Positioning report

Analysis of the current shipping industry structure 
and a vision for a renewed shipping industry ecosystem

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2015
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This *positioning report* aims at summarizing the current state of the shipping industry in Finland and outlining opportunities and solutions for improvement and renovation of the shipping industry. First, the report provides a picture of the inefficiencies that pervade different activities within the shipping industry, from production and logistical planning to shipbuilding. In broad terms, the problems that affect the shipping industry nowadays are related to 1) fragmentation of the overall logistics chain apparent in the lack of communication, collaboration and coordination among the stakeholders, and 2) a cost-centered approach to investments, in particular in shipbuilding, which overlooks the benefits and value of more efficient technologies.

The report then moves on to providing a vision for a renewed shipping ecosystem, including the presentation of various solutions that can eliminate the outlined inefficiencies and induce a new industry logic. The second part of the report not only presents the actual logic of each solution but also highlights which stakeholders are crucial for attaining the goals, what their roles and duties are in accomplishing the solution, and how these relate to each other. Generally speaking, the outlined solutions, 14 in total, tackle different areas of opportunity, namely: shipbuilding, sea logistics, and production planning. The presented proposals form a continuum, from one end of the logistical chain to the other end, in which no solution is totally independent. Although each solution addresses diverse issues, all the solutions together provide a collaborative approach towards development and implementation of new technologies, strategies and ways of working, and obtaining support from authorities. The vision proposes new business models for port operations and shipbuilding, a cooperative model of co-investment in and operation of vessels, enhanced processes and tools for cargo coordination and information transparency, which are prone to materialize in a more efficient shipping industry.

The necessary information for the development of this positioning report was gathered through a series of discussions and workshops with the representatives of companies involved in the abovementioned projects and outside of them, as well as through desktop studies and knowledge from previous related projects. Therefore, the authors would like to acknowledge the essential collaboration of the diverse stakeholders (ship owners and charterers, industry, technology providers, authorities, port operators, and many others) that were involved in the process. This report is called a positioning report because its aim is to be the starting point for developing and implementing a common vision for how shipping industry can be advanced in the focal country. Thus, the vision presented in the report is not a final word, but is the ground for
developing new collaborative solutions together.

Financing provided by FIMECC (Finnish Metals and Engineering Competence Cluster) within REBUS (‘Towards Relational Business Practices’) program, Project 2 ‘Logistics Networks’ and Tekes (Finnish Funding agency for Innovation) within RECO (‘Redesigning Ecosystems’) project is cordially acknowledged.
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1. Introduction

1.1. Background
Finland, similar to an island nation, continues to be dependent on the sea and on shipping. Throughout the ages, the sea has been both an opportunity and a challenge for Finnish society. Finnish wellbeing is largely based on the competitiveness of industrial activity and on maintaining security of supply. Shipping will continue to play a key role in the future, as the majority of the changing cargo flows will continue to rely on shipping.

The tightening regulations on gas and particle emissions, water management in shipping and energy efficiency of vessels make it apparent that shipping cannot rely on a low-cost transactional industry logic. Instead, it has to transform into a highly efficient function, which supports and enables Finnish industry as such. Cost cutting and a ‘patchwork’ approach only shift the environmental burden and costs to other parts of the logistical chain instead of solving the real problems. Thus, a more profound shift needs to occur in the way the industry is organized, and the way value is created and distributed among the actors.

This means that actors in the shipping industry, including the export industry as the user of logistics services, need to see themselves as part of a business ecosystem, where their actions and performance largely depend on the business of each other. Indeed, many innovative ideas and technologies remain unused due to the prevalence of outdated working methods. Thus, a more integral innovation is needed that would change the underlying governance structures and business logics in the shipping industry, which can only be achieved through collaboration among the business actors. For Finland, it is an opportunity to create the world’s leading sea logistics industry, because currently the demands of the sea, which is sometimes covered in ice, have already promoted technical development in such a way that industrial companies have to continuously improve their competitiveness. Many of Finnish technical innovations have spawned global companies in the fields of energy, propulsion, cargo handling, automation, and information systems. In addition to the technological knowledge, the Finnish tradition of collaborating and a high degree of business model innovation are bound to make such a large shift possible. Since similar environmental criteria will be implemented worldwide, there is an opportunity to develop this knowledge concerning organizing sustainable shipping industry so that it will become a crucial export potential in the future.

1.2. Aim and outline of the report
The aim of this report is to illustrate the current state of shipping industry from the Finnish perspective and the elements that make the industry inefficient and, importantly, to present a vision for the way the industry can become profitable and...
competitive. In judging whether the industry is efficient, from the economic point of view, simple criteria can be used: industrial cargo needs to be transported on time, undamaged, and at a reasonable cost, while ensuring that the value-adding activities of the involved business actors are fairly compensated for, and that the infrastructure (vessels, harbors, etc.) is fully utilized. As regards environmental efficiency, emissions and particle reduction, as well as compliance and outperforming of the coming environmental regulations, are the minimum requirements.

The analysis of the current state of the industry draws attention to various ‘rigidities’ that lock-in inefficient ways of working, and these are hard to change by a standalone company or authority. In Chapter 2, such inefficiencies are presented for each stage in the logistical process: production planning, delivering cargo to ports, ships approaching ports, operations at ports, sea voyages, and shipbuilding. It is important to recognize and appreciate the close connections and symbiosis between the export industry, shipping, and shipbuilding. Therefore, in this report they are all seen as part of the larger shipping industry ecosystem and are analyzed as part of the logistical chain. The fuel and energy industry, which can also be considered an important part of the larger business ecosystem, is not analyzed in detail in this report. However, it is also important to acknowledge that the choices regarding the fuel technology in ships have a large effect on the way the vessel is operated due to the differences in the maturity of various fuel industries.

After analyzing the main reasons for low utilization of vessels and ports, the long idling times at ports, difficulties in planning and unreliability of sea logistics, and cost-oriented logic when investing in vessels, a vision for renewed shipping industry ecosystem is presented in Chapter 3. This vision specifically focuses on the way the shift towards the renewed ecosystem can be achieved. For this to be achieved, the target business ecosystem is presented as a set of solutions that need to be implemented in order to establish the new structure and logic of the shipping industry.

The focus in this report is on Finnish production, shipping, and shipbuilding industries, and it considers the operations in SECA and the Baltic Sea in particular; with specifically, dry bulk and general cargo shipping being addressed. One of the reasons why immediate attention to this segment is needed is the fact that such cargo normally has low value, and when higher fuel costs are incurred, this might increase the total cost of the cargo, i.e. Finnish export products, beyond feasibility limits. This segment can also be characterized as old-fashioned and less prone to technological innovations, where only a few companies are striving for greener and more innovative operations. The problem

\(^1\) Also called ‘break bulk cargo’.
is that such positive initiatives struggle to become an industry standard, which can be explained by the rigid structures that are difficult to change by individual efforts. The shipbuilding industry is explored from a number of perspectives. Finnish shipyards, on the one hand, experience difficulties competing with globally used shipyards, which are cost-efficient, but still offer very limited standard solutions. However, on the other hand, the value of more advanced vessels is not apparent to most of Finnish shipowners, and this has led to the prevailing cost-oriented model of investing in vessels.

This report can be called a *positioning report* because it can be used as a tool for realizing a common vision and, importantly, for deciding on concrete steps that can lead to the implementation of such a vision. During the development of this report, a large number of discussions with the ecosystem actors were conducted, followed by more in-depth roundtable discussions of currently problematic issues and ideas for achieving efficient sea logistics. Due to the large number of actors involved in such an ecosystem, it is crucial to identify the role of each one as regards making changes towards a more efficient industry. Collaboration and common understanding of the desired future and required actions are of the utmost importance. Therefore, after presenting the current situation and the vision for a renewed shipping industry, a brief summary of actions and changes that need to be implemented by the relevant actors is presented in Chapter 4. This report is expected to serve as a basis for further co-development of the vision and a concrete action plan together with the industry and policy actors.
2. Current industry structure and inefficiencies

2.1. Production and logistics planning

Production and logistics planning originate at the consignor. Nevertheless, while the consignor is an extremely important driver for shipping activities in general, this has often led to a narrower consideration of the factors that should be taken into account when planning the delivery of goods. The reason for this is the current operating logic, in which relevant actors limit themselves to taking care of their own business. Indeed, the complexity of logistics in general makes it necessary to divide resources and responsibilities in order to facilitate specialization and cost efficiency. However, such division by no means implies isolation, but should instead call for cooperation between actors in order to combine their resources and knowledge.

In order to ship its goods, the industry should take into consideration the factors affecting transport. Nevertheless, the ability for the industry to see beyond the fairway has thus far been limited. Issues arising from the lack of transparency keep the industry somewhat isolated from the logistics: a typical case of this being the fact that delays are not properly communicated by carriers to the consignors, which, in turn, results in delays that affect the reliability of the industry. The reason behind this is simple: by informing delays at the very last minute, a carrier makes sure that the consignors will not have time to search for alternative shipping options and, thus, will remain ‘locked’ to the initial carrier. This is a serious threat to trust among business partners and a cause of unnecessary resource losses.

Another problem caused by the consignors being relatively isolated from the shipping activities is the fact that production schedules do not necessarily match the operation schedules of the ships, which in turn causes either inventory build-up or delays. Additionally, the consignor might only be considering a very limited set of factors (e.g. freight rate of a ship, location of the departure port) and while these factors are helpful for making initial estimations of shipping costs, they should not be the sole criteria for final decisions. By only evaluating the most immediate factors, the consignor takes unnecessary risks: the fact that a freight rate is low, does not directly translate into savings. Instead, it can mean, for example, that the chosen ship is inefficient, prone to delays, and with sub-optimal cargo handling. Following the same logic, connecting to the port next-door does not mean that the goods will reach the final destination more quickly and cheaper, as the chosen location might lack processing capacities (e.g. cranes, quays, personnel, etc.), which will unavoidably affect the budget and schedule in a negative way. The limited perspective when making logistical choices is also reflected in charter party agreements: the focus on keeping schedules obstructs any efficien-
cy improvements on a total logistical chain level. For example, in cases when the delivery time of a cargo is, in practice, not crucial, it is still often impossible for a carrier to reduce the ship’s sailing speed thereby reducing costs and emissions, i.e. execute slow steaming, due to the penalties for late delivery set in the contracts. There are special ‘slow steaming clauses’ developed by e.g. BIMCO\textsuperscript{2}, which set the procedures for how a carrier and a consignor can agree on slow steaming if it is beneficial for both sides, and for how these benefits should be shared. However, such clauses are not widely used due to the reluctance of the actors to integrate production and operations planning on the industry’s side with logistical planning on the carrier’s side.

As it has been pointed out previously, the communication link between consignor and carrier does not meet the current needs nor does it profit from the current technological developments. Historically, a mediator between these two actors was necessary because the existing technology made it complicated, or just plainly impossible, for the consignor to scout for ships with adequate cargo capabilities and vice versa. To be precise, participation in the spot market was, and still is, mostly dependent on mediators, such as cargo brokers. Despite the ubiquity of Internet, these mediators, who are usually burdened by obsolete communication protocols, still flourish. Nonetheless, these intermediate roles, rather than releasing stress from the system, add to the inefficiencies as the brokers are not only entitled to commissions but also naturally seek to protect their own interests by maintaining their influence over the spot market: thus, costs increase and opportunities are missed.

The above is a very good example of how inertia has prevented the industry, in general, from taking the necessary steps towards the implementation of modern technologies that would enable a more efficient operation. Not only has the current ICT been underutilized for establishing the much-needed direct linkage between the carrier and the consignor but also, onboard the ship, the utilization of route optimization tools have been negatively affected by the inability to find a suitable investment logic for the affected actors. This is despite route planning having both a direct impact on logistics planning and a cost element, thus, unavoidably affecting the final delivery cost. This resilience to investment is unfortunately evident in other aspects of the chain as well.

Old-fashioned vessels put an additional strain on the logistics planning because they lack the cargo hold innovations that would enable the combination of those consigned goods that, due to their nature, could be safely transported together. The lack of proper cargo separation contributes to a prevalence of routines that, while minimizing risks of cross contamination, are more complex to implement (e.g.
vessels handling a certain cargo are categorically banned from handling other incompatible cargos, ‘cleaning’ shipments are required for transitioning between incompatible cargos, etc.). This issue results in ships being underutilized and an increase in the shipping rate of goods that demand certain cleanliness. Moreover, these very protocols place an unnecessary burden on an already sub-optimal information flow (as previously exemplified), as the carrier must provide information about the previous cargos, including eventual intermediate cleaning cargos.

The main challenges at the production and logistical planning stage include the following:

- The industry has a limited perspective on the logistical chain; a door-to-door approach to delivering cargo is not taken and the business logic of shipping is not taken into account in production planning.
- Contracting criteria are insufficient: low-quality ships are preferred due to low freight rates, and slow steaming is obstructed.
- Lack of transparency between production and operations planning on the industry side and logistical planning on the carriers’ side reflected in, for example, the presence of brokers.
- Lack of industrial initiative in requiring vessels that show good operating performance and eliminate contamination risk, despite the direct impact on the consignors’ business.

2.2. Land logistics

It is extremely important that the industry is able to ship its goods through the most efficient ports, as mentioned in the previous section. For this to be possible, there have to be reliable and fair-priced land logistic connections to these ports. In other words, multi-modal transportation should, ideally, provide a smooth corridor between consignor and consignee regardless of the different stages through which shipped goods have to go. This, however, requires the integration of yet more actors in a somewhat fragmented ecosystem.

One of the problems of transporting goods between industries and ports is similar to that of the shipping logistical chain, i.e. a fragmented information flow that does not allow for accurate tracking and negotiations. On the other hand, and due to the railroad traffic industry being highly concentrated in Finland, the industry finds it extremely challenging to influence transport rates, demand developments in the service, and stimulate the expansion of the infrastructure through increased railroad traffic demand. This lack is compensated for by turning to road transportation, a branch that, besides being less energy efficient and having a limited capacity, is already now the cause of increased emissions, noise contamination, heavy congestions, and increased abrasion of roads. Land transportation can be seen both as a...
part of the total logistical chain and as a competing solution for delivering cargo – there is a threat that if shipping costs increase dramatically, more cargo volumes will be switched to land and especially to road transportation. This would be an adverse effect of emission criteria imposed on sea transportation due to an increased emission level on land.

Land logistics as such is a broad industry, which deserves deeper exploration. In this report, it is only briefly discussed as an element in the total logistical chain, which can have a direct impact on, for example, port operations due to delays. Taking a broader perspective, the capacity of land logistics connected to ports can define the ‘throughput’ capacity of the total logistical chain. Thus, further exploration is needed as regards the role of land logistics in the total chain, but it can already now be concluded that the integration of production and operations planning and sea logistical planning cannot be achieved without the involvement of land logistics.

The main challenges at the land logistics stage include the following:

- Fragmentation in the total logistical chain is relevant for land logistics as well.
- The high costs of land logistics define the choice of ports instead of being seen by consignors as only one part of the total costs.
- The capacity of land logistics can become a bottleneck in the total logistical chain.

2.3. Ship approaching port

During the past few years, merchant shipping has faced challenging factors – e.g. the downturn in the global economy, the global financing crisis, high fuel costs, increasing operating costs and falling freight rates – influencing the entire value chain of the shipping industry. The largest cost factor in merchant shipping is fuel oil, and the easiest way to reduce fuel consumption is to reduce ship’s speed\(^4\). This strategy, known as slow steaming, offers other advantages apart from fuel savings: the shipping industry reduces its carbon dioxide emissions (\(\text{CO}_2\)) into the atmosphere and the consumption of cylinder lubricating oil in the main engine, which in turn reduces solid particle emissions. To reduce the consumption of lubricating oil, however, it is also required to tune the engines to the expected lower sailing speed.

Current charter party agreements and port rules force shipping companies to increase sailing speed during the voyage, especially when a ship is approaching a port. As a consequence of the ‘first come, first served’ principle and the system for giving notice of readiness, the ship rushes to be first in the queue to a port. The ‘first come, first served’ approach is simple and transparent, especially in smaller ports, and the most used way of arranging queues at ports. In large ports around Europe,

\(^4\) For example, reducing the nominal speed from 27 to 22 knots (by 19%) will reduce the engine power by 42% of nominal output; this results in an hourly main engine fuel oil savings of approximately 58%. In short sea shipping average sailing speed is lower, but this example is used to provide an indication of how sailing speed reduction affects fuel consumption.
Queuing at a port is a problem that causes unnecessary waiting time for ships. According to interviews with several Finnish ports, this exact problem of spending too much time in a queue rarely exists in Finnish ports due to the small amount of vessel traffic. However, it is the uncertainty about how much time a vessel will spend waiting for a quay due to the ‘first come, first served’ principle that creates the necessity to ‘rush to wait’ and makes slow steaming increasingly challenging to implement. The slow steaming scenario does not only include the consignor’s perspective but also the shipowner’s and the carrier’s perspective, and agreements with the port and stevedoring company. It has been argued by some experts in the maritime industry that slow steaming vessels are more likely to arrive at a port according to a schedule: when a ship sails at full speed, it cannot sail faster in order to make up for lost time if it is delayed in a previous port or by weather conditions. If a ship is slow steaming, it can increase its speed to compensate for lost time. In addition, when a ship is slow steaming, the consignor has to accept that the transportation time of its goods will be slightly increased. For some goods increasing transportation time requires changes to the consignor’s logistics and can have an effect on the costs for ‘goods in progress’. However, for many consignors, supply chain reliability is more important than transit time. Moreover, if unproductive time spent when approaching ports could be reduced, the total voyage duration could be kept at the original level. Delays in breaking ice passages also influence the operations of ship, port, stevedoring companies, and consignor. If several vessels arrive at a port at the same time, this might cause congestions at the port and thus extra waiting time for a ship, which is costly for the carrier. The costs of waiting can ultimately raise freight costs.

In order to assure smooth traffic during the winter it is important that ships operating to or from Finnish ports have a good performance despite the ice. Fairway dues are collected by the Finnish government to cover the costs of maintaining fairways and the ice breaking of sea passages, and can reach significant amounts for one port call. Finnish fairway dues are often criticized for being too high and unfair for vessels with irregular traffic, adding significant costs to their sea logistics. Finnish carriers, however, have had a competitive advantage since they call on Finnish ports more often, and thus receive a waiver for their fairway dues much faster. The Finnish government has proposed a temporary reduction of fairway dues for 2015–2017 in order to decrease the cost burden on the business sector, particularly due to the expected marine fuel cost increase. Such a decision will have a controversial effect on the sea logistics: potentially reducing
shipping costs, but also reducing the competitiveness of Finnish shipping companies. Moreover, in comparison to current fuel inefficiency and low utilization of vessels, such a measure can have only a marginal effect.

Another actor involved in the process of a ship arriving at port is a shipping agent, who is the representative of a ship at a port and a ‘node’ between the ship, the carrier, and the port. The agent’s tasks cover a wide range of duties related to organizing and coordinating the port call. The agents’ role increases the added costs due to their intermediate function. All these tasks are nowadays necessary because a common communication network, that would link carriers, ports, authorities and other relevant functions, is not yet operational. Such a communication network is required, because it would not only allow an evident reductions on fees and commissions, but would also prompt a more direct and transparent way of operation.

The main challenges at the stage when a ship approaches a port include the following:

• The ‘First come, first served’ principle obstructs voyage planning and forces vessels to increase speed, and thereby fuel consumption and emission levels, in order to be first at a quay.
• The necessity to wait for icebreakers increases idling time for vessels.
• The presence of intermediaries caused by lack of coordination between communication tools adds to logistical costs and lack of transparency.
• Reduction of fairway fees can have a negative effect on the competitive advantage of Finnish vessels operating locally.

2.4. Port operations
Operations at ports play an important role in the entire set of logistic operations. Inefficiency in port operations, incorrect coordination of port activities, and lack of information exchange between actors involved in port operations can serve as a trigger for all the subsequent and preceding problems in the supply chain. The port operations include several actors and activities.

Ports, naturally, play a crucial role in developing port cargo handling capacity and processes. Depending on the activities performed by a port company, their business models vary: private ports tend to serve only certain industrial customers and usually provide their own stevedoring services, while public ports are open to any vessels and can either do stevedoring as well or work based on a ‘landlord model’, where the port spaces are rented to port operators. At the moment, Finnish ports are going through an organizational change where they have to be corporatized at the beginning of 2015 due to the EU’s competition statutes. This means that in order to survive, a port needs to be profitable without direct governmental support. This might be a challenge if the earnings from vessel charges,
infrastructure leasing, and some services, e.g. mooring, do not correspond to the investments made in the port infrastructure. The reasonable strategy is to attract more vessels in order to increase the revenue. However, if stevedoring is outsourced, it is challenging to ensure that the infrastructure such as the cranes are utilized efficiently, and that the stevedoring service is attractive for the carriers and the industry. Thus, it is crucial for port companies, especially those utilizing the ‘landlord model’, to be able to influence the attractiveness of the port as an aggregate function through joint efforts with stevedoring companies and other port operators. Currently, it is a common situation that there is only one stevedoring company at a port, which largely dictates the actual port working time and processes, or there are a number of competing companies that do not cooperate and use the infrastructure of the port sub-optimally.

One of the most value-adding port activities is unloading and loading the cargo. First and foremost, the ports need to be furnished with proper equipment for ensuring the efficiency of cargo handling operations (e.g. loading, unloading, and cleaning). Although it might require considerable investments in the short-term, it is expected to pay-off in the long-term by attracting more companies from the industry and shipowners. Cargo handling equipment, suitable for the respective cargo types and volumes, will allow failures to be avoided, and thus prevent delays related to equipment repair or searching for backup equipment, which can inhibit constant additional costs.

Unloading the cargo from the ship after arrival and loading it with new cargo for departure, in most cases, falls under the responsibility of the stevedoring company, whereas the ship crew usually does the cleaning of the cargo hold (see further on for more detailed description). Thus, the stevedoring company is a crucial actor in terms of delivering the cargo to the end customer, as the loading and unloading needs to be done properly and timely. However, there are several factors hindering the efficiency of the stevedoring function. First, weather conditions, such as rain or snow, may increase the times for loading and unloading by stevedores. Some cargos, e.g. grain, can be damaged by weather conditions and, thus, it is not possible to start unloading or loading until it stops raining or snowing. Definitely, there are technological solutions that allow all-weather loading and unloading, which are installed on some vessels and in some ports.

In Finland, stevedoring is perceived to be rather expensive, especially due to the 3-shift work system and specific fringe benefits. The stevedoring business has its roots in heavy industry, which brings certain traditions to the work style at ports. However, nowadays stevedoring increasingly requires service business thinking and way of working.
Thus, challenges related to stevedoring are often caused by carrier’s or consignor’s (depending on the contract) unwillingness to pay for overtime as well as tight collective agreement and restrictions on stevedores’ working times. As a consequence, certain disruptions in the logistical chain can occur, which finally affects several actors (e.g. carriers and consignors).

In Finland, the terms of work and pay are negotiated between the Transport Workers Union (AKT) and the Port Operators Association. The working times are quite restricted, e.g. most ports do not operate on weekends or at night. The collective agreement sets stevedores’ working shifts between 06:00–15:00 and between 15:00–24:00 if locally there has not been a different agreement. In some private industrial ports, where stevedores belong to a union not under the AKT, port workers can operate 24/7, which enhances the attractiveness of these particular ports for their customers.

The global character of shipping operations increases competition among the stevedoring companies and requires a change in the worker’s mind-set and working style, as well as implementation of more flexible working times.

After the discharge of the cargo by the stevedores, the ship’s crew cleans the cargo hold before receiving any new cargo. The time needed for cleaning the cargo hold may vary depending on the type of cargo and the technique used for this operation. For example, scrap metal can accept superficially cleaned holds and thus does not require thorough cleaning. Innovative methods, e.g. using leaf blowers, save considerable time when cleaning the cargo hold from cargos that do not require thorough cleaning. Fertilizers, in contrast, require the cargo hold to be thoroughly cleaned and also dried. Drying the cargo hold is especially complicated in wintertime and might cause more delays. Environmental safety also plays a role in the cleaning process. In some cases, the cargo hold needs to be rinsed with either sea or clean water and in some countries there are certain procedures that have to be completed in order to ensure the eco-friendliness of the process. For example, in the case of seawater, German environmental authorities may require discharge water samples to be examined before any discharge and, therefore, rinsed water is pumped into ballast tanks and then discharged later during the voyage.

Waiting for the next cargo may cause further delays in the logistical chain. In order to avoid shipping on ballast, the ship can sometimes stay in the port for considerable time, thus reducing its productivity and affecting the income of the shipowner and the charterer. The delay times caused by the different factors involved in the loading and unloading process also negatively affect other actors, e.g. the consignor and the end customer, as their work effectiveness depends on timely cargo delivery.
Operations such as bunkering, ballast water pumping, and waste handling are also highly related to environmental issues (e.g. may cause oil spills and inserting non-native species into other waters). Thus, the ship’s crew should act responsibly in order to avoid additional fees. Any irresponsible and improper actions of the ship crew in terms of these processes may cause additional costs for the shipowner. Furthermore, such behavior reflects negatively on the corporate image of the shipowner and consequently may undermine the business relationships with other actors in the shipowner's network.

The untimely and restricted exchange of information between the actors involved at this stage of the logistical process is yet another issue that hinders the effectiveness of operations in ports. In particular, the information flow between the consignor, shipping agents, and stevedores often creates additional delays and complications. Due to a lack of proper and timely information from the agent, e.g. regarding the amount of cargo to be loaded or unloaded and more concrete instructions regarding the handling of the cargo, the stevedoring company may not be able to plan their operations accordingly. Consequently, the consignor does not receive information about the specific times when the loading/discharging ends and thus cannot inform its customer about the estimated delivery time, which might create relationship problems between these actors.

Finally, the regulatory factor plays a certain role in undermining effective port operations. The Custom checks processes differ from port to port, which requires the ship’s crew to have knowledge of these differences and adapt to them. Administrative procedures at some ports cause additional costs for the shipowners and consignors, as well as delays in the schedule.

The main challenges at the port operations stage include the following:

- Differences in business and particularly the earning logics of various port operators can appear in the form of fragmentation and low efficiency of the port as a whole.
- The low speed of loading and unloading and risk of cargo contamination, which results in low utilization (in terms of cargo hold and time) of vessels.
- The fragmented character of the business hinders implementation of innovations in cargo handling due to the challenge in the fair sharing of the investment burden and the consequent benefits among the affected actors, such as port management companies, stevedoring companies, shipowners, carriers, and consignors.
- The inflexible working times of stevedores that result in idle time for vessels in ports.
- Lack of coordination between consignors and other actors causes additional delays in port operations.
2.5. Sea voyage
The sea voyage is an important part of the logistical chain, as it largely affects costs and revenue generated by a carrier. Furthermore, if the ship sails in ballast, it does not generate any revenue. This directly affects the profitability of the carrier and the freight rate offered to the consignor. Ballast shipping, on the way to the loading port or on the way back from the unloading port, is either taken into account by carriers when calculating a freight rate (if ballast shipping is predicted) or is taken at the carrier’s risk. Thus, the costs of sailing ballast are at least partly covered by the rate offered to the consignors. The unpredictability of and currently a limited access to information concerning the spot market and therefore difficulties to find return cargo force carriers to cover the risk with unnecessarily higher freight rates. At the same time, consignors often take advantage of vessels that struggle to find outbound or return cargo and are able to receive cheap offers, which barely allows the carriers to cover the costs of the voyage, but is nevertheless preferable compared to sailing empty.

This challenge is connected to the issue of voyage planning and cargo coordination, where the potential for combining cargos and increasing transparency in the spot market have been discussed. It is important to note, however, that in the northern Baltic Sea there are more south-bound material flows compared to northbound, which makes a certain share of ballast shipping unavoidable. Nevertheless, finding a cargo to be transported at least for a part of the north-bound voyage would already have a positive effect on a carriers’ profitability, and potentially lead to lower freight rates.

Regarding the generation of operating costs during a voyage, the real-time performance of a vessel is crucial. This is due to the fact that bunker costs constitute a major share of the operating costs generated during the voyage. This is increasingly important in the light of the tightening sulfur emission regulations, which will lead to a switch to more expensive grades of marine fuels. Improvements in fuel efficiency are therefore a way to control bunker costs and reduce emissions. There are a number of factors that affect fuel efficiency, which can be split into two major categories: the effect of systems installed on a vessel and actual operating choices made by the carrier during the voyage.

When a vessel is designed and built, the choices about the hull shape, the power and propulsion system, and fuel technology are made. During the maintenance a number of critical adjustments, such as engine tuning and anti-fouling, are made. The challenge is that often these choices are not based on the actual operating conditions of the vessel since the shipowner is not the one to operate it, and thus has no incentive to invest in more advanced systems that would lead
to more cost-efficient operations or increased revenue capacity. Moreover, in most cases, detailed performance data about the ships' fuel consumption and other relevant parameters are not currently recorded so as to be utilized for modernizing vessels or designing new ones.

The choice of fuel technology not only affects the bunker cost through the price of the fuel, but also defines the fuelling points and the potentially longer voyage to reach them as in the case of the rather underdeveloped LNG infrastructure in the Baltic Sea. Further, the design and maintenance of the hull has an effect on fuel consumption. In the pursuit of cargo hold shapes that are easy to build and have large capacity, shoebox-shaped vessels became the dominant design for bulk carriers, leading to sub-optimal hydrodynamic properties and low fuel efficiency. Definitely, there is a need to have a balance between the fuel efficiency, the cargo hold capacity, as well as vessel stability and safety when designing a hull. Maintenance of the hull, e.g. antifouling, also has an effect on bunker consumption during the voyage. The challenge is to find effective and safe, i.e. non-toxic, antifouling agents to be used, combined with optimized maintenance schedules.

There is a certain trade-off as far as the design of the ship's engine is concerned, since a vessel operating in the Baltic Sea needs to follow both Finnish-Swedish Ice Class rules (FSIC) and the Energy Efficiency Design Index (EEDI) requirements, which entered into force at the beginning of 2013. Thus, a ship's engine needs to have enough power to operate in ice-infested waters, while showing high enough energy efficiency and low emission level as set by the EEDI. Although corrections regarding ice-class vessels, which allow a relatively higher engine power, have been proposed to the EEDI regulations, keeping the engine power close to the minimum ice-class requirements, in practice, means the need for extensive ice-breaking assistance. Apart from engine power reduction, EEDI compliance can be achieved through hull design, the use of cleaner fuels like LNG, and increasing propulsion system efficiency. It is important to note that vessels fulfilling both FSIC power output requirements and the forthcoming EEDI rules already exist today, however, their compliance with these multitude of regulations does not always imply good actual performance during sea voyages. It is crucial that the design of energy-efficient power and propulsion systems is supported, rather than obstructed, by contradicting requirements. There needs to be a balance between striving to achieve regulative compliance and designing vessels which are technically capable of operating in the most fuel-efficient manner, e.g. capable of slow-steaming. Moreover, in order to achieve environmental goals it is reasonable to assess emissions per cargo unit rather than only imposing design criteria on...
vessels: the discrepancy of such regulations can become apparent if 'green' vessels sail in ballast or half-empty.

Apart from the features of the installed vessel systems, the actual operation of the ship largely affects the bunker consumption. This includes the choice of the sailing speed and trimming, which partly depends on the properties of the ship itself as discussed above, but also requires real-time adjustment to the actual weather conditions and route characteristics. Often, these choices are made based on the crew’s experience, which means that they can be rather subjective and suboptimal. The choice of the navigation route as such affects fuel consumption, sailing safety, and sailing time. This is also connected to the question of voyage planning, because setting an unrealistic time for a voyage may force the crew to sail at a higher than optimal speed so as not to compromise the schedule. The use of navigation software that adjusts a vessel’s speed and route requires investment. However, while the effect of better fuel efficiency is experienced by a ship operator, the investment costs are borne by the shipowner. Thus, there appears a challenge to the cost and benefit sharing, as discussed earlier.

To summarize, the cost efficiency during the sea voyage directly affects the profitability of the carrier. The choices regarding route and sailing mode are not always based on the real-time data on sailing conditions, which affects fuel efficiency and therefore operating costs. Moreover, the carrier is often not able to affect the design choice made at the shipbuilding phase, which will ultimately define fuel efficiency and safety during sailing. There is an apparent need to reflect the actual operating conditions and desired operating mode (e.g., slow steaming) in the design of the vessel’s systems and in the way the vessel is operated.

The main challenges at the sea voyage stage include the following:

- The high rate of ballast shipping reduces the profitability of carriers, unreasonably increases freight rates, and increases environmental impact per cargo unit transported.
- Low fuel efficiency and consequent high bunker costs are caused by the mismatch in vessel design and actual operations, as well as subjective operating choices.

2.6. Shipbuilding

The major source of inefficiencies in the current maritime logistics system from the shipbuilding point of view is derived from the lack of communication between all the relevant parties during the design phase. The design phase is very consequential because at this stage the specifications of the ship are fixed. The specifications, in turn, determine the capabilities and other properties of the ship when in use.

During the design phase, discussions, most often concerned with the specifications of a new ship, take place between the
future shipowner and a design office. From the shipowner’s point of view, the intention is to specify a ship that will have acceptable capabilities in transporting certain types of cargo with as low investment as possible. In other words, the aim is to maximize the net present value of the investment by minimizing the initial capital outlay. From the design office’s point of view, in turn, the intention usually is to start from existing designs and modify them, if necessary, to meet the requirements of the particular case at hand.

In other words, both parties, the design office and the future shipowner, rely on existing ways of working and dominant designs instead of abandoning previous assumptions and exploring novel ideas. However, there is usually no information available that would encourage or even enable this - and therefore such conservatism is well founded. In addition, it may be that a ship with more agile capabilities would not be able to realize its potential benefits unless the logistical system as a whole would allow such capabilities to be put into productive use.

Nonetheless, this way of designing ships prevents two major benefits from being realized. First, the ship is not explicitly designed to be in accordance with either the cargo flows of the whole logistical system in which it is to be embedded, or the plans and wishes of the industry whose goods the ship will eventually transport. Admittedly, the shipowner may have a relatively good experience-based insight into these issues; however, the minimization of the initial capital outlay usually overrides the concern to maximize the earning potential of the ship. In other words, the initial investment is perceived to be a more important concern than the match between the capabilities of the ship, the cargo transport market conditions, and especially the wishes of the industry. This is especially apparent in a case where the shipowner is not the one to operate the ship, but rather time charters it. For example, it may be that certain consignors would greatly benefit from being able to ship smaller consignments more often, and this would be possible if the ship was equipped with appropriate cargo hold compartmentalization. However, the issue of cargo hold compartmentalization may not surface during the design phase – that is, if the industry and ship operators are not heard during the design phase.

Second, the current practice of not involving the suppliers of systems for the ship (such as cargo hold and propulsion) during the design phase implies that the system suppliers are unable to offer their newest innovations or otherwise most appropriate offerings to be incorporated into the specifications. Moreover, because the ship is not explicitly specified to the market’s needs, the system suppliers could not, even in principle, tailor their offerings to enable the ship to be optimally compatible with such
needs and thus become ‘function providers’.

It must also be noted that the key functionalities of the ship to a large degree determine the operating expenses of the ship – another central consideration for the business case of the ship. For example, the propulsion system and the hull profile together have a large effect on the fuel consumption of the ship, whereas the cargo hold and cargo loading and unloading equipment determine, for instance, the time it takes to change over from an incoming load to an outgoing load. In this regard, it may be possible for the system suppliers to positively affect the cash flow and second-hand value of the ship by tailoring their offerings to the particular requirements in each case, but as long as the system suppliers are not involved during the design phase, this possibility remains unrealized.

Thus, the lack of communication between all the relevant parties, ranging from the system suppliers to the industry, i.e. the customers of the ship’s transport capacity and capability, entails that the ship cannot be optimally designed with regard to the market needs and actual operating profiles. Instead, there is a substantial emphasis on economizing on the initial investment.

Consequently, the subsequent bidding for the building project is based on the design specification, and the shipyards are incentivized to offer as lowest bids as possible while still satisfying the specification. In other words, the shipyards are not incentivized to offer the future shipowner the best possible business case (i.e. considering both the initial capital outlay and the earning potential and operating costs), but instead the shipyards mostly seek to minimize the initial capital outlay. Moreover, because the shipyard traditionally acts as the central hub actor in building the ship, the bid is based on the cost calculations and projections made by the shipyard; instead of both the shipyard and the key system suppliers working together to evaluate how such a consortium could, through collaboration, act more efficiently during the future building phase.

During the building phase, the shipyard awarded with the building project has the incentive to carry out the project with the lowest costs possible while still maintaining that the specifications and the schedule are met. Consequently, the project is, in accordance with the specifications, divided into subcontracting deals where the focus is also on fulfilling the conditions of such deals with the lowest costs possible. Thus, during the building phase, all the actors are also incentivized to minimize the costs of their operations as long as the specifications, fixed during the design phase, and the agreed schedule are met.

In sum, the overall picture that emerges from the current way of building a cargo ship is that throughout the project the overriding concern for most, if not all, of the actors involved is to reduce the costs of their op-
operations, which to a large degree derives from the shipowner’s desire to minimize the initial capital outlay for the ship.

The main challenges at the shipbuilding stage include the following:

- The cost-oriented way of designing and building ships affects the operating costs and earning potential of a vessel in a negative way.
- Lack of coordination between the actors owning or operating a vessel in one or another form obstructs seeing a ship as a long-term investment.
- The mismatch in the vessel design and actual operating conditions results in high operating costs and low revenue potential for a ship operator.

2.7. Summary

In Chapter 2 we have described the current situation in the shipping ecosystem and outlined the inefficiencies in the logistical chain which hinder development and improvement of the current business ecosystem. They are schematically presented in Figure 1. The major ‘problem areas’ can be divided into three major topics:

- Cargo coordination
- Port operations
- Shipbuilding

The problem of cargo coordination concerns the way cargo delivery is organized throughout the logistical chain. Production and logistics planning represents itself as a complex decision-making process involving several actors (e.g., shipowners, consignors, the stevedoring company, and land logistics operators). Lack of instructions or information sharing between these actors during the production and logistics planning, results in other actor’s inability to plan their activities accordingly, and thus delays in business operations occur. During the actual logistics operations, limited information, e.g. about any delays, may influence the credibility of the respective actor by reflecting badly on its partners’ business and cause additional costs. Incomplete information also restricts the actors’ possibilities of analyzing their actions after the actual shipment, and therefore understanding the reasons behind any of the unpredicted additional costs and delays in the process.

As a consequence, this lack of complete and multifaceted analysis impedes proper improvements to the logistical process. These challenges lead to the prevalence of ballast shipping, low utilization of vessels, and obstacles to smooth cargo flow, which results in low efficiency of the total logistical chain and high transportation costs.

Port operations deserve a special attention, because currently one third of a vessels’ time is spent in ports. The actual work, such as loading or unloading, waste management, or bunkering, constitute only a part of this time, while quite a significant share is idle time. After ‘rushing’ to ports and consuming a considerable amount of bunker, vessels are then forced to wait due to
a range of reasons: extensive reporting and notification procedures, stevedores’ working practices, waiting for ice-breakers or pilots, etc. The actual loading and unloading can be done more rapidly as well. This, however, requires a coordinated effort in improving onboard and port cargo handling equipment and facilities, which is currently hard to achieve in a highly fragmented logistical chain.

Finally, the decision-making process in shipbuilding is biased towards the initial capital expenditure instead of the more holistic consideration of the ship as a business case; where both the initial investment and the earning and operations during the life cycle of the ship are given equal emphases. This is due to the fact that the relevant parties, such as potential industrial users of the ship, are not involved earlier in the process. Consignors are the main decision makers when it comes to the choice of the ship to transport their goods. Furthermore, the shipowner needs to take into account the needs of the carrier, as it will be the carrier that will be using the systems installed on the ship. The more the systems respond to the needs of the carrier and the consignors, the greater will be the customer base for the ship itself – and the higher the time charter rate that can be set, thus, providing benefits for the shipowner in the long-term. For system providers, it is currently challenging to promote their innovative solutions, since not all the actors that benefit from those solutions are involved in the ship’s design process.

In the next chapter, we provide a vision for a renewed shipping industry ecosystem and a number of solutions that need to be implemented in order to achieve it.
Figure 1. Schematic representation of some inefficiencies in the shipping ecosystem
The vision for a renewed shipping industry ecosystem put forward in this report builds on the understanding of the inefficiencies that hinder cost-efficient and timely logistics. The understanding for the need for transparency, information integration, and collaboration in order to increase the total value production in the industry resulted in the articulation of 14 solutions that alter the ways some of the most inefficient activities are performed (see Figure 2). This concerns shipbuilding, sea logistics, and production planning and the interplay between them. The solutions presented in this chapter can be seen as dialogues that need to be started among those actors that are involved in, benefit from or are affected by certain activities. They are presented in 4 groups and are unfolded further in this chapter and in Figures 3-6:

- Solutions for strategic development of logistic capacity (Figure 3)
- Solutions for alliance-based shipbuilding, maintenance and operation (Figure 4)
- Solutions for streamlined logistical planning (Figure 5)
- Solutions for efficient port operations (Figure 6)

The description of the solutions is then followed by outlining the implications for the relevant actor types, and the required input in building a new model for the shipping industry (see Chapter 4).
Figure 2. Vision for a renewed shipping industry ecosystem
3.1. Strategic development of logistic capacity

**Vision**

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<th>Logistical chain</th>
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**Strategic development of logistic capacity**

- Decisions on building new vessels are based on industrial needs, available technologies to fulfil these needs in the best possible manner, and feedback from real operations.

- Decisions on the development of port, land and sea infrastructure is coordinated so as to create smooth transport corridors and align capacity of different segments in the logistical chain.

- “Guided” investment reduces the risks of shipowners and port operators to generate ‘sunk costs’.

- Industry is able to affect the development of door-to-door capacity which suits their needs.

*Figure 3. Solutions for strategic development of logistic capacity*
Solution 1: Controlled fleet renewal

Controlled fleet renewal builds upon fulfilling all the forthcoming regulations relevant to ship design, while investing in ‘functional’ vessels that have a good return on investment and operative properties. In order to do this, it is crucial to establish ‘feedback for design’ processes, where real-life operating data is gathered and analyzed, ensuring that the actual users of the vessel provide their requirements and expectations. In terms of time, feedback for design is perhaps the one solution that requires more effort and time to make it effective. This does not, however, imply that it is to be discarded, as its results can have a significant influence on the future of shipping technologies and on the way research and development, in general, is carried out. In the aviation and automotive industry, the implementation of telematics for diagnosis and failure prevention is today a reality, and in the computer world, it is not uncommon that both software and hardware usage data is reported back to their developers in order to improve their products.

Thus, the idea for the proposed solution is similar to that of automation signals, which assist shipowners and operators to realize and benefit from efficiency gains during the run-in and usage stage of a ship; such signals could also provide learning benefits for the key function providers. This learning is made possible by the detailed data from actual ship operations provided by their respective systems, as well as organizational and inter-organizational knowledge concerning how to make ship operations more efficient from the very beginning. That is: the same information that now assists a ship operator to monitor the performance of its fleet can also be utilized by the function providers in order to better understand the impact of their solutions and to assist in their development as the life cycle of their product proceeds.

Moreover, such data and knowledge would be particularly valuable in alliance-based ship design, construction, and operation, which is discussed further in section 3.2. The observed improvement potentials could be communicated and acted upon throughout the alliance with the profit-generating potential of the entire ship in mind, instead of a single technology supplier with a focus on the respective ship system alone. Thus, such an alliance-based scheme becomes essential for enabling the investment on the necessary feedback loops and the disclosure of performance data among the alliance members for their joint benefit.

In order for a project to succeed, it is not only necessary to count on efficient technological solutions, but also a clear understanding of what a customer expects from every solution and how all the different demands are prioritized is crucial. That is, the need to manage the require-
ments arises. The software industry has been pioneering this field for many years. Management of requirements particularly relates to the information exchange that takes place at the shipbuilding phase: requirements not only originate from the owner and the yard, they also originate from the market and they should be catalogued correctly. The requirements should ideally be:

1) based on comprehensive and explicit information (cargo demand, technological capacities of the shipping environment, intended routing, etc.);

2) communicated in such a way that they enable the efficient operation of the vessel – to truly produce a vessel that will succeed in an environment that is only going to become more competitive.
**Solution 2: Strategic infrastructure development**

The corporatization will reveal those ports that are not competitive enough and which have been operating with the municipality’s and the state’s support. This will also have an effect on investments, as the number of ports will decrease and cargo flows will be concentrated into fewer ports. The state should take this change into account and invest more rationally in infrastructure connected to ports: ideally investments are allocated where there are enough cargo flows and where investments are actually needed. The existing connections to ports will be developed so that cargo can be transported to ports faster, more safely, and efficiently. This will require strategic discussions between the state, ports, and industry in order to identify which ports are needed, what their specializations are, and which ones need infrastructure investments. The industry takes part in the discussion by outlining which routes, ports, and infrastructure are necessary for their operations.

Developing cargo solutions such as using e.g. bags, megaunits, or containers can require investments in the port’s infrastructure. In order to fulfill customer needs and attract new customers, ports, and stevedoring companies need to invest in cranes, other loading and unloading infrastructure and covered terminals suitable for all weather conditions. Steady and concentrated cargo flows are expected to make this economically possible. Infrastructure investments would ultimately benefit the industry through reduction of delays and faster loading and unloading.
3.2. Alliance-based shipbuilding, operations, and maintenance

**Vision**

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**Shipyard**

**Design office**

Provider of cargo handling function

Provider of propulsion function

Provider of navigation function

**Financier**

**Shipowner**

Carrier/ship operator

Industry 1

Industry 2

**Ship crew**

**Land logistics operator**

**Port**

**Stevedoring company**

**Union**

**ICT solution providers**

Authorities and policy-makers

**Agents**

**Cargo broker**

**Maximizing return on investment**

Support in realizing benefits

**Coordinated design**

**Feedback for design**

**Solutions for alliance-based shipbuilding, maintenance and operation**

- The ship is seen as a common long-term investment, and it is in the interest of the whole alliance to build a functional ship that has low operating costs, good environmental performance and high revenue potential.

- Investment and risk sharing among alliance members.

- Design of the ship is based on predicting operating mode, which helps to install relevant solutions for reducing fuel consumption, cargo hold cleaning costs and time, and minimize breakdowns.

- Function providers use their expertise to help the operator to utilize designed features and run the ship in the most efficient manner.

- Smart maintenance and modernization allow reducing dry docking time and increase operating time and revenue.

**Figure 4. Solutions for alliance-based shipbuilding, maintenance and operation**
Solution 3: Alliance for shipbuilding and operation

An alliance-based way of building and operating (dry bulk cargo) ships offers several potential ways to address the inefficiencies discussed in Chapter 2. First, from a building point of view, one of the key efficiencies that such collaboration would enable is the ability to design and build a ship according to an actual logistics market and cargo flow needs. For this purpose, all the respective actors need to be involved in the initiative from the very beginning. Such actors not only include the shipyard, but also the key function providers for the ship (e.g. engine and propulsion function, cargo handling function and navigation function) as well as the shipowner, who represents the interface to the cargo market.

The second central efficiency that such an alliance would enable is avoiding the risk premiums to be incorporated into the project (and thus the price of the ship) many times by different actors. This necessitates that all the actors participate in the construction at cost (i.e. not including any profit margins or actor-specific risk premiums), which, in turn, requires considerable trust and openness from the participants. Briefly, the participants would construct the ship with an ‘open-books’ principle as a joint effort. This is a bold goal, but the incentives for the participants to achieve this goal would be the following:

1) The increased competitiveness that such an alliance could achieve through increased efficiency (e.g. project risk would be taken into account only once at the alliance level);
2) The alignment of actors’ needs (and thus reduction of overall risks) through a risk- and benefit-sharing arrangement that would extend to the operating, as well as the profit-generating stage.

In short, the alliance would perceive the ship as a joint business case in which the ship first must be built in order to enjoy the subsequent benefits.

Such an alliance could collaboratively and holistically design a ship according to market-based needs because all the key actors, as alliance members, are involved in the initiative from the start. Moreover, when the ship is a joint business case for the alliance, there is an incentive for each of the alliance members to bring their best knowledge to affect the economic viability of the initiative. For example, in order to allow all the technically contributing alliance members to optimally utilize their knowledge, they should be given total control over their respective area, from system design to installation and commissioning. Therefore, the role of the yard in such an alliance would be significantly different from a traditional shipyard. The yard in the alliance would be, to a large degree, a networked project management organization whose main responsibility is to manage the whole initiative during the
building phase, whereas each of the main function providers has total responsibility for their respective ship systems. Moreover, the yard would most probably exercise this managing role by coordinating the interfaces between different ship systems. The more comprehensive role of the function providers, in turn, means that they have overall control and responsibility for their respective systems – also during the operation stage of the ship. Thus, the function providers could perhaps be best understood as ‘capability enablers’ for the ship.

Nonetheless, because the joint efforts of the alliance also extend to the operating stage of the ship, the alliance members not only have an incentive to optimally build the ship to fulfill a cargo market need, but also have an incentive to maximize the profit-generating ability of the ship in actual operation. The reason for this is the benefit-sharing business model according to which each of the alliance member benefits if the earning potential of the ship is increased. Thus, the function providers, for example, have an incentive to update their equipment in accordance with the changing market conditions, whereas the shipowner has an incentive to be in constant dialogue with the function providers concerning how the market conditions are changing and how those could be taken advantage of through different ship capabilities during modernization. Correspondingly, the shipyard would have the responsibility and an incentive to have the ship maintained in such a manner that the days it is out of operation due to docking, for example, are minimized.

Another very real possibility to positively affect the economic viability of a ship through reduced docking, which is currently underutilized, is to extend the intervals for the mandatory inspections that require docking. This requires that the ship be designed to be ‘inspectable’. In other words, one of the design goals of the ship should be that as many of the inspections as possible can be conducted with the ship remaining in the water, and preferably conveniently scheduled to co-occur with the ship’s maintenance (see solution 7). For example, the hull of the ship should explicitly be designed to be conducive to inspection by divers instead of requiring dry-docking for the inspection. In this manner, the docking interval for a new (dry bulk cargo) ship could very well be extended from the current 4-5 years to 7-8 years and perhaps even beyond.

Making the ship ‘inspectable’, in turn, requires that the ship classification society and the relevant flag state authorities are involved early on during the ship design phase so as to incorporate the inspectability aspects into the ship’s design, and to otherwise ensure that the planned technical solutions for the ship are conducive to realizing extended docking intervals.

In any event, this alli-
ance-based business model not only would enable ships to be built in better accordance with the market needs, through early-stage design collaboration, but also would allow this to be done more efficiently and competitively. Furthermore, extending the alliance to the operation stage of the ship’s life cycle would also increase efficiencies at that stage due to shared incentives of the alliance members towards operating the investment in the most efficient way.
Solution 4: Cargo handling function

Cargo handling is an essential functionality in a cargo ship, which has a direct and significant connection to the revenue earning potential of the ship as well as its operating costs. This function includes the ability of a vessel to carry cargo in its cargo hold, and cargo loading and unloading capability.

A cargo hold as such does not have many qualities that would have intrinsic value. Instead, the cargo hold derives most of its value from enabling the ship to transport cargos in quantities and qualities that are in demand in the market. In addition, the cargo hold provides value through enabling efficient switching from one cargo load to the next (e.g. loading, unloading and cleaning). Thus, for cargo hold innovations to fully deliver value, the logistics ecosystem in which the ship operates must support such innovations – or at least not be prevented from utilizing them. Moreover, the starting point for the specification and the design of the cargo hold must be the cargo flows in the logistical system in which the ship will be embedded.

First of all, an improved cargo handling function would enable transporting more than one consignment at a time. This would require compartmentalization of the cargo hold in such a way that the contents of the consignments will not mix under any circumstances – both during the voyage, and during loading and unloading. Of these, preventing mix-up during loading may be technically more demanding to achieve because this most probably would necessitate hatch covers that provide loading and unloading access to one compartment of the cargo hold at a time while other compartments remain sealed. This arrangement would also make the ship more resistant towards weather conditions as non-sensitive cargo could be loaded or unloaded during, for example, rain, while sensitive cargo would simultaneously remain protected.

Nonetheless, in addition to being a functional requirement, this is also a ‘psychological requirement’ because currently most of the industrial consignors are reluctant towards cargo combinations, because of the perceived risk of cargo mix-up, risk of delays, and assumed increase in logistic complexity when several consignors share a voyage. Furthermore, in order to respond to changing market conditions, the compartmentalization should be reconfigurable – and the faster the better.

Secondly, in order to allow the ship to optimally respond to the cargo market conditions, the cargo hold should be very efficiently and effectively cleanable. This means that the cargo hold should allow thorough cleaning, without the necessity for much effort or special arrangements, as this would ultimately decrease operating costs. One major technical consideration in this regard is making the cargo hold surface as smooth and durable.
as possible so that residues from previous cargo are minimized, any remains are easily removed, and rust and paint flakes from the hold surface do not contaminate the cargo.

As regards cargo loading and unloading, a conceivable possibility, which would require a shift in the whole logistical chain, would be to transport bulk cargo in large bags, megaunits, or containers. While such methods would not necessarily offer faster loading or unloading in all cases, they would make the whole transport chain from origin to destination ("door to door") more efficient. With regard to ships, for example, large bags, or containers would practically eliminate the need of cleaning the cargo hold and offer significant protection against cargo mix-up.

Finally, there are additional possibilities for innovation with regard to the cargo handling. For example, the cargo hold could be fitted with a system for weighing the cargo being loaded which would eliminate the need for an external surveyor to estimate the cargo weight after loading, and thus eliminate the extra time and cost associated with this task.

In any event, the main benefits that these functional cargo handling solutions could provide would be to enable the ship to better correspond to the cargo flows in the market and to make the cargo-related harbor operations faster, thereby enabling more voyages per year.
Solution 5: Propulsion function

The propulsion functionality of the ship offers several possibilities. First of all, the engine(s) in conjunction with the rest of the propulsion system can be designed and specified so that best performance is obtained at slow steaming speeds. Therefore, not only would slow steaming decrease the fuel consumption of the ship in comparison to current sailing speeds, but additionally the engine would achieve the best fuel economy and consequently the lowest emissions under such operation mode, instead of being optimized for higher sailing speeds.

In general, in order to realize all the benefits from the ship engine(s), the engines should be tailored in accordance with the actual sailing conditions and profile of the ship instead of the design speed or any other non-actual sailing speed. Such adjustment would significantly benefit from recorded data from actual ship operations, which would explicitly indicate how the ship is actually being operated. Moreover, modern real-time engine monitoring and remote management would allow the propulsion capability provider to monitor and fine-tune the system whenever a need arises.

A potential concern in this regard is the fact that fulfilling ice class criteria requires higher engine power compared to a ship that does not sail in ice conditions. This requires special attention to the propulsion system design. The conceivable ways to address this concern are through hull design (e.g. designing the frontal profile of the ship to optimally break ice even with lower engine power), and by furnishing the ship with equipment – such as electric boosters – which can deliver additional power for propulsion when specifically needed. However, as discussed earlier, there should also be initiative from policy-makers to introduce environmental criteria that are based on system effects such as emissions per cargo unit rather than applying strict regulations on engine power output.

Furthermore, in order to achieve maximum efficiency from the engine and the rest of the propulsion system, they must be rigorously designed together with the hull of the ship. Thus, the hydrodynamic properties of the hull should be optimally conducive to the intended (slow) steaming speed of the ship, and the engine specification should correspond to this setup. Another particular hull-related concern is biofouling, which can significantly increase the drag of the ship and may require extra engine power to compensate in order to maintain sailing speed. Thus, the hull should be coated with anti-fouling material in order to avoid this effect and to make the extra compensatory engine power unnecessary.
Solution 6: Voyage optimization, automation, and reporting

The sketching of the optimal sea voyage is of paramount importance to the question of fuel saving, especially in the context of regulations regarding the Energy Efficiency Design Index (EEDI) and emission of air pollutants. Compliance to such regulations should not be limited to equipping ships with energy efficient engines that operate with greener fuels and/or are equipped with proper pollution abatement units. In addition to this, improved performance can be achieved by making sure that the vessel sails a route that will not compromise timeliness or bunker savings. Since optimal sea routes dynamically change, immediate action concerning the vessel’s speed profiles becomes necessary if one is to gain from continuously sailing on the optimal path. This requires immediate correspondence between planning and execution, which, in practical terms, is a demanding task that requires constant attention from the crew both onboard and ashore and could even create the need for a larger crew, thus increasing costs. However, if the vessel is properly automatized, this approach could definitely yield even more fuel savings, because information on updated speed profiles is continuously fed to the engine room without the need for a crew-member to adjust the operation parameters manually.

Additionally, the vessel can be equipped with tools that allow for single point communication with authorities, consignees, and shipping companies, which will reduce the burden on the crew onboard during reporting. This way, time is saved in avoiding multiple submissions of repetitive data, which also minimizes human error.

As new builds and upgrades are being planned, it is then important to bear in mind the deep impact that good planning, automation, and simplification of reporting procedures could have on operational costs: for this purpose it is necessary that the vessel is equipped with proper optimizing and reporting tools and automation gear. It is important to note, however, that coordination with consignors and proper charter party agreements and clauses are required in order to achieve flexibility in adjusting routes, speeds, and timetables. For that, a benefit-sharing model is required so as to redistribute the benefits of, for example, slow steaming to both sides.
Solution 7: Smart maintenance and modernization

Maintenance, traditionally represents time during which the ship is not in service and thereby is not able to generate revenue. ‘Smart’ maintenance, in contrast, refers to the ways to reduce this unproductive time.

There are two main ways to make maintenance smarter. First, the maintenance should be based on the actual needs of the specific ship instead of generalizations or averages. In effect, this would necessitate equipping the ship with appropriate monitoring capabilities that would record both equipment usage (e.g. operating hours) as well as equipment condition (e.g. mechanical vibrations or oil impurities). Based on this data, function providers or the authorized service providers for the equipment could tailor the maintenance to the actual usage of the equipment and forecast forthcoming maintenance needs. Furthermore, modern data transmission technology enables this monitoring and data analysis to be conducted remotely and in real time.

Secondly, the ability to forecast forthcoming maintenance needs would allow scheduling the maintenance so that it minimally disrupts ship operations. While such interruptions cannot be entirely eliminated (e.g. periodical dry docking due to classification society requirements), a substantial proportion of smaller-scale operational maintenance could be scheduled to take place, for example, during loading and unloading, which can in some cases take up to a whole day or more. This, however, necessitates good and especially reliable forward-looking communication between the ship operator and the maintenance service providers so that the required people and materials can meet the ship in the right place (port) at the right time. In an alliance-based shipbuilding such communication is bound to be in the interest of all the parties.

Smart modernization, in turn, requires a dialogue between the alliance members concerning how the market conditions are changing and new innovations emerge, and how those could be taken advantage of through modernizing different ship capabilities. For example, configuration of the cargo hold can be changed if there is a significant and persistent shift in cargo types transported by a vessel.
Solution 8: Run-in and performance guarantees

Efficiency gains that are expected from installing better systems on ships are achieved in ship operations during the run-in and usage stage in the life cycle of the ship. These gains, in turn, translate into increased profits for the ship operator. Such potential gains derive from the fact that typically ship operators are not able to fully utilize the potential and the capabilities of a new ship, especially during the first few years of operation. In other words, there is a gap between the capabilities of the ship ‘on paper’ and that which the ship operator experiences in practice.

Therefore, the providers of ship functionalities (such as cargo hold and cargo handling equipment, and engine(s) and the propulsion system) could offer run-in and usage services for the shipowner and ship operator through which they could assist the operator to realize the potential and capabilities that their respective systems are designed to offer. Such services would be part of the alliance-based ship-building and operating, and the efficiency gains would be then shared among the participants of the alliance. In practice, run-in can be achieved by training ship crew, assigning employees from the system providers to participate in a number of first voyages, and on-board and remote monitoring of vessel performance.

Furthermore, if the system providers could accumulate data from a few such cases on how they have been able to increase the efficiency of a new ship in operation, they could use such data as evidence-based sales argumentation in future sales negotiations.
3.3. Streamlined logistical planning

**Vision**
- **Shipyard**
- **Design office**
- **Provider of cargo handling function**
- **Provider of propulsion function**
- **Provider of navigation function**
- **Financier**
- **Shipowner**
- **Carrier/Ship operator**
  - **Industry 1**
  - **Industry 2**
- **Ship crew**
- **Land logistics operator**
- **Port**
- **Stevedoring company**
- **Union**
- **ICT solution providers**
- **Authorities and policy-makers**
- **Cargo broker**
- **Agents**

**Shipbuilding**
- **Ship design**
- **Construction**
- **Production and logistical planning**

**Logistical chain**
- **Land logistics**
- **Ship approaching port**
- **Port operations**
- **Sea voyage**

**Figure 5. Solutions for streamlined logistical planning**

- Maximizing return on investment
- Support in realizing benefits
- Coordinated design
- Feedback for design
- New ships enable new way of operation
- Optimal door-to-door infrastructure
- Requirements management
- 2. Strategic infrastructure development
- 3. Alliance for shipbuilding and operating
- 4. Cargo handling function
- 5. Propulsion function
- 6. Voyage optimization, automation and reporting
- 7. Smart maintenance and modernization
- 8. Run-in and performance guarantees
- 9. Integrated production and voyage planning
- 10. Electronic market place for spot market

**Streamlined logistical planning**
- Increased vessel utilization leads to lower freight rates and higher revenue for carriers.
- Optimal consignment sizes reduce consignors’ warehouse needs and ‘goods in progress’, as well as helps them serve their customers better.
- Development and integration of production and logistical planning tools decreases total transportation time and cost.
- Renewed contract models enable fuel savings.
Solution 9: Integrated production and voyage planning

Producing value for the entire logistics network is not limited to addressing issues in terms of port-to-port operations. A door-to-door approach is bound to yield better results as the problems burdening the logistics network are tackled at an early phase, i.e. the production and logistics planning of the industry.

The idea behind this solution is to enable a dialogue between shipping operations and the production planning of the industry in order to optimize production schedules. This will not only help to increase the utilization rates of vessels, and keep the industry's inventory levels at their optimum, but it will also guarantee that delivery estimates become more accurate. It will thus foster more positive relationships, on the basis of reliable business transactions, between consigner, consignee and carrier.

The deployment of this solution relies on the collaboration between ICT companies, ship operators, and the industry in order to develop the necessary software and provide vessels with adequate communication tools. In principle, properly equipped vessels would feed relevant information directly into the industry’s planning and monitoring tool in order to create a more complete understanding of the logistics chain. In addition, ship operators can better plan their routes, if knowledge of cargo availability from industrial customers and levels of stock at warehouses at the destination become available, allowing smooth and continuous delivery streams between regular trading partners.

From the industry side, this solution also involves coordination among various consignors so as to pool cargo flows together and thereby increase the utilization of vessels. Ultimately, this will lead to decreased freight rates.

Due to the above mentioned investment and development requirements, this is a solution that is better suited for industrial players that either take full control over the (time) chartering and operation of the ship or have long lasting and well established agreements with a ship operator.
Solution 10: Electronic marketplace for spot market

Notifications regarding the availability of cargo or vessel capacity are usually made by the broker and take the form of e-mails sent to the ship operator or cargo owner, respectively. The problem with this approach is that it is highly unselective, slow and cumbersome, as e-mails are usually sent as large distribution lists resulting in flooded inboxes. Moreover, this approach limits the direct negotiation between the cargo owner and ship operator within the spot market. The idea of an electronic marketplace will then address this situation by providing a directory with which it is possible to search for the availability of cargos, and the ships’ capacities are advertised together with contact information and tools for direct communication.

By providing consignors and ship operators with an electronic arena where they can interact directly, the brokering function will completely remain in their own hands, thus cutting down commission costs and speeding up the process of finding cargo in the spot market. This will result in fairer competition and reduced freight rates as a direct consequence of minimized ballast sailing (increased vessel usage rate).

The enabling technology is currently available; however what is actually needed is the initiative of actors that would materialize the technical development of the tool together with a business model that would outline the most efficient way to make the tool profitable. Moreover, there is a need for commitment from the industry and shipowners to utilize this tool so as to create a large enough web-based marketplace. In this regard, it is especially important that the industry be the first one to be approached and encouraged to implement the electronic marketplace, as it is usually the case that the industry is the one to actively look for cargo capacity; ship operators also seek cargo offers actively, however less frequently.
3.4. Efficient port operations

**Vision**

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<tr>
<th>Stratégizing</th>
<th>Shipbuilding</th>
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**Efficient port operations**
- Quicker turnaround at ports reduces idle time and increases earning time for carriers.
- Ports become more competitive due to reduced port time and costs.
- Transparency of port operations allows reliable logistics and maintenance planning.
- Reduced idle time at port and new approaching rules enable slow steaming and fuel savings.

Figure 6. Solutions for efficient port operations
**Solution 11: Information transparency**

Centralized data portals, such as PortNet and SafeSeaNet, are mandatory requisites for improving information exchange between actors and for the release of different applications that will tap into the available information in order to provide added value services.

Among the many functions that these services could have is enabling transparency in routine shipping operations, and port benchmarking. To be precise, data that can be directly linked to performance should be provided to the affected actors (e.g. delays should be informed to the industrial actors, port handling times should be included in the voyage and production planning, port congestions should be visible to ships’ crews, etc.). This will mean that better strategic decisions are made (e.g. avoid slow ports, opportune scouting for replacement carriers, etc.) and free-market competition becomes a reality. Additionally, this will make it possible for ports to better handle their queues by basing their berth assignments on unbiased and accurate data (such as ETA), which will allow for virtual arrival or any other queuing paradigms that in turn render slow steaming possible.

The timely communication between cargo owners, ship operators, and port operators (stevedores included) is also an aspect that could be addressed by enhancing information transparency. Exchanging information on cargo type and amount and other information relevant for cargo handling can have a positive impact on turnaround time and the quality of the service. For example, the stevedoring company should have enough information about the cargo and handling guidelines in advance so as to plan activities beforehand. A functional information platform will allow this, improving stevedores’ productivity and communication with the industrial actors. The industrial actors will thus know the time needed for loading and unloading and be able to better assess and control the process. This benefits both (1) the stevedores by enabling higher work efficiency of the personnel and thus providing a competitive advantage on the market and (2) the industry and the end customer by providing more information on the course of the delivery, better handling of their cargo, and reduction of possible damages.

Through these electronic portals, authorities (e.g. customs) will be able to exchange risk assessments and other relevant documentation so that administrative work is simplified and optimized, minimizing the burden on both the authorities and the industry. The implementation of these systems by the authorities does not only have a streamlining effect but also gives more credibility to the data, thus prompting more transparent operations throughout the entire logistics network. This, of course, implies the appointment of a regulatory authority, whose
role will be mainly devoted to safeguarding that all the information contained within the common databases is truthful and up to date. Considering the long term scale, the electronic data interchange regarding documentation (such as the manifests, the bill of lading/sea waybill and service invoices) will further ease transactions.

In order for such portals to provide reasonable functionality, the enabling technology must be in place and a shift in the mindsets of the actors in the logistical chain is necessary. Business models for governing collaborative operations (e.g. gain sharing between investors and beneficiaries of technology and updated charter party agreements) and legislation for data verification, usage, and protection should be developed to produce the necessary shifts in the business mindsets.

8 Finland’s National Single Window tool.
9 European level maritime information exchange platform.
Solution 12: Slot and queuing system

In order to enable slow steaming there is a need for a new and fair kind of slot and queuing system at ports. Currently, a queue is arranged by order of arrival, the so-called ‘first come, first served’ principle. Even though the principle is reasonable, especially in smaller ports, it does not support slow steaming because ships are rushing to the port in order to be first in the queue. Unnecessary waiting times at ports are also expensive for ships, and thus ships should be served as soon as possible. Synchronizing sailing times with the occupancy of quays will allow ships to be served quickly and efficiently. Possible solutions for a queuing system are e.g. virtual arrival and arranging the queue based on estimated time of arrival (ETA). Virtual arrival requires that the following conditions have been taken into account:

1. A known delay in the unloading port.
2. A mutual agreement between the parties.
3. An agreed Charter Party clause that establishes the terms for reducing the speed to adapt to the new arrival time.
4. An agreement on how to calculate the virtual arrival and the performance of the ship.
5. An agreement on how to assign the benefits between the involved parties.

Instead of the ship informing the port and the stevedoring company about its ETA, the port could notify the vessel about the time when the port is ready to receive it. After receiving information about the free slot at the port, the ship can slow steam and obtain service immediately after arrival at the port. This requires good communication between the involved parties (vessel crew, carrier, industry, stevedores, and port), a mutual agreement, and developed ICT systems. One possible solution is to further develop PortNet so as to respond to the communication demands of virtual arrival.
Solution 13: New stevedoring business model

The stevedoring business has inherited its working habits from industry. This means that presently it is more likely to be seen as industrial business instead of a service business. However, stevedoring should be seen as service business in order to improve the efficiency of port operations and cargo handling. This means that employees’ and employers’ organizations need to find a common understanding on how the stevedoring business can be developed to become more service-oriented.

Stevedoring is considered to be expensive and inflexible. Thus, the business model needs to be improved without jeopardizing work places or the profitability of the companies. One possible solution is a ‘pool’ for stevedoring services where stevedores are paid only when the service is needed; this would require a collective stevedoring service organization for several ports in order to guarantee a sufficient income level for stevedores. In such a case, working hours would need to be flexible compared to the present situation. In addition, carriers need to be ready to pay more for stevedoring services, which will in return allow them to receive increased efficiency and reduced times at a port, and ultimately reduce shipping costs.
Solution 14: Renewed port business model

The Finnish ports will be corporatized at the beginning of 2015, meaning that in order to survive they need to be profitable. The present ports’ business model is based on earning by the number of ships and their tonnage, as well as some services like mooring. Thus, for port management companies, it is crucial to be able to influence port operations, even if they are performed by other actors such as stevedoring or piloting companies, so as to ensure that the port as a whole is efficient and thereby attractive to customers. For this to be realized, port actors need to come to a common understanding about strategic goals and the future vision of the port in order to achieve better utilization of the infrastructure and attract more ships to the port. Thus, there is a need for continuous discussions and cooperation between port operators, especially between the port management and stevedoring companies.

An effective port is a port where both ships and cargo spend as little time as possible. One possible way to make a port more competitive and more attractive for its customers is a slot system discussed in the solution 12. The slot system enables slow steaming and reduces the time that a ship uses in a port. The port’s flexibility, which means the ability to react rapidly to changes, also affects port efficiency. Most of the above-mentioned requirements for a port’s efficiency can be fulfilled if the information flow between parties is more transparent. The providers of cargo-handling solutions should also be more actively involved in developing port operations and ensuring that the cargo-handling solutions on shore match the ones on the ships, and serve the cargo flows efficiently.

Paper work requires a considerable amount of time at the port itself as well as on the carrier’s side. Thus, it is important that reporting and notification systems are harmonized, and that all information is available in one place. Ideally, there would be one ICT system that serves the needs of the parties when approaching and being at a port. Of course, to be effective and functional, the ICT system needs to be used by all parties.

Although Finland has a large number of ports, sea transport is highly concentrated, and the 10 largest ports in Finland handle nearly 80% of the total cargo. Thus, it is important that investments in port infrastructure and port connections are made where the investments are actually needed. This requires long-term planning on the industrial side. The industry should see its logistical chains as a whole in order to be able to conduct long-term planning. Moreover, cooperation between ports and shipowners is needed when developing loading equipment at ports and on vessels in order to make sure that new vessel designs can be exploited efficiently.

In order to reduce costs at the
ports, different kinds of automation should be considered. For example, automatized mooring and unmooring systems and pre-gate systems can improve port efficiency and safety at the port.
4. Managerial and policy implications

**Shipyards and design offices should:**
- Embrace alliance-based shipbuilding and operating.
- Recognize that the starting point for the design of a new ship is the transportation service it is intended to provide. This service, in turn, derives from the needs of the consignors, most often the manufacturing industries.
- Reflect on the fact that the traditional roles and business models may not be the most profitable ones in the future. A shipyard may profit from taking a more project-coordinating role whereas a design office may find it profitable to move to the direction of business consultation (i.e. regard a ship as a business case instead of an engineering task).
- Acknowledge that when a shipyard is not tied to a particular physical location in a way that a traditional yard is, this opens up better possibilities for international operations.

**Function providers should:**
- Adopt alliance-based shipbuilding and operation.
- Recognize that the ship systems are capability enablers rather than equipment. Thus, the value of the supplied systems is determined by their contribution to the capability of the ship to provide a valuable cargo transport market service.
- Appreciate that ship systems can deliver more value if designed together as a set of mutually reinforcing capabilities. In other words, the ship systems can be more than the sum of their constituent parts.
- Accept that gathering and accumulating data from actual ship operations can provide valuable learning opportunities that can be realized both in existing installations and, especially, in future projects.

**Shipowners need to:**
- Adopt alliance-based shipbuilding and operation.
- Consider the ship systematically as a business case, placing equal emphasis on revenue generation, operating expenses and initial capital outlay.
- Concede that the most profitable and sustainable business model for a shipowner, like any business, is based on its most competitive and unique resources. Such shipowner resources are most likely knowledge-based and concern the way the sea transport market works, as well as relationships towards customers. Thus, a profitable way to specifically leverage such resources would be to participate in a joint effort (i.e. the alliance-based shipbuilding and operating) where all the other members equally contribute their unique and competitive resources.
Carriers/Ship operators need to:

- Consider that a business model that increases transparency for information sharing with industrial partners, ports and port operations, function providers, authorities, etc. is essential for better integration between the involved actors, thus enabling optimal investment and operation.
- Understand that technology is an aspect that can have important direct implications, and that it is not only the responsibility of the owner, but also a necessity of operators to co-invest on technical improvements.
- Adopt more collaborative and up-to-date charter party agreements that enable newer approaches such as slow steaming and virtual arrival and provide guidelines for what the implications of the shared information might be.

The industry should:

- Adopt more collaborative and up-to-date charter party agreements that provide guidelines for what the implications of the shared information might be.
- Adopt warehouse and production reporting in order to allow an optimal and continuous sea operation and feedback to function providers to aid in technology development.
- Become the key initiator for marketplace tools, as the industry is currently the more active actor in the spot market, and thus could become the main user of this technology.
- Incorporate as much information about the logistics chain as possible into its production planning in order to improve its warehouse levels and delivery estimates, and to aid the logistics chain in operating in a more interconnected manner.
- Disclose its market needs for new-builds and infrastructure, while actively taking part in their development, as these factors directly translate into better freight rates and overall shipping terms.
Ship’s crews should:
• Realize that the ship’s crew determines, to a significant degree, the operational effectiveness of the ship. This operational effectiveness, in turn, has a significant impact on the economic viability of the ship, which is in the long-term interests of the crew as well.
• Accept ship automation as a means to increase the efficiency and thereby the economic viability of the ship and the whole shipping industry. Therefore, ship crews should adopt ship automation because it is in their long-term interest to keep up with technological advances.
• Implement technological innovations as they are in the short-term interests of the crew, because they can make the crew’s jobs safer (e.g. closed system loading/unloading), less burdensome (e.g. easier cargo hold cleaning) and more predictable (e.g. slow steaming and advance slot assignment).

Land logistics operators should:
• Develop the land infrastructure.
• Offer competitive prices by profiting from the liberalization of rail and road traffic. This implies that new land logistics operators are necessary in order to trigger the necessary changes.
• Provide information for better logistics planning. Such information is related to, among others, operating times, availability of fleet and coverage network.

Ports need to:
• Accept that the Port management company needs to be able to influence port operations in order to ensure that the port as a whole is efficient and thereby attractive to its customers.
• Adopt a new kind of slot and queuing system at ports in order to enable slow steaming.
• Discuss investments in port infrastructure (e.g. cranes and covered terminals) with industry, ship operators, and function providers in order to fulfill customer needs and attract new customers.
• Harmonize notification and reporting systems and make critical information available in one place.
• Implement automation such as e.g. automatized mooring and unmooring systems as an option to reduce costs at ports.
**Stevedoring companies and unions should:**

- Develop stevedoring business into a more service-oriented business in cooperation with unions, the industrial companies and the Finnish Port Operators Association.
- Establish a collective service organization for several ports in order to make the business more effective.
- Invest in port infrastructure (e.g. cranes and covered terminals) in order to fulfill customer needs and attract new customers.

**ICT solution providers should:**

- Develop tools for communication and information exchange between different operators, in the form of reporting (between customers and to the authorities) and feedback to function providers.
- Develop voyage planning tools that provide efficient ship navigation (better routing, optimal speed profiles, updated routes based on weather forecasts) and direct connection to the ship’s automation systems.
- Develop an electronic marketplace that directly links ship operators and industrial partners and guarantees both safety (e.g. careful disclosure of sensitive information) and relevant information (e.g. market information is only provided to relevant parties).
- Comply with National, European and International standards and with other ICT tools in order to create a mutual intelligible information environment, where data flows are not obstructed and where the continuous development of novel applications is not hindered but rather encouraged.
Authorities and policy-makers should:

- Invest more rationally in infrastructure connected to ports: ideally investments are allocated where there are enough cargo flows and where investments are really needed.
- Conduct strategic discussions between the state, ports, and industry in order to perceive which ports are needed, what their specializations should be and which ones need infrastructure investments.
- Understand fully the total shipping business ecosystem in order to plan policies and support, so as to not incur in counterproductive measures, such as the example of the reduction of fairway fees, which can have only a marginal effect on costs, but lead to the reduced competitiveness of Finnish ship operators.
- Develop such environmental regulations that force companies to increase environmental efficiency on a system level rather than lead to sub-optimization. See, for example, ‘emission per cargo unit’ discussed in section 2.5.
- Further develop PortNet in order to respond to communication demands of e.g. virtual arrival.