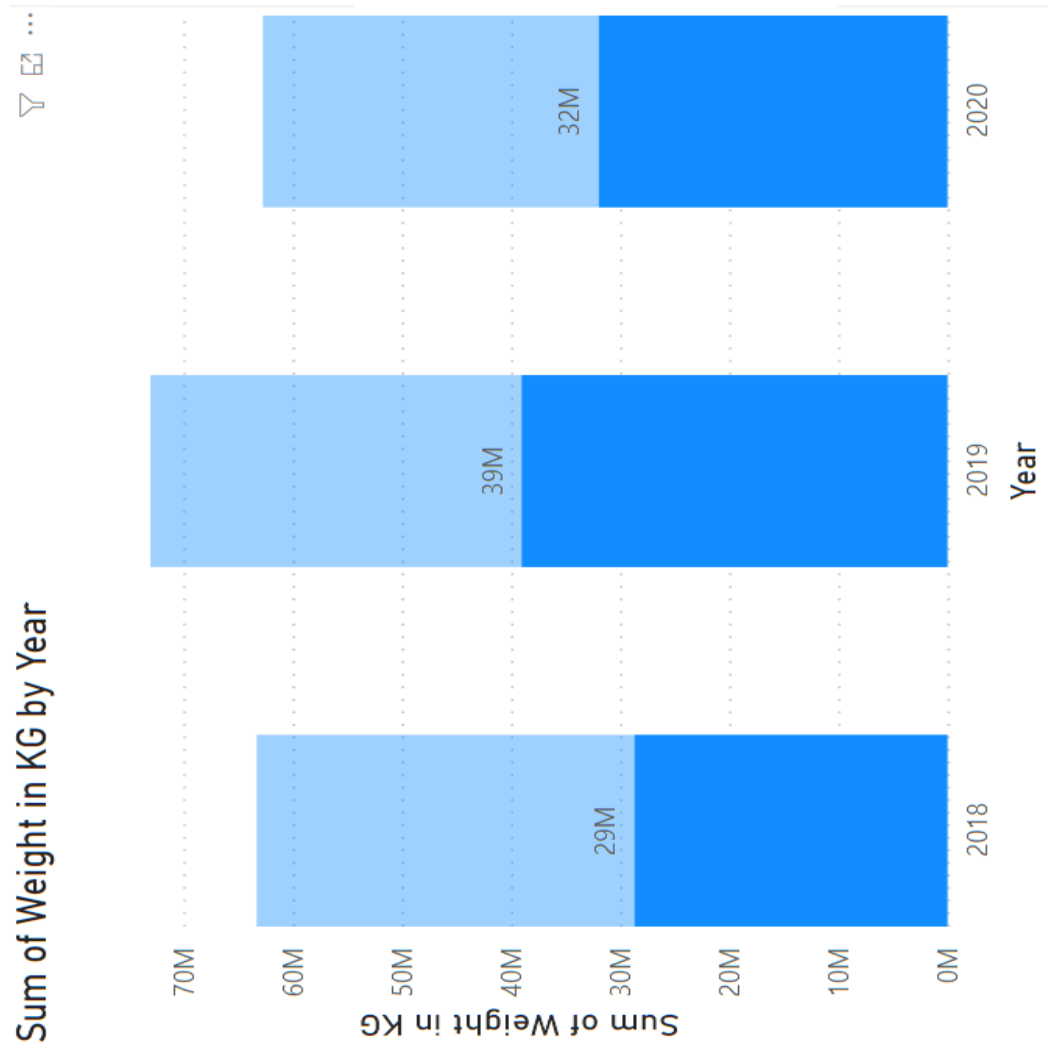


Figure 11. GPC shipping data 2018-2020

The dark-blue area shows the part of total shipments that are related to GPS’s export activities from OSL from 2018 to 2020. Weight is still denoted in million kilograms.

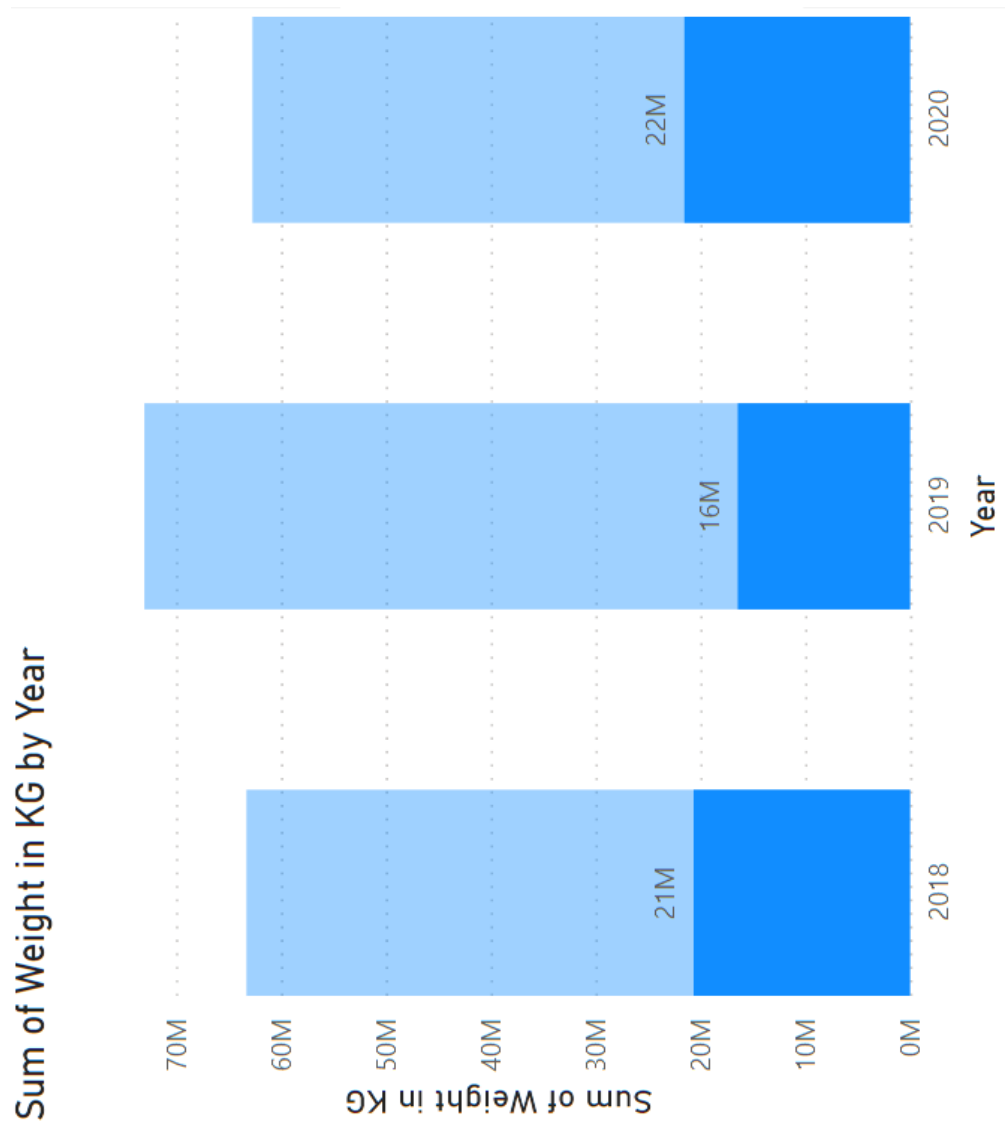


Figure 12. OSCC shipping data 2018-2020

This is the equivalent chart but representing OSCC’s shipping activities for the same timeframe.

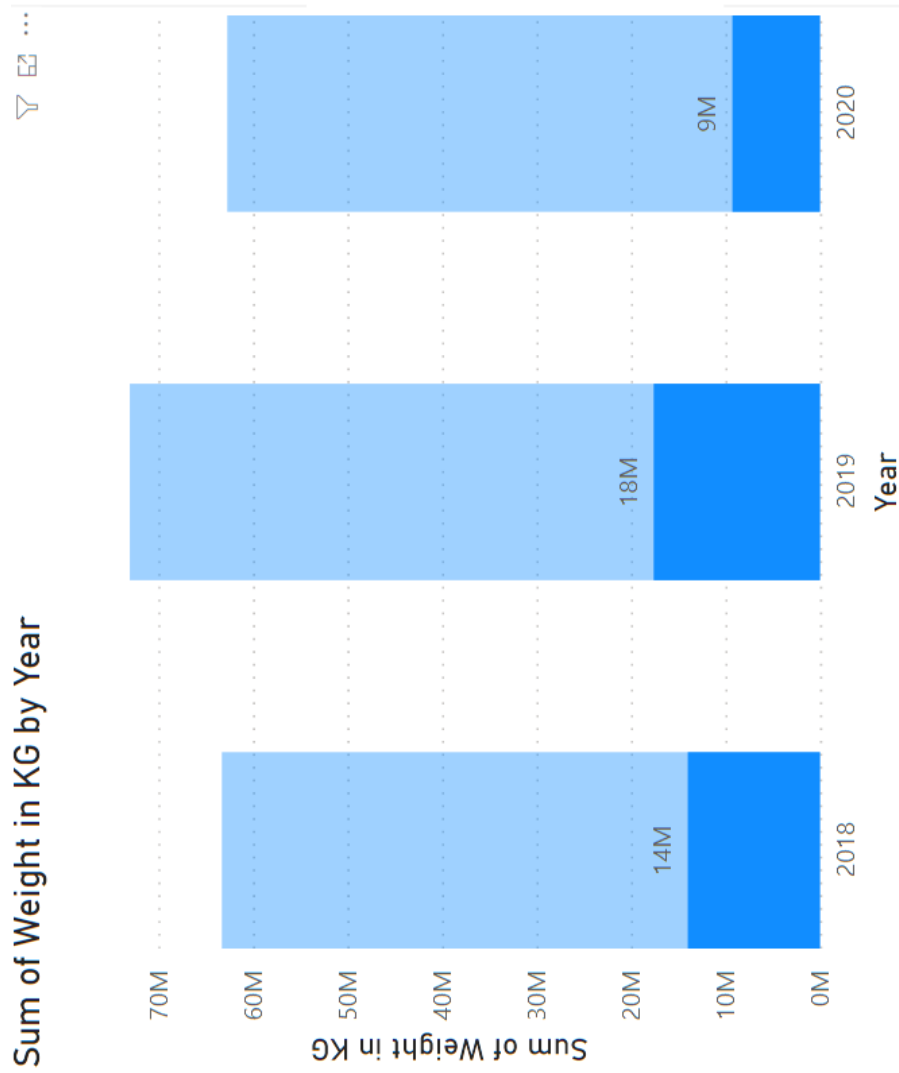


Figure 13. Other exporters at OSL 2018-2020

This last chart shows the total quantities of all other actors from 2018 to 2020, totalling 41 million kg. As we can clearly see, GPC and OSCC are by far the most dominant export actors in the seafood export sector at OSL. The total weight exported from OSL over the last three years was 199 million kg.

#### 4.7 Discussion of PowerBI analysis

The key takeaway from the shipping data collected from Salmosped, is the impact that the pandemic had on the seafood export business. A ten-thousand-ton reduction in exports is dramatic for a sector that the previous year

transported 73 thousand tons. However, the quick recovery of the industry also showcases some of the resilience in the supply chain. Being able to move from transporting seafood in the belly of passenger planes to dedicated cargo planes allowed the industry to keep most of the product to move. Regardless, the exporters were constantly challenged by the fact that covid-rules of different countries kept changing. This required the sector to be dynamic and quickly adapt to the new export climate. As seen from the analysis of the different export destinations, Norwegian seafood reaches a very broad market. We argue that this was a crucial factor for why the sector managed to curve the export drop to roughly 13%. The multitude of markets meant that the exporters already had networks in these markets, which potentially made it easier to offload extra capacity in these markets.

The variety in different airlines that transport Norwegian seafood also meant that the exporters were not completely reliant on a few airlines. This was important because the financial health of the airliners was severely damaged from the reduced passenger traffic. Already having working ties with 59 airlines meant that Norwegian seafood had a wide variety of potential companies that potentially could take up extra capacity if one of the other actors failed to do so.

From the analysis of the export traffic share we see that GPC is the biggest player in terms of Salmosped exports with 100 million kg exported over the previous three years. This is followed by OSCC with 59 million kg in export.

## 5.0 Findings & Discussion

Throughout this paper we have presented the actors and systems found at OSL and its cargo terminals. These analyses have allowed us to explore the different actors and their supply chain operations from receiving the commodities at the terminals to forwarding the shipments abroad.

The market for seafood consumption, and its transport, is expected to increase in the coming decade. To sustain the increasing amount of goods received, the terminal capacities at OSL need to have the right amount, or excessive capacity. Additionally, we have explained the different effects other factors may have on the efficiency, uncertainty, and reputation for future cargo operations. Whichever solutions and changes that are made for the cargo operations at OSL, it seems that efficiency, capacity considerations and information flow are important measures to further expand on. This brings us back to the problem statement, which we will explore in the discussion as well as in our findings.

*What are the key dynamics, challenges, and opportunities of seafood export handling at Oslo Airport Gardermoen?*

This part of the thesis will present our theoretical findings and the results from our qualitative analysis containing the theoretical framework and interviews conducted with Avinor, Salmosped AS, OSCC and GPC. This part also includes our discussion on the topic. As a result of this, we present our findings divided into several categories, which are tied to categories within information flow and capacity utilisation. First comes an overview of the current issues before the part is ended with a look at potential solutions.

## 5.1 Current issues with communication

### 5.1.1 Cold chain communication challenges

According to Gardermoen Perishable Center (GPC), they see the biggest issues in the current supply chain within this area. The communication, or lack of it, is the biggest uncertainty when it comes to the delivery of goods to the terminal. However, the potential in building a better communication network was discussed and found to hold a lot of opportunities.

What seems to be an issue in incorporating a better communication platform for all actors involved in the supply chain is the competition itself. From both GPC and OSCC there is great knowledge of the market and their own activities, and both discuss and mention the same issues during the interviews. Optimization, efficiency, and capacity constraints were found to be a common denominator throughout our investigation. By looking towards the theories and literature presented throughout this paper, most of it can be explained by the lack of information between the relevant actors. Furthermore, the lack of information flow does not only affect the capacity constraint directly, but also the indirect operations throughout the supply chain. As mentioned by Budd & Ison, (2017); Gardiner et al., (2005) the airport's efforts to attract cargo operations will be significantly easier when offering specialized structural advantages, terminals, warehouses, equipment and so forth to customers.

As can be observed from this overview, the necessity to improve the communication flow between the actors involved in the cold supply chain when transporting seafood to OSL is important when considering further improvements to the terminals. Directly to lessen the impact of peak days and capacity constraints, and indirectly for future expansion in attracting new customers.

### 5.1.2 Information flow between systems

The field of trucking has over the last decades seen a drastic shift towards more foreign workers. One interesting aspect we found relating to this, which was not mentioned much in the literature, is the language barriers that can be found between the “joints” in the supply chain. This was mainly an issue between the road transporters and terminal buildings. As mentioned, the information flow and overview of the transport routes is low, and the terminal owners do not specifically know when or what the carriers are delivering the perishable goods. An uncertain situation can be further stressed when drivers do not speak a language that the terminal workers understand. If there are any issues with the package that only the driver knows about, it is difficult to pass this information on to the handlers without some form of translator or system. This has had a positive effect for reducing costs, but it has also made communication more challenging since the actors then no longer have the same native language and English skills can at times be less than optimal.

Throughout our research we have found that the communication and language aspect of shipments is mostly put aside to other studies, and not mentioned much in the handling of cargo. This builds upon the need to further research the effectiveness of cold supply chains that transport fresh goods between several differentiated actors, especially in regards of system implementation to lower risk of uncertainty to mitigate language barriers.

## 5.2 Current issues with capacity and requirements

### 5.2.1 Capacity and unused capacity

OSL has two key seafood terminal operators, GPC and OSCC. These act as competitors and are constantly fighting for greater market share of the transportation volume. This can at times result in suboptimal scenarios where one terminal has maxed out capacity while the other is not. This means that trucks could spend time waiting in line to unload their cargo at the specified terminal while the other terminal is standing empty. This could potentially be

solved by a coordination of capacity between the two terminal handlers. But according to both GPS and OSCC this is not so easy to implement as an actual solution. Given that we are talking about export via an airport, there are numerous security aspects that must be considered. Implementing capacity sharing between the two terminals would require a large degree of trust between them since one company would essentially ship their product through the other company's facilities. The implication here is that there are several scenarios that could cause trouble and complicate the situation. For example, who has the responsibility for the product if it is damaged while being outsourced to the other terminal. And who is legally responsible for the product during the capacity sharing period. These are just some issues that complicate the situation. So, from talks with both terminals, we found that neither of them sees this as a viable option for capacity expansion.

As a result of the competition between the two terminals operating cargo operations from Gardermoen, the capacity constraints are natural to discuss. As mentioned earlier, communication between the two of them are minimal due to the competition aspect of their operations. We have mentioned previously throughout the paper that communication and information flow are essential when considering efficiency in capacity utilisation planning. By not having a well-structured information flow, the capacity which already is at a minimum (especially on peak days) can be expected to be uncertain and easily exceeded.

Presently there are different views regarding the capacity at the terminals from the different parts of the supply chain found at OSL. Whereas the terminals themselves stress that the capacity is good enough, forwarders gave an explanation around the fact that they find it to be less than ideal. They also expressed worries about the expected increase in the years to come. The emphasis on efficient storage and capacity utilisation was found to be a dominant theme when conducting interviews. While only some mentioned safety as a major cost factor.

More specifically when discussing the capacity considerations, we found a difference between the actors in how they see the near future of exporting fish



products. Forwarders see the capacity as something that is already holding back the expansion of export from OSL, whereas terminal owners tend to see the capacity utilisation as good enough, but with some issues during peak days. This seems to be a trend within the sector, that operators see the same problems today and for the future, but with different wishes on how to achieve them.

We would naturally consider the covid-19 restrictions making it more difficult for all actors to get a good overview of the situation between all actors, thus making potential agreements undertaken in the previous year more difficult to achieve.

This makes us consider that a possibility of cooperation between the actors of the supply chain to implement an information flow system to gain insight in both transportation and capacity would benefit all actors. However, as was discussed throughout the interviews, the competitive advantage between the actors could be lowered with such a solution. Nevertheless, such a solution could be beneficial for all participants, as it is well documented literature surrounding the benefits of having a controlled information flow.

When asked, all participants in our interviews mentioned capacity constraints as being the main challenge they face, and especially during peak days. The two terminals at OSL both stress that the capacity they can provide is enough, but the average terminal capacity is not big enough for peak demand.

However, the severity of capacity constraints is found to be different for each part of the system. Where terminal owners focus mostly on peak days and the capacity constraints of big volumes at once, forwarders tend to see the capacity as being an overall issue at OSL. This may come from the way forwarders utilise the facilities, as it will most likely tend to fall on high-capacity days, but it is nevertheless important to discuss. According to Salmosped, GPC and OSCC, high-capacity days usually occur during Tuesday, Friday, and Saturday. Especially when considering the rapid increase of fish transport by air which is expected to increase massively in the coming years.

Concerning what we can deduce from the differences in observed and explained scenarios, it seemingly falls under the lack of communication and openness that we have discussed earlier. Naturally, it is normal for competitors within a market to keep certain information for themselves to remain their competitive advantage. There is however a difference between keeping all information classified, making it difficult to dissipate uncertainty. Attempts to improve proper information flow could help the total flow of the cold chain, which as previously mentioned has some very specific requirements.

### 5.2.2 Food safety and cold chain requirements

Since seafood is classified as a cold chain in terms of supply chain type, it has certain requirements that make it different and more complex as compared to other perishable goods cargo such as fruit and vegetables. Specifically, these relate to the temperatures that the seafood cannot exceed. This is especially important when considering that temperature is the single most important environmental factor affecting the deterioration rate and postharvest lifetime of fresh product as seafood (J.-W. Han et al., 2018). This is generally handled using refrigerated trucks and storage spaces, as well as using ice. This is costly and requires either energy intensive infrastructure or the use of ice to keep the product at the right temperature. The biggest issue mentioned by the freight forwarders is that ice takes up both valuable volume and weight that could have been used to transport other products. It also melts with time, which means the handlers must refill the ice supply at certain intervals.

Keeping seafood at the required temperature remains the most important deterioration rate and postharvest lifetime. This was both confirmed by the actors we talked to in the industry and from literary sources such as Chaudhuri et al., 2018; Esmizadeh et al., 2021; J.-W. Han et al., 2018; James & James, 2010; Ji & Guo, 2009; Montanari, 2008. However, when there is a way to cut costs even at the expense of safety, that boundary risks being stretched, especially when the margins and competition in the market is very strong.

Given the need for the shipment to be ready on the tarmac when the plane arrives, it could happen those pallets with seafood could end up standing in the

blistering heat for hours if the dedicated plane were running late. This highlights an important issue in this industry, namely oversight. These products travel across the earth and go through several different places with varying jurisdictions and regulations. This makes it incredibly difficult to make sure that the industry is operating according to the rules. Transporting cold chain products have very specific requirements which are often capital intensive to implement.

As both confirmed during the interviews with the handlers (GPC and OSCC) and (Bogataj et al., 2005), handling seafood requires quick reaction time to make sure that the temperature doesn't fluctuate outside the approved range. As mentioned, it is possible to implement technologies such as chart recorders, data loggers, time-temperature indicators (TTIs) or colour changing labels and active RFID tags with temperature sensors. However, we argue that it can be difficult to get companies to install devices that would ensure a very high level of food safety. We believe this is partly because it is very difficult to prove where or even if a violation has occurred. Also, the high level of competition between the actors results in a constant pressure to keep costs down. All these factors play into the risk in cold chain logistics and is something both the handlers, regulators and customers should consider.

### 5.3 Potential disruptions and vulnerabilities

Throughout 2020 there has been a substantial number of papers released trying to explain the effects of the ongoing pandemic, as well as suggestions for future research. By using keywords such as *air cargo operations*, *pandemic*, *COVID-19*, we found more than 40 scientific papers. Adding *cold chains* to this search, 4 scientific papers present themselves, but these are mainly concerning pharmaceutical transportation.

Between March 2020 and May 2020 the first implementation of a wide range of flight suspensions began (Sun et al., 2021), where May 2020 is considered the month with the least amount of serviceable flights in newer aviation history. However, the air cargo transportation market and its demand has proven to be

decently stable throughout the pandemic. This can be found in literature (Choi & Park, 2020; Kim et al., 2020; T. Li, 2020) and was also confirmed throughout conducted interviews. As a substantial amount of perishable goods from OSL is transported in the excess capacity found in the belly of passenger aircraft, it could have had severe consequences. Through the interview we conducted we found that passenger transport routes were more severely affected than the pure cargo routes, and they were able to transition a lot of shipments over to dedicated cargo planes.

As we have discovered in the literature and through interviews, climate considerations are becoming increasingly relevant for the sector. The high levels of CO<sub>2</sub> emissions are generally seen as the main contributor to global warming, and the aviation industry certainly has its share of contribution towards this. This puts seafood exported by air freight in a difficult position, since the exporters are completely reliant on-air freight to get their products to the market in time. Getting the fish as fresh as possible to the markets is one of the key trademarks for the seafood sector. This means transportation options such as trains, trucks or shipping are too slow to reach the markets outside of Europe without the product losing too much value. However, there is an asymmetric cargo flow between Asia and Europe which means there is excess capacity when flying eastwards from Europe towards Asia. Given that these flights would otherwise potentially travel back without filling up capacity one could argue that it is good resource utilization to fill up the free space.

What type of airline is used to transport the cargo also has a huge effect on the number of emissions that are being released from the shipping operations. Newer airlines are a lot more efficient than the older models. However, the freight forwarders that we interviewed argued that they had very little market power in affecting what kind of planes were being used for the operations. They argued that this was something that had to be decided from the airlines. Alternatively, there had to be some sort of intervention from Avinor or a government decree that demanded a certain standard in terms of reduced emission requirements. The challenge of individual change was echoed by all the actors that we talked to and highlights the difficulty for one actor to improve

their footprint alone. This could be because almost all such initiatives to reduce emissions cost money that will then be reflected in the bottom line of the company. Unless the customers are willing to pay for this feature, it will make it harder to compete with competitors that do not implement such solutions.

### 5.3.1 Air freight from the North of Norway

A huge amount of seafood farming happens in the northern parts of Norway. Nevertheless, the seafood is primarily shipped by truck to the more southern airports or directly to the end markets. This partially stems from the fact that there are certain attributes that make shipping by air from Northern Norway impractical. First is the issue of balanced cargo flow. Northern Norway is a sparsely populated part of the country where the importation of goods is limited. This means that a lot of the planes that travel up North will have to fly with excess capacity. This plays into the overall cost structure for the goods that are then transported from North-Norway to the end markets. What effectively happens is that the revenue from shipment of seafood must cover the cost of transportation from North-Norway to the end market, but also part of the cost of the initial journey to North-Norway. The cost increases make it more difficult to compete with airports located further south that have a better-balanced cargo flow.

The northern parts of Norway are also famous for the challenging weather. This increases the uncertainty around air travel, which is particularly vulnerable towards weather. This risk is also increased by the challenging topography in the north, which makes landing and take-offs more difficult than airports such as Helsinki and OSL. Given the intricate scheduling of international air travel, this can have far reaching consequences. As discovered through our interviews, these factors play into why freight forwarders often pick airports further south with more stable climates. The infrastructure in these areas also make it challenging to fully load planes towards their capacity. According to our interview with Avinor and Transportutvikling AS, this could result in flight flying a less weight and volume than economically optimal. The primary reason for this is that the runways are too short to accommodate the big cargo planes.

One benefit of air shipping from the north that is worth mentioning is that the geographical layout makes transportation to the Americas more favourable than from further south. The difference is quite marginal with Oslo - New York coming in at 5,794 km, versus Tromsø - New York with a distance of 5,749 km, 45 km less.

## 5.4 Potential solutions

We consider that the efficiency of the cargo terminals and operations can be increased through efficient information flow, increased capacity utilisation and by sustaining and/or increasing reputation with actors in the market. The market increase in consumption must be met to sustain and increase cargo operation from OSL.

### 5.4.1 Value chain communication

From the analysis, literature review and interviews conducted, effective communication throughout the supply chain appears to be a high priority. This corresponds well with the literature on the topic which signifies the importance of effective communication, even though the field on aggregate has already had a strong improvement in this area. As Hertwig and Rau (2010) points out, the efficiency in air cargo logistics has continuously improved due advances in IT and communication. Nevertheless, this has not been enough to satisfy the current demand for efficiency from the actors in the industry.

One way of improving communication and traceability throughout the supply chain is with Radio Frequency IDentification (RFID). This technology is well known as being both effective and trustworthy. RFID has the potential to improve traceability throughout and effectively contribute positively to the risk management of transporting fresh products (Maruchek et al., 2011; Raab et al., 2011; Ringsberg, 2014). Additional benefits to implementing such a system are ensuring visibility, monitoring of individual containers, optimization, and building transportation plans (L. Wang et al., 2010) or storage plans (Raab et

al., 2011) to further reduce the risks. Considering RFID, this is not something new, and has gained increased attention as it has proved to increase flexibility, effective demand management, volatility reduction, reducing cost fluctuations and enabling organisations to make better decisions (Z. Li et al., 2012; Nakandala et al., 2014; Shi et al., 2010; L. Wang et al., 2010).

This solution could help distribute the deliveries more evenly which could make operations cheaper and minimise uncertainty. This implementation could allow them to track and plan cargo operations accordingly to gain an increase in efficiency to cope with the existing demand, especially during peak demand days. As a result, distribution of perishable goods would be less volatile to capacity constraints and potentially less workforce needed outside normal operating hours.

However, since the value chain is fractured into so many different sections with each section filled with a multitude of different companies, it is very difficult to coordinate such an approach. For a solution to have maximum effect it should be utilized for all parties in the operation. This solution faces the same challenge that most other initiatives in this sector does, namely that it costs money upfront. This often scares the actors away and they end up utilizing other facilities and airports. New IT and communication solutions also face challenges with stricter data handling regulations. This raises the challenge of implementing new technological solutions.

One important aspect that is not mentioned as much in the literature regarding this implementation is the security benefits for airport terminal operations. Discovered from the interviews is that there are extensive costs to the expanding and complex security measures that must be taken at an airport terminal. Being able to increase visibility will benefit the uncertainty aspect of security measures, which could help decrease costs. Additionally, as found in the literature review, effective from June 30, 2021, international standards require that all international air cargo carried by commercial aircraft operators (both cargo and passenger airlines) must be screened or received from an earlier airport which has already screened or confirmed its cargo (*Air Cargo Security*

*Options To Mitigate Costs of Compliance With International Security Requirements, 2020).*

#### 5.4.2 Attracting customers and cargo traffic

The effects of communication and relationships are mentioned thoroughly in the literature review, and how a cargo terminal can benefit greatly when increasing visibility and relationships with actors involved. By increasing relationships and visibility, new actors are more likely to investigate starting operations from them. This could allow all actors at OSL to gain and serve new markets that previously would not be accessible. This may not only include cargo operations, but increased passenger operations as well.

By implementing a new system that supports the actors of the supply chain, the network and quantity of transport could see an increase in traffic. Not only by directly attracting new operators into using the services provided, but also by taking advantage of already existing infrastructure. Since the global demand for commodities such as fresh salmon is high, it would be beneficial to implement such a solution to not only increase efficiency today, but also to prepare for the next expansion of storage and warehouse capacity. As the export of fish from Norway is expected to increase steadily through the next decade, being able to catch a bigger market share is key to sustain the increased demand. As discussed in the literature review, the subjective reputation could be a gateway in increasing transport, especially for freight only services. When discussing reputation, this may consist of low cost, high quality, familiarity, or possible airline alliance.

While marketing may give a short term increase in reputation, airlines and freight service providers consider the general airport reputation and experience with cargo as more important as it can reduce uncertainty regarding the quality of cooperation between the actors of the supply chain (Kupfer et al., 2016). However, the guarantee of securely guaranteeing future terminal capacity, absent of abrupt regulation changes, and unfavourable climate conditions



(temperature environment both for goods and aircraft) will play a considerable role in catching future markets.

Due to the difficulty in retrieving information regarding reference data from airlines and cargo operators about the benchmarks of choosing an airport, further research is needed to fully map how preferences are made. This section is therefore based on theory that exists with plausible benchmarks for capturing market shares.

#### 5.4.3 Improving capacity with off-site location

From the interviews we conducted with relevant actors at OSL, we devote our attention towards the different advantages and disadvantages that could present themselves when considering cargo and warehouse locations.

In addition to the strategic advantages of being present on-site, it could be advantageous to have facilities off-site to either serve as a capacity increase for future, non-critical goods, or as a short-term dissipation of capacity constraints that exists today. We assume that the percentage of received goods will stay the same, but with an increased quantity in the future. Seafood demands much space, not only in its size itself but also storage compartments which need to be properly tempered. As the quality of the seafood directly corresponds with its temperature when stored, we could see the motivation for using differentiated warehouses on the outskirts of the aircraft site if transportation can be managed for allocated time slots. We estimate that capacity constraints can be lessened and done more effectively if critical goods were kept on-site, while non-critical goods were allocated towards less central facilities.

#### 5.4.4 Improving capacity with terminal centralisation

Discussions around centralisation and its potential and weaknesses have been discussed for many years (Cardinal, 2001; Damanpour, 1991; Yang et al., 2015). A general conclusion throughout the literature is that a structure that is

centralized in its core can affect both effectiveness and efficiency of the information flow throughout their whole operational structure. This includes both quantity and quality, as well as employees willingness to generate and share ideas and expertise (Jansen et al., 2006; Paper & Rodger, 1996; Pierce & Delbecq, 1977; Sheremata, 2000; Thompson, 1965).

Conversely, negative affections to centralisation are also found. Whetten (1978) found that centralization had a positive effect on the output of manpower but negatively on the staff's perceptions of effectiveness. However, these claims come majorly from situations where there are found conflicting interest groups within a system, which can be said as not being the case within a building which focuses on being as effective as possible and with a common goal.

When discussing the possibilities of one centralised terminal at OSL, there are some distinct differences and similarities found when we conducted the interviews. Consolidating these findings with existing literature and analysis, it is reasonable to assume that they originate from much of the same areas.

Considering a future construction of a new and centralised terminal, actors should be aware of certain factors regarding terminal operations. It is complex, thus requires a large investment for the construction of the system. Implementation of the different co-organisations that will be part of the supply chain is of great importance. The most critical aspect to be highlighted during the interviews was the importance of neutrality related to such a facility. Lastly there are important needs for a system that can sufficiently control operation costs from its launch (Chaudhuri et al., 2018). As the primary operation of transport of perishable goods is to deliver a fresh product, this is naturally a primary concern for customers when buying a perishable product (Wu et al., 2018).

## 6.0 Conclusion

Oslo Airport Gardermoen (OSL), together with its operators, are trying to improve its seafood cargo operations to be prepared for the expected increased market demand of fresh fish to overseas markets. Additionally, improved air cargo operations abilities can help boost the attraction of the airport, as air freight operators, airlines and other actors that actively take part of the value chain will have greater options to achieve optimal cargo balance. The aim of this thesis was to investigate the dynamics of the seafood cargo operations at OSL, as this has the potential to shed light on important mechanisms that can help improve the overall operational efficiency at the airport.

Our research question was: *What are the key dynamics, challenges, and opportunities of seafood export handling at Oslo Airport Gardermoen?* Through our research we found signs of inefficiencies surrounding optimization, efficiency, and storage capacity between the participants in the value chain.

A common denominator throughout our research is that the information flow is restricted outside of the booking and usage of facilities, even though actors would benefit from a higher information flow. We see this as partly a lack of will to cooperate, but also a technological challenge where tracking solutions such as RFID are not used. Better information flow could potentially improve visibility, as well as increase flexibility, reduce cost fluctuations and increase the attractiveness of their air cargo services at OSL. Through better solutions for seafood export, OSL could help attract new traffic and bolster the airport's competitive advantage.

We also found challenges related to the utilization of capacity in terms of handling on peak days and subsequent storage at appropriate temperatures to avoid product degradation. By exploring the potential of cooperation between the two terminal handlers one might be able to reduce cargo build up during peak times. Reducing the waiting times of trucks would also improve OSL's reputation as an efficient cargo exporter of seafood. Improving communication

with the trucks could help optimize the use of manual labour required for offloading.

In a long-term perspective, as the volume of fish export continues to increase, we see a need for better structural solutions to efficiently transport the incoming seafood. This could free up more space and increase capacity to handle the increasing volumes. The key challenge here remains how to organize and finance these activities as the primary driver of operations is the effective cost of shipment. This will need to be further explored as there are a multitude of different actors and perspectives, especially when one takes a holistic look at the value chain and not just the operations that occur at OSL.

Regardless, the robustness of the operation is better than our initial investigation would suggest. This has been tested and proven during the time of the pandemic. Even though the seafood brokers saw a decrease in seafood exports, the volume reduction in 2020 compared to previous years shows the operational abilities of the market to adapt and accommodate sudden changes. This shows a strong ability to handle challenging situations and can be viewed as a strong indicator that the market and operations are solid. However, there are overall needs for improvements, particularly within communication between the operators to increase visibility and decrease volatility, and capacity utilization within storage and handling of incoming goods. This is crucial to meet the expected rise in demand.

This investigation highlights the key mechanisms, challenges, and opportunities between actors within this value chain, especially in terms of communication and capacity utilization. It displays how an increase in operational efficiency can promote the reputation and how an increased information flow can result in reduced uncertainty, volatility, and costs.

## 7.0 Future Research

As seafood export is expected to grow in the years ahead, we are likely to discover many challenges and problems related to the export operations. Capacity will continue to be a major focus, so solutions that aim to increase this will be very valuable. One aspect is the physical infrastructure related to the export. Currently there are two primary terminal handlers at the airport who handle all the traffic. One potential alternative is consolidating into one big terminal. Alternatively, as suggested by Avinor, is the building of one big freezer hotel to help alleviate some of the capacity issues. Research aimed at investigating the viability of these solutions would be very valuable to the industry.

Another underexplored topic is how one should finance new activities, which now is a major roadblock for any development. This ties into a general need for better guidelines when it comes to who should be responsible for financing and organising potential projects. This paper has looked at some of these problems related to the OSL, but the issues become even more complex when one takes a broader view. It is unclear what the government role is in the development, and if the mandate of Avinor means they should invest more into cargo facilitating projects. This creates uncertainty which makes projects more difficult to plan and complete. That is why a probe into the role of the different stakeholders could be beneficial, as it would help improve transparency in a somewhat opaque sector. Complicating things even further is the fact that national companies can easily seek alternatives abroad if national regulation and taxation schemes are introduced to help alleviate some of the problems around financing. Therefore, it would be interesting to look at solutions related to seafood infrastructure and export from an EU perspective. An exploration of game theory might be able to help explain the interaction between the different interest groups and how one could proceed to come to consensus.

As briefly touched upon in this study, there are certain problems related to emissions when transporting food by air instead of rail, ship, or truck. Accurate

ways for measuring emissions related to food exports remains both difficult and an interesting research opportunity. Creating a common framework for measuring emissions would be a challenging research project since a lot of cargo handlers would argue that they are utilizing extra capacity on the flights that would otherwise go to waste. This type of research would potentially have to consider not just the weight of cargo divided by emissions, but also the fact that certain types of cargo are more important for the commercial viability of the route.

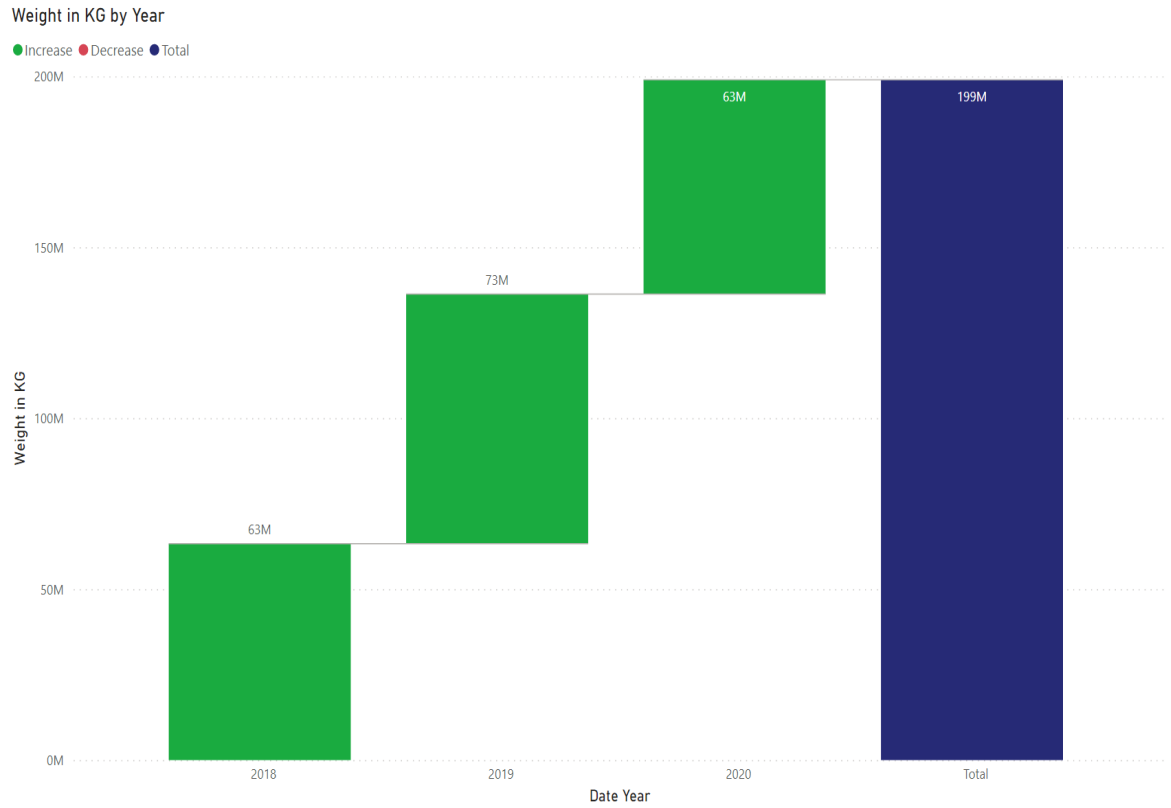
## 8.0 Limitations

This study aimed at getting a holistic overview of the seafood export from OSL, and in doing so we tried to establish contact with all the key stakeholders in the value chain. However, gaining access to the airline companies proved to be a rather challenging task. Strict guidelines in terms of PR-policies meant that getting a dialog opened became very difficult. Therefore, this study does not include any official inputs from the airlines.

The study is also limited by the difficulty of getting accurate shipping data. We were successful in getting data from one of the biggest brokers, but this does not paint a complete picture of the seafood export. Ideally, we would like to have data from all big brokers. Also, our data only span three years which somewhat limits the exploration of long-term trends. Preferably, the analysis would include data at least a decade or more back in time.

The data collected from the interview can potentially also be a bit limiting. This can be because the firms we interviewed do not necessarily want to reveal the relevant information because it could damage their position or benefit their competitors. The companies interviewed could potentially also benefit from exaggerating certain claims to promote their agenda.

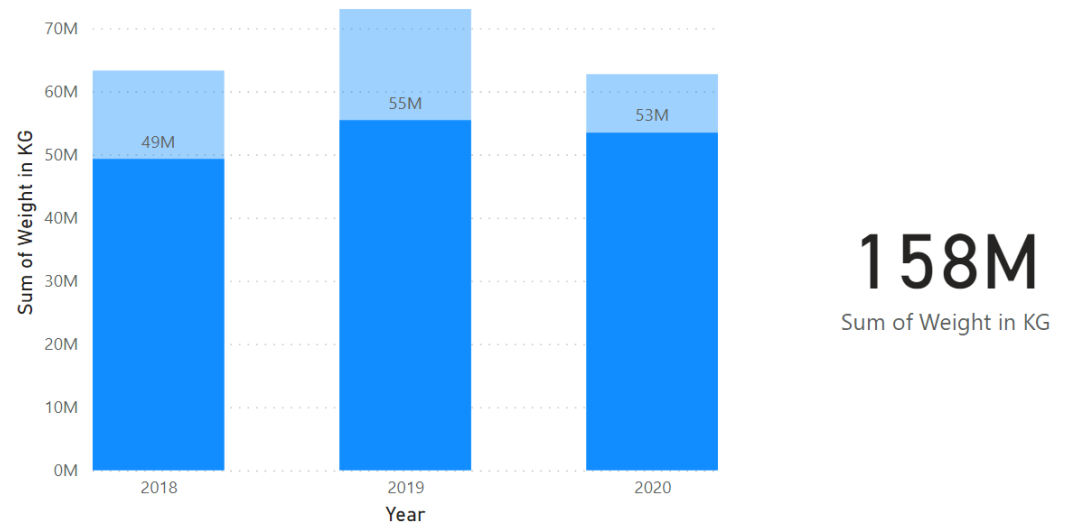
## 9.0 Appendix



*Figure 14. Shipping quantity from one of the big seafood brokers. Weight is denominated in million kilograms.*

*These numbers are the total amount, and not purely through GPC or OSCC. See Figure 15 for extracted data from the two main actors only.*

Sum of Weight in KG by Year



*Figure 15. Total shipping volume for the two main terminal handlers at OSL. Weight is denominated in million kilograms.*

*Terminal 1: GPC*

*Terminal 2: OSCC*

*The remaining (light blue) is divided between several other actors distributing to other airports in Europe.*



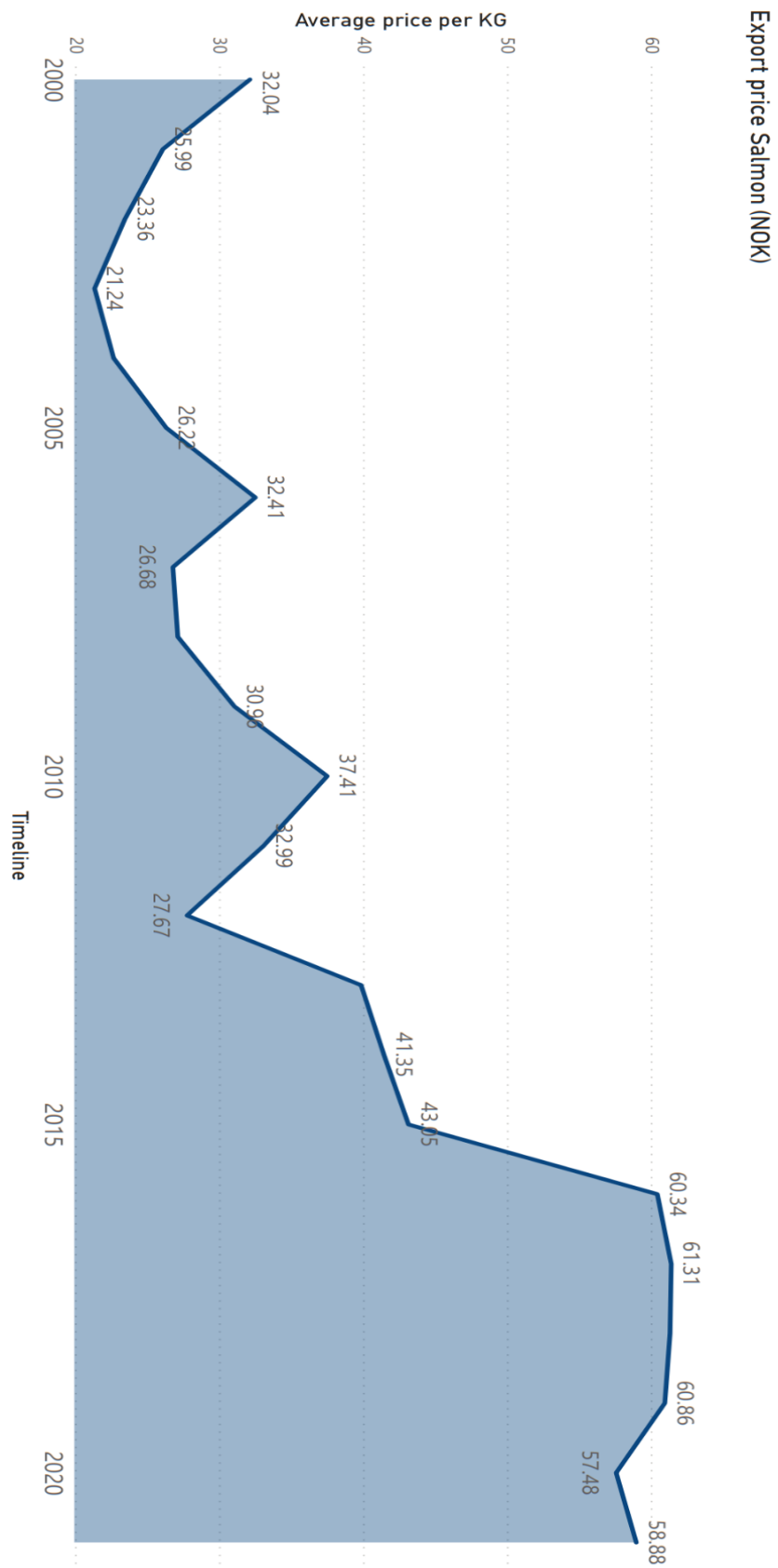


Figure 16. Export kilo price for salmon from 2000 until 2020  
Average, yearly price per kg.

## Interview guide (Interviews conducted in Norwegian)

1	<b>Today's challenges</b>
	<ul style="list-style-type: none"> <li>- What are today's main challenges related to exports of seafood via Gardermoen Airport?</li> <li>- What do you see as the biggest challenge ahead for export to markets outside Europe? Especially considering that the volume continues to increase?</li> <li>- How do CO2 emissions and climate considerations affect their operations?</li> <li>- How does your company work to map and reduce emissions?</li> <li>- How do uncertainties and unforeseen events like the current pandemic affect their operations?</li> </ul>
2	<b>Terminal - Potential and benefits</b>
	<ul style="list-style-type: none"> <li>- What are the opportunities and benefits for you of having an efficient export hub at Gardermoen?</li> <li>- What would a perfect export hub look like for you?</li> <li>- In what way do you think such an export hub will generate and affect your revenue?</li> </ul>
3	<b>Terminal - Challenges and prerequisites</b>
	<ul style="list-style-type: none"> <li>- What do you consider to be the main challenge associated with the development of an export terminal at Gardermoen?</li> <li>- What prerequisites do you think are needed to have an efficient export hub?</li> <li>- Which key players do you consider critical to implementing a hub?</li> </ul>
4	<b>Other</b>

Table 7. Interview guide

Interview 1 (Broker) 19.04.21

## **1. Dagens utfordringer**

### **Hva er dagens hovedutfordringer knyttet til eksport for sjømat via Gardermoen Lufthavn?**

Kapasitet. To terminaler som vi prater om. De terminalene de har to ulike lokasjoner. Den ene er midt i smørøyet. Bakdelen er at det er lite areal å flytte fisk på. Den andre er moderne og nyere bygg. Bygget i seg selv er greit i seg selv med godt areal. Men lite gjennomtenkt innflyt. Ikke nok lasteramper, som gjenspeiler dette med kapasitet. Opplevs for oss som en flaskehals. For mye fisk som skal leveres, spesielt på peak-dagene. Ikke kapasitet til å bemanne riktig som resulterer i lastekøer. Transportører som møter opp så tidlig de kan, så blir det fortsatt kø. Tidvis er det et volum som ikke passer for terminalen og vi opplever masse forsinkelser på dette.

En god kombinasjon av oppsett eller lokasjon er viktig for god temperaturregulering av fisk. Vi må ha areal som er kapabel til å lagre fisken over tid. Større areal må til som er moderne og som har en haug av lasteramper som kan ta imot mye samtidig. De har veldig korte frister på seg. Det er der det stopper opp i dag.

Terminalene vil si at de bruker de feil, men sett utenfra er det ikke det. De har for lite gulvareal. Når en kunde av oss skal bygge ut, så gjør de det i et 20-årsperspektiv. Det tenker vi også er lurt på Gardermoen, så langt perspektiv er målsettingen.

### **Hva ser dere for dere blir den største utfordringen fremover rundt eksport til markeder utenfor Europa? Spesielt med tanke på at volumet fortsetter å øke?**

Kapasitet her også. Dagens situasjon tvinger kundene våre til å se på andre alternativer for Gardermoen. Det blir da å finne aktører som går utenfor Gardermoen, og det er vi i utgangspunktet ikke tjent med. Hverken de på

logistikken eller eksportøren. Da investerer de heller i å bypasse Gardermoen. Det fordrer at man betaler for en bedre service enn det som foreligger i dag.

Betalingsvillighet: Skulle man gjort noe med situasjonen på gardermoen så ville det nok kanskje påvirke prisen, men den betalingsvilligheten vil nok tvinge seg frem også for den servicen som de kan tilby.

### **Hvordan påvirker CO2 utslipp og klimahensyn deres operasjoner?**

Foreløpig ingenting. Norge ligger ganske langt bak på dette kravet for å kunne dokumentere CO2-fotavtrykket. Vi gjør i grunn meget lite med dette. Men det er naturlig at det vil komme mer og mer, men det må bli linket til en overordnet agenda. Norsk utslipp er også så lite sett i det store bildet.

Er det politisk vilje i Sverige? Tror heller det er mer med at Sverige er mer et industriland enn det Norge er. Helt annen type næring med større trykk på akkurat det å formidle et CO2 avtrykk for produkter. Vi har olje/fisk og det som Sverige ikke har, og vi har derfor ikke de samme produktene.

### **Hvordan jobber selskapet deres med å kartlegge og redusere utslipp?**

Ingenting idag. På nasjonalt nivå er nok dette for konkurrentene våre også. Et viktig marked for oss er USA. Får de det plutselig for seg at det skal være bærekraftig, så blir det plutselig et krav. USA er mer naturlig at blir et marked der det kommer først.

Enkelt flyselskaper nevner litt her og der. De fleste har en intern kalkulator. Fokuset er der, og du får den hype-funksjonen. Men foreløpig er det litt i startfasen. Men det er et fokus på det, bare ikke helt realisert.

### **Hvordan påvirker usikkerhet og uforutsette hendelser som dagens pandemi deres operasjoner?**

Internt er vi sårbare for at arbeidsstokken skal bli syke. Derfor er det viktig for oss å finne en balansegang mellom det å ha fullt lag på jobb, og samtidig oppfordre til å bruke hodet på privaten. Ideelt sett ønsker vi at folk jobber på kontoret og ikke hjemme.

Passasjerfly fra A til B er der vi generer inntekt for det meste. 16-18 tonn med laks på fly fra Norge til USA. Reiseforbud gir dårligere tilbud i markedet og mindre kapasitet. Flyselskapene har satt inn samme fly uten passasjerer, så da har plutselig mengden frakt økt igjen. Vår omsetning har skutt i taket med et laverer volum fordi prisene har gått opp. Risikoen har gått opp. Det kan man se på volatiliteten. Produksjonskostnaden pluss lakseprisen har svingt opp og ned som en berg og dalbane.

Alt sett under ett så går alt under det jevne med litt kopiering fra uken før. Noen markeder er litt av og på, men det er generelt alltid et grunnvolum. Litt mer usikkerhet med en plutselig hard lockdown i en eller flere market. Det er den dynamikken vi må sloss med hver uke, plutselig noe nytt som har dukket opp.

Til tross for det så har det vært veldig stabilt. Det har definitivt gått seg til og kunne vært så mye verre.

## **2. Terminal - Potensial og fordeler**

### **Hva er mulighetene og fordelene for dere ved å ha en effektivt eksport-hub på Gardermoen?**

Vi ser utrolig mange fordeler. Et norsk eksportvolum ønsker vi å ha eierskap til fra norsk jord. Det er det ultimate ønske. Forutsigbar terminal som er i stand til å håndtere dagens volum, men også at det er tenkt 10-15 år frem i tid mtp kapasitet. Vi ser at vår bransje er at vi vil doble kapasitet innen de neste 4-5 årene. Det er masse muligheter. Må også ta innover seg at vår bransje utvikler seg når det kommer til produkter, ikke bare laksen, som man kan dra opp fra havet. Kjempepotensial til å promotere de flotte produktene vi har å by på. Det blir en naturlig begrensning når vi på hjemmebane ikke klarer å håndtere det som vi har i dag. Andre commodities tåler ikke å transporteres ned i Europe og må på fly.

Dra den litt lenger vil vi si at det er driftskritisk. Det er ikke forsvarlig det vi driver med i dag som å kjører ned til London i dag og lagres over natten der. Gardermoen har ikke den kapasiteten som trengs for at det skal være forsvarlig. Innen 4 år skal de største kundene våre doble volumene. Peak season kan vi bare droppe, det er bare et eneste stort kaos. Merkostnadene er skyhøye. Handle ikke om muligheter, det er driftskritisk at kapasitet utbedres.

Alle er klar over at sjømaten er arvesølvet vårt. På et tidspunkt vil det være det som genereres aller aller mest penger inn til Norge AS og vil gå forbi olje og gass. Da er det skremmende at allerede nå i 2021 er kapasitet langs på hælene. Vi er ikke i nærheten til å være i stand til å håndtere volumet som eksisterer i dag. De fleste har et tydelig og klart bilde på hvordan fremtiden vil komme til å være, men det gjøres ingenting.

Det er aktører her som bare kan halte og gjøre ingenting uten at det blir noen konsekvens. Det må tilpasses gjeldende forhold, og det gjør det ikke nå. Må tilpasse oss hvordan kundene og transportørene fungerer.

### **Hvordan ville en perfekt eksport-hub sett ut for dere?**

En nøytral aktør. Stor internasjonal nøytral aktør som gir oss et 20-30 års perspektiv. Vi mener at nødvendig areal er: 15.000-20.000 kvm tilgjengelig areal for lagring og mottak. Dette er vi ikke i nærheten av nå.

### **Konkurrenter som eier terminalene? Prioriterer de seg selv?**

Nei det gjør de på en måte ikke, så der er de delvis nøytrale. Så det er form for nøytralitet her i dag. På papiret er det kanskje ikke så dumt, men det er mange instanser som skal tegne noe sammen her, noe som er utfordrende. Men stort sett er det ganske nøytralt. Ingen forkjøpsrett etc.

**Nøkkelspillere?** Avinor, noen ministre, departementer og noen typer bransjeorganisasjoner, spesielt de som driver med varetransporten som henter hos noen på Vestlandet. De har et mareritt i lossekø. Dette burde absolutt stå i revidert nasjonalt transportplan mtp Sjømat Norge. Ellers synes vi det er lite gehør i departementet. Vi blir sett på en litt uviktig spiller i denne rollen. Det

hadde vært annerledes hvis et *oppdrettsanlegg* går hardt ut i media, men de må jo også være forsiktige med tanke på deres merkevare. Tør kanskje ikke å gripe situasjonen da man er redd for konsekvensene.

### ***Hva er konsekvensene for fiskeriselskapene ved å si ifra?***

Konkret: Det er jeg ikke sikker på hvorfor. Sliter med å se hva konsekvensen skal være med å si at man er rimelig misfornøyd med hvordan ting fungerer på Gardermoen til oversjøiske markeder. Kanskje noe touchy tema, kan vinkles mye. Laksen finner alltid en ny vei og transportører begynner å bli lei av å møte flaskehalsen på Gardermoen. Man risikerer jo at omsetningen forsvinner ut av landet.

### ***Er dette også til myndighetene?***

Det tror vi ikke myndighetene er klar over rett og slett. Vi må ha noe statlig som sier at vi må ha areal. Det er begrensninger på hvor det kan puttes mtp. rundt en terminal. Voldsomt mange restriksjoner. Men områdene finnes. Avinor må beslutte.

Ikke avsatt penger til en tredje rullebane på Gardermoen. Da kan bygges mye infrastruktur på Gardermoen da kontra hva det koster for en rullebane.

### **Hvordan kan terminalen hjelpe til å få til en bedre cargo-balance flow?**

Det er en del av pakken. Absolutt en del av den. Avinor går etter passasjerene, så kommer det andre litt i andre rekke. Prioritetene er skjevfordelt. Spesielt på peak-dagene. Tirsdag, fredag og lørdag er peak-dager.

## **3. Terminal - utfordringer og forutsetninger**

### **Hvilke forutsetninger tror dere trengs for å få til en effektiv eksport-hub?**

Utfordrer til oljen og gassen er jo laksen. Den er jo spådd til himmelen, men det er en bransje der alle har det de trenger. Alle de andre bygger for 20-30 år frem i tid. Det gjør ikke vi. Vi velger selv om vi skal henge med eller ikke.

Det som det koker ned til er at passasjervekst brukes som en utelukkende hjemmeseier, selv når vi konstant belyser at vi ikke kan håndtere frakten fornuftig og bærekraftig. Det er ett tall som alltid følger Gardermoen: Passasjerantallet. Ikke noe annet. Makskapasiteten er på passasjerer etc. Frakten blir nedprioritert mener vi. Virker som om tøylene er frie. Det er en skandale.

### **Hvilke nøkkelspillere anser dere som kritiske for å implementere en hub?**

Avinor, og en global *handling* aktør. Globale giganter. Så er det å trykke inn disketten det står *handling* på. Dette er ikke rocket science.

### **Hva anser dere som det svakeste leddet i sjømat supply kjeden?**

Det er nok fra lastebil til terminalen for lagring. Det er der flaskehalsen er. Den store akilleshælen til Gardermoen er lagringen, det er altfor lite.

Interview 2 (Terminal) 27.04.21

## **1. Dagens utfordringer**

### **Hva er dagens hovedutfordringer knyttet til eksport for sjømat via Gardermoen Lufthavn?**

Største utfordring i dag er alt som handler om sjømat skal omfattes på kortest mulig tid. Største utfordring for de som terminal er at vi har noen deadline å forholde oss til til flyselskapene til når vi skal være ferdig med vår jobb. Vi vet nesten aldri når varene kommer inn til vår terminal. Har jobbet med å bli bedre på informasjon fra leverandører. Eksempel: Terminal som vi drifter 24/7, men til lørdag, men vi vte aldri når fisken kommer inn fra midnatt og utover. Oppleve at vi sitter med bemanning fra midnatt, men kommer ikke noe frakt før 4-5 på morgenen. Får deretter dårlig tid i andre enden og det gir større kostnader. Dette er pga for lite informasjon fra avsendere, men også fordi at alle varer som skal fra en leverandør skal ofte over fjellet og det kan også gi utfordringer. Største utfordring: Har ikke godt nok nettverk som gjør at vi til enhver tid vet når varer kommer og hvor lang tid vi har på å produsere.



**Hva ser dere for dere blir den største utfordringen fremover rundt sjømateksport til markeder utenfor Europa? Spesielt med tanke på at volumet fortsetter å øke?**

Ser ikke noe stor utfordring på det. Ser det bare positivt. Men det som må gjøres for å ta hånd om denne økningen er har vi to sjømatterminaler, der den ene er større og vi er minst. Pga konkursen som driftet denne før, så var det tre flyselskaper som flyttet over til *Terminal 2*. Jobber med å få flere tilbake, har fått én. *Terminal 1* og *Terminal 2* få til en bedre fordeling og splitt mellom de to terminalene for å drifte et større volum fra Oslo. *Terminal 2* sliter med kapasitet på enkeltdager der vi har god. Derfor kommer det rykter om for lite kapasitet da det egentlig ikke er det. Fordele kapasitet burde gjøres mye bedre. *Terminal 1* har mulighet til å bygge ut med 2500 kvadrat. Andre endringer kan også gjøres til å ta imot økninger.

Sammen med mattilsynet jobbet med at det er ønskelig å få til et kjølehotell på Gardermoen. Både vi og *Terminal 2* med et slikt et kunne kjøre og parkere inni der og flyselskapene kunne hentet frakten der. Da kunne vi produsert mye mer og tidligere. Gjennomgående kjøleanlegg hele veien. Ned vekt på flyene pga mindre is, lavere pris. Høyere kvalitet.

**Hvordan påvirker CO2 utslipp og klimahensyn deres operasjoner?**

Vi er opptatt av miljø. Vi ser jo på Gardermoen at det flys fra gamle 747 til nye Dreamlinere. Noen har veldig mye utslipp. Vi som terminal sitter dessverre ikke i en posisjon der vi kan påvirke hva som kommer til Oslo. Flyselskapet som beslutter det selv for å hente frakt. Noen er nye, og andre er veldig gamle. Må gå mer til Avinor tror vi til hva som settes av krav til hvem som kan fly til og fra Oslo. Det er relevant, men det er ikke så mye vi gjør. Det vi gjør her direkte gir ikke særlig til CO2-utslipp.

***Hvordan jobber dere med å kartlegge og eventuelt redusere utslipp?***

Veldig lite sånt sett.

**Hvordan påvirker usikkerhet og uforutsette hendelser som dagens pandemi deres operasjoner?**

Den største påvirkningen er at vår produksjon har gått ned til god produksjon 6 dager i uken til kanskje 2-3. All passasjertrafikken er borte. Norwegian og Thai er borte fra 28. mars 2020. Det halverte volumet vårt. Noen fly kommer bare for å hente sjøfrakt, men de er begrenset til spesielle dager. Enkelt å ha god bemanning før 7 dager i uken, men etter corona har vi måttet permittere en del og gjøre om skiftplaner. Vi ønsker passasjertrafikken tilbake så fort som mulig.

## **2. Terminal - Potensial og fordeler**

### **Hva er mulighetene og fordelene for dere ved å ha en effektivt eksport-hub på Gardermoen?**

Dette er alfa og omega. Derfor vi hele tiden jobber for å effektivisere og bli bedre. Nok kapasitet til å drifte det volumet som skal driftes. Kortest mulig tid på terminal. Alt det vi gjør skal inn og ut på samme dag. Vi ser på muligheter for et kjølehotell, samt å utvide terminal med det som de har mulighet til. Større effektivitet.

### **Hvordan ville en perfekt eksportterminal sett ut for dere? Noen konkrete punkter.**

Egentlig ikke mer enn kjølehotell. Flyselskapene tjente veldig gode penger før, men nå har det vært mer at hvem som taper minst kontra hvem som tjener mest. Vi har allerede en modernisert terminal. Feil at Avinor skal drifte en terminal. Ikke så viktig for meg hvem som eier. Det som er viktig er at det ikke blir et monopol.

I dag har vi to terminal på Gardermoen. Vi har jo mulighet til å øke ytterligere på de volumene som er i dag. Det vi gjør i dag er kilobasert inntekt. Vi sitter på kontrakter med flyselskapene og vi har ikke så store marginer. Derfor så sier jeg at dersom man skulle bygge en så stor terminal på Gardermoen vil fordyre transporten fra Oslo, og gjøre at eksporten ikke øker da konkurransen i markedet er så stor. De to terminalen som er i dag driftes på en ganske god og fornuftig måte. Vil få veldig mye bra sjømateksport fra Norge om dette effektiviseres. Det kom litt skeivt ut det prosjektet om terminal da det virket som om terminalen

skulle driftes av Avinor, som ikke var sant. Har ikke noe imot hvem som måtte eie eller drifte så lenge det driftes 100% likt for alle og at det gir like muligheter for alle i bransjen til å være med å skape noe.

### **Hvordan kan hub'en hjelpe til å få til en bedre cargo-balance flow?**

Vi er i samtaler med kunder som er i flyselskapene. Er med på å diskutere og snakke sammen om hva som er for det beste med selskapet og bransjen generelt. Bransjen har en del forum som man går sammen og diskuterer utfordringer.

### **Problem at det er for mye eksport kontra import?**

Det hadde ikke kommet et eneste fly til Oslo med mindre det hadde vært import her. Fisk er så stabilt på store volum at det kan gi store inntekter selv om kiloprisen er lavere. Import går ganske knirkefritt.

## **3. Terminal - utfordringer og forutsetninger**

### **Hva anser dere som hovedutfordringen knyttet til utviklingen av en eksport-terminal på Gardermoen?**

Koordinering og samarbeid. Vi er to konkurrenter sånn at vi ikke kan direkte snakke sammen. Jeg mener at Avinor som drifter Oslo Lufthavn og som står i spissen for å få folk til å få selskaper til å fly til Oslo. Jeg tror kanskje at det burde vært en litt mer gjennomsliktig fordeling av når man får inn noe nytt til flyplassen. Avinor skal ikke ta noe parti, men heller informere litt til begge selskapene og informerer litt om det generelle rundt om på Oslo Lufthavn. Noen kjenner kanskje bedre til den ene eller den andre, og tar et valg utav det. Litt mer informasjon knyttet til at man har to terminaler, at de er like bra for å få til den fordeling. Generelt burde hele lufthavnen vært bedre på dette.

### **Hvordan løse den kabalen med å være konkurrenter?**

Flyselskapene sammen med speditørene burde også være mer åpne med hverandre slik at alle blir mer klar over situasjonen. Koster jo mer når ting går og bookingen ikke går i orden. Hvorfor fly fra den ene når det ikke er kapasitet mens det er det på den andre? Litt lett for at ting går på relasjoner i denne

bransjen. Burde se ting generelt og åpent. Ingen her tror jeg klarer å ta livet av hverandre, heller av seg selv. Åpenhet og ærlighet for å få det til å bli best mulig for Norge. Alle har et ansvar for å bidra til det som til det beste for sluttkunden i utlandet som skal ha disse varene. Uavhengig av hvem som eier eller drifter.

**Hvilke forutsetninger tror dere trengs for å få til en effektiv eksport-terminal?**

Kan utvide 2800 kvm hos oss. Akkurat nå er det kjølekapasitet på 3500. Det vil ta mange år før dette ikke skal være nok. Den andre terminalen har ganske bra kapasitet i dag, men ønsker også å utvide der de er. Jeg tror at hvis man skulle endre på noe på kort sikt: Kjølehotell og bedre spredning på kundemassen. Da vil det 100% sikkert ikke være noe kapasitetsproblem på Gardermoen.

**Hvilke nøkkelpillere anser dere som kritiske for å implementere en terminal?**

Speditører og eksportører, helt klart. For at ting skal gå mer effektivt og bedre er det best at alle leddene har god informasjonsflyt. Logistikken fra pakkeri til terminal vil være veldig veldig viktig. Dette jobbes det med, og vi har jobbet mye med det det siste året.

**Hva anser dere som det svakeste leddet i sjømat supply-kjeden?**

Hvis man tenker på hvor mye sjømat som går fra Norge og ut i verden, og hvor mye som går feil, så er det ekstremt bra. Feilmarginprosenten er veldig lav i forhold til hvor mye som sendes. Biltransportørene er nok det svakeste leddet. Språkutfordringer kan forekomme når du kommer på en terminal. Det forstås kanskje ikke hva du mener og kommer med, kanskje ikke riktig dokumentasjon, så vi ser størst forbedringspotensialer her. Dette kan være i leddet til og fra oss. Dårlig utstyr på bilene er også mulig. Sjøførene klarer ikke gjøre seg forstått verken på norsk eller engelsk. Slike utfordringer kan eksistere på bil transportsiden. Mye utenlandsk transport som skaper noen utfordringer, men mye er bra og.

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