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Article

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ORIGINAL ARTICLE

Open Access

Maritime supply chain sustainability: South-East Finland case study



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Abstract

Emphasis on sustainability practices is growing globally in the shipping industry due to regulations on emissions from transportation as well as increasing customer demand for sustainability. This research aims to shed light on the environmental sustainability of companies involved in maritime logistics at the major Finnish seaport, HaminaKotka. This seaport is a part of International Maritime Organization's (IMO) Baltic and North Sea emission control area, with special emission-reducing measures contributing directly to United Nations' Sustainable Development Goals (SDGs) by mitigating negative impacts of industrial activity on environment and climate change. Two semi-structured interviews with companies at HaminaKotka were carried out to construct a case study examining the sustainability challenges at hand. In addition, experience of one of the authors in a managerial position at the studied seaport complex, as well as the sustainability communications of the companies situated in the area were used to support the findings. The companies improve environmental sustainability by using multimodal transport chains, alternative fuels in the transports, and environmental sustainability demands towards their partners. However, the most important measures, according to these companies, are transport mode selection and cargo load optimization. Moreover, companies have identified bottlenecks of cargo flow at the hinterland due to road infrastructure constraints. As regulations and customers are requiring environmental sustainability, companies are forced to renew their operations, strategy and business models. Especially, the emission-reducing regulations drive companies to implement means to control the produced emissions.

Keywords: Sustainability, Supply chain, Shipping, Hinterland, Finland

Introduction

In Europe, direct goals to reduce greenhouse gas (GHG) emissions from transports (which amount to approximately quarter of all produced carbon dioxide emissions, Solaymani 2019) have been introduced. More precisely, carbon dioxide emission levels should be 60% lower by 2050 in comparison to the levels of 1990 (European Commission 2016). Moreover, harmful air pollutant emissions reduction goals from European transports beyond 2020 (compared to levels of 2005) include sulphur by 59%, nitrogen oxides by 42%, ammonia by 6%, volatile organic compounds by 28% and atmospheric particulate matter with diameter less than 2.5 µm by 22%. Additionally, sulphur and



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nitrogen emissions have been targeted for reduction specifically in maritime transports globally. The acceptable level for sulphur content in used fuels, particularly in Baltic Sea region, has been 0.1% since 2015 (Hilmola 2019) and globally that is 0.5%, as of January 2020 (International Maritime Organization [IMO] 2019). The new regulation regarding nitrogen oxide emissions in the Baltic Sea region (80% reduction compared to 2016), coming into effect in January 2021 (International Maritime Organization [IMO] 2019), basically requires the new ships used in the said area to use either Liquefied Natural Gas (LNG) as fuel or have catalytic emission cleaners to comply with the stricter nitrogen emission regulation (Ministry of Transport and Communications 2016).

United Nations' (UN) Sustainable Development Goals (SDGs), or the 2030 Agenda for Sustainable Development, is a programme devoted for global collaboration to enhance prosperity and sustainability of the planet earth and its habitants, adopted by the UN member states in 2015 (United Nations 2019). Although the SDGs primarily target state level decision makers, the responsibility over specific tasks and objectives leading to realization of these goals falls on the shoulders of smaller actors, in the context of this research to seaport and logistics operators. It is the role of decision makers to set general directions for the organizations (e.g., the mentioned air pollutant, greenhouse gas and maritime emissions), whereas organizations must produce value (be it monetary, or other desired outcome) within the set guidelines. Moreover, seaport complexes are often owned by a local government, industrial corporations or some kind of consortium, therefore striving to serve a public interest.

It is important to directly and indirectly promote the noble end goal of all SDGs to avoid negative effects of "cherry picking", where the immediate benefits (e.g., image) are prioritized and the purpose of the SDGs is forgotten (Wang et al. 2020). However, organizations can actively only focus on the most relevant ones, i.e., those to which they can directly contribute within the realm of their capabilities, depending on their industry, surroundings and specialization (Kronfeld-Goharani 2018). Thus, the most relevant SDGs for HaminaKotka seaport complex (located in Finland) and the companies operating in the area are presented in Table 1 (synthesized from the studied companies' sustainability communication as well as research by Kronfeld-Goharani (2018) and Wang et al. (2020)). Both mentioned researches also study sustainability communications of companies operating in maritime industry. In their study, Wang et al. (2020) show that maritime companies focus mainly on SDGs #8, #9 and #11 in their communications, but also others (e.g., #12, #13, #14, #16 and #17) are regarded albeit to a much lesser degree. On the other hand, the study by Kronfeld-Goharani (2018) indicates that ocean industry focuses on SDGs #1, #3, #4, #7, #8, #9, #12, #13, #14 and #16. The difference of those results can be explained by the varying scope of the studies, latter one being wider. Ultimately, the most relevant SDGs for this research must be decided depending on the specifics of the studied seaport complex, associated companies and the surrounding region. Therefore, the sustainability reports of the studied companies hold most importance in the selection of the SDGs relevant for this study. It should be noted, that while companies' sustainability communications sometimes could misalign with their actual operations, they can be used to investigate the strategic trajectory and ambitions of those companies.

While it is important to develop comprehensive guidelines of sustainable development for people and organizations to use as a reference, it is next to impossible to truly

Table 1 Most relevant SDGs for HaminaKotka seaport in terms of mitigating negative environmental impact

Sustainable Development Goal	Explanation of the goal	Contribution to the goal
8. Decent work and economic growth	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all	Durable and efficient supply chains act as a backbone of an economy. The seaport complex and the partner companies employ considerable share of people in the region.
9. Industry, innovation and infrastructure	Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.	Infrastructure is developed to be as efficient as possible and viable innovations are utilized to support this goal.
12. Responsible consumption and production	Ensure sustainable consumption and production patterns.	Transportation is a focal part of any product's life cycle, and thus this part should be sustainable.
13. Climate action	Take urgent action to combat climate change and its impacts.	Lower GHG emissions from transportation mitigate the negative impact on climate change.
14. Life below water	Conserve and sustainably use the oceans, seas and marine resources for sustainable development.	Lower emissions from maritime transports mitigate the negative impact on life below water.
15. Life on land	Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.	Lower emissions from hinterland transports mitigate the negative impact on life on land.
17. Partnership for the goals	Strengthen the means of implementation and revitalize the global partnership for sustainable development.	Establish collaborative effort towards the sustainability including the companies operating in the seaport complex.

Source: United Nations 2019

know what is in the best interest for the coming generations on earth (Jaccard 2006). Hence the generality and relatively ambiguous nature of the UN's SDGs. The most urgent areas of improvement, within the context of realizing the SDG agenda, for the companies operating in the field of maritime logistics in South-East Finland remain in environmental sustainability. Consequently, that seems to be one of the foci of the decision making targeting the studied region. Hence, this research aims to answer the following questions:

RQ1. How do the SDGs transform activities of maritime logistics companies in South-East Finland?

RQ2. How do the environmental regulations on maritime transport affect these companies?

RQ3. What measures have the studied companies implemented to comply with the regulations and to contribute to the SDGs?

The rest of the article is structured as follows: The relevant literature on sustainability communications and environmental sustainability in multimodal supply chains are reviewed in the [Literature review](#) section. Then, in [Methodology](#) section, the methodology is presented, which is followed by the showcasing of results from the case study in [Results](#) section. Thereafter, the results are discussed in comparison to previous studies, and recommendations for enhancing environmental sustainability in the Hamina-Kotka seaport complex are drawn in [Discussion](#) section. Lastly, the conclusions are presented in [Conclusions](#) section.

Literature review

Orientating company's operation towards achieving SDGs represents an avenue for marketing that company's sustainability. As established, environmental sustainability is a relevant area of focus for maritime companies looking to contribute towards SDGs. Therefore, communications related to SDGs by companies involved in maritime supply chain activities could be called green marketing. Papadas et al. (2017) divide green marketing to strategic, tactical and internal levels. A company wishing to engage in green marketing should initiate and maintain activities on all the three levels in order to avoid simply green washing their operations (Papadas et al. 2017). Similarly regarding green marketing of seaports, Lam and Li (2019) state that the marketing strategy should follow the overall strategy of the seaport. While a single company's performance can benefit from green marketing (Papadas et al. 2017), communicating the efforts towards achieving SDGs can improve the image of the whole shipping industry in terms of sustainability (Wang et al. 2020). In this regard, larger actors of the industry hold an important role in communicating fulfilment of SDG agenda, since they have more capacity and capabilities to engage in such marketing in comparison to smaller actors of the same industry (Kronfeld-Goharani 2018).

In order to market the sustainability of the shipping industry, some substantial action towards sustainability is of course required. Intermodal terminals and hinterland operations play an important role in enabling cargo to flow efficiently through seaports (Henttu and Hilmola 2011; Othman et al. 2016). When multiple options for transport modes are at disposal, the involved supply chains are more durable due to flexibility of the transport chains (Christodoulou and Kappelin 2020). While multimodal transport chains can enhance environmental sustainability of the overall transport (e.g., substituting road transport with rail, Bergqvist and Monios 2016, Christodoulou and Kappelin 2020, Henttu and Hilmola 2011, Kelle et al. 2019), every switch between different transport modes generates additional cost (Das and Jharkharia 2018; Panova et al. 2017; Wang et al. 2015). Moreover, heavy reliance on road transports during hinterland operations may lead to congestion (often due to inadequate spatial planning around dry ports, Wagener 2017), which in turn lowers efficiency of the seaport via throughput time increases, and furthermore causes more emissions (due to standby engine running) and congestion on the roads used for these operations (Christodoulou and Kappelin 2020; Thorisson et al. 2019).

To enhance sustainability, whether looking at a singular company perspective or as a larger cluster, interorganizational collaboration is often vital to realize that goal effectively (Bergqvist and Monios 2016; Centobelli et al. 2017; Evangelista and Durst 2015; Liimatainen et al. 2012). Success of the multimodal transport chain relies on simplified, standardized processes and the quality of communication (Dua and Sinha 2019), i.e., collaboration, between separate actors in multimodal chains to yield efficiency and higher level of service provided (Christodoulou and Kappelin 2020; Veenstra and Zuidwijk 2016). Othman et al. (2016) go as far as to describe the required level of collaboration for fluent cargo flow between hinterland and seaports as symbiotic. In some instances, the needed infrastructure for multimodal collaboration is lacking, due to the absence of the topic in planning of the logistics areas (Wagener 2017).

The described regulations on emissions act as an external factor driving the affected companies to optimize their multimodal transport chains towards higher environmental sustainability (Wang and Sun 2019). Technological advances in transportation act a

pivotal role in shipping companies' efforts to enhance environmental sustainability (Stalmokaitė and Yliskylä-Peuralahti 2019). While ordinary road freight in Finland is not yet suitable to be widely electrified, due to the long average distances for cargo and short operational range of electric vehicles (Liimatainen et al. 2019), the contemporary range of autonomy would fit well into pre and post haulage operations on roads supporting other modes of transport (Wagener 2017). At the same time, LNG fuelled trucks could be feasible in road transportation (Osorio-Tejada et al. 2017) and reduce the amount of emitted harmful air pollutants during operation (Zhiyi and Xunmin 2019). Additionally, High Capacity Transports (HCT) could also help to reduce the stress on environment and to the hinterland infrastructure (in form of easing up congestions, due to reduced amount of tractor units needed for the same amount of cargo; Bergqvist and Monios 2016).

Methodology

HaminaKotka seaport complex was chosen as the target for this case study (Eisenhardt and Graebner 2007; Ghauri and Grønhaug 2010), because it represents a major actor in the Finnish economy. It handles a significant share of total Finnish imports and exports (Fig. 1). Formerly Hamina and Kotka were separately operating seaports, but they merged into a larger seaport complex in 2011. HaminaKotka is only behind Sköldvik seaport, which specializes in oil transportation (both raw materials and finished products are transported mostly by sea), and head-to-head with Helsinki seaport in the capital area of Finland. HaminaKotka mainly serves the wood and paper industry of Finland, but other categories of cargo are also handled, such as metals and minerals. In addition, HaminaKotka is the largest seaport of Finland in terms of transit traffic volumes, not far ahead of Kokkola, another large transit seaport in this country. Furthermore, HaminaKotka engages in short sea shipping inside Finland, and also lately has been involved as the logistical hub for the construction of a gas pipeline at the Baltic Sea. These cargo flows are not reported in the Finnish national statistics, which only

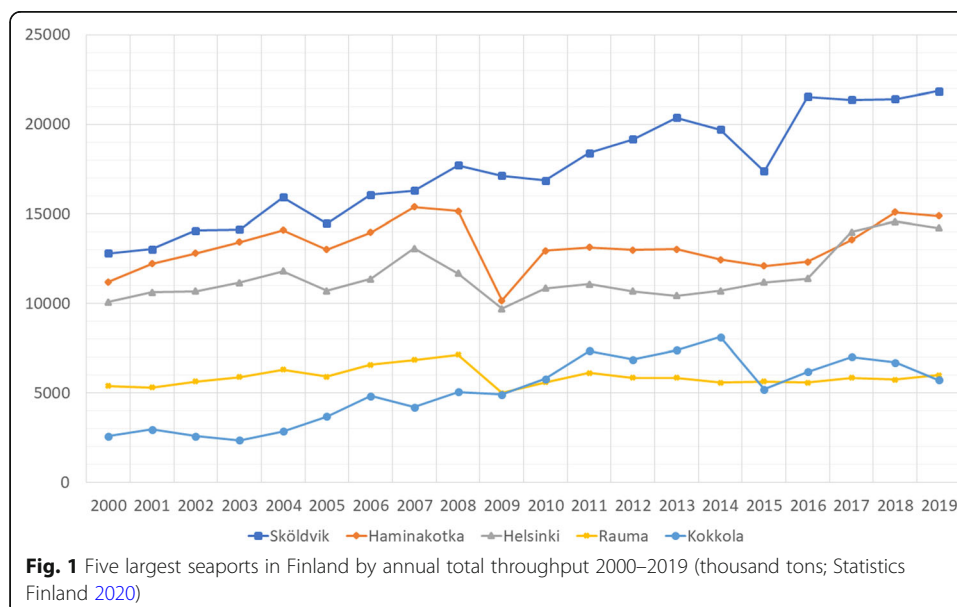
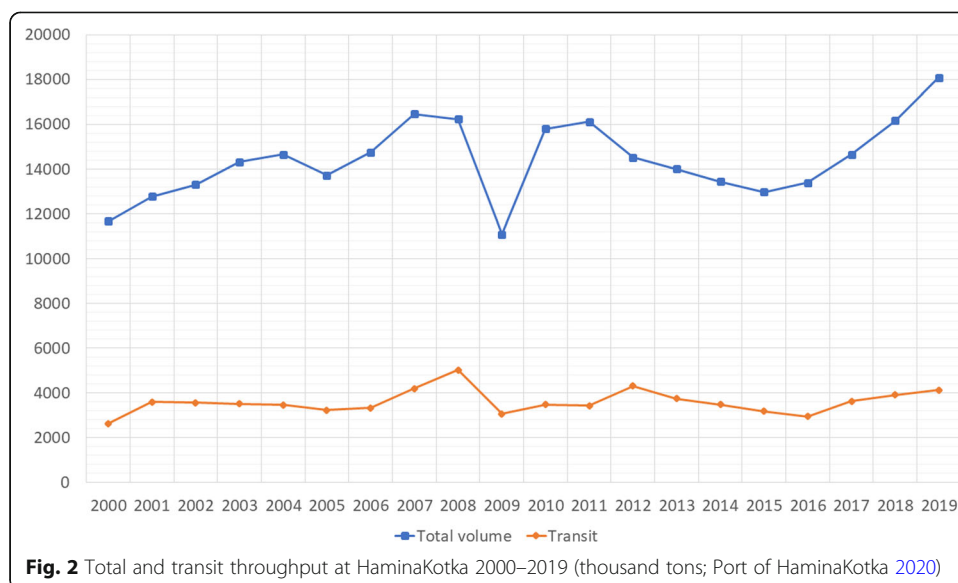


Fig. 1 Five largest seaports in Finland by annual total throughput 2000–2019 (thousand tons; Statistics Finland 2020)

takes exports and imports into account. Hence the actual throughput volumes at HaminaKotka are greater (Fig. 2), reaching an all-time high in 2019. The studied seaport complex is located in South-East Finland in the region of cities Kotka and Hamina, a bit over 100 km to the east from the Finnish capital area of Helsinki. HaminaKotka is an intermodal node in maritime supply chains where maritime, rail and road transport modes connect, allowing flexible solutions for transporting different types of cargo. Especially the growth of railway traffic in the region during last decade has been in tens of percent. There are approximately 130 different companies operating in the area of this seaport complex, consisting of logistics operators, forwarders, terminal operators and supporting service providers (e.g., fuel terminals).

In order to establish a company level perspective on the environmental sustainability activities, case study approach was chosen for this research. The case study was constructed with a qualitative exploratory approach to recognize ongoing trends and best practices among the maritime logistics companies of South-East Finland. This was achieved through number of semi-structured interviews, which targeted the logistics companies in the HaminaKotka seaport complex. To create a holistic picture of the multimodal transport chains taking place in this particular region, interviewees were chosen from companies specializing in shipping, hinterland transports, multimodal logistics and forwarding. Especially, it was fruitful for the research to establish contact with an umbrella organization, whose purpose is to do marketing for the member companies (consisting of mainly port managing bodies, terminal operators, logistics operators and transportation companies) as well as to promote collaboration between those otherwise separate actors in the common supply chains.

Two focal companies, in terms of the transport operations and their sustainability in the HaminaKotka seaport complex, have been interviewed: The mentioned umbrella organization and a maritime logistics operator. The umbrella organization has been the initiator in promoting adopting sustainable development orientation for its member companies in the seaport complex. The maritime logistics operator represents a voice from the practice side, which is important to consider in instances such as focus shift



towards sustainability. The interviewee from the umbrella organization is the CEO of said organization. From the maritime logistics operator, the manager of container operations was interviewed. Thus, it can be stated with confidence that the interviewees hold insight on the studied subject matter. Each interview took approximately 45 min, and followed a semi-structured protocol, where the interviewer had defined an interview protocol, but at the same time let the interviewee conduct the direction of the discussion to enhance the exploratory nature of the research with possible findings that were not considered in the interview protocol design. The umbrella organization's representative was interviewed at a site in Mussalo, Kotka, where many of the companies' headquarters operating in HaminaKotka seaport complex are located. The maritime logistics operator was interviewed via online call.

In addition to the two interviews, one of the authors of this article shares their experience regarding the case of sustainability in HaminaKotka seaport complex. They possess experience from extensive period working in a managerial position in development of the seaport complex. The experience from this tenure consists of infrastructure and traffic management development, for which along with economic and operational efficiency, environmental sustainability acts an important role.

To support the findings from the interviews and the first hand experiences of one of the authors of this article, as well as to map the general situation of company activities following the SDG framework, we gathered secondary data from websites of companies operating in HaminaKotka (e.g., annual reports). From the approximately 130 companies active at HaminaKotka, 96 had company websites available. These websites were systematically studied in order to map the situation of sustainability communication among the actors in the examined region. The systematic study comprises of firstly investigating whether the company has published a sustainability report from previous accounting period, or any other form of sustainability communications. If a report or other form of communication was found, the content of that communication was analysed. This analysis focuses on finding inclusion of environmental and social sustainability in the communications, and if the SDGs have been used as a framework for reporting the sustainability of the studied company's operations.

Results

Experiences from managerial position in HaminaKotka

The governing body of HaminaKotka seaport complex arranges on-land transportation in collaboration with the seaport operators with a goal to keep the traffic fluent, thereby eliminating unnecessary emissions due to congestions leading to idle vehicles and machinery. Historically, congestions in truck traffic have caused significant amount of emissions in the area, but the situation has gotten better. In addition, usage of less emitting fuels has also contributed to diminishing emissions.

Regarding the emissions from ships, a traffic organizing system has been introduced to HaminaKotka (same system is used in Hamburg and Helsinki seaports). This system is used to optimize departure times of different ships. While many seaports have introduced shore power for berthing ships, HaminaKotka currently doesn't have such capabilities. Furthermore, seaports in Finland are obliged to have an operating license, which contain limits for allowed emissions. Considered emissions are divided into three

categories: exhaust, emissions to ground and emissions to water. The emission limits are enforced by mandatory traffic volume reporting, which is used to produce calculated emission amounts for the seaport. In some cases, the noise pollution is also measured and reported.

In addition to traffic emissions, the infrastructure related emissions are measured in HaminaKotka. Energy consumption is monitored, and lighting optimization has yielded reductions in that area. Also, produced waste is measured and reported. These are as well included in the mandatory reporting for the operating license. The operating license as a framework for environmental sustainability in the seaport complex could be considered one of the leading ones globally in terms of its comprehensiveness.

New infrastructure investments require an assessment on environmental impact, which consists of comparison of different solutions from which the most suitable one is chosen. Often the most technically and environmentally fitting option is also the most economic one. In addition, newly build water infrastructure requires a special construction permit. Likewise, infrastructure construction projects are also subjected to similar emissions measurement and reporting obligations as the seaport transport operations.

HaminaKotka seaport complex employs a quality system, which comprises detailed instructions related to quality and environmental matters. Based on this system, different codes of conduct have been designed for different operators, concerning environmental and safety issues. Many operators also have their own quality and environmental systems, some bearing different types of certification.

Interview results

The main topics which emerged during the interviews are presented in Table 2. The discussions were mainly focusing on the current practices in HaminaKotka, development of operations in the past few years, overall sustainability of business in the region and the interviewees' vision of the near future for the seaport complex. Due to the geographical location and history of HaminaKotka, transportation between Finland and Russia remains as a highly relevant topic, even though this particular section of business has gone through massive changes in the past decade. Moreover, while the logistics field continues as a highly cost oriented industry, the interviewed companies recognized relevance of sustainable development of operations and the unique position that the region has in this regard to use sustainability aspects of their offerings as a competitive advantage in global transport chains.

The hinterland infrastructure in the area has gone through extensive development in the recent years. Both road and railway infrastructure in the area, and that of leading to the HaminaKotka seaport, has seen substantial investments and development measures. While the companies situated in HaminaKotka agree in unison that the infrastructure development projects have been mainly successful, bottlenecks in road transport flows have been occurring due to the lacking supporting infrastructure. Namely, the intersections between the European Route E18 (Stretching from Northern Ireland all the way to St. Petersburg, Russia; in this research the eastern section within Finland, from Helsinki to the border area, is considered) and smaller roads leading to cities and industrial areas have reportedly been the weak links in the transport chains. These smaller roads enable cargo flows from inland industrial locations in South-East Finland

Table 2 Overview of the topics emerged in the interviews

Types of handled cargo	Network of organizations
Importance of wood industry. Metal products. Project transportation.	Logistics operators, forwarders, carriers, exporters, importers. Road and rail transports are important in the hinterland operations.
Intermodal operations	Highway E18
Transport selection is a focal part of business. Intermodality is an important factor towards higher sustainability of transport chains (e.g., companies selecting larger share of railway transport over road in the total transport chain).	Important part of road infrastructure. Traffic flows well on this highway but lagging development of the roads connecting from inland to this highway (e.g., highways number 15 and 26) are creating bottlenecks in the road freight transportation.
Finland and Russia	Current situation
Challenges due to fading transit traffic through Finland to Russia. Sanctions and counter sanctions between EU and Russia. Sanctions had less impact on the traffic in HaminaKotka, but the succeeding collapse in Russian rouble's value severely diminished cargo between these countries. Russia is shifting from using transit countries to own ports. Future of freight traffic is uncertain, but potential is recognized to exist.	Fierce competition has driven prices down, and carriers' offerings are pretty much on par. Due to imbalance of imports and exports (much more exports) in HaminaKotka, large amounts of empty containers are delivered to the port (up to 40 thousand empty containers monthly). Maritime regulations are not having a significant impact to competition, although they are increasing the prices for all the carriers.
Sustainability	Future directions
Transport mode selection between sea, road and rail is one of the most important factors for environmental sustainability of transport chains. Alternative fuels (LNG, electricity) are not widely implemented in road traffic, but electricity is seen as promising option for the numerous short (10-100 km) transportations taking place in HaminaKotka region. High Capacity Transports (HCT) are increasingly utilized, and through load size optimization, they contribute to the environmental sustainability of operations. Sustainability is expected to be driven by larger actors, who in turn demand sustainability from their smaller partners. Social sustainability of the operations is high, since the Finnish laws and regulations are comprehensive and strictly monitored in these matters.	Adopt higher degree of digitalization to shift to more efficient and transparent business practices. Sustainable development strategies are becoming more important. Focus more on value-adding activities in logistics.

towards the coastal areas, hence the identified bottlenecks have significant impact on the overall operational flow of HaminaKotka. In addition to road transport, these smaller roads are typically used for travelling between the cities (e.g., commuting) in South-East Finland.

As already established, the international maritime regulations drive shipping companies to considerably reduce sulphur and nitrogen emissions, which requires them to use modern shipping technology. While the interviewed companies seem to be aware of the stricter regulation, very few carriers stated extensive vessel fleet renewal to meet the minimum requirement. However, the interviewed companies indicated to have taken substantial measures to tackle emissions and enhance environmental sustainability of their operations. These activities include cargo size optimization, transport mode selection in intermodal transport chains, and HCT on road. HCT, in terms of Finland, stands for road trains that have gross weight up to 100 tons with maximum length of 34.5 m, and these vehicles are allowed to operate on certain roads, which can support the weight and length of this type of vehicles. One of the interviewees stated that the maritime carriers have approximately same level of environmental sustainability in their operations, and the substantial differences in the transport chains are achieved through hinterland transport mode selection. While road transport mode remains important

mode in the hinterland, feasibility of railway transports in the region is growing. This is due to ongoing development of a railway connection from HaminaKotka to Kouvola to allow higher volumes of cargo to be moved on rail instead of road in the hinterland section of operations, which would decrease the amount of emissions originating from road transports. The reduction of emissions by favouring railway mode is possible due to the mentioned railway section being electrified.

Road transportation in Finland follows EURO engine classification, which sets a maximum amount of emissions acceptable depending on the vehicle's year of manufacture. This system enables fleet renewal activities to contribute towards environmental sustainability, even if it is not the main concern for the investment. However, alternative fuel technologies have emerged alongside the conventional solutions to enhance environmental sustainability while still providing adequate efficiency and economic feasibility. The interviewees seemed to be indifferent towards LNG as a fuel for road transports. Not many have considered this option, since there is not yet extensive practical proof for this alternative fuel's viability in terms of costs, although the overall emissions seem to be lower from LNG trucking compared to conventional due to the elimination of nitrogen oxide emissions (Zhiyi and Xunmin 2019). Usually the road carriers are cost sensitive, and justification of the investment required for LNG fuelled truck can be difficult. Furthermore, elimination of nitrogen oxides enhances the well-being of surrounding living beings due to its characteristic of forming into particulate atmospheric matter dangerous to breathing (Rao et al. 2012), thus promoting SDG #14. However, electric vehicles were seen as noticeably interesting for maritime logistics companies, due to the required low to medium range of autonomy for road transport mode as a supporting part of multimodal transport chains in the studied region. Electric vehicles were seen as especially feasible for the short distance (less than 100 km) transports taking place in the region of HaminaKotka. Interviewees pointed out that these vehicles could be recharged during their loading and unloading, thus mitigating operating range constraints typical for contemporary electric vehicles. Moreover, this alternative would effectively eliminate all emissions during operations, i.e., remove emissions from the vicinity of roads.

As indicated by the interviewed marketing and collaboration promoting company situated in HaminaKotka, it is extremely difficult for individual companies to comply with the tightening regulations on emissions, which indicates that collaboration between separate actors in supply chains is vital for successfully easing the impact of the operations on environment. Collaboration in this context stands for exchange of information on best practices, reporting environmental sustainability metrics of operations, and coordinating operations to eliminate possible overlap or slack. Moreover, marketing is especially important to enhance the competitiveness aspect of environmental sustainability in logistics, since heightened awareness of customers could influence the logistics service provider selection and enable justified premium in price for lower environmental impact. Both interviewees concluded that larger actors would adopt sustainability measures first and disseminate them to their smaller partners.

Sustainability communications review

After examining the 96 available websites of companies operating in HaminaKotka, it was evident that approximately 51.04% companies had regarded sustainability of their

operations in some manner (e.g., offering sustainability reports or showcasing sustainability in their value offering). Few of the studied companies had also established environmental sustainability as a driver for their strategy, communicating it as their primary competitive advantage. Exactly the same share of the companies (51.04%) had targeted environmental sustainability in their communication, whereas only 34.38% had also emphasized social sustainability of their business. Moreover, 17.71% of the companies had directly included SDGs in their sustainability communications, and all these companies were larger enterprises with international operations. Detailed results concerning the studied companies' sustainability communications on their websites can be found in Table 3. In addition to slightly over half of the companies who directly communicated sustainability aspects of their business, numerous companies indirectly communicated practices which ultimately contribute to the SDGs, e.g., efficiency of operations through route planning, transparent communication, intermodal transport opportunities or recycling of raw materials. Interestingly, only four of the companies (9.52% of the companies involved in sea transportation) had openly regarded IMO's tightened regulations in maritime traffic and listed substantial actions to achieve compliance with these emission regulations. Mainly, three approaches to the tighter emission regulations were observed: using cleaner conventional fuels, sulphur emission scrubbers and LNG fuelled vessels. Furthermore, many of the larger companies operating in HaminaKotka were demanding certain degree of sustainability from their partners within the respective supply chain.

Discussion

Infrastructure constraint issues leading to bottlenecks in hinterland operations were identified by the maritime logistics companies on the main roads leading to Hamina-Kotka seaport, similarly as described by Thorisson et al. (2019) and Wagener (2017). This case study reveals some recommendations for overcoming such obstacles. Introduction of feasible new technological advances (e.g., alternative fuels) can increase the

Table 3 Overview of the companies operating in HaminaKotka seaport

Type of organization	Share from the companies operating in HaminaKotka	Sustainability generally addressed in communications (percentage from respective organization type group)	Environmental Sustainability addressed in communications (percentage from respective organization type group)	Social sustainability addressed in communications (percentage from respective organization type group)	SDGs as a part of the sustainability communications (percentage from respective organization type group)
Sea transports	43.75%	57.14%	57.14%	33.33%	23.81%
Road transports	27.08%	42.31%	42.31%	23.08%	11.54%
Railway transports	26.04%	44%	44%	20%	12%
Air transports	16.67%	43.75%	43.75%	25%	12.5%
Warehousing	20.83%	35%	35%	5%	0%
Other	40.63%	51.28%	51.28%	46.15%	17.95%
Total	100%	51.04%	51.04%	34.38%	17.71%

Some companies are involved in multiple different types of transportation and activities, which results in the second column to add up higher than 100%

environmental sustainability of the transportation in the area of the seaport complex (Stalmokaitė and Yliskylä-Peuralahti 2019). HCT could answer to these infrastructure constraints by reducing the number of separate vehicles needed on the road for the same amount of cargo (Bergqvist and Monios 2016). Recent focus on development of the railway infrastructure at the seaport could ease the constraint currently stressing the road infrastructure in the area. Furthermore, a wider catalogue of transport mode options can enhance the environmental sustainability of the seaport complex due to decreasing the emissions originating from the road transport traffic at HaminaKotka (Bergqvist and Monios 2016; Christodoulou and Kappelin 2020; Henttu and Hilmola 2011; Kelle et al. 2019).

Collaboration between the organizations within HaminaKotka, as well as their partners outside, towards enhanced sustainability of business was highlighted in the interviews and to some degree in the sustainability communication of the studied companies. As mentioned by Wang et al. (2020), some of the studied companies even went beyond their own specific field in the pursuit for sustainability, i.e., contributing to SDGs which are not in direct relation with their core business. In addition, it was evident from the sustainability communication of the studied companies that some of them are directly or indirectly contributing to SDGs, but they are not explicitly communicating it. Such marketing can be expected benefiting the overall performance of the seaport complex (Papadas et al. 2017).

While the green initiatives of the studied seaport complex can substantially reduce the stress of the operations on the surrounding environment, prestigious green port status would most probably increase the freight flows through this port (due to pressure from regulations as well as demand by customers and partners in the supply chains, effectively favouring ports with a green status), thus making the operations management more difficult. In order to benefit from the green port status, it is necessary to brace for possible further challenges to mitigate the risk of reducing the green port marketing strategy to “green washing” (Lam and Li, 2019) or the engagement to SDGs to “rainbow washing” (Wang et al. 2020). This type of publicity would hurt the image of the seaport and probably cause a decline in the freight flows directed to that seaport.

Conclusions

The regulations concerning emissions are driving companies in transportation industry to adopt environmental sustainability in their daily business operations. For many companies, this could prove to be a challenge, since significant reduction of produced emissions requires considerable investments to vehicle technology and operations management solutions. Especially in maritime logistics, the sulphur and nitrogen emission regulations drive the vessel fleet operating at Baltic sea to be renewed (International Maritime Organization [IMO] 2019; Ministry of Transport and Communications 2016). Moreover, as the hinterland operations of HaminaKotka seaport depend greatly on road transport, ongoing emission reduction plans targeting road traffic are forcing the affected companies to rethink their multimodal transport chains with new technologies (e.g., engines using alternative fuels) and practices (e.g., favouring railway in transport mode selection).

The port managing body and the companies operating in the seaport complex seem to have identified benefits of environmentally sustainable image. However, if

HaminaKotka seaport complex and related companies wish to enjoy the benefits of a green port status, collaborative effort in environmental sustainability towards this common goal is required. Since the marketing benefits of green port status come from companies favouring such ports in their supply chain design, neglecting the environmental impact of operations could completely undermine any competitive advantages or even diminish the seaport brand (Lam and Li. 2019).

UN's SDGs offer a comprehensive overarching framework to control the sustainability of operations in clusters such as HaminaKotka seaport; however, to conduct the operations towards these goals, more specific company and operations level guidelines and agreements are needed. Firstly, selecting the focal SDGs depending on the business practices and operating models of the companies forming the cluster is vital. After that, it is possible to pinpoint the feasible methods of enhancing the sustainability. It is important to note, that the progress towards the target of SDGs should be considered as continuous process of improvement. Ultimately, maritime logistics companies should try to implement all the SDGs to their strategy to ensure the achievement of their target (Wang et al. 2020).

The overall effect of the SDGs and orientation to green port operations can be seen as positive on all three aspects of sustainability. Through targeting environmental challenges, logistics companies at the seaport can subsequently enhance the lives of the workers and inhabitants of the nearby areas, and as the customers of the seaport are becoming increasingly environmentally aware, the economic sustainability can be secured. Moreover, while the larger multinational companies in the studied region have integrated SDGs into their strategy, the collaborative nature of the effort needed to achieve these targets requires contribution of the smaller, local actors. External forces, such as regulations (Wang and Sun 2019) and sustainability demands within a supply chain, are helping with the cause, but also intraorganizational forces, such as identifying sustainability as a competitive advantage, are most probably required to convince companies to adopt higher degree of sustainability in their activities.

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Authors' contributions

Main author of this research is Oskari Lähdeaho, who is responsible for the data gathering through interviews and survey on public sustainability communications of the studied companies, and writing of the first draft. Olli-Pekka Hilmola has commented, improved and modified the manuscript. Riitta Kajatkari has improved and modified empirical parts of the revised draft. The author(s) read and approved the final manuscript.

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Availability of data and materials

Used empirical data of this research is available from corresponding author by request via e-mail.

Competing interests

There does not exist any competing interest among authors of this manuscript.

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References

- Bergqvist R, Monios J (2016) The last mile, inbound logistics and intermodal high capacity transport - the case of Jula in Sweden. *World Rev Intermodal Transp Res* 6(1):74–92
- Centobelli P, Cerchione R, Esposito E (2017) Developing the WH2 framework for environmental sustainability in logistics service providers: a taxonomy of green initiatives. *J Clean Prod* 165:1063–1077
- Christodoulou A, Kappelin H (2020) Determinant factors for the development of maritime supply chains: The case of the Swedish forest industry. *Case Stud Transp Policy* 8(3):711–720
- Das C, Jharkharia S (2018) Low carbon supply chain: a state-of-the-art literature review. *J Manuf Technol Manag* 29(2):398–428
- Dua A, Sinha D (2019) Assessment of quality of multimodal transportation for containerized exports. *IIM Kozhikode Soc Manag Rev* 8(1):10–22
- Eisenhardt KM, Graebner ME (2007) Theory building from cases: opportunities and challenges. *Acad Manag J* 50(1):25–32
- European Commission (2016) A European strategy for low-emission mobility. <https://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX:52016DC0501>. Accessed 18 Dec 2019
- Evangelista P, Durst S (2015) Knowledge management in environmental sustainability practices of third-party logistics service providers. *Vine* 45(4):509–529
- Ghauri P, Grønhaug K (2010) *Research methods in business studies*, 4th edn. Pearson Education Limited, Essex
- Henttu V, Hilmola OP (2011) Financial and environmental impacts of hypothetical Finnish dry port structure. *Res Transp Econ* 33(1):35–41
- Hilmola OP (2019) *The Sulphur cap in maritime supply chains: environmental regulations in European logistics*. Palgrave Macmillan, Pivot Series, London
- International Maritime Organization (2019) List of amendments expected to enter into force this year and in the coming years. <http://www.imo.org/en/About/Conventions/Pages/Action-Dates.aspx>. Accessed 17 Dec 2019
- Jaccard M (2006) *Sustainable fossil fuels: the unusual suspect in the quest for clean and enduring energy*. Cambridge University Press, Cambridge
- Kelle P, Song J, Jin M, Schneider H, Claypool C (2019) Evaluation of operational and environmental sustainability tradeoffs in multimodal freight transportation planning. *Int J Prod Econ* 209:411–420
- Kronfeld-Goharani U (2018) Maritime economy: insights on corporate visions and strategies towards sustainability. *Ocean Coast Manag* 165:126–140
- Lam JSL, Li KX (2019) Green port marketing for sustainable growth and development. *Transp Policy* 84:73–81
- Liimatainen H, Stenholm P, Tapio P, McKinnon A (2012) Energy efficiency practices among road freight hauliers. *Energy Policy* 50:833–842
- Liimatainen H, van Vliet O, Aplyn D (2019) The potential of electric trucks – an international commodity-level analysis. *Appl Energy* 236:804–814
- Ministry of Transport and Communications (2016) Nitrogen emissions from ships restricted in the Baltic Sea and North Sea. <https://www.lvm.fi/-/nitrogen-emissions-from-ships-restricted-in-the-baltic-sea-and-north-sea>. Accessed 18 Dec 2019
- Osorio-Tejada JL, Llera-Sastresa E, Scarpellini S (2017) Liquefied natural gas: could it be a reliable option for road freight transport in the EU? *Renew Sust Energy Rev* 71:785–795
- Othman MR, Jeevan J, Rizal S (2016) The Malaysian intermodal terminal system: the implication on the Malaysian maritime cluster. *Int J E-Navigation Marit Econ* 4:46–61
- Panova Y, Korovyakovskiy E, Semerkin A, Henttu V, Li W, Hilmola OP (2017) Russian railways on the Eurasian market: issue of sustainability. *Eur Bus Rev* 29(6):664–679
- Papadas KK, Avlonitis GJ, Carrigan M (2017) Green marketing orientation: conceptualization, scale development and validation. *J Bus Res* 80:236–246
- Port of HaminaKotka (2020) Statistics. <https://www.haminakotka.com/about-port/port-haminakotka-ltd/statistics>. Accessed 12 Feb 2020
- Rao S, Chirkov V, Dentener F, van Dingenen R, Pachauri S, Purohit P, Amann M, Heyes C, Kinney P, Kolp P, Kilmont Z, Riahi K, Schoepp W (2012) Environmental modeling and methods for estimation of the global health impacts of air pollution. *Environ Model Assess* 17(6):613–622
- Solaymani S (2019) CO₂ emissions patterns in 7 top carbon emitter economies: the case of transport sector. *Energy* 168:989–1001
- Stalmokaitė I, Yliskylä-Peuralahti J (2019) Sustainability transitions in Baltic Sea shipping: exploring the responses of firms to regulatory changes. *Sustainability* 11(7):1916
- Statistics Finland (2020) International sea transport by port and commodity group 2000–2019. http://pxnet2.stat.fi/PXWeb/pxweb/en/StatFin/StatFin_lii_uvliik/statfin_uvliik_pxt_001.px/. Accessed 6 Feb 2020
- Thorisson H, Hendrickson DC, Polmateer TL, Lambert JH (2019) Disaggregating uncertainties in operations analysis of intermodal logistics systems. *ASCE-ASME J Risk Uncertainty Eng Syst B Mech Eng* 5(1):011007. <https://asmedigitalcollection.asme.org/risk/article/5/1/011007/368953/Disaggregating-Uncertainties-in-Operations>
- United Nations (2019) Sustainable development goals. <https://sustainabledevelopment.un.org/?menu=1300>. Accessed 18 Dec 2019

- Veenstra AW, Zuidwijk RA (2016) Towards efficient multimodal hinterland networks. In: Zijm H et al (eds) Logistics and supply chain innovation, lecture notes in logistics. Springer International Publishing Switzerland, Cham pp 55–66
- Wagener N (2017) Intermodal logistics centres and freight corridors - concepts and trends. *Logforum* 13(3):273–283
- Wang M, Liu K, Choi TM, Yue X (2015) Effects of carbon emission taxes on transportation mode selections and social welfare. *IEEE Trans Syst Man Cybern Syst* 45(11):1413–1423
- Wang Q, Sun H (2019) Traffic structure optimization in historic districts based on green transportation and sustainable development concept. *Adv Civil Eng* 2019
- Wang X, Yuen KF, Wong YD, Li KX (2020) How can the maritime industry meet sustainable development goals? An analysis of sustainability reports from the social entrepreneurship perspective. *Transp Res D Transp Environ* 78:102173
- Zhiyi Y, Xunmin O (2019) Life cycle analysis on liquefied natural gas and compressed natural gas in heavy-duty trucks with methane leakage emphasized. *Energy Procedia* 158:3652–3657

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