Chapter 4

The Value Aspect of Reallocating Seafood Freight from Road to Sea Transport

Per Engelseth, Irina V. Karlsen, Shulin Huang and
Arild Hoff

Additional information is available at the end of the chapter

http://dx.doi.org/10.5772/intechopen.68779

Abstract

A case study elaborates on the project organization promoting change of transport mode in a food chain from a value perspective. This project organization may perspectively be viewed as a supply chain with value conceptions different from the everyday seafood supply chain it is meant to develop. Value is in this project context revealed as an inter-subjective complex phenomenon, founded in that value conceptions by actors located at different locations in the supply chain. This renders customer value as one of many dynamic value components in this project organization. Value embedded in a supply chain is therefore always a source of uncertainty, a subjective perspective; it cannot be considered as a clear functional purpose in projects aimed at developing food supply. The route to reallocate seafood freight should therefore focus on organizing interconnectivity to support networking and the project members accepting that the project outcome is emergent.

Keywords: food logistics, sustainability, short sea shipping, intermodal transport, customer value, supply chain management

1. Introduction

Established 45 years ago, the Norwegian aquaculture industry has progressively grown, which has now become one of the most important industries in Norway's economy. Nowadays, most of the fresh salmon products are transported on roads. This mode of transport involves challenges such as risk associated with frequent accidents on these wintery Norwegian roads, low quality of the transport service purchased on an open market managed by seafood product customers and limited environmental sustainability. Short sea shipping (SSS) offers an alternative transportation solution being characterized by a lower level of pollution than road transport and providing sufficient transport speed to market. This case focuses on the seafood cluster including the island municipalities of Frøya and Hitra as well as the Rørvik municipality on the coast of central Norway. Export volumes are expected to experience a fivefold increase from these two industrial clusters. If these goods are continued to be transported by land, this may in addition to that road transport is considered not environmentally sustainable also lead to increased deterioration of roads.

In autumn 2014, as a result of cooperation between Kristiansund and Nordmøre Harbour company and North Trøndelag Harbour Rørvik IKS, the *Coastal Harbour Alliance* was established. The mission of this alliance is to provide a satisfactory volume for fresh fish export to reallocate the Hitra/Frøya and Rørvik municipality freight flows from road to sea, involving two closely located ports of origin. A key technical facilitator of this transport solution is efficient intermodal transport, using the same container carried on at least two different transport modes. The main focus of the project is to find a solution satisfying transport demands of the end customers in the everyday seafood supply chain in terms of frequency, cost and reliability.

Based on a case study by Engelseth et al. [1], this chapter discusses further the value aspect of this proposed freight reallocation from road to sea transport. This development organization is separate from the supply chain itself that it aims to change. The applied road transport solution involves considering a range of factors associated with customer preferences as well as a wider concept of societal intertwined with environmental value. Value is a perception. In a supply network, different actors hold different perceptions of value associated with reallocating seafood freight from road to sea transport. Initially, these factors are indicated and discussed. Factors impacting on these value perceptions are varied and include CO_2 emissions, degree of experienced uncertainty, experienced accident rates, demands regarding time to market, product quality objectives, logistical feasibility and costs and business relationship strength. This consideration of value as a transient phenomenon in project development of food chains is the starting point of our investigation. The chapter considers this by first discussing freight reallocation as a networked project organization. This section establishes the current status quo of the project in its networked context pointing to fundamental network-related challenges of freight reallocation to the SSS mode. This is followed by development of the concept of value in such an organizational setting. This is followed by an introduction of SSS as transport mode. The final section before conclusion describes the actual freight modes applied in the case from a supply chain perspective, involving both logistical and inter-organizational integration concerns.

2. Freight reallocation: project, network and organizations

The proposed freight reallocation from road to sea transport is organized as a project. The possibilities of reallocation of seafood freight flows from road to sea here are great due to favourable allocation of key ports in the municipalities' neighbourhood and efforts and interest from the government, aquaculture and logistic service providers' side. While the current dominant road transport mode favours the use of low-cost foreign trucking service providers, the establishment of a SSS with short distance trucking feeder routes favours the local Norwegian truck companies since they are already established in this region.

The restructuring to SSS will take some time. However, the creation of the new modern harbour facility at the industrial park on the small island of Jostenøya (see **Figure 1**) within the island municipality of Hitra greatly increases the efficiency of transporting through this mode, with direct loading from the seafood producers established at the industrial park with its adjacent harbour and short road transport from producers located at a few kilometres' distance from this new harbour facility.

Sea transportation will in the proposed start-up phase be as a supplement to road transportation. Currently, the participants of the project are actively seeking the opportunities for return cargo flows. There are a lot of opportunities, for example, fruit and vegetable freight flows from the EU countries to Mid-Norway and Western Norway that can be combined together. Even though the new production facility implies an adjacent harbour location, the change to SSS is not decided upon yet; it is subject to active discussion in the industrial network. One major reason for this is that freight in most cases of seafood export in the region is commonly determined by the customer. The commonly used ex works clause also implies that it is the distant customers, not being really aware of production and logistics infrastructure concerns in Norway that in practice determine how the freight is to be transported.

This means that a change of road to SSS transport involves convincing the seafood producers' foreign customers. Most of these importers are located in the EU and currently have their goods transported door-to-door by trucks. This is clearly, except for the frequent accidents on wintery Norwegians roads (see **Figure 2**), a convenient transport solution. Furthermore, the seafood producers and exporters are fundamentally indifferent to how their goods get transported, by which trucking company, it is only when they take into consideration societal

Figure 1. The projected industrial park and harbour facility at Hitra.

Figure 2. Seafood on Norwegian roads is prone to frequent accidents.

values promoted to their own export market customers such as retailers that they may tend to prefer sea transport solutions. This, however, may also demand traceability to verify the use of transport modes. Such choices may accordingly benefit the reputation of the firms from corporate social responsibility standpoint.

To reallocate this freight from road to sea involves accordingly a marketing effort on behalf of Kristiansund and Nordmøre Harbour company that owns the in-development industrial park and harbour facility and the Hitra municipality supporting the establishment of this production and port service infrastructure. Thus, this challenge also encompasses the project organization of the Coastal Alliance to reallocate seafood freight from Hitra and Frøya municipalities from road to sea transport. These are the main stakeholders holding a value perception regarding the active use of the new harbour facility at Hitra. It is accordingly a project-related challenge to convince the foreign importers of seafood from the Hitra and Frøya facilities to import their goods using SSS. For this reason, the customer value perspective of this freight reallocation is vital. However, since many networked supply chain actors involved in the potentiality of developing transport from Hitra to the markets have varying conceptions of value, we must also scrutinize this concept of "value". We then turn to consider what we mean by "customer value" in this organizational as well as societal context. This is followed by discussing the environmental concerns related to reallocating freight to SSS through this project.

3. On "customer value" and value in general

The notion of "value" is essential in all forms of business. Simply speaking value may be considered as "something that people regard highly, cherish or protect" [2]. This implies a semiotics understanding of value, associated with texts and conversation. In the business community, the economic aspect of value is highlighted. From a supply chain management perspective, pertinent to our inquiry, what is highly regarded, cherished or protected is associated with perception of supply benefits weighed rationally speaking against the costs of perceived ownership. It is a balancing game of perceived positive and negative outcomes of an acquisition. Christopher [3] terms this balancing in the organizational context of a supply chain as "customer value".

Being a statement of subjectivity, the concept of "customer value" is inherently complex. The human mind and its preferences are no objective phenomenon; preferences are contingent and change. Value is considered in this study as always intersubjective. This is vital, because shared understanding of what constitutes customer value in the conglomerate organization of a supply chain also represents a binding force. Value is an integrator, a boundary object that helps to integrate in the supply chain. It plays the role of potential, to secure recurrent purchases through continuous customer satisfaction achievement.

Customer value is in business practice clearly a complex phenomenon. Supply chains are here considered as linkages characterized by systemic integration, an organizational structure. Being complex means that value from the perspective of the customer is seen as a process; it is emergent. Since value is always in flux, for the supplier, it is also a moving business target.

Clearly, what is written here represents a particular process approach to appreciating "value" in supply chains and thereby managing them. Given that customer value is the key objective in a supply chain and that we have already indicated that customer value is customer perception of benefits balanced against costs of acquisition and use, this in itself is regarded a process. Because, the customer evaluating follows a timeline, it is a learning process that emerges through interaction in the business relationship between the customer and the supplier. Furthermore, in line with Richardson's [4] view that no firm is an island and in line with Håkansson and Persson [5] who describe firms' interaction in supply chains as integrated hubs of interaction with various heterogeneous suppliers and customers, this entails some level of network complexity. This complexity resides at different levels of QUERY. Perrow [6] classifies levels of analysis, starting from the individual level, through group, department, division, organization, inter-organization and finally at organizational set. The "inter-organizational" level is commonly termed as the relationship. The organizational set is commonly termed as "network" or "chain" in supply chain literature, a systemic configuration of different firms working together. In this study, this network is a time-limited loosely coupled project organization bound by a common functionality of developing sustainable seafood transport. All these layers of reality in business can be considered as subject to complexity, and they do have impact on perceptions of what in practice is customer value in different ways. What is vital is having a fundamental understanding about the "value", which is dynamic in real life and can be found at different organizational levels. Furthermore, the characteristics of value at these levels interact with each other. Clearly this paves the way for a research proposition regarding what characterizes such interdependencies, but this is out of bounds of this book chapter.

In this chapter, we seek to address practical issues regarding perceptions of value associated with reallocating freight from road to SSS transport. This implies the need to simplify our analytical framework. In relation to the levels of analysis, we concentrate on customer value at the organizational and network levels as well as the relational level that binds firms together. These levels of analysis are illustrated in **Figure 3**.

The choice of omitting the more personal levels of analysis is because of the data, which mainly encompasses value perceptions regarding the different organizations involved in the network, regarding the research issue at hand. These perceptions are considered embedded in a network that is characterized, in line with Gadde et al. [7], by its atmosphere. A key feature of network atmosphere is the level of trust influencing the willingness to integrate.

Figure 3. Levels of analysis applied in this study.

In this case, we focus on integrating a project organization associated with food freight reallocation. Describing a network as a set of interacting business relationships also entails that various relationships are interdependent. An action in one business relationship has impact on a larger network organizational structure consisting of more or less integrated firms. In this chapter, we propose a form of domino effect on other relationships, and this includes how value is perceived as emergent due to interaction in different relationships affecting the network atmosphere. Finally, it is vital to stress that, even though customer value is ultimately measured by the customer, other network actors may also perceive this factor. This is captured in the industrial marketing literature as the concept of "value proposition" [8]; value may be proposed by the supplier, and this creates foundation for dialogue to create customer value through interaction.

The value proposition implies therefore a boundary spanning effort by the supplier, aiming to reach out to interact with the customer and thereby learn first-hand what the customer needs are and is willing to pay, for a market offering. This market offering is accordingly viewed as reciprocally interdependent in the business relationship between the customer and supplier. This is clearly a process, a mutual adjustment. The customer or supplier may have carrying degrees of power, but seldom does one dictate over the other a conception of "value". This process of adjustment, learning what is valued for one's own firm and the other firm, is again embedded in a network structure.

This structure can also be conceived as having properties concerned with the meaning of "value", as discourse or alternatively termed as "network culture". Networks may, following Cooren [2], be associated with a common binding discourse. At this aggregate level, customer value is never a precisely measurable artefact. People are self-reflective, and what we like and what we prefer are in continuous change, both cognitively fluid and contingently dependent. In our case, this discourse can be described as a business culture, rules, canons and norms that define the network as a collective of firms. The network may be considered as a societal level of investigation to the degree that organizations partaking in the network are not merely business organizations. The network may also be considered as an ecosystem This implies taking into account in addition to economic concerns, also nature and societal concerns. In this study, such environmental concerns are considered contextual, not part of the network itself. The studied network does, however, consist of a mix of business organizations and public entities. Value is a complex phenomenon in a business network setting. We now turn to considering the shipping solution value is associated with.

4. Short sea shipping

The main common transportation modes are classified as either road, sea, air, pipelines or rail. In a supply chain, which is a business context, value perceptions will be the strongest influencer when choosing among these alternatives. From a business perspective of the individual supply chain actor, priority is given to achieve company profitability. Choices are, however, limited by the reason of distance and characteristics of goods. Recent technological innovations facilitate easy shifts between different modes possible. The container is a key resource in such transport configurations. This functionality is called intermodal transport. Furthermore, especially when transporting fresh perishable foods, reefer containers secure food quality and low-cost transport intermodal changes. Traceability is assured through temperature control that also enables maintaining a standard quality of fish products over a prolonged timeline of transport duration. The quality of traceability is dependent on the level of supply chain integration.

Intermodal transport represents combining minimum two transport modes in a particular transportation chain without any change of container; a combination of road, rail and water transport. Initial and final road transportation must be as short as possible [9]. This means that intramodality, following Boske [10], can be described as a process of transporting freight through a systemically organized network involving combinations of different modes of transport in which all the component parts are seamlessly linked and efficiently coordinated using standardized transport resources, the container being the core facility. Intermodal transport concerns investment infrastructure cost, maintenance cost for terminals, purchasing cost for vehicles and equipment and cost for transfer and storage. These factors constitute the transport process associated with intermodal transport.

The overall economic benefits of intermodal transportation are proposed by Yevdokimov [11] as divided into four elements: (1) an increase in the volume of transportation in an existing transportation network, (2) a reduction in logistic costs of current operations, (3) the economies of scale associated with transportation network expansion and (4) better accessibility to input and output markets. The cost structure for the transportation at each phase, however, is unclear and thereby hard to break down to create an accurate perception of the total that intermodal transport at an aggregate network level is cost-effective over long distances and in large volume. This is due to the inter-organizational character of this form of transport; companies reluctantly only share their cost information.

In the studied case, the supply chain undergoing potential freight reallocation, the combination of sea and road transport is advocated by the network actors with the intention to achieve efficient transportation performance. One of the reasons, as described in the introduction, is to utilize a multimodal concept with SSS as the main transport mode, to reduce road accidents, and to reduce traffic congestion in urban areas. Road driving in residence site has arose noise pollution and unsafe conditions for people in the local area. In addition to that, less greenhouse gas emission is desired in the long term from the perspective of green logistics.

According to Rodrigue et al. [12], the term "green logistics" refers to logistics designed not to only be environmentally friendly but also economically functional. This implies a statement of network value, a part of the discourse this SSS development project is embedded in. There is no evidence that taking environmental considerations into logistics system would have negative influence on logistics performance [13].

Taking a supply chain perspective, managing this chain involves integration of this multimodal transportation system through a chain of interdependent suppliers. The customer, in this picture, is each intermediary, with the end user far off in the distant markets waiting to purchase and later eat their quality seafood from, in this case, Norway. Customer value, perceived by an end user in the food chain, is accordingly fragmented. It is perceived as a sequentially interdependent, a cumulative quality where each leg of transport impacts on the following. In such long-linked sequentially interdependent inter-organizational entities stretching from raw-material source to consumption, typical for manufacturing and for modernistic food production, sequential interdependencies are prominent. A following activity is dependent on the completion of a previous one; when such activities are networked between different firms, this creates interdependencies, a form of network power.

Thompson [14] describes variation in power-based interdependencies as being either reciprocal, pooled or sequential. In cases of dominant sequential interdependencies, resource pooling and intense interaction (reciprocity) support a long-linked form of production. In services, it is either core pooled or reciprocal interdependencies that are supported by sequential timing. This means that logistical coordination is a prime effort in food chains. Modernistic (industrialized) food chains are a particular form of supply, similar to manufacturing. Activities are such supply chains need, fundamentally, to be coordinated as series of events in a process. To synchronize the activities carried out in supply chain processes, a series of transport services need to be sufficiently integrated and coordinated. The aim of integration concentrates on lead time minimization and improvement on resource utilization [15]. Following Macharis and Bontekoning [9], intermodal transportation assumes optimization of its individual modes not only separate organizational transport components but also as a part of transport network as a whole system. Since this concerns inter-organizational integration, this also is a supply chain management issue.

The case of infrastructure development at Hitra to accommodate sea freight involves a particular form of sea transport sending goods from Hitra for a shorter distance, for reloading to mainly road transport, but potentially also long-distance sea transport in cases of frozen seafood transport. SSS usually defined as the shipping of cargo flows for quite short distances along a coastline. The EU Commission considered SSS as "the only freight mode that can offer a realistic prospect of substantial modal shift from road, as well as improve competitiveness and reduce environmental damage" [16]. In the current supply chain, considered as a whole system, SSS is a supplement to road transportation. Transport intermodality is accordingly a facilitator of efficient SSS. The viability of SSS also depends on type of transported freight. This consideration is generically considered when choosing the right transport mode. Air transport is fast but costly and is best suited for lightweight and smaller goods, road transport is convenient over short to medium distances since it provides door-to-door transport and sea transport is inexpensive but slow and can carry heavy bulky goods. In addition, in terms of environmental concerns, sea transport can carry large volumes in a single vessel and are therefore considered more environmentally friendly. Also road wear and accidents make SSS a preferable mode of transport compared to road transport of the goods.

To secure logistically efficient transport, SSS involves the use of technically adapted ship designs. The main technologies of the SSS are Float-on-Float-off (FLO-FLO), Lift-on-Lift-off (LO-LO) and Roll-on-Roll-off (RO-RO). The FLO-FLO ships are also known in which the floating cargo is floated into the ship's cargo space by submerging the ships' loading area. A typical disadvantage of this arrangement is that the ship must be lowered out at sea, which allows the floating vessels to be stowed into a stowage level vertically fixed within the ship. In addition, this submerging operation of the ship must be adjusted to fix deck or girder structures, which segregate the cargo containers at various cargo levels. Such intermodal transport is used mainly in developing countries with limited harbour facilities.

The LO-LO vessels, illustrated in **Figure 4**, are container vessels transporting a wide range of products that must be loaded and discharged in the port by crane and derricks. The cargo is lifted on the vessel according to a particular plan that is required by technical characteristics of the vessel, "not equipped with ballast-adjusting mechanisms. The LO-LO solution will be relevant for other types of cargo and included in use at Hitra. These are vessels commonly considered as "container ships".

The RO-RO technology is used for the fresh fish transportation in the studied case. Roll-on-Roll-off is the technology, which is applied in the design of ships and allows to carry wheeled cargo. This is the only one solution for sea transportation of heavy-wheeled freight such as trucks and other bulky construction and road machinery. According to Medda and Trujillo [17], the RO-RO vessels need considerable investment that implies the requirements for a satisfactory level of the commercial operations. The RO-RO vessels have built-in or shore-based ramps that allow the cargo to be efficiently driven on and off the ship during loading/

Figure 4. A FLO-FLO ship operation.

discharging in the port. They can be described as freight ferries. Much as a car ferry, the ship load (in our case trucks) is driven on/off the deck on its own wheels. Advanced engineering technologies allow the ship owners to compete in the SSS market through the functionality optimization of RO-RO ships and flexibility in cargo access equipment. The use of stern ramps suitable for the different types of quays and port facilities, custom-made shore ramps, provides highly efficient and quick loading and unloading [18].

RO-RO technology illustrated in **Figure 5** is primarily associated with higher speed of loading and unloading of goods compared to traditional container vessels [19]. The capacity of such vessels is unlimited compared to other modes of transport, illustrated by specialized car transport vessels used for long-distance transport. While car transport vessels are adapted to this particular type of freight, the SSS RO-RO ships are constructed as smaller vessels under 10,000 DWT adapted to reap benefits of quick loading and unloading, particularly important when ships call at numerous ports loading smaller consignments of freight.

Appling RO-RO technology implies a truck is loaded at Hitra or Frøya, driven to the port at Hitra and loaded on the ship. The truck is a semi-trailer, where the trailer section containing a reefer container remains on the vessel, while the truck returns for further engagements. Likewise, at the port of destination, a new truck picks up the trailer for further transport. The trailer has an upper side rail that is a part that is a beam that runs the length of the upper frame of the trailer. The rear reflector is a light-reflecting device that marks the back end of the reefer. The lower side rail is a beam that runs the length of the lower frame. Support legs hold the semi-trailer in a horizontal position. A piece of metal that protects the end of the support leg of the reefer is called the sand shoe. A front reflector marks the front end of the reefer using a light-reflecting device.

Much of the long-distance refrigerated transport by truck is done using such trucks pulling refrigerated semi-trailers (reefers) only onto the vessel, the decoupling form the trailer. The number of trailers involved into the transportation process is estimated to be 100 semi-trailers due to skip capacity. Return cargo is a crucial and still unsolved economic factor. The project

Figure 5. Loading a RO-RO ship.

is based on the concept of collaboration between supplier, recipient, shipping company, road logistics provider and harbours. The trailer will function both as a cargo carrier and a distribution unit.

A vital factor in all transport logistics is the speed. This impacts on the time of delivery and accordingly on customer value. A negative correlation exists between vessel speed and vessel capacity. Therefore, according to Woo and Moon [13], maintaining certain vessel size is also a basis of speed control. From the terms of decision-making, managers count economic saving from slow speed and extra income which is raised by speed-up service. This shows how value incorporates in transport both cost and benefit perceptions, and this needs to be balanced. This balancing can be associated with mathematical optimization principles. However, when considering the environmental performance, slow speed is the preferable choice in maritime shipping if it is still possible to be able to meet given time limits. This entails that when widening the level of analysis to the network level, encompassing both the environmentally concerned society and the nature itself as substance matter, further perceptions on what constitutes value emerge. In the model of speed optimization on the fixed shipping routes, the main business objective is to reduce fuel consumption. This is possible to achieve by adjusting the sailing speed. Given capacity constraints of ships and harbours, as well as uncertain weather conditions, it is however difficult to optimize ship routing. Shipping is in practical circumstances, therefore a complex process where optimized routing represents plans functioning as an indicator.

5. The environmental context

In this section, SSS is discussed in the context of the natural environment. First a few words are provided on what constitutes environmental concerns pertinent in relation to transport mode selection. Focus is here on the factor of global warming, seen as a human-inflicted phenomenon. The processes of goods production, transportation, inventory storage and end customers' consumption are causing greenhouse gas (GHG) emissions. GHGs in the atmosphere are major foundation of the greenhouse effect. Mora et al. [20] pointed out that if the greenhouse gas emissions are not reduced, humanity can face a serious problem as the excess of the historical planet's temperature already in 2047 with its impact on ecosystems, biodiversity and the livelihoods of people worldwide [21].

After oil and gas extraction, manufacturing and mining activities, the transportation of goods is among the most polluting industrial activities to the environment and ecosystem. Road freight transport is a major source of carbon dioxide (CO_2) emissions that comes from the burning of petroleum-based products in cars engines. The amount of other greenhouse gases emitted during fuel combustion is quite small. There are gases as methane (CH_4), nitrous oxide (N_2O) and hydrofluorocarbon (HFC) emitted during mobile air conditioners and refrigerated transport use. However, construction and renovation of port area emerge large amount of pollutants into air and water, which threaten the lives of local people and natural surroundings [22].

Reduction of emissions is an important objective of any national environmental policy. According to the international Kyoto agreement, Norway is aimed to reduce greenhouse gas emissions to 84% of the registered level of emission in 1990. There is also an agreement implied by Norwegian parliament in 2008, where the emission reduction is set as a national target. The Ministry of Transport is working to achieve these goals by stimulating public transport and innovative types of transport, by investment in new technologies and encouraging a change to vehicles with lower emissions. This policy is also supported by the economic instruments: CO_2 taxes and green energy subsidies. These policies are intended to promote transition to increasingly using environmentally friendly transport modes.

Road transport involves consuming unclean fossil fuels, which emits CO_2, NO_x, sulphur compounds and other toxic substances. These substances seriously damage air quality, also at a local level. It is a serious health concern, especially for people with breathing disorders. Rommert et al. [23] analyse choice of transportation (transportation mode, intermodal transport, equipment choice and fuel choice) against their environmental impact. This study reveals that larger scale of cargo to transport will lower CO_2 emissions per g/t/km. Among all transportation modes (container vessel, rail, truck and plane), transport by vessel is the most CO_2 efficient and offering highest fuel economy. It is a price-wise and economical transport mode. Therefore, the SSS is attractive from an environmental perspective in likewise as being economically feasible [16]. This form of transport usually does not allow door-to-door delivery and is slow.

Governments are not sitting idle while ships pollute the air. Sea transportation is thus subject to a particular tax system. The Sulphur Emission Control Areas (SECA) for shipping companies was entered into force in September under new EU legislation. There have been introduced certain taxes and requirement to use fuel where the sulphur content should not exceed 0.1% when operating within the SECA. The SECA includes North Sea, which Norwegian shipping companies are crossing during their import/export operations. Therefore, it will have impact on operation cost and will increase charges to the customers [24]. Ships emit NO_2, but this transport-related value can be improved based on the available or a new technology:

- Fuel switching
- Development of new technologies and vehicles that are more efficient
- Minimization of fuel use by adopting driving practices
- Improvement on maintenance
- Switching from one transport mode to another during a transportation chain

In our case, all transportation related to export of fresh fish to the EU countries represent about 130 mill.ton.km/year with emissions equal 76 g CO_2-ekv./ton.km [25]. Sustainable transportation is a transportation that satisfies individuals and society's needs in a long-term perspective. This implies production sensitive to human and environmental health concerns, in equal conditions for current and future generations. Sustainable transport is economically efficient and energy effective, competitive, operating offering alternative transport solutions and accomplished by the use of innovative technologies. A sustainable transport system considers environmental aspects and aimed to reduce emissions and waste, minimize consumption of natural rare resources and decrease the use of land and production of noise. In addition to this, there is a strong transport link between sustainable transport and reduced accidents and congestion on roads. Sustainable transport contributes to economic development. Social progress and living quality are improved by implementing the concept of sustainable transport. Thomaeus [26] points out that a transport system can be concluded as sustainable where economic efficiency and environmental protection complement each other or in a balance with acceptable level. The adjusted system of information sharing and integration is vital for sustainability of fresh fish supply as perishable goods and greatly influences the waste reduction. The estimated food waste from manufacturer to the end customer in different supply chains is about one-third from the production volume. Some major causes of waste in fresh fish supply are weather conditions, lack of coordination of supply flows, road accidents, failures in the transportation process, shortcomings in the shelf-life management and inconsistency between demand and supply.

Taking a sustainability perspective, it is imminent to include considerations of food waste. This is because much of the seafood transported from Norway is in a fresh state making them perishable goods. Poor transport quality increases the risk of food waste during transport impacting on ethical considerations regarding efficient food use in relation to human welfare aimed at a global level. Food waste reduction involves fundamentally improved coordination of food production volume with customer demand and improvements on the efficiency and performance of the supply chain as a whole system. In the case of fresh seafood supply, it is necessary to consider the specificities of transportation and features of the product, affecting management and performance of the whole chain [27]. The logistics providers in fresh fish supply chain targeted to deliver the product to the end customer in perfect condition and maximize available shelf-life time. Seafood that is poorly delivered indicating transport discrepancies may be improved by changing the design and use of the products. Three main characteristics of the food market, affecting the structure of the supply chain, were identified by Kittipanya-ngam et al. [28]:

1. Demand uncertainty. Customer demand is influenced by natural factors as weather conditions and seasonality and encouraged by promotion actions [29].

2. Customer order lead time. Usually, lead time required by customers is short.

3. Supply chain lead time allowance meaning perishable goods are characterized by limited life cycle and efficiency in the supply chain; allocating the sharing of the expected time to transport and handle goods between the logistical elements of supply chain is of crucial importance.

The perishability of the goods does not permit creating an inventory buffer against demand changeability and failures in the transportation. According to Ahumada and Villalobos [30], this can be compensated by flexibility in the supply and increased speed. Collaboration between participants at an operational level of the chain and as minimum partly integrated support system together with the use of advanced forecasting techniques allows to achieve required level of speed and flexibility [30]. This may improve logistical coordination in the supply chain. The unit of analysis in our case study is fresh fish supply chain that consists of the following main elements: producer, port of loading, logistics provider, port of discharge and end customer. We now turn to consider the economic considerations of this conglomerate organizational entity, the studied network and its organizations.

6. Supply chain and logistics

Customer-responsive supply chains, the "value chains", have the capacity to combine scale with product differentiation, and cooperation with competition, to achieve collaborative advantages in the marketplace. It makes commitments to the welfare of all strategic partners, including appropriate profit margins, fair wages and long-term business agreements, balancing cost with benefit perceptions. It emphasizes high levels of performance and inter-organizational trust. A supply chain thus consists of a system for sharing information among strategic partners, including shared values and vision, shared information and shared decision-making [31]. A value perspective of the supply chain as unit of analysis for transport mode alteration, accordingly, places focus on value perceptions of the supply chain collective studied in this case regarding reallocation of freight to the potential of SSS.

Economic matters in such a supply chain structure can be measured by service level, and this metric is affected by the factors like time to market, product quality, customization and flexibility [3, 7, 15]. Efficiency is then measured by calculating the economic saving of transportation cost and positive contribution on environmental protection. Despite advantages of supply chain integration, decision-makers always balance saving on supplier integration and relative cost raised by it, the transaction cost factor. Perols et al. [32] describe two types of supplier integration having paradoxical impacts on time to market. Time to market can be accelerated by supplier process integration while product integration slower time to market. And it also reveals that a positive technology spillover effect occurs with successful assimilation within a strategically organized supply chain.

The main participants of the freight reallocation project are:

- Municipalities: Hitra and Frøya
- Members of The Coastal Harbor Alliance: Kristiansund and Nordmøre Harbour IKS with Hitra Coastal Port as a part and Vikna port authority Rørvik Harbour KF
- Producers/aquaculture: Marine Harvest, Lerøy and SalMar
- Road transportation companies: DB Schenker, Bring and OTTS
- Shipping companies: Blue Water

Their role in the seafood export chain varies. Some of these networked actors are directly involved in goods handling and/or ownership; others, such as the Hitra municipality, are only indirectly linked within this chain. When the projected SSS is in operation, these supply chain actors need to cooperate together to detect and reduce environmental impact, the carbon footprint and pollutions upon the whole supply chain and gain economic benefits from their somewhat detached and local network perspective. This represents the operation perspective, a continuous network effort. It is expected that the production of aquaculture will grow to 800,000 tons by 2020. Production will be five times larger than the current production volume in 2050. According to long- and short-term forecasting, a considerable increase in the production of seafood and other goods is estimated and will require new transportation solutions that will reduce CO_2 emissions caused by trucks, road accidents and road maintenance coast. New automotive technologies, improved fuel, development and improvement of the road system promote a sustainable growth of road transport share in transportation. All export flows of fresh salmon are transported by road between South Norway and the EU markets. Salmon road Fv. (regional highway shown in **Figure 6**) 714 is connecting the coastal municipalities Snillfjord, Hitra and Frøya, Orkanger and Trondheim. The 57.6-km-long stretch between Haugen in Orkdal municipality and Sunde in Snillfjord Municipality has low standard. The daily goods flow on trucks loaded with salmon lies between 50 and 80 semi-trailers per day. This corresponds to 17,000 semi-trailers from Hitra/Frøya yearly. Sixty percent of them are oriented to the EU markets. Traffic figures from Nord-Trøndelag are more than 3000 per year. Considering together these volumes, there is a possibility to reduce the number of semi-trailers between Mid-Norway and Europe for 12,000–13,000 vehicles not considering the return cargo flows. The use of foreign transport logistics companies has proven to increase competition and the number of accidents on Norwegian roads considerably. During winter period, transportation becomes especially challenging. Such conditions are an important reason for development of the terminals and harbours of intermodal transportation in this supply chain.

The official opening of Hitra Port took place on 16 October 2014. Regular container ship calls started in November 2014. After 5 years, the main elements of the infrastructure are on the place. The infrastructure of the port includes production and social components as engineer

Figure 6. The “salmon road”.

communication, gas, electricity and water supply system with huge water reservoirs and waste water solution. Hirtshals Harbour in Northern Denmark was initially considered a starting point for the establishment of a sea transport connection. The sea transport solution will reduce current cost of road transportation by 20–25%. The price depends on volumes of return cargo flows that will be obtained over some time. Government support and financing are of high importance in implementation phase. The calculations that have been done show that an increase in return cargo flows by 10–50% can reduce prices about 10–45% depending on the distance from receiving port to the end destinations [25]. Handling equipment, communication lines, two new aquaculture plants, warehouses, facilities of the companies providing service and maintenance for aquaculture and marine industry and another buildings and facilities are included into the project and will be built after some time.

Hitra Port is located right in the fairway between Trondheim and Kristiansund and is therefore commonly considered a natural traffic and logistics hub for seafood and fishing industry in the Hitra/Frøya region. Hitra Coastal Port and its underlying commercial space, Hitra Industrial Park, total represent a development area of around 1.5 million m^2 (1500 da). They are labelled as a "seafood logistics centre". The seafood logistics centre is directly connected to the main origins of seafood production in Mid-Norway. A well-connected transport network and extensive logistics capacity makes it possible to manage further increase in future seafood transport demand. The salmon production industry is growing steadily. Indeed, it exhibits great opportunities for cooperation with the EU markets and excellent possibilities to service Mid-Norway and Northern Norway. Many shipping companies and transportation companies are interested in using the Hitra Port as both a seafood and general cargo/unit loads hub, storage hotel, a regional distribution centre, trans-shipment terminal, hub for speed boats and ferry passengers, special storage, etc. Several companies have expressed interest in establishment in the area; some companies are in negotiating position. The world's largest salmon producer, Marine Harvest, has now secured 50 da (+ option for another 10 da) to build new salmon factory in this area. There will also be good opportunities for Hurtigruten (the daily coastal liner carrying both light freight and passengers) and cruise vessels in the port. Hitra municipality will establish a future-oriented and sustainable environment. The convenient location, along with great and new quay and harbour facilities, will provide great opportunities for economic development in the region and within the company. This indicates a multiple use potential for the harbour facility at Hitra.

Much infrastructure has already been developed at Hitra during the last 2 years. The cargo terminal Hitra Coastal Port is operational from this year and includes terminal facilities, areas and equipment appropriate for both RO-RO and LO-LO services. The port's logistics centre provides possibilities for frozen and cold storage, offers warehousing and transit storage and provides a good distribution systems via Fv714 that is connected to the port through Hitra tunnel. The upgraded Fv714 is 75 km to Orkanger and 40 to Frøya and is conducive to efficient cargo distribution.

Originally, the municipality decided to build the 120 acre industrial area of north-west side of Jøstenøya where the industrial park is located at Hitra. The first plots are already sold to Marine Harvest AS and Brødrene Sunde AS that secured themselves the land for development. Now also Bewi, Sunde Group and Lerøy are in the course of building factories at the industrial park adjacent with the two salmon factories. The Bewi company and their competitor Sunde

Group each will build a new factory for the production of polystyrene boxes—fish crates factories. They do this in order to increase capacity and to be even closer to the aquaculture companies that also will establish themselves in the region. This will contribute to greater security of supply for Bewi's customers in the region. Bewi considers that it is important to be established in an industrial hub that Jøstenøya will be. The overall strategy of Bewi and Brødrene Sunde is to be a supplier of packaging for both aquaculture and agriculture and building industry. This implies they are competitors in the clustered location. Their overall logic of having production facilities at the industrial park is to provide their customers even better in quality, flexibility and environment through their innovative and trend-setting products, by being near them. The juxtaposition of the packaging factors implies considerable investment leading to logistics efficiency. Keep in mind that the volume of packaging freight, since the type of packaging used may not be folded or made smaller in any way for transport, equals the volume of packaged goods freight. By building of a new factory, Lerøy plans to merge factories in Hestvika and Dolmøya to one factory in Jøstenøya. These two factories work reasonably well today. The company Lerøy has been working for several years to merge the two factories and make the production process more efficient. This implies increase production efficiency for this company as well as logistical improvement since the two factories are now to be co-located by the harbour.

Due to demand by the companies involved in establishing themselves in the industrial park at Jostenøya, the industrial area must expand eastwards with another 60 acres. The cost of the expansion is estimated to 46 million NOK; the municipality finances it by borrowing (through a loan). It is important that companies build their facilities quickly, so that the municipality can gradually collect tax on the investment in Jøstenøya. The Hitra municipality has a strong position and extraordinary potential for industrial growth in national context. It may be possible after meetings with the Ministry of Transport where the project was presented to apply for start-up support for fresh fish exports from Mid-Norway. It is given that the full power of a restructuring of the transport side must happen this year.

These descriptions reveal how value in the supply chain clearly is differentiated between the actors, and that value is networked. In addition, through networking what constitutes a good, valued solution becomes an emergent outcome of this type of exchange process. The discussion also is interesting because it does not reveal choice of transport mode as on the agenda, even though the industrial park also is designed as a harbour. It is therefore a clear implication that this is something the Coastal Alliance needs to market to the companies establishing themselves in the industrial park. This is because it is through the business relationships between the seafood exporters and their customers that the choice of transport mode is decided upon.

7. Conclusion: value as a networked phenomenon

One of the main findings derived from this study is that the concept of "supply chains" is contingent of various developmental projects. The design of this study reveals this since its direct focus to challenges associated with freight reallocation from road to SSS through this study intentionally does not illustrate the seafood supply chain itself in detail. The provided narrative in this chapter considers accordingly features of this development project. This project organization is relatively fluid. It has no clear starting point, and it is unclear whether the activities to secure SSS freight of seafood by some form of political body, which this organization is in fact, will ever cease to exist. It is difficult to judge this as "inefficient" or "working well", since this project represents thereby a political organization. It is an expression of value concerns from firstly a societal level, including conveying environmental concerns held by society at large, and secondly the economic concerns of the companies involved in this project. Value is beheld by the perceiver, and this value is a contingent factor.

During inquiry, the researchers also encountered events which disrupted this investigation. For instance, actors became at a stage much more secretive due to what a logistics service provider perceived as unwillingness from central Norwegian government to support this reallocation effort. A perception of the supply chain as a culturally embedded game emerged. Clearly such perceptions are vital when contemplating the role of "value" in both the devolvement project itself and the value of economical salmon supply, being the aim of the project. This indicates that value is not limited to considerations associated with the perceptions of the various actors in this developmental network, but that value changes due to actions by one actor. Value in the project is networked and reciprocally interdependent. Actions are done by single networked actors, this leads to changes perceived by other actors and then these changes challenge the actors to enact upon these changes to make sense of the changed situation. This enactment through network interaction leads to actors rethinking how they further act in the process of development. This provides us a strong suggestion that "value" in the supply chain is a dynamic phenomenon. This statement implies we consider the developmental project as a supply chain itself, associated with levels of integration and challenges related to trust and coordination, different from the supply chain this project of freight reallocation is supposed to impact on.

Finally, within supply chain management literature, developing "customer value" has attained widespread use. Its use is almost synonymous with attaining a customer-responsive supply chain. Increasing attention and awareness to customers through the use of flexible resource implies creating an agile supply chain. This may be viewed as a source of competitive advantage. Through this study, focusing in those value resources in a particular food chain in different space and time dimensions, this space-oriented and static understanding is viewed as simplistic.

Through this study "value" in a supply chain context emerges as dynamic, a complex phenomenon. There are several aspects of this complexity revealed through this study. Value is networked. First, value is different in relation to the supply chain itself and the developmental project. This is, of course, related to that this study does not concern the supply chain of seafood export itself. Second, the supply chain is a network consisting of differentiated actors, a source of both complementarity and conflict. From a geographical point of view, this space dimension implies separateness and distance hampering intense personal interaction and that conceptions of value may differ between the different interdependent supply chain actors. While supply chain management, with its rather closed systems view, postulates that supply chain actors should integrate under the light of a common articulated purpose, this to align such value perceptions, we question the usefulness of this quest. Similarity between firms increases friction and poses threats of paradoxical happenings. In this project organization, it is pooling the similar actors that is especially challenging. They are at least potentially competitors.

Diversity in the network is a prime source of complementarity and a source of force to innovate. The spread of value perceptions also leads us to consider that customer value is not necessarily better than the other value considerations. When achieving customer value, this is commonly in supply chain academia and practice considered as a hierarchical higher order value, as an explicit and therefore static purpose formulation; this rules out that interaction between supply chain actors can lead to a valuable learning process that customers may learn from the suppliers to improve the value of supply. Connectivity also implies the right to withhold sensitive information, embedded in a continuously developing project discourse. This leads us to the third and final observation. Value is a dynamic phenomenon. This feature of change is dependent on quality interconnectivity in the supply chain. This implies that integration is a key effort, not aligning explicit values, but to interconnect actors to communicate, to learn. Value is perception, and value therefore is uncertain in the case description. This implies a view that managing a supply chain can be viewed as a complex process, possibly a system. A systems' view is feasible when development seeks to integrate the network around a common accepted statement of supply purpose.

The main recommendation regarding the aim of the developmental project is to develop a network discourse (atmosphere, culture) where trust and learning are highlighted. Integrating should be facilitated by organizing, and continuously improving, interconnectivity between the project actors. The main force of development should accordingly be focused not first on seeking common values but in developing connectivity, trust and values regarded as emergent network properties. Value has proven emergent in this strategic project network. It is not an easy path; it may fail. We simply propose heightening integration efforts this to a higher level of, what may be called, strategic thinking, regarding project design. Following this process view, there are no guarantees regarding output characteristics. Focusing on the process and not the output certainly involves risks. Further research may be associated with inquiry more directly into the development of supply chains form such a process view. This may be organized following case study research strategy where action research may be considered as one of the main research pillars in such a study.

Author details

Per Engelseth*, Irina V. Karlsen, Shulin Huang and Arild Hoff

*Address all correspondence to: peen@himolde.no

Department of Logistics, Molde University College, Specialized University in Logistics, Molde, Norway

References

[1] Engelseth P, Karlsen IV, Huang S and Hoff A. Network Constraints of Reallocating Seafood Freight from Road to Sea. Operations and Supply Chain Management. An International Journal. Forthcoming. 2017

[2] Cooren F. Organizational Discourse. Cambridge UK: Polity Press; 2015. 99

[3] Christopher M. Logistics and Supply Chain Management. London: FT Prentice Hall; 2016

[4] Richardson GB. The organization of industry. The Economic Journal. 1972(September): 883-896

[5] Håkansson H, Persson G. Supply chain management: The logic of supply chains and networks. The International Journal of Logistics Management. 2004;**15**(1):11-26

[6] Perrow C. Complex Organizations. Brattleboro VT: Echo Point Books & Media; 2014. 194

[7] Gadde, LE, Persson G and Håkansson H. Supply Network Strategies. Chichester UK: Wiley; 2010

[8] Kaplan DP and Norton P. Strategy Maps: Converting Intangible Assets into Tangible Outcomes. Cambridge MA: Harvard Business Press; 2004

[9] Macharis C, and Bontekoning YM. Opportunities for OR in intermodal freight transport research: A review. European Journal of Operational Research. 2004;**153**:400-416

[10] Boske LB. Multimodal/Intermodal Transportation in the United States, and Latin America-Government Plans, Policies, and Programs. Austin: LBJ School; 1998

[11] Yevdokimov YV. Measuring economic benefits of intermodal transportation. Transport Law Journal. 2000;**27**:439-452

[12] Rodrigue JP, Comtois C and Slack B. Green logistics (the paradoxes of). In: Brewer AM, Button KJ and Hensher DA, editors, The Handbook of Logistics and Supply-Chain Management. London: Pergamon/Elsevier; 2001

[13] Woo JK and Moon DSH. The effects of slow steaming on the environmental performance in liner shipping. Maritime Policy & Management. 2014;**41**(2):176-191

[14] Thompson JD. Organizations in Action. New York: McGraw Hill; 1967

[15] Persson G. Achieving competitiveness through logistics. The International Journal of Logistics Management. 1991;**2**(1):1-11

[16] EU Commission. Strategic Goals and Recommendations for the EU's Maritime Transport Policy until 2018. Brussels: Commission of the European Communities. 2009. Available from: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=URISERV%3Atr0015/ [Accessed 23-01-2015]

[17] Medda F, and Trujillo L. Short-sea shipping: An analysis of its determinants. Maritime Policy & Management. 2010;**37**(3):285-303

[18] MacGregor. Shortsea RoRo Ships. 2016. Available from: http://www.macgregor.com/en-global/macgregor/merchant-ships/shortsea-roro-ships/Pages/default.aspx/ [Accessed 14-03-2016]

[19] Todorov DM. Ro-Ro Handbook: A Practical Guide to Roll-On Roll-Off Cargo Ships. Atglen, Pennsylvania, USA: Schiffer Publishing; 2016

[20] Mora C, Frazier AG, Longman RJ, Dacks, RS, Walton MM, Tong EJ, Sanchez JJ, Kaiser LR, Stender YO, Anderson JM, Ambrosino CM, Fernandez-Silva I, Giuseffi LM and Giambelluca TW. The project timing of climate departure from recent variability. Nature. 2013;**502**:183-184

[21] Statistics Norway SSB. Aquaculture, 2014, Final Figures. Continued Growth in Aquaculture, Figure 1. Available from: http://ssb.no/fiskeoppdrett/ [Accessed 03-12-2016]

[22] Rondinelli D and Berry M. Multimodal transportation, logistics, and the environment: Managing interactions in a global economy. European Management Journal. 2000;**18**(4):398-410

[23] Rommert D, Jacqueline B and Ioannis M. Operations research for green logistics: An overview of aspects, issues, contributions and challenges. European Journal of Operation Research. 2012;**219**(3):11100-11111

[24] DSV. Global Transport and Logistics. EU Environmental Low. Sulphur directive (SECA). http://www.ie.dsv.com/about-dsv/press/News/2014/11/EU-Environmental-Low-Sulphur-Directive/ [Accessed 05-05-2015]

[25] Netter JE. Sustainable Transport Solutions for Fresh Fish from Central Norway to the Continent. Final Report. Hitra Municipality. Trondheim, Norway: Enova Project; 2013

[26] Thomaeus B. The European Concept of Green Corridors in Sustainable Transport Systems: Case of East-West Transport Corridor in the Baltic Sea Region. United Nations Framework Convention on Climate Change. Kyoto Protocol. 1998. Available from: http://unfccc.int/kyotoprotocol/items/2830.php/ [Accessed 25-03-2016]

[27] Kaipia R, Dukovska-Popovska I and Loikkanen L. Creating sustainable fresh food supply chain through waste reduction. International Journal of Physical Distribution & Logistics Management. 2011;**43**(3):262-276

[28] Kittipanya-ngam, P, Shi Y and Gregory MJ. Food Supply Chain (FSC) in manufacturing companies –an exploratory study on product and configuration. In: Proceedings of 17th EurOMA Conference; Porto, Portugal; 2010

[29] Taylor DH and Fearne A. Demand management in fresh food value chains: A framework for analysis and improvement. Supply Chain Management: An International Journal. 2009;**14**(5):379-392

[30] Ahumada O and Villalobos JR. Application of planning models in the agri-food supply chain: A review. European Journal of Operational Research. 2009;**196**(1):1-20

[31] Stevenson S, and Pirog R. Values-based food supply chains: Strategies for agri-food enterprises-of-the-middle. Annual Meeting of the Rural Sociological Society; Manchester, New Hampshire. July 28. 2008. Available at: http://www.allacademic.com/meta/p244246_index [Accessed 05-05-2010]

[32] Perols J, Zimmermann C and Kortmann S. On the relationship between supplier integration and time-to-market. Journal of Operations Management. 2013;**31**(3):153-167