University of South-Eastern Norway

Functional requirements for sustainable short sea logistics system
Ports' perspective

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Abstract

Purpose: The purpose of the thesis is to define functional requirements for sustainable short sea logistics system from ports' perspective.

Research methodology: In this study, a qualitative research methodology is applied. Semi-structured interviews were conducted to collect data from various port representatives. Systemic approach was employed. The collected data was analyzed by using systems engineering method – requirements analysis.

Results: Analysis shows that port representatives have quite similar attitudes towards sustainability in short sea shipping and see the role of ports as a vital element in multimodal transportation system. Main requirements for sustainable short sea logistics system, as were derived, are: centralized port network ownership, single digital platform for communication between parties, advanced telematics and control systems for cargo handling and infrastructure development in and outside the ports.

Contribution: This study contributes to the knowledge creation on sustainability in short sea logistics from ports' perspective.

Keywords: short sea shipping, system requirements analysis, sustainability, maritime logistics, maritime supply chains, ports.

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Introduction

Seaborne transport is very important part of transportation system. Around 40 percent of European domestic goods and passengers' transportation is carried out by ships. The cargo volume from hundreds of trucks can be loaded onto the ship, but only small part of harmful emissions will be produced from. In Norway, there exists potential for transferring more than 5 million ton of cargo from road to the sea, which corresponds to reduced CO_2 emissions of 300 000 ton per year (Norwegian Shipowners Association, 2017). To achieve that, competitiveness of short sea shipping (SSS) must be strengthened.

One of the measures to strengthen competitiveness of SSS is to make ports a more efficient hubs for freight transport. Efficiency in ports depends on many factors and in order to improve that and make a step closer to sustainability, it is necessary to identify problems and bottlenecks associated with the process of cargo moving through ports.

In this study I set out to examine the port representatives' attitudes towards sustainable short sea shipping. The inclusion of the ports' perspective goes some way towards complementation of existing knowledge, a major part of which deals with shippers' perspective. To achieve the goal, the System Requirements Analysis (SRA) method is employed, which, based on the problems identified, aims to define requirements for sustainable short sea logistics system from a ports' perspective. This will in order help to generate insights that could inform policies aimed at inclusion of SSS into sustainable maritime supply chains.

1. Literature Review

This chapter contains systematic review of published academic literature within two focus areas: sustainability from maritime supply chains' perspective and short sea shipping. Since sustainability in maritime supply chains is a relatively new concept and the amount of published academic literature is limited, a number of articles from more general area of sustainable supply chain management was added to the review.

1.1 Sustainability in maritime supply chains

Sustainability is a core business concept of 21st century. Despite many companies saw sustainability as a mean to create more value for shareholders, throughout the years situation has changed; nowadays more and more companies pay tribute to sustainable practices. However, there is still a long way to go. As the global managing partner of McKinsey&Company Dominic Barton pointed out, "*the speed and scale of what we need to do – I don't think it's sufficient*" (HBR Ideacast, n.d.).

A maritime supply chain is a relatively new concept, but number of articles was published in last years. Sustainable maritime supply chain can be defined as

> *Integrating maritime organizational units (ports, shipping companies, etc.) along a supply chain and coordinating materials (container, bulk and general cargoes), information and financial flows in order to (a) fulfill (ultimate) customer demands with the aim of improving competitiveness of the supply chain as a whole to make profit subject to compliance with regulations to control (b) social and (c) environmental impacts* (Cheng, Zanjirani Farahani, Lai, & Sarkis, 2015, p.1).

Sustainability in shipping involves meeting the needs of the present generation, but without compromising the future generations' needs (Yuen, Wang, Wong, & Zhou, 2017). Incomplete research, dealing with maritime sustainability for its many dimensions (Cheng et al., 2015), requires more attention from researchers in order to enhance sustainability in maritime industry, create more value for current and future generations, and reduce negative environmental footprint to the minimum.

Three aspects of sustainability have to be considered simultaneously in order to support long-term competitiveness (Carter & Rogers, 2008). A sustainable maritime supply chain has to be economically viable and synchronize the processes and partners involved in achieving maximum profitability (Lam & van de Voorde, 2011). Economic sustainability (i.e., minimizing costs and maximizing profit in a short and medium-term perspective) receives highest attention from researchers and there exist a lot of published literature on this issue.

However, economic performance alone is insufficient for long-term sustainability. Environmental problems – raising sea level, Arctic ice melting, weather anomalies and polluted air – pushed the society and businesses towards implementing more eco-friendly operations and creating eco-friendly business models. For example, green shipping practices, especially using of "green design" ships are seen as a vital step in achieving environmental sustainability. Green design involves advanced power system, cleaner fuels, energy efficient power management systems, hydrodynamic smooth hull, special coatings, efficient propellers, etc. Moreover, green shipping management may improve environmental performance and financial performance (Lam, 2015). Green supply chain design, especially in maritime industry, is a quite challenge in practice, because it requires simultaneous consideration of different factors, usually opposing to each other, such as transportation/handling costs, amount of exhaust gas emissions and particular matter (PM)

pollution. Very often, to reduce harmful emissions, additional investments are needed – modernization of power system philosophy, installation of scrubbers, switching to clean (more expensive) fuels, etc. From the other side, these investments can save money in the future because the compliance with IMO and other bodies' requirements is necessary for trading legally, provides access to the ports and make a vessel much more attractive for the charterer. There was an attempt to evaluate various multi-objective approaches for solving these complex problems (Kadziński, Tervonen, Tomczyk, & Dekker, 2017). Authors argue that minimization of costs and carbon dioxide emissions are aligned but minimizing PM emissions involves much higher costs and may lead to increased carbon dioxide emissions. However, the study is based on one case study, which limits its application for a broader or different situation.

Extensive literature review conducted by Mansouri, Lee, & Aluko (2015) revealed that environmental sustainability in maritime shipping has received the highest attention in the last years. However, despite quite a number of published articles on environmental sustainability in maritime transport, much of the research is not implemented, what may be considered as a gap between academia and practice. Authors have identified the gaps in theoretical development of multi-objective optimization (MOO) as part of decision support system (DSS) to enhance environmental sustainability in maritime shipping. As they have shown, majority of the suggested solutions (about 75 %) are technically oriented, which includes slow steaming, speed optimization, schedule optimization, weather routing, berthing optimization, and other technical solutions; only less that 25 % are policy-oriented. They also argue that adoption of MOO based DSS by maritime industry is still a challenge and further efforts are needed.

Social sustainability focuses on the needs of people. This involves respecting rights of the people, improvement of employees' job satisfaction, customers and partners relationships,

relationships with authorities of all levels. It was suggested that corporate social responsibility (CSR) has positive effects on firm's performance – both financial and non-financial (Lu, Lin, & Tu, 2009). Using methods of multiple regression analysis, authors have identified three critical CSR dimensions – 'community involvement and environment', 'employee and consumer interests' and 'disclosure' and suggested that shipping firms should emphasize these dimensions when undertaking strategic planning.

Another area of extensive research is efficiency in ports. Since ports are the nodes in supply chain network and serve as intermediary facilities between land-based and maritime transport, the role of ports in achieving sustainability requires more attention. From economic and environmental sustainability perspective, five largest UK ports were also investigated (Asgari, Hassani, Jones, & Nguye, 2015). Authors gathered data from logistics experts and port managers and applied multi criteria decision making methodology and analytical hierarchy process (AHP) to evaluate port performance by means of environmental and economic criteria and indicators. Some of the environmental indicators are green policies, air pollution, noise pollution, electricity consumption, environmental certificates; economic indicators are: transportation cost, fuel cost, electricity cost, shipping cost, port congestion, infrastructure, among others. Port time uncertainty and thereby amount of emissions is seen as one of the biggest factors in order to achieve sustainability in maritime shipping (Kontovas & Psaraftis, 2011).

UK supply chain carbon mitigation strategies were assessed in paper (Sanchez Rodrigues et al., 2015). By using a combination of alternative ports and various multimodal strategies and using five different scenarios, authors tried to minimize the distance of transportation (in TEU-km). They concluded that the scenario, which involves the expansion of port Southampton with a shift of containers from road to rail, has the lowest carbon dioxide emission and the lowest freight

transport cost. They also showed that significant reduction of the overall carbon dioxide emissions (as a part of environmental sustainability goal) can be achieved by shifting freights from road to rail and by using different logistics strategy, namely taking away cargo flows from the largest ports and re-route the flows into smaller ports. Also, proper combination of road, rail and maritime transport freights can reduce carbon footprint and total transportation cost. The role of small ports is important in efforts of improving overall sustainability.

In their paper Yuen et al. (2017) authors analyze drivers and outcomes of sustainable shipping practices from the resource dependence, planned behavior and stakeholder theories' perspectives. Results show that stakeholder pressure, shipping companies' attitude and behavioral control towards practicing sustainability are the antecedents of sustainable shipping practices. It is also shown that both stakeholder pressure and sustainable shipping practices influence the business performance of shipping companies. Introduction of behavioral theories can better explain motivation and consequences of sustainable shipping practices; stakeholder theory provides very interesting framework, because it implies the pressure of various stakeholders (public, employees, suppliers, customers and shareholders) on the firm. The theory of planned behavior expands the views of stakeholder theory by addressing such drivers as shipping companies' attitude and behavioral control. Resource dependence theory further draws connection between the antecedents of sustainable shipping practices, stakeholder pressure and business performance. To improve the adoption of sustainable shipping practices, authors argue for shaping the attitude of shipping companies. Top management commitment towards sustainability should be expressed in companies' vision, mission, goals and objectives, and further disseminated to the employees in the company. In addition, shipping companies can increase their self-efficacy by dedicating financial resources for implementing sustainable shipping practices (training, creating task forces) to

oversee management of sustainable activities and be responsible for sustainable performance of the company.

To combine multi-dimensions of supply chains and sustainability, a hybrid approach of QFD-ANP was developed (Lam, 2015). Author postulates that all players in maritime supply chain should adhere to customers' expectations in devising social and ecological solutions for achieving economic performance. A case study of major container shipping company shows that the approach is applicable and flexible to accommodate different customer requirements and design requirements, according to a firm's situation. The four main customer requirements defined are: cost and price competitiveness, pollution reduction, efficient use of fuel and resources, and health, safety and security.

Another decision support model was proposed by Wong, Tai, Lau, & Raman (2015). Authors argue that their continuous utility-based model is developed to assist marine planners on the decisions of slow steaming from cost saving and optimal speed perspectives. The model is applied to Trans-Pacific (liner) route in determining optimal speed, with fuel consumption, carbon emission and on time delivery as factors. However, the model is limited in its application for ocean-going liners and have not been tested in other applications.

Table 1 summarizes reviewed published academic literature on sustainability in maritime supply chains.

Table 1 - Reviewed literature on sustainability in maritime supply chains

Study	Research objective	Findings
(Lu et al., 2009)	Examines the relationships between CSR and organizational performance	Various CSR aspects have positive effects on financial and non-financial performance
(Kontovas & Psaraftis, 2011)	Examines the fuel cost and emission reduction in 'slow steaming' and 'decreased time in port' scenarios	Speed reduction may be beneficial in terms of reducing emissions and fleet overcapacity; "booking by rendezvous" system is proposed
(Mansouri et al., 2015)	Examines the potential of MOO as a decision support to improving sustainability in maritime shipping	MOO appears to be a viable approach to the modelling and optimization of operational and strategic decisions in maritime shipping
(Lam, 2015)	Aims to design a sustainable maritime supply chain by taking customer requirements as a focus	Analytical approach for guiding shipping companies' sustainable design was developed
(Lam & Lai, 2015)	Aims to develop a model for shipping companies to attain environmental sustainability in their operations	Analytical approach for designing environmental sustainability was developed
(Asgari et al., 2015)	Examines economic and environmental sustainability performance of five major UK ports	Five largest UK ports were ranked, in accordance with sustainability performance
(Sanchez Rodrigues et al., 2015)	Assesses carbon mitigation strategies for UK supply chains by using a combination of alternative ports	Five different scenarios were compared to each other, resulted in a conclusion that some ports can be expanded, and some ports can be fed from rail
(Wong et al., 2015)	Examines slow steaming sustainability initiatives	A slow steaming decision support sustainability model is developed and reviewed to balance the cost savings, commercial profits, environmental needs and social dimensions
(Yuen et al., 2017)	Examines the drivers affecting the adoption of sustainable practices in shipping companies; Examines the effects of a firm's attitude, norms, behavior control and sustainable shipping practices on a business performance	Stakeholder pressure, shipping companies' attitudes and behavioral control towards sustainable practices are the antecedents of sustainable shipping practices
(Kadziński et al., 2017)	Examines analytical approaches for solving green supply chain design problems	Various efficient solutions were generated

Despite the fact that quite a number of articles on maritime sustainability issues is published, they are not meant to be complete. Cheng et al. (2015) propose the topics worth further research, including: measuring sustainability in maritime supply chains, real life case studies, sustainable maritime network design, sustainability in regional and national supply chains. Lam & Lai (2015) suggested further research on application of ANP-QFD decision making tool for shipping firms to improve environmental sustainability. Their study uses an approach which integrates ANP and QFD and shows how to apply it in order to examine the interactions among customer requirements and design requirements. As authors note, their study is limited by considering only parameters in the 'customer cooperation program' (i.e. 'shippers'), and that the "*further research can extend by examining requirements from other stakeholders of shipping firms such as inland transport operators, terminal operators, and consignees*" (Lam & Lai, 2015, p. 282). Yuen et al. (2017) note that their research is limited by not only the sample itself (Singapore-based container and dry bulk shipping companies), but also due to the fact that other shipping sectors and stakeholders, such as freight forwarders, brokers, and operators of mixed-cargo vessels have not been included in the research.

1.2 Short sea shipping

Different authors put quite a different meanings in the term "short sea shipping" (SSS) (Paixão & Marlow, 2002; Douet & Cappuccilli, 2011), but throughout the thesis, the following definition is meant by this term, namely those given by the European shortsea network:

> *Shortsea shipping means the movement of cargo and passengers by sea between ports situated in geographical Europe or between those ports and ports situated in non-European countries having a coastline on the enclosed seas bordering Europe. Shortsea*

shipping includes feeder services along the coast, to and from the islands, rivers and lakes"

(European Shortsea Network, n.d.)

A number of articles devoted to short sea shipping was published in recent years. From a strategic perspective, Morales-Fusco, Saurí, & De Melo (2013) discussed the potential of SSS, based on the characteristics of demand, goods' producers and the cargo transported. They suggested two strategic opportunities by using SSS – greater economies of scale, compared to road haul, and more capacity to absorb seasonal or uncertainty demand variability. Viewed from another perspective, Mulligan & Lombardo (2006) argue that SSS seeks to address two key problems – traffic congestion and pollution. Due to the fact that fuel consumption is one of the key benefits of SSS, which reduces harmful emissions in itself, another positive environmental effect can be achieved. Authors speculate that moving cargo from trucks to waterborne transport will reduce traffic congestions on highways and in bottlenecks, so that remaining truckers can drive faster and realize better fuel economy. Authors also conclude that SSS will not develop automatically and collective efforts are needed. Some of the solutions they argue are government subsidizing and tax benefits for SSS providers, which is intended to improve financial benefits for them. Financial viability is very important issue, because from the shippers' perspective, who will eventually have to switch from road to water transport, this mode has to offer either lower costs or reduced transportation time. Since speed increasing results in much higher fuel consumption, the only way for SSS to become attractive for shippers is to reduce costs. In this aspect, Medda & Trujillo (2010) call for inclusion of external costs into total transportation costs of road transport and SSS and speculate that this can improve financial and social position of SSS towards road freight.

Economic and service benefits of SSS in regional markets were somewhat analyzed in previous studies. Galati et al. (2016) showed that, for a particular route from Spain to Italy, SSS

option for food transportation is cheaper than corresponding road haulage, while Casaca, Galvão, Robles, & Cutrim (2017) showed that cabotage users in Brazil aim to enhance the integration of logistics between transport modes only if better services (real time monitoring and door-to-door delivery) are provided. Suárez-Alemán, Campos, & Jiménez (2015) carried out economic analysis and showed that most of SSS corridors between Spanish ports and ports in Rome, London and Moscow generate substantial external cost reduction.

However, some authors (Paixão & Marlow, 2002) argue that promotion of shift toward sea transport instead of road transport faces significant challenges in practice. They identified strengths and weaknesses of SSS. Their analysis shows that there are many weaknesses, namely difficulties in offering door-to-door transport service, inefficiencies in ports, poor layout of ports and terminals, lack of port capacity, lack of transparency in port charges and tariffs, lack of integration between seaborne and surface transport modes, lack of flexibility in service departures and arrivals, huge amount of paper work, amongst others. All these issues result in low levels of reliability of SSS and, as a consequence, unattractiveness of SSS for the shippers. Authors recommend further analysis of SSS based on the principles of theory of competition and call up the ports and SSS providers to pay attention to the analysis and implement the results.

Another study (Medda & Trujillo, 2010) also points out to the ports, where the exchange from one mode to another in a transportation network occurs. Authors argue that ports are the vital links in a transport chain and more policy attention is needed. Poorly performing ports are supposed to become more specialized, what can improve operators' perceptions of reliability of SSS. They also argue for more support for the implementation of telematics and control systems for cargo handling. A proactive role of ports in integrating different links of logistic systems is seen as a key issue for SSS (Musso, Paixão Casaca, & Lynce, 2010).

Logistic strategies enabling SSS integration into multimodal transport chain were somewhat identified in previous studies (Paixão Casaca & Marlow, 2009). In total, eleven strategies were considered valid after reliability tests, and key strategies are recommended for SSS: total quality management strategy, integrative strategy, freight-forwarding strategy, partnership strategy, inland clearance depot strategy, terminal strategy, outsourcing strategy, time-management strategy. Integrative strategy implies development of integrated transport solutions, bringing together into single network transport operators, facilities and infrastructure, while inland clearance depot strategy suggests involvement of these depots to streamline operations (Paixão Casaca & Marlow, 2009). Authors suggest that by choosing the right mix of logistics strategies, SSS can fit within the logistics needs of users and become part of multimodal transport services.

Despite numerous studies elucidated SSS as a potential competitor to road transport, a deeper analysis of cargo flows in France revealed some problems. That is, as of 2011, the cargo which could not being transported by trucks, has been the main cargo for SSS, and short transit times and distance favors truck transport anyways (Douet & Cappuccilli, 2011). Authors also noted that the role of the EU in reduction of administrative bottlenecks that hinder development of SSS in Europe should be evaluated. Moreover, more recent study showed that SSS still has not achieved the goal of becoming reliable competitor to road transport. Suárez-Alemán, Trujillo, & Medda (2015) argue that, despite number of attempts made by the EU in order to promote SSS since the early 1990's to the late 2000's, sea transport has experienced decrease in comparison to road transport, which has grown. They have found that giving grants to companies to facilitate shifting of cargo from road to sea, without increasing port efficiency, is ineffective. Examples of this are Marco Polo I and Marco Polo II programs, which required around EUR 895 million to initiate and implement but did not bring any significant positive results. As authors suppose, one of the

probable reasons why this happened is that EU policies did not take into account valuation of time factor – how differently firms see the time of intermodal operations. The efficiency of ports is very essential, because of the time spending for handling documentation and administrative procedures. Promotion of ports' efficiency and encouraging of SSS against road transport is seen as a must. At the same time, giving grants to companies to shift cargo from road to sea, without promotion of port efficiency is ineffective.

Table 2 summarizes the reviewed published literature on short sea shipping issues

Table 2 - Reviewed literature on short sea shipping issues

Study	Research objective	Findings
(Paixão & Marlow, 2002)	Examines the strengths and weaknesses of SSS	Authors give strengths/weaknesses assessment. Strengths identified are: geographical, financial, energy, environmental advantages, underused capacity for expansion, potential for employment and economic growth. Weaknesses are many.
(Mulligan & Lombardo, 2006)	Examines the potential environmental benefit of SSS	Environmental benefits, based on calculations of fuel consumption, are presented; key considerations for implementing SSS are discussed
(Paixão Casaca & Marlow, 2009)	Identifies logistics strategies so that SSS can be integrated in multimodal transport chains	Key strategies for SSS were identified: total quality management, integration, freight forwarding, partnership, inland clearance depots, terminal, outsourcing, time management
(Medda & Trujillo, 2010)	Carries out literature review and examines how SSS can alleviate traffic congestion and maintain freight flow efficiency	Intermodality of SSS requires special attention to the ports, where there is an exchange from one mode to another
(Douet & Cappuccilli, 2011)	Demonstrates what has been doing wrong by the EU resulted in poor performance of SSS	Industry players underrate SSS; administrative issues and legal responsibilities are too complicated so that SSS could not compete with road transport
(Sambracos & Maniati, 2012)	Examines potential economic and social benefits of Greek SSS corridors	Sea mode is more competitive than the road alternative; but this transport solution is to be developed

(Morales-Fusco et al., 2013)	Assesses freight-distribution strategies, which can benefit from considering SSS from the beginning	There are two strategic opportunities from using SSS, in comparison to road-haulage systems: greater economies of scale and more capacity to absorb demand variability
(Suárez-Alemán, Campos, et al., 2015)	Examines potential economic benefits of Spanish SSS corridors	Most SSS corridors generate substantial cost reduction compared to road transport; competition is important to keep costs lower.
(Suárez-Alemán, Trujillo, et al., 2015)	Critically analyzes the intermodal competition between road and sea transport in the European freight transport market	The EU needs to focus on ports and transport system efficiency as a whole in order to compete effectively in the freight transport market
(Schøyen & Bråthen, 2015)	Develops a method to estimate energy efficiency for feeder vessels	Short sea container shipping operations may be much more energy efficient; efficiency in ports must be improved
(Galati et al., 2016)	Examines economic benefit of SSS compared to road transport in the food trade between Spain and Italy	Road option is 30 percent costlier than SSS option
(Casaca et al., 2017)	Investigates cabotage users' perception in integrating cabotage into their multimodal transport systems	Cabotage users aim to enhance the integration of logistics between transport modes and to adopt modal shift strategies if better services are provided

1.3 Summary from the literature review

Systematic literature review shows that there are, at least, two positions with regard to short sea shipping. The first one states that SSS is economically viable, environmentally friendly alternative or supplement to road transport. Scholars argue that economies of scale, low carbon emissions and alleviating of traffic congestion are big advantages of SSS. However, the second viewpoint blames SSS as overestimated in terms of 'easiness of implementation' transportation mode, which is still not capable to compete with road freight and has not achieved significant market share despite big investments and EU support initiatives. Some scholars argue that these initiatives were done wrongly and main reason of weak position of SSS is inadequate policies.

It is necessary to note, however, that not only academia, but maritime industry players are also concerned regarding SSS potential. One of the biggest shipowners associations in the world, Norwegian Shipowners Associations, recognizes importance of establishing more comprehensive, systematic approach to seaborne transport and point out that the critical success factor is development of major intermodal harbors (i.e., ports), which will connect rail, road and sea transport seamlessly into one sustainable transport system (Norwegian Shipowners Association, 2017).

Summarizing the points from the reviewed literature on maritime sustainability and SSS issues, it is reasonable to conclude that, in order to make a step closer to established sustainability in transport network, the whole transport system efficiency, especially efficiency in ports, is needed to be improved. Ports are the nodes in transportation network, where there is a changing from one transport mode to another. Ports are essential, because many different stakeholders' interests usually collide in there, because of a conflict of that interests. Generally, the main stakeholders are shippers (owners of cargo), freight forwarders, agents, vessel operators, and port authorities. Since economic issues are important, and the port fees depend on particular characteristics of the vessel, port authorities may give preferential access to their facilities to certain companies and vessels, do not taking into account a transport system as a whole, which can result in establishing unsustainable transport logistics system. Following the steps in Grady (2013), a system approach may be applied, which requires carrying out a system requirements analysis.

2. Research methodology

This chapter describes applied research methodology. In the first part the research interest is specified. In the second part the research objectives are formulated. In the third part applied research method is explained and justified. Sampling method and arguments on trustworthiness and authenticity of the research are also presented. In the fourth part main steps in data analysis – KJ method, scenarios and Quality Function Deployment (QFD) are presented.

2.1 Specifying the research interest.

The research interest is specified on investigating an integration of SSS into sustainable maritime logistics system. Systemic approach is applied. Some basic definitions follow below.

- System. "*A system can be broadly defined as a set of integrated components that interact with each other and depend upon each other, to achieve a complex function together. A system can be decomposed into smaller subsystems or components and a system may be one of the components for a larger system*" (Liu, 2015, p. 4).
- Requirement**.** "*A requirement is an essential attribute or characteristic for a system or an element of a system, which is coupled with value and units information for the attribute by a relation statement*" (Grady, 2006, p. 48).
- System requirements analysis (SRA). "*SRA is a structured, organized methodology for identifying an appropriate set of resources to satisfy a system need and requirements for those resources that provide a sound basis for the design or selection of those resources*" (Grady, 2006, p. 7).
- Short-sea shipping (SSS). "*SSS means the movement of cargo and passengers by sea between ports situated in geographical Europe or between those ports and ports situated*

in non-European countries having a coastline on the enclosed seas bordering Europe. SSS includes feeder services along the coast, to and from the islands, rivers and lakes" (European Shortsea Network, n.d.).

2.1.1 Focusing the interest.

Based on previous research on sustainability in maritime supply chains and short-sea shipping, the study is focused on small Scandinavian ports, which provide services for short sea vessels, including ports' infrastructure, inbound and outbound cargo and information flows. Ports are assumed as nodes in a short sea shipping and multimodal supply chain networks. Many researchers argue that efficiency in ports should be increased in order to facilitate SSS (Suárez-Alemán, Trujillo, et al., 2015; Medda & Trujillo, 2010; Schøyen & Bråthen, 2015).

2.1.2 Selecting a perspective.

Short sea transportation, as well as a road and railroad transportation, is a service, offered by transportation companies to the shippers. Shippers decide which mode of transport is appropriate for them, depending on transportation costs, time of delivery and reliability of the supply chain. Shippers' perspective is important, because facilitation of SSS requires their right attitudes, willingness to use maritime transport instead of trucks and obtain something in exchange. However, ports' perspective is also important since it can add more knowledge and understanding of the whole system efficiency. This thesis focuses on ports' perspective; opinion of port representatives is of high importance and able to help achieving sustainability in short sea logistics system and in a whole multimodal transportation system.

2.2 Research objectives.

The objectives of the research are:

- To explore published literature on sustainability in maritime supply chains and short sea shipping;
- To identify ports' needs and transform those needs into requirements statements;
- To generate insights that could inform policies aimed at integration of SSS into sustainable maritime supply chains;
- To identify areas for further research.

2.3 Research method.

One of the systems engineering methods – requirements analysis – is proposed to define functional requirements for sustainable short sea logistics system. Systems requirements can be categorized into four main categories: functional requirements, performance requirements, constraint requirements and verification requirements (Liu, 2015). Main attention throughout the thesis is put onto the functional requirements. However, different types of requirements overlap with each other, so multiple aspects and perspectives may be considered.

2.3.1 Systems requirements analysis basics.

Any two or more objects, which interact cooperatively in order to achieve a common goal or function, constitute a system (Grady, 2013). The author distinguishes five fundamental descriptors of a system:

- System architecture – the complete set of things that form a system;
- Interface - parts of the system must interact in useful ways. The medium for this interaction is interface;
- Environment;

- Predefined goals or functions;
- Prescribed process for operation of the system.

The system interacts with external entities called "terminators" and all the parties interested in development of the system are called "stakeholders" (Grady, 2006). The ultimate system abstraction is shown on Figure 1.

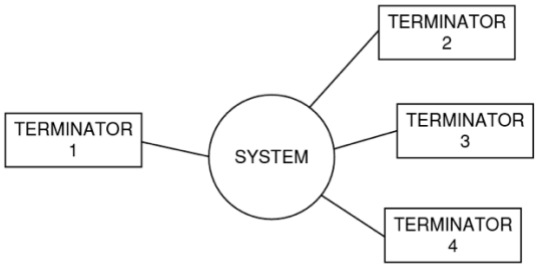

Figure 1 - The ultimate system abstraction (Adapted from (Grady, 2006))

End customers, or ultimate users of the system, are able to initially identify their needs for a brand new or a being modified system (Grady, 2013). They can realize that certain needs are not fulfilled and express their needs in simple terms – '*customer need statements*' (Grady, 2013). The need statement is one or two sentences that define what customer expects the system to accomplish (Grady, 2013). However, these statements cannot serve themselves as a basis for system design, because they are incomplete, vaguely stated in naïve language and sometimes controversial (Liu, 2015). The user statements need to be organized, translated, filtered and formatted into a sound set of requirements. This process is referred to as the Requirements Analysis (RA).

Requirements are necessary attributes for the system. More precisely, the system requirements analysis (SRA) is defined as

> *Structured, or organized, methodology for identifying an appropriate set of resources to satisfy a system need and the requirements for those resources that provide a sound basis*

for the design or selection of those resources. It acts as a transformation between the customer's system need and the design concept (Grady, 2006, p. 7).

The purpose of SRA is to decompose a statement of customer into parts and decide what the system has to do in order to satisfy the need. The process of SRA is the transformation of an input to a desired output. Input is a combination of customer statements, output is a requirement specification, or requirements list, from which system design solution can be generated (Brace & Cheutet, 2012). Having a clearly defined system need is very important and seen as a foundation for system success (Liu, 2015).

SRA is the most critical activity in the conceptual design stage. In general, SRA should address the following issues (Liu, 2015):

1) Defining system mission. Defining overall system objective and main functions the system is intended to provide;
2) Defining system stakeholders. Identification of the major user classes for the system;
3) Defining system performance. How well the system functions have to be performed;
4) Defining the system effectiveness factors. How effective and efficient the system should be;
5) Defining the environmental factors. The external environment in which the system performs via interfaces.

2.3.2 Requirements capture technique.

As the required data is to be collected on many cases (multiple organizations) relatively simultaneously and then will be examined to detect patterns of association, the best design for this kind of research is cross-sectional design (Bryman & Bell, 2015). In order to create a list of

requirements, it is first necessary to define the customers' needs - inputs from multiple users, expressed in their relatively simple statements.

There are many sources and techniques that could be used to collect requirements – user interviews, surveys, questionnaires, observations, study of documents and reports and study of similar systems (Liu, 2015). In order to define customers' needs, semi-structured online interview with the respondents was employed in the thesis. Main reason behind the decision of using interview as requirements capture technique, instead of a survey, is that it allows asking respondents directly about their needs and saves quite a lot of time. Prior to the decision of using an interview technique, an online survey was designed and probed by online distribution to potential respondents. However, prohibitively low response rate on the survey and big amount of time needed for potential respondents for answering the survey questions, led to the implementation of online interviewing. Either Telegram, Skype or FaceTime was used as a medium for online audio conversation.

Prior to conducting interviews, the interview guide was prepared. The interview guide contains the series of questions, starting with questions regarding demographics with the purpose to present sample. Afterwards, close-ended questions were included in order to indicate how strongly respondents agree or disagree with the specific statements. After close-ended questions, the series of open-ended questions were presented. Since during the semi-structured interview it is possible to vary the sequence of the questions and ask more follow-up questions in response to what is seen as a significant replies (Bryman & Bell, 2015), this advantage was used and additional questions were asked in order to obtain more of the valuable information.

The interview guide was prepared to cover the topics, which are needed to be investigated. Questions are designed in such a way that every category in the five main issues in SRA (mission,

performance, stakeholders, performance, effectiveness factors and environmental factors) are filled out with, at least, one question. The interview consists of three parts. The first part starts with general questions about respondent's background, role in the port, how long he or she occupies this position and main responsibilities. Also, main characteristics of the port (annual port calls, types of cargo the port handles and current state of the short sea shipping infrastructure) are asked. Date and time of the interview are also indicated.

After collecting basic demographics information, the close-ended questions are asked. Respondents are asked to indicate how strongly they agree or disagree with the pronounced statements. Likert 5-point scale is used (Bryman & Bell, 2015).

Final and most demanding and time-consuming part of the interview is the open-ended questions, where respondents are asked to share their thoughts on various topics associated with sustainability and system requirements. As previously mentioned, all the questions aim to reveal port authorities' attitudes toward sustainability. Afterwards, port authorities' opinions towards sustainability are grouped into five basic categories, which correspond to the fundamental issues in system requirements analysis. Follow up and probing questions were asked as interview proceeded. The interview guide is presented in Appendix B.

2.3.3 Sampling.

It is supposed that the analysis uses inputs from stakeholders and translates them into functional requirements for the system. Establishing a sustainable multimodal transport logistics system overlaps the domains of multiple groups of stakeholders. From a management perspective, typical stakeholders are (Talley, 2012):

1) Shipowners, charterers and operators;

2) Maritime sector associations;
3) Ship builders;
4) Ports, terminals and seaways;
5) Customers/shippers (retailers, manufacturers, cargo owners, freight forwarders);
6) Sustainable shipping coalitions;
7) Public;
8) Government and regulators.

All of these stakeholders have a set of their own requirements (needs) that should be noted. However, based on previous studies (see the literature review), the main concentration of identified problems is observed in ports, which are considered as having low efficiency and not very attractive for shippers for multiple reasons. Based on this, the study is limited to the port and terminal authorities and tries to define how do these stakeholders see the problems of inefficiency in their ports and what actions could be done to improve efficiency and attract port users (shippers, freight forwarders and cargo owners) into short sea shipping. Port users have a great power in defining transportation mode, because they have their priorities concerning convenience, speed, time, reliability and cost of transportation. Their needs are well known; usually those are timely delivery and low transportation cost. But how to meet their needs and what should be done from ports' perspective is an important issue, and solution will allow to make a step towards sustainability in maritime industry and in whole multimodal transportation system.

A non-probability sampling method is employed due to the following considerations. Generating a random sample requires defining precise population, from which to draw it. Due to the limited available information about potential respondents and time and cost considerations, it is a big challenge to define the complete population of all interested parties, hence a truly random

approach to sample selection could not be used. Instead, a non-probability sample selection was conducted, using information on potential respondents, who were available to the researcher. Researcher's personal knowledge of ports, which are part in SSS logistics network, port managers, connections of supervisor and the faculty staff were used. Also, the search was conducted via internet on promotional web-pages for contact information, such as Shortsea Shipping Norway (Shortsea Shipping Norway, 2018). In addition to convenience sampling technique, some kind of a snowball sampling technique was used, when information on potential new respondents was drawn from previous information source (Bryman & Bell, 2015). For example, during investigating on of the port activities on the official website, information on particular shipping company was found, so that later this company was included into the sample.

In order to invite potential respondents for an online meeting, the request for participation in research project (informed consent, see Appendix A) was sent personally to participants by email, which is listed for public access on the official webpages. The request for participation was prepared in accordance with recommended template, provided by the university. In those cases when personal emails were not listed on the websites, the request was sent to companies' emails for general enquires. It was preferable for participants to hold a managerial position and/or have solid knowledge of the company performance and logistics philosophy. Since the good knowledge of their firms' sustainability practices were required from the participants, a request to forward the request to a competent person in the organization was stated when email was sent to general email address. After sending the email, a phone calls were made in order to be sure that participants have received the request for participation in research project and will not miss it in a spam folder or wherever. Also, during the phone calls it was stated that participation in the research is of high

importance for the researcher, but nevertheless voluntary. Also, in a couple of days from original calls, a reminder phone calls were made in order to motivate potential respondents for a response.

It is also necessary to note that the sample is relatively biased, since only available respondents, whose contact details were found, were chosen. After pre-selection of candidates, a list of twenty potential respondents was composed. Unfortunately, only six candidates were responsive enough and agreed to participate in the research (see Table 3). Also, the sample size is affected by time considerations, because some of the companies contacted originally showed willingness to participate, but due to organizational routines were not capable to arrange interview in a rational time horizon, available for the researcher for doing the thesis.

Table 3 - The Participants interviewed in this study

Participant №	Role	Date of the interview	Medium
1	Senior expert in loading/discharging	April 14th, 2018	Telegram audio
2	Assistant director	April 17th, 2018	FaceTime audio
3	Port captain	April 17th, 2018	FaceTime audio
4	Commercial manager	April 18th, 2018	Skype audio
5	Technical manager	April 20th, 2018	FaceTime audio
6	Shipbroker	April 25th, 2018	FaceTime audio

2.3.4 Trustworthiness and authenticity

Trustworthiness and authenticity are two major criteria for assessing qualitative study (Bryman & Bell, 2015). The research was planned and executed with strong commitment to follow commonly accepted rules of proper academic research. The next paragraphs evaluate the trustworthiness and authenticity of this the research.

Trustworthiness is made up of four criteria – credibility, transferability, dependability, confirmability (Bryman & Bell, 2015).

Credibility, i.e. how good is the match between observed phenomenon and theoretical ideas developed from the observations, is an important characteristic of qualitative research. To ensure

credibility the method of triangulation is used (Bryman & Bell, 2015) when multiple sources of data are supposed to be used. Findings were somewhat compared with the other authors' research on sustainability in maritime supply chains and short sea shipping from previous years. Unfortunately, another technique called '*respondent validation*' was not used to ensure credibility of the study because of time considerations and privacy concerns.

Transferability is difficult to confirm in qualitative research, and particularly in this research. The problem is that quite a small sample was obtained (only 6 'cases'). Despite the sample representatives gave quite different and unique opinions and work in different contexts, it is not possible to transfer results to other cases, which have not been studied. There should be a good analysis conducted in order to find similar patterns in data and results, and consequently compared with other cases, leading to transferability of results. From this point of view, the research is quite limited.

Dependability can be well ensured since all the raw data materials, such as notes, interview transcripts, planning documents and 'sticky notes' with ideas and users' needs statements on them are available and may be audited if necessary.

Confirmability supposes that personal values and theoretical inclinations do not sway the research and findings derived. Data were collected and analyzed objectively in the research, without swaying for or against any particular issues. However, it is absolutely impossible to ensure full objectivity in qualitative research (Bryman & Bell, 2015).

The other criteria - authenticity of the research - is difficult to evaluate. One of the issues to ensure authenticity is to fairly represent different viewpoints among members of the social setting (Bryman & Bell, 2015). Since this research is only focused on ports, the ports' perspective

limits authenticity by the definition. In order to fully satisfy the criteria of authenticity, other stakeholders need to be included in the study. This should be a further direction for the research.

In addition, some authors argue for another criteria in business and social qualitative research evaluation (Yardley, 2017). These criteria are sensitivity to context, commitment and rigor, transparency and coherence, impact and importance. Among other criteria, 'importance' criteria could be argued as the most important one, because it tells how useful is the knowledge, generated from the research. In the 'Discussion' chapter relevant considerations will be given.

2.4 Data analysis.

Requirements, especially those coming from users, are of different quality and have different formats. In order to implement these requirements, we need to elicit and record them in predetermined syntax and structure. In general, RA involves the following activities (Liu, 2015):

1) Rewrite the user original requirements into the correct syntax format, the "shall" statement;
2) Organize the requirements into different categories and hierarchies; derive the requirements that are not included in the original requirements;
3) Perform trade-off studies to prioritize the requirements;
4) Document and record requirements, establish semantics for relationships and provide rationale for each requirement.

The purpose of RA is to prepare the requirements for the next step – functional analysis, which is out of the scope of the thesis. To bridge users' statements and requirements statements, three methods of RA - KJ method, scenarios and Quality Function Deployment (QFD) – were employed.

KJ method (also referred to as affinity diagram) is a tool to organize a set of captured requirements into a structure based on their relationships. It is seen as a good way to consolidate different ideas generated after the interviews, especially when meeting participants with diverse experiences (Liu, 2015). The procedure of conducting the affinity diagram analysis was done in several steps:

1) Idea generation. Each captured requirement was recorded on a separate paper strip;
2) Idea sorting. All related ideas are put together;
3) Idea grouping. Ideas are grouped and sub-grouped into a hierarchical structure;
4) Documenting and recording the final group structure.

A scenario is an informal description of how the system will be used. The main task is to 'tell a story' about user task activities and system functions. A scenario is written in a plain narrative language, providing a natural way for system users to understand how the system shall work. This information should include context, environmental conditions and any support information.

QFD is a tool that enables establishment and prioritization of the measures that relate to requirements, ranking them in order, so that most important features get more attention (Liu, 2015). It is used to build a matrix of customer requirements and the system measures. Originally developed as a tool in product design, later it got recognition in other areas as a *"process of embedding the voice of the customer into product and service design"*, including design of complex social systems (Gerst, 2004). As was previously noted, OFD was employed in Lam (2015), where author aims to design sustainable maritime supply chain by taking customer requirements as the focus. To illustrate the approach, an analysis of major container line was conducted in that study. Since this analysis proved an effectiveness of the method and keeping in

mind the similar setting of the research (the aim is to define ‘functional requirements’ from port authorities perspective), the QFD approach is employed in the thesis. A spreadsheet template from “QFD Online" (2010) was adopted for the purpose of the study.

3. Results

This chapter provides findings from the conducted interviews and supported with in-depth analysis of the collected data. Findings are presented in the following order:

- General findings from close-ended questions (ports' capacity utilization, ports' specialization, advanced telematics and control systems for cargo handling, infrastructure, government support);
- System stakeholders and external environment;
- System performance and effectiveness;
- Overall system objective;
- Functional requirements for sustainable short sea logistics system, derived from users' statements using QFD approach.

3.1 General results from close-ended questions

Some close-ended questions were asked during interviews with port representatives, who also sometimes commented on their choice and explained why they have answered that way. Results are presented in this section.

3.1.1 Ports' capacity utilization.

After the basic demographic information was collected, the interview proceeded with the close-ended statements, where participants were asked to indicate how strongly they agree or disagree with those statements. The first statement was formulated as *"My port fully utilizes its capacity"*. Results are given in the table 4.

Table 4 - Answers distribution on the "My port fully utilizes its capacity" statement

	Absolutely agree	Agree	Neither agree nor disagree	Disagree	Absolutely disagree
Participant 1			✓		
Participant 2				✓	
Participant 3				✓	
Participant 4			✓		
Participant 5			✓		

As seen from the table 4, no one said that they agree with the statement. Ports have more capacity, they have available berths and space for cargo. They can handle more vessels. There are three "*neither agree nor disagree*" answers and two of the participants commented on this that they have on average 3 vessel calls per week, so they can have another three. The third participant answers that they have capacity, but the condition of some berths is not acceptable for the vessels due to poor technical condition. The other two participants answered "*disagree*" and commented that capacity is utilized quite badly (just around 30 % of total capacity is being utilized).

3.1.2 Ports' specialization

The second statement was formulated as "*Ports must become more specialized (e.g. pure container or pure bulk) in order to improve overall efficiency*". Results are given in the Table 5.

Table 5 - Answers distribution on the "Ports must become more specialized (e.g. pure container or pure bulk) in order to improve overall efficiency" statement

	Absolutely agree	Agree	Neither agree nor disagree	Disagree	Absolutely disagree
Participant 1		✓			
Participant 2		✓			
Participant 3				✓	
Participant 4		✓			
Participant 5				✓	

As seen from the table 5, participants have been divided into two groups – who agree with the statement and who disagree. The post-conversation analysis and transcribing of the interviews shows that it may be due to the reason explained further. Both participants 4 and 5 are representatives of multipurpose ports, which provide services not only for cargo vessels, but also for passenger cruise liners and passenger ferries. In my opinion, from their perspective it may be seen that specialization is not the best solution, since they transfer the image situation into their particular ports. They both have quite long working experience in their port, so it just can be that they are used to operate that way in an external environment, where the port has to serve almost every maritime market segment.

3.1.3 Advanced telematics and control systems

The third statement was formulated as "*Ports must be equipped with advanced telematics and control systems for cargo handling*". Results are given in the table 6.

Table 6 - Answers distribution on the "Ports must be equipped with advanced telematics and control systems for cargo handling" statement

Participant №	Absolutely agree	Agree	Neither agree nor disagree	Disagree	Absolutely disagree
Participant 1	✓				
Participant 2	✓				
Participant 3	✓				
Participant 4		✓			
Participant 5	✓				

As seen from the table 6, and it is quite obvious, all participants agreed that the ports must be equipped with high-end systems for cargo handling. Participant № 4 puts emphasis that these kinds of systems are needed, but their port is little bit behind. However, technological advancements and their application for port operations are seen as necessary measures in order to improve efficiency.

3.1.4 Ports' infrastructure development

The fourth statement was formulated as "*Ports require infrastructure development for inbound and outbound cargo flows in order to increase overall efficiency*". Results are given in the table 7.

Table 7 - Answers distribution on the "Ports require infrastructure development for inbound and outbound cargo flows in order to increase overall efficiency" statement

	Absolutely agree	Agree	Neither agree nor disagree	Disagree	Absolutely disagree
Participant 1	✓				
Participant 2	✓				
Participant 3	✓				
Participant 4	✓				

Participant 5	✓				

All the participants strongly agreed with the statement. They find infrastructure as one of the key factors that affect overall ports' efficiency.

3.1.5 Government support for the ports

The fifth statement was formulated as "*Ports can perform very well and create value without government support (e.g., tax benefits, investments in port infrastructure)*". Results are given in the table 8.

Table 8 - Answers distribution on the "Ports can perform very well and create value without government support (e.g., tax benefits, investments in port infrastructure)" statement

Participant #	Absolutely agree	Agree	Neither agree nor disagree	Disagree	Absolutely disagree
Participant 1				✓	
Participant 2			✓		
Participant 3			✓		
Participant 4		✓			
Participant 5				✓	

Participants are divided in their opinions on the government support for ports. But all of them commented on the issue approximately the same. Respondents see the port activities as a business, which should play business rules. All of them think that government should not be involved in the business activities but agree that government support is needed when it comes to infrastructure development not in the port itself, but the outside infrastructure and the hinterland. All of them mention railroads infrastructure, and quality road networks which would connect the

ports with the hinterland and other inland facilities. In the discussion section this issue will be elaborated in more detail.

3.2 Defining system stakeholders and external environment

One of the questions in SRA is to define system stakeholders, i.e. all the parties who have interests in the system functioning. Stakeholders in maritime industry, and in a transport industry as a whole, are well known from the literature (Talley, 2012) and from everyday experience. However, in order to be completely sure that no stakeholders were missed or not taken into account, and to define precisely which stakeholders affect the efficiency in ports, the respondents were asked the following: "*What are the other entities (if any) that affect efficiency in your port? How do they affect efficiency?*" The other entities also represent the external environment where the system operates. It will be shown below that external infrastructure is crucial for port performance, so therefore these two issues from SRA (*stakeholders* and *external environment*) are combined into one question and respondents were asked to answer in detail. Results are given in the Table 9.

Table 9 - Entities that affect efficiency in the ports and external environment

Participant №	Parties that affect efficiency
Participant 1	Inspectors who take samples from the cargo, shipowners, vessels' crews and officers, port agents
Participant 2	Customs, road authorities, rail authorities, *"not competent or educated shipping companies"*
Participant 3	Shipping companies
Participant 4	Rail and road, people who live nearby
Participant 5	Labor Union, road and rail authorities, "*regulations regarding noise and light pollution*" (i.e. government – ed.), non-professionals in the board of directors

The results are quite obvious, and all the third parties are well known. But it is interesting to note, however, that three of the respondents mention rail and road authorities as entities that hinder efficiency at some time. One of the interviewees commented that the rail authorities don't collaborate enough to remove the bottlenecks in the area outside the port, which is, according to the interviewee's statement, resulted from poor planning of passenger-cargo traffic on the railroad authorities' side. The other respondent argued that the railroad capacity is not enough and suggested that the second rail track should be constructed in the port area and outside, but the rail authorities are not interested enough. The third respondent pointed not exactly to rail authorities, but to the bad rail *infrastructure* in the area outside the port, and complete absence of this infrastructure inside the port.

3.3 Defining system performance and effectiveness factors

Another question in SRA is to define factors which are linked to performance and effectiveness of the system. The activities itself, which take place in the ports, directly affect performance and effectiveness of the whole system. It is interesting to see, which activities in the port, from the ports' perspective, need more attention. During the interviews with port representatives, the open-ended question "*Which activities in your port are needed to be redesigned in order to make operations more sustainable and attract new customers?*" was asked. The results are presented in Table 10.

Table 10 - System performance and effectiveness factors

Participant №	System performance and effectiveness factors
Participant 1	Fully digitalized documentation processing, no paper work
Participant 2	Communication between port, customs, rail and road authorities should be redesigned
Participant 3	Proper planning and communication between parties (shipping company, port, rail). Best practices from big advanced ports should be followed by smaller ports
Participant 4	Cargo handling. Storage of cargo in the port area should be eliminated; cargo has to be transshipped directly from the ship to other modes (other ship, rail or truck)
Participant 5	Ports needs exemptions from the current rules. Ports should work 24/7. Completely automated gate at the terminals.

As seen from the table 10, the port representatives see quite different performance and effectiveness factors. In the 'Discussion' chapter this will be elaborated in more detail.

3.4 Defining overall system objective

One of the open-ended questions for the interviewees was "*Please describe how you see the ideal port performance?*" The intention was to collect data based on individual attitudes of the ports representatives. All individuals may have their own opinion on sustainability and may see the situation from different aspects. The results are presented in Table 11.

Table 11 - Overall system objective

Participant №	Main objectives for ideal system performance
Participant 1	Safety – all operations are conducted in a safely manner; environmentally friendly; efficient
Participant 2	Environmentally friendly; electrical technologies for cargo handling should be implemented; smooth transportation to hinterland; coordination between all players should be established in such a way to increase efficiency

Participant 3	Ships should use only clean battery power when approaching the shore; ports should provide vessels with the shore battery power; better organization of work between all parties, including government
Participant 4	Good infrastructure enabling smooth cargo flows without storing; promotion among public is needed; use electricity produced from renewables for port operations
Participant 5	Ports needs exemptions from the current rules. Ports should work 24/7. Completely automated gate at the terminals.

It can be observed that the respondents' comments on various questions are quite similar (see tables 9 – 11). I think it is logical, that they are consistent in their thoughts and opinions and try to highlight the most important issues from their perspective in every question asked. In the next section all the derived statements will be organized and prioritized using research method, mentioned in the previous sections.

3.5 Deriving requirements from the users' statements

As mentioned earlier, the three recommended methods to derive, organize and prioritize requirements – affinity diagram, scenarios and Quality Function Deployment (QFD) – were used.

3.5.1 Affinity diagram

KJ method was used for organizing various users' statements into specific categories. The results are presented in Figures 2 and 3. In total, there were nine categories identified, namely *ecology, public, infrastructure, governance, digitalization, promotion, operations, communication and centralization*. All the nine categories cover every aspect of sustainability (ecological, public and economic aspects are intertwined and cannot be distinguished separately).

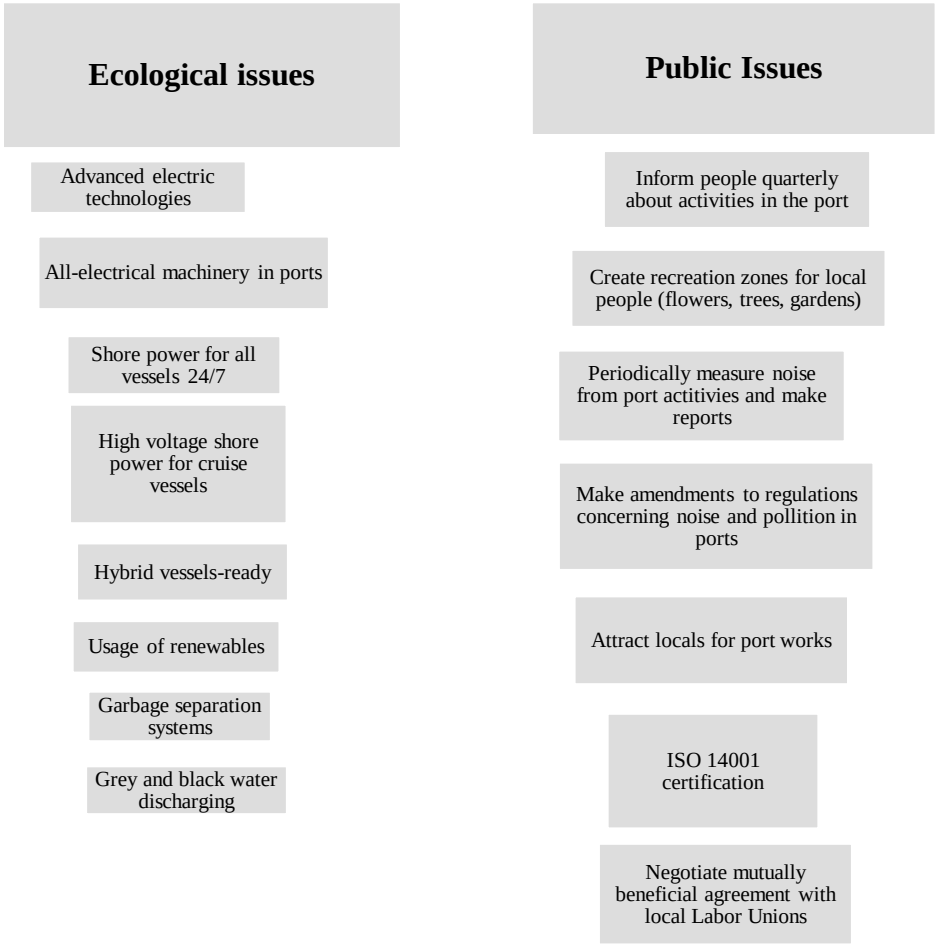

Figure 2 - Affinity diagram representing users' 'ecological' and 'public' concerns

Infrastructure	Communication	Governance	Digitalization	Promotion	Operations	Centralization
Infrastructure development (especially rail)	Internationally accepted rules and regulations	Port as a business structure	Digital solutions for planning	Create and visualize the hubs (including the hubs of information)	Containers should go by rail after being discharged from vessels	Strong commitment from the government
Infrastructure development outside the port (rail, road, hinterland)	Single digital environment for all parties	Self-sustainable, like other companies	Advanced telematics and control systems	Change the way of how people see the things	Make amendments to the railroad rules and regulations	Business programs together with the government
Infrastructure along the coast	Cooperation between all parties, including government, rail, road, port authorities, shipping companies and other stakeholders	Professional managers	No paper documentation anymore	Increase education level of employees	Customs 24/7	Governmental strategic decisions on establishing ports network
Inland depots			All-digital cargo registration (not only containers)	Inform people that sea way is a good way	Balance between inbound and outbound cargo flows	Effective planning, realization and control of investments
Maintenance of the current port infrastructure			Automated gates at the terminals	Visualize how important the ports are	Discharged cargo goes directly to hinterland, no storage in ports	Centralized ownership (government ownership, similar to Avinor)
			Digitalization and systemizing of the whole port operations		Sufficient number of train tracks coming into ports	

Figure 3 - Affinity diagram representing users' needs identified

3.5.2 Scenarios

As mentioned earlier, scenarios are plain narratives about the system; they help to understand the functions, context and environment where the system will be used.

The scenario:

The next issues shall be considered for successful integration of short sea shipping into sustainable multimodal logistics system:

The port network shall be *state-owned* or shall have other kind of *centralized ownership* with a *strong commitment from the government* for sustainable development. Every port of the network shall be operated as a *business unit*, be *self-sustainable* as any other enterprise, and have *professional managers* in the executive boards. *Centralized ownership* is needed to enable *strategic decision making* with regards to the system development, establishing a sustainable ports network, effective planning, execution, control of investments. Primary investments shall be directed not only for *maintenance* of aged current ports' infrastructure, but also for *infrastructure development* in ports itself and the area outside the ports. New railroads, infrastructure along the coast, inland depots and dry ports shall be connected into a *single network* with *centralized planning* to make operations sustainable. Planning shall be conducted using *advanced digital planning systems* and involve road, rail and any other authorities, who have a stake in a system development and system functioning. *Communication* between all the parties shall take place in a *common digital environment*, in accordance with *revised* international *rules and regulations*.

All *documentation* turnover shall be done *digitally*, without paper forms and documents. Ports must be equipped with *advanced telematics and control systems* for cargo handling, have *automated gates at container terminals* and, as a whole, all port operations shall be digitalized and systemized in order to achieve sustainability. Containerized cargo, being discharged from the

vessels, shall be loaded *directly onto rail or trucks*, *without storing* it on a port area. Customs shall be operated 24/7 and enable *digital customs clearance*. *Balance between inbound and outbound cargo flows* shall be achieved properly, without excessive or deficient capacity utilization. Cargo flows shall be distributed in accordance to ports' capacities and maximize capacity utilization of every port in the network. *Sufficient number of train tracks* shall be presented in every port in order to efficiently move cargo to the hinterland.

In order to achieve desirable cargo shift from roads to sea, *intensive promotion* is needed. Every hub shall be *visualized* (e.g. Oslo airport OSL – Kristiansand port KRS). It is necessary to *explain people* why sea transport is better than the road alternative, show ecological and public benefits and explain why ports are important as a part of sustainable transportation system. Also, port employees shall obtain *proper education* and pursue sustainability as a core value.

Local *people* who live nearby port areas shall be *regularly informed* about activities in the ports by means of meetings with port representatives in port areas. Periodical *measures of noise and pollution* shall be conducted and reported. Special *recreational green zones* shall be created inside and outside ports areas. Local citizens and companies shall be *involved* in port operations.

Special attention shall be paid to ecological issues. Ports shall be self-sustainable and maximize electricity generation from *renewable sources of energy*, such as sun or wind. *Advanced electrical and electronic solutions* shall be implemented in ports. Ports shall be able to provide *high voltage power to cruise vessels* (where applicable) and *shore power* for all other vessels *24/7* and be ready for *next-generation hybrid and full electric vessels*, which require advanced shore electricity charging facilities and electricity storage systems. All incoming *waste* from vessels shall be handled *separately* and disposed in accordance to regulations.

3.5.3 Quality function deployment (QFD)

QFD began with the identification of customer needs (WHATs) and functional requirements (HOWs). As was mentioned earlier, a set of customer needs was shortlisted down to nine categories - *ecology, public, infrastructure, governance, digitalization, promotion, operations, communication and centralization*. A set of functional requirements was derived from the set of needs and shortlisted from about 30 units down to 15 units. This is because requirements were combined, some of them were repeated and meant the same concepts.

In order to build House of Quality (HoQ) a free online HoQ spreadsheet template was used ("QFD Online," 2010). The users' statements were listed in a left column; the derived functional requirements were listed in an upper row. The level of interrelationship discerned was weighted on a four-point scale (strong, moderate, weak, none) and a symbol representing this level of interrelationship was entered into the respective matrix cell. The triangular roof matrix of the HoQ is used to identify whether functional requirements support or impede one another. The final step was to identify weight and relative importance of each of the requirements. The resulted full HoQ is presented in Appendix C.

In total, fifteen functional requirements were identified. Among these requirements, 'centralized ownership', 'single digital platform for communication between parties', 'advanced telematics and control systems for cargo' and 'infrastructure development' are found to be the most important elements for the observed companies with relative weight 15.4%, 12.2%, 10.8% and 10.7% respectively. In the discussion chapter detailed considerations on this result will be given.

4. Discussion

This chapter conducts discussion reflecting the findings with consistency of academic literature. The research objective was formulated as "to identify port representatives' needs and transform those needs into requirements statements and generate insights that could inform policies aimed at inclusion of SSS into sustainable maritime supply chains". Requirements were derived from port representatives' statements and reflect their perspectives. In this chapter those requirements are critically analyzed and compared with other authors' findings on related topics – short sea shipping in general and sustainability in maritime supply chains.

It should be noted that despite the fact that requirements are assigned with different relative weights during calculation of the HoQ, all of them are important, since they were derived from users' needs and shortlisted down to 15 units. The most important ones get distinct sub-chapters. Also, it should be noted that all the requirements are interrelated.

4.1 Requirements to establish centralized port network ownership

It may be observed from the HoQ (see Appendix C) that 'centralized ownership' has moderate to strong relation to almost every customer's need, which resulted in high relative importance of this requirement (15.4%). Indeed, sufficient infrastructure, effective communication, governance, centralization and operational efficiency require excellent centralized planning, what would enable effective decision making regarding infrastructure development, rational ports' capacity utilization, seamless communications and operations in ports, where the cargo changes its transport mode (the latest was indeed found as inefficient (Medda & Trujillo, 2010; Suárez-Alemán, Trujillo, et al., 2015). This result aligns with another research, where authors argue for "*adopting an integrative strategy*" which is supposed to "*develop integrated transport solutions*

very much supported by a network approach as to bring together infrastructure, transport operators and facilities" (Paixão Casaca & Marlow, 2009). Integrative approach toward sustainability in supply chains was also proposed in another research, where authors note that "*these* (integrative) *chains outperform the others as the service users can have smoother material, information and financial flows by the more synchronized chain*" (Lam & van de Voorde, 2011).

Many believe that the 'network approach' requires some kind of centralized planning, maybe not governmental, but other highly concentrated and centralized kind of planning, execution and control. All activities in the system must be carefully planned and implemented, which is very difficult to achieve if we have randomized stand-alone players, who utilize their own business models, and try to improve their own efficiency without considering other activities in the system.

Quite strong emphasis was put on the planning and regulations. Given the question whether government should help for infrastructure development, one of the respondents clarifies:

> *"It needs to be planned behind. It needs to be regulated. We cannot have democracy to decide, because democracy is the worst enemy in our way. I think that if the government wants to do some national security, open port, then Norwegian government can give support, we can take ally forces, soldiers and vessels in Norway. They need to support this, because it's cost is little bit extra. Then it's fine, we can take subsidies. I think it's a wrong politics, but maybe I am too conservative..."*

The importance of planning and government regulation was highlighted by the respondent. Strategic planning and decisions regarding key national security and economic issues is seen as a government's responsibility, but the other activities constitute a port's business and the government should not be involved.

4.2 Requirements to establish a single digital platform for communication among players

Another crucial requirement, as was derived from the users' statements, is development and implementation of some kind of single digital platform for all parties participating in supply chains. The platform is supposed to provide a real-time information on what's going on with the cargo, proper timing of arrival/departure to/from ports, required capacity in the port, required number of rail platforms and trucks. All the interested parties may have access to this platform so that better planning and execution can be achieved. This result aligns with similar findings in Casaca et al. (2017), where authors propose that in Brazil the information technology/information systems (IT/IS) factors are very relevant in the cabotage (short sea) services, because for the shippers knowing of their cargo whereabouts along the different routes helps to improve operational efficiency. Also, communication among different players in transport chain, which is provided by IT/IS, is seen as very important and add value to the transportation services.

Another digital solution, which is already being implemented in some Norwegian ports, is fully digitalized customs processing. It is also supposed to be included in the common digital system, but not every port, as per now, has implemented digital customs clearance. However, respondents realize the benefits this solution will provide in terms of efficiency and argue for its implementation.

4.3 Requirements to promote SSS and port services

Another requirement, which has not received a high relative weight (only 3.7%, as can be seen from the HoQ), but which was emphasized by ports representatives, is promotion of SSS and port services, which are vital part in SSS system. As noted earlier, in the recent past EU made an

attempts to promote SSS (Medda & Trujillo, 2010), but these attempts were considered unsuccessful by some scholars (Douet & Cappuccilli, 2011).

Promotion of SSS and port activities requires local public involvement. By their nature ports are located in shore zones which, due to economic growth and increasing population, are becoming more and more attractive for development companies. From this perspective, it is quite interesting to see the public relationships with the ports. As one of the respondents stated, - "*Norway is such a country today that everybody knows that they need a port, but no one wants it.*" Problems associated with port activities such as noise and light pollution, air pollution and increased road traffic in and out of port, are being resolved differently. But in general, ports authorities understand their role as facilitators of economic growth. As one of the respondents points out, "*In this part of Norway we have all kinds of factories, local businesses. And we are here to deliver this, to have economic growth in* (this) *part of Norway. We have huge responsibility for the cities around us*".

The ports understand responsibility for local businesses and people's wealth. But cargo owners and shippers sometimes don't even think about the alternatives. Respondents commented on the statement about the number of trucks on European roads. During the interviews it was found that ports have a lot of capacity available and are underused, both smaller and bigger ports. As respondents commented, one of the reasons of underused port capacities is lack of awareness and promotion of short sea transport amongst public and cargo owners. One respondent notes on this,

> *"I think that we need to tell the people. They need to listen. Many cargo owners, they don't think about the ships. Also, it is very cheap to use cars. For many of them, it is very easy to use trucks because it's cheap, and it goes from step to step. You can put something when you use a ship, you have to take it to port, then you have to take it from a truck, then to the*

shop. So, when you see traffic inside Oslo, I think it is necessary to do something about that. Because, there is queue everywhere, not only in Norway, but in another Europe. But I think, it's price, it's easy to use truck. We had some equipment coming to us from Stavanger. I asked, why did not you use the ship from Stavanger to us? And he said – oh, I didn't know. I did not think about that."

Respondent realizes the problem of huge truck traffic on a road. She agrees that it is quite cheap to use a truck for cargo transportation, but when the distance is quite big, for example, when we need to transport cargo from the western part of Norway to southeastern part, it may be not very cheap to use a truck. Using a short sea vessel for transportation could be a good solution, but the lack of awareness of the cargo owners, as a result of poor promotion of short sea shipping services, force them to use a truck and do not even think about another alternative. As respondent puts it, when talking about cargo owners – *"Yes, exactly. It's like old habits – "I have always done it that way."*

It is also possible that port managers themselves do not fully commit to change their habits and move towards sustainability, but the problem existence is generally recognized. As one respondent comments,

"I've been in a port business for more than 20 years. Ports are ports. Old men are not always willing to change. I see there is a tension out of the port. New people are coming, and we understand that we need to be friends with those people. I am not saying that we are not friends with people, but still a lot of education work is required. We have to understand that environment is very important for people. We have to do something. Ports have a lot of work to do."

Under "education work" interviewee means that the ports must be promoted, and people have to know and understand why the port is important for their particular region.

Marketing promotion is required for SSS. In Paixão & Marlow (2002, p. 174) authors argue: "*...rather passive movement of shipping companies towards new marketing strategies embracing customer service, growth, and new transport concepts (innovation), partnerships, alliances with other mode operators, an inappropriately organized position in the transport market...*" This statement remains true even fifteen years later, but, again, port authorities recognize this problem. Further collaboration with short sea shipping companies, local public and cargo owners can resolve this issue.

4.4 Infrastructure development requirements

All respondents commented that a lot of problems in ports (inefficiency, lack of demand and not optimal capacity utilization) is due to poor or absent hinterland infrastructure. The infrastructure problem is closely related to the government, planning and cooperation issues and cannot be distinguished separately. Quite similar attitudes among respondents were observed during the interviews with port authorities. When it comes to the question whether the government should support ports by providing tax benefits or investing in ports infrastructure, almost all of them argue that the government, in general, should not do that. But there can still be the cases when it is desirable. For instance, one of the interviewees gave very emotional comment on this:

> *"If we are talking about infrastructure development in ports of Norway, with the laws that we have today, I think that it is wrong. Because how it works in Norway – everyone wants to have money from the government, and then [they say] maybe "we subsidize the ports*

that cannot survive", because we can think of different solutions. But I am in huge need of a lot of money to build the port for the future in the […]. If I say that nobody else, but only [my port] can have some money – that will be the most correct answer. But in general, I'm against subsidies from the government. Ports need to work harder, be more efficient, be bigger and manage themselves so we can tell central politicians 'to take a walk' and we manage ourselves – together with businesses and factories in our region. This is very difficult, because it varies from port to port and country to country. That's why intra-European programs that can give you governmental money is good, because there's a plan behind it, but just to give money – I am against".

The person who made this comment has been working in shipping and logistics for the whole adult life, he is undoubtedly an expert in the area, so it does make sense. The emphasis is put that carefully planned investments are needed, but not just subsidizing. This opinion also aligns with the results in Suárez-Alemán, Trujillo, et al. (2015), where authors show that despite big investments made by EU to facilitate short sea shipping, outcome of the funding programs was very poor – money was spent, but desirable results were not achieved.

4.5 Requirements related to environment and cleaner energy

Ecological part of sustainability is seen as a very important issue by port representatives. Indeed, ports in general are located closely to residential areas, so local people are also concerned. Almost all respondents argue for clean electric shore power for all vessels berthing in a port. Another requirement is to produce power locally, be self-sustained and use renewable power for port's administrative purposes, such as PV panels installed on top of warehouses or offshore wind farms. Green technical solutions are required to achieve environmental sustainability.

Another requirement is to create recreational zones in or outside port areas. As it was stated earlier, all the requirements are interrelated and this one is closely connected to the 'public' part of sustainability. Almost respondents argue that some kind of 'green recreational zones' are necessary for establishing friendly public relationships. One interviewee puts it: "*We use a lot of money to make it nice – flowers, trees, green areas. […] So, people can see that we do our best, we make it nice for people […] We are open, come along and have a look. People standing there, watching every day.*"

4.6 Other requirements

Among other requirements that can be distinguished are:

- Reduce amount of paper works and documentation. This was also noted more than fifteen years ago in Paixão & Marlow (2002), but looks that there are still problems and not all ports have switched to paperless documentation processing.

- Hybrid and all electric vessels-ready ports. Technological advancements and innovations in battery propulsion technologies provide huge opportunities for green cargo transportation. It is obvious that in the nearest future the number of hybrid vessels will be increased (DNV GL Maritime, 2015).

- Advanced telematics and control systems for cargo handling. Port representatives agree that implementation of new technologies will improve efficiency in their ports. This result aligns with those in Medda & Trujillo (2010).

- Negotiate up-to-date agreement with the Union. One of the respondents noted that they have efficiency problems resulted from "*old-fashioned Union from before Second World War*", which has "*some strange rules and regulations*". Some new exemptions for ports are suggested.

- Ports as a business structure. This is quite contradictory requirement, because it is difficult to find a trade-off between centralized ownership of the whole port network and business objectives of every particular port. Nevertheless, one interviewee puts it: "*We need more professional board of directors in the port. We are owned by a municipality – that is fine. But we should do business and we need more professional players. We should run it, but it should be owned by the government, like Avinor airports.*"

4.7 Limitations and future research direction

No matter how complete the original requirements are, they still will be far from defining every factor of the system (Liu, 2015). The system – 'sustainable short sea logistics system' – consists of elements, which interact with each other and this interaction represent interest for different stakeholders. In order to design a system, one needs to define all the requirements for the system, i.e. all stakeholders' requirements are needed to be collected and analyzed. Since my research focuses on port's perspective only, this is a first big limitation of the study – by its definition.

Another big limitation is a sample size. Unfortunately, only five port representatives and one ship broker were responsive enough and agreed to participate in the research. Despite their high level of expertise, the small sample size constitutes a problem when it comes to transferability of findings. Every new case study and new interview may reveal new findings and new requirements may be derived. This will expand the requirements list and may change relative importance of every requirement.

The third limitation, in my opinion, originates from the language of interview. The interviews were conducted in English, which is not a native language neither for the researcher

(me), nor for the respondents. Despite quite a high proportion of Norwegian people who can fluently speak English, I have observed that some respondents were struggling when tried to explain particular phenomena. It is possible that some ideas were neither fully explained by respondents nor understood by me.

Summarizing the limitations listed above, it may be suggested that further research on SSS and sustainable short sea logistics system are implementing a systemic approach, including other stakeholders' requirements. Also, a *bigger sample size* is preferable. If more respondents will be involved in the study, the more transferrable will be the final results, which in order increase trustworthiness of the study. Information can be collected by means of mixed research methods, so interviews may be complemented by online surveys, researcher's field observation and other methods.

5. Conclusion

This study contributes to the empirical literature on sustainability in short sea logistics from a ports' perspective. Based on published literature on sustainability in maritime supply chains and short sea shipping, it was concluded that poor efficiency in ports requires more attention.

By applying systems engineering method – requirements analysis – it was shown that the main requirements for sustainable short sea logistics system are: centralized ownership of ports network; single digital platform for communication between parties; advanced telematics and control systems for cargo handling; infrastructure development. Centralized ownership will enable effective communication, planning, control and decision making regarding short sea activities and is seen as an important issue for developing policies aimed at integration of short sea shipping into sustainable maritime supply chains. Single digital platform will serve as a tool which is supposed to combine to a real-time information on cargo status with proper timing of arrival/departure to/from ports, required capacity in the port, required number of rail platforms and trucks, etc. All the interested parties may have access to this platform so that better planning and execution can be achieved. Advanced telematics systems in ports will improve efficiency of cargo handling. Infrastructure requires development not only in ports, but in also a hinterland. Both road and rail network developments are required to achieve sustainability in short sea logistics and multimodal transportation as a whole.

To overcome limitations of this research and define a more complete list of requirements, further research is recommended. This may include a bigger sample size and adding other stakeholders into analysis. The further research can be complemented by online surveys and field observations.

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Appendix A

University College of Southeast Norway

Request for participation in research project
"Functional requirements for sustainable maritime logistics system"

Background and Purpose
My name is Vasilii Fedulov. I am conducting research on behalf of University College of Southeast Norway. I am graduate student in Maritime Management and currently working on my master's thesis.

Our purpose is to learn more about sustainability in maritime industry and define requirements for integrating short sea shipping into sustainable intra-Europe multimodal transport system.

You are requested to participate because you are port representative and have experience and knowledge of port activities. You will be one of approximately 20 respondents, who were selected based on available information from ports' official websites (convenience sampling).

What does participation in the project imply?
Qualitative data will be collected during **the interview**. **The interview will take around 35 - 50 minutes**. The interview will be conducted online, via Skype/Viber/WhatsApp/Telegram **audio call**. The interview starts with general questions about respondent's background, role in the port, how long he or she occupies this position and main responsibilities. Also, main characteristics of the port is asked. Date and time of the interview is also indicated.

After collecting basic demographics information, the closed-ended questions are asked.

Final and most demanding part of the interview is the open-ended questions, where respondents are asked to share their thoughts on various topics associated with sustainability.
What will happen to the information about you?
All personal data will be treated confidentially. Only the researcher (me) will have access to personal data, which will be stored separately from other project files. **Participants will not be recognizable in publications.**
The project is scheduled for completion by **May 15th 2018**. All personal data will be deleted after this date.
Voluntary participation
It is voluntary to participate in the project, and you can at any time choose to withdraw. If you decide to withdraw, all your personal data will be made anonymous.
If you would like to participate or if you have any questions concerning the project, please contact Vasilii Fedulov - 144690@usn.no. Project supervisor – laura.busa@usn.no.

Appendix B

The interview guide for port authorities

The interview starts with general questions about respondent's background, role in the port, how long he or she occupies this position and main responsibilities. Also, main characteristics of the port (annual port calls, types of cargo port handles and current state of the short sea shipping infrastructure is asked). Date and time of the interview is also indicated.

After collecting basic demographics information, the closed ended questions are asked.

Final and most demanding and time-consuming part of the interview is the open-ended questions, where respondents are asked to share their thoughts on various topics associated with sustainability and system requirements.

All the questions aim to reveal port authorities' attitudes toward sustainability and are grouped into five basic categories, which correspond to the fundamental 'issues' in system requirements analysis. The rationale for the questions is presented in the table below. Follow up and probing questions will be asked as interview proceeds.

The interview for port authorities

Question	Comment
Demographics questions	
1) Please share with me your background; 2) Please indicate your role in the port. Also, please indicate (if possible) annual turnover, annual vessel calls and types of vessels and cargo your port specifies on (e.g. container, bulk, etc.); 3) Please describe, what are the main activities of your port?	Open-ended question. Information collected will help to define the sample and its characteristics.
4) Please describe, what is existing traffic infrastructure for short sea shipping in your port? Where do you get electricity from?	Open-ended question. Answers will help to define current state of infrastructure for SSS in ports.
5) I will pronounce five statements and ask you to indicate how strongly do you agree or disagree with them: - My port fully utilizes its capacity (on annual basis); - Ports must become more specialized (e.g. pure container or pure bulk) in order to improve overall efficiency; - Ports must be equipped with advanced telematics and control systems for cargo handling;	Close-ended questions with Likert 1 to 5 scale; 1 – absolutely agree, 5 – absolutely disagree. Answers will help to corroborate the statements from literature concerning port performance. Reference: (Medda & Trujillo, 2010),

- Ports require infrastructure development for inbound and outbound cargo flows in order to increase overall efficiency; - Ports can perform very well and create value without government support (e.g tax benefits or investments in port infrastructure)	
All the issues in general	
6) Please describe, how do you see the ideal port performance? *Hint: keep in mind economic, environment and public considerations*	Open-ended question. The question statement is very broad, and answer is supposed to provide insights on overall port system performance, including external environment and potential stakeholders.
Defining system stakeholders, defining environmental factors (issues # 2, 5)	
7) What are the other entities (if any) that affect efficiency in your port? *Hint: you can think of current public policies or regulations, third-party service providers or shipping companies*	Open-ended question. The answer is supposed to provide insights on potential system stakeholders, and environment in which the system must perform
Defining system performance and effectiveness factors (issues #3, 4)	
8) Please indicate, which activities in your port are needed to be redesigned in order to make operations more sustainable and attract new customers? *Hint: keep in mind economic, environment and public considerations*	Open-ended question. The answer is supposed to provide insights on the required performance of the port system (i.e. how well the functions have to be performed) and better understand potential effectiveness factors
9) Please indicate, what actions could be done in order to reduce bureaucracy or simplify documentation/custom clearance?	Open-ended question. Answer is supposed to give insights on how to improve port system efficiency and performance. Reference: (Paixão & Marlow, 2002)
Conclusion and final remarks	
10) We are about to end the interview, but since you have an experience in your particular area, maybe you do have any comments or suggestions regarding your vision towards sustainability in transport industry, or maybe I missed something when investigating this topic? *If you want to provide feedback on the interview, you can do it now*	Open-ended question. It is supposed that answer will reveal possibly uncovered issues in survey questions or will provide feedback regarding the survey

11) If in any case I have some other questions, is it possible to contact you? How?	

After the interview respondents are thanked and short remark about confidentiality and anonymity is given.

Appendix C – Quality Function Deployment