

Ecological maritime transportation

How can ports in the baltic sea adjust  in the changing operational environment?

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Abstract

Maritime transport is sometimes considered to be the most ecological mode of transport when it comes to CO₂ emissions. With new environmental legislation, such as the so-called Sulphur Directive, it is possible to render maritime transport even more environmentally friendly. Yet, the change towards a more ecological mode of transport seems to be more focused on ship operations and shipping companies. It should be noted that ports are a prerequisite for maritime transportation and important logistical nodes. Thus, the ecology of maritime transportation cannot be assessed without considering the emissions from ports. Legislation is one of the most significant driving forces that lead the ports to invest in environmental actions. Nevertheless, ports may also find motivation to reduce their environmental effects voluntarily by, for example, applying best practices, introducing environmental

systems or standards or by engaging in corporate social responsibility.

Different management practices can affect ports' daily operations, development and expansion plans, and possibly competitiveness as well. In this study, we conducted an e-mail questionnaire directed at commercial maritime ports located in the Baltic Sea region. In general, all ports that participated in this research were committed to environmental issues and complied with environmental legislation. Several of the participating ports stated that they would operate at the same environmental level even without environmental legislation. In addition, the ports have realized that they can also achieve cost savings with best practices and green solutions.

Key words

Low carbon, best practices, port operations, environmental policy instruments and Baltic Sea.

Introduction

Dense ship traffic, port operations and port related land transportation cause a lot of different kinds of emissions to air and water. Especially ships produce waste, black and grey waters, ballast waters etc. Emissions to air are the most important factors that increase the greenhouse effect and climate change. The main source is exhaust gas from combustion engines that are used in marine and road traffic and partially in train traffic, as well as, working machines in the port area. Diesel and petrol fuel are almost sulphur-free (0.01%), but the bunker that ships use had a sulphur content of 1.1% in 2009 and 2015 the level of sulphur in Emission Control Areas (ECA) is 0.1%. (VTT 2009).

In addition to emissions to air and water, ports are facing many other challenges also, such as the changes in the economy, increasing competition, as well as various environmental and other legislative changes. Globalization and an increasing demand for goods have led to a growing requirement for freight transport in Europe. Transport is responsible for around a quarter of EU greenhouse gas emissions making it the second biggest greenhouse gas-emitting sector after energy. (European commission, 2012). Maritime transport emits around 1.000 million tonnes of CO₂ annually and is responsible for about 2,5 % of global greenhouse gas emissions (IMO, 2015).

Earlier it was thought that maritime transport is an ecological mode of transport. This is correct when speaking of CO₂ emissions. However, the other greenhouse gas emissions of maritime transport are even higher than in other modes of transport. Although most of these emissions take place at sea, the most directly noticeable part of shipping emissions takes place in port areas and port-cities. However, relatively little is known about ship emissions in ports. (OECD, 2014)

It has been indicated that port activities can have significant negative impacts on the environment. Shipping has an environmental impact both on ports, as well as on the immediate vicinity of the ports. The environmental impact of ports may be related to problems caused by port activity itself, problems caused at sea by ships calling at the port or emissions from inter-modal transport networks serving the port hinterland. Due to the wide range of these impacts, a broad mix of policy instruments needs to be applied in order to manage the environmental impacts. In addition, the “optimal” mix of instruments is likely to vary from port to port. (OECD, 2011)

With new environmental legislation, such as the so-called Sulphur Directive (Directive 2012/33/EU), it is possible to render maritime transport more environmentally friendly. Yet, the change towards a more ecological mode of transport should be more focused on ship operations and shipping companies also. In this paper we discuss how ports can take part in the new ecological trend and at the same time benefit from the integration of environmental interests in their operations.

1. Port related environmental policy drivers

Environmental effects of port activities can be controlled and decreased in several ways. Legislation is one of the most significant drivers that lead the ports to invest in environmental actions. International, regional and national legislation regulates the port operations and sets different kinds of economic incentives or disincentives to the operation. Yet, the ports may also find motivation to reduce their environmental effects voluntarily from their own driving forces, from societal pressure, in order to improve the port operations or in order to gain competitive advantage (Madjidian et al. 2013). The ports can go even further in managing their environmental effects than required by law, for example, by engaging in corporate social responsibility (CSR), developing best practices and introducing certifications.

1.1. Environmental policy instruments

policy instruments effects port operations and usually policy instruments are divided into regulatory instruments, economic instruments and information based guidance. Environmental effects of port activities can be controlled and decreased with each kind of the policy instruments. Regulatory instruments include, for example, jurisdiction and decrees, restrictions and licenses (Kuronen & Tapaninen, 2010). Regulatory instruments are effective and easy to enforce and their weaknesses include their economic efficiency and public acceptance. The implementation and enactment can also be sometimes expensive or difficult (Vieira et al. 2007). In addition, regulatory instruments may not promote changes or innovations, because they do not include any economic incentives (Klemmensen et al. 2007).

Economic instruments include for example taxes, subsidies and fees. Economic instruments can achieve environmental targets with good economic efficiency. However, they also often face acceptance difficulties, because they tend to increase prices (Kuronen & Tapaninen, 2009; Vieira et al. 2007).

Information guidance is based on the idea that information can lead to a voluntarily change in behaviour. The effectiveness of information guidance is totally dependent on the interest of the operator. Information-based guidance includes, for example, certifications that can be used in ports. While regulatory and economic instruments are usually based on legislation, with consequences for non-conformity, information guidance is completely dependent on the actors' voluntary interests (Kuronen & Tapaninen, 2010).

1.2. Port related and national legislation

Legislation is the most powerful way to lead ports to environmental investments. In the EU-level there are many different regulations that influence the European ports and their management directly or indirectly. However, not all port related EU legislation affects the environment. For example, the Birds Directive (Council Directive 79/409/EEC, on the conservation of wild birds) and the Habitats Directive (Directive 92/43/EEC, on the conservation of natural habitats and of wild fauna and flora) and the Natura 2000 network that is based on them, can affect the ports directly. The directives can for example affect the ports during port development and port expansion plans. (European Commission, 2013).

In addition to EU legislation, practically all ports are affected by national environmental regulations. Ports have to follow national environmental policies and environmental management systems. In addition, ports in Finland and Sweden, for example, have to get an environmental permit for port operations and in Finland ports have to go through an environmental

impact assessment (EIA). For example, in the Finnish legislation, there are almost 90 different laws, acts, regulations and rules that affect port operations and port construction.

The aim of the Finnish the Act on Environmental Impact Assessment Procedure (468/1994) is to further the assessment of environmental impact and consistent consideration of this impact in planning and decision making, and at the same time increase the information level of citizens and give them the opportunity to participate in decision making. Environmental impact assessment procedure shall be applied to such projects, which may have significant adverse environmental impacts, due to the special features of Finland's nature and environment. Assessment procedure shall also be applied, in individual cases, to a project that will probably have significant adverse environmental impact.

1.3. Corporate social responsibility

In the corporate social responsibility (CSR) concept, companies voluntarily take part in actions that contribute to a cleaner environment and a better society. CSR takes into account the environmental, social and economic aspects of company operations and the aim is to find a balance between those three factors. (Elkington, 1994) This is achieved through interaction with stakeholders and by integrating any concerns into business operations, which will potentially result in economic benefits, as well (the Commission of the European Communities, 2001; Kujala, 2009).

Corporate social responsibility activities are not usually taken into serious consideration in companies whose activities are in a business-to-business level, such as ports. Nevertheless, stakeholder involvement is a central part of a company's CSR activity. (Poulovassilis & Meidanis, 2013). It should be noted that sometimes the values of the companies are the only thing that separates them from their competitors, and a "green" company is usually associated with good quality service and innovativeness (Holmgren, 2010; Acciaro, 2012).

The benefits gained with CSR are largely dependent on the measures taken, the costs related to them and the measured time period. Benefits can be gained in different fields, such as the environment, human resources, customer relations, innovation, reputation and financial performance. The focus in CSR should be on obtaining long term profits which include not only monetary profits but also social and environmental benefits, which are often challenging to measure and whose positive outcomes can be seen only after a while (Kunnaala-Hyrkki & Brunila, 2015; Poulovassilis & Meidanis, 2013).

1.4. Best practices in port operations

One key element in the competition between the Baltic Sea ports now and in the future will be their environmental status and capability to respond to the challenges of sustainable development (Brunila & Anttila, 2013). Developing best practices and sharing them allows ports to enhance their operations and helps them to choose the most cost effective measures for decreasing their environmental impact (e.g. GHD, 2013).

However, it should be recognized that the ports are not the same; each port and its surrounding area can be considered to be unique. Thus the importance of different environmental aspects depends on the characteristics of each port, and not all best practices applied in one port are directly applicable in another. Nevertheless, several environmental issues are common to all ports, and they face common environmental challenges (Hiranandani, 2014).

Ports utilize a range of sustainable practices. Best practices for ports have been developed in for example previous projects. Best practices are closely linked to the concept of Green Port. The key elements in the Green Port concept include: long term vision, stakeholder participation, shift from sustainability as a legal obligation to sustainability as an economic driver, actively sharing knowledge with other ports and continuous strive towards innovation (PIANC, 2013).

1.5. Standards and certificates

Best practices are closely linked to environmental management systems or standards, such as the ISO 14001, the Port Environmental Review System (PERS), or the Eco-Management and Audit Scheme (EMAS). The most common and well-known environmental system is the ISO 14001. The system is made flexible so that it is applicable in companies and organization of different sizes and types. The standard covers the terminology and principles of CSR, stakeholder communications and other core issues of CSR.

Unlike other ISO standards, the ISO 26000 is not intended as a basis for certification. Instead, it is meant as a comprehensive guidance document for public as well as private organizations of all sizes wishing to become more effective in fulfilling their social responsibility (ISO 26000:2010 Guidance on social responsibility). Environmental management systems and standards can include good practices that ports can use in their operation. Environmental management systems also indicate the port's preparedness to actually comply with environmental legislation, and to strive for environmental improvement and sustainable development (Madjjidian et al. 2013).

2. Management of ports in the baltic sea area

The results of this section are based on questionnaire study, which were carried out using the web-based system “Webropol” (<http://w3.webropol.com/>). Ports that are located in the Baltic Sea area were invited to answer the questionnaire. The aim was to exclude recreational ports and smaller ports, the transportation volume of which was less than 0.5 million tons per year. No other restrictions were made based on the port operations. The questionnaire was sent to 188 recipients from all countries surrounding the Baltic Sea. The questionnaire received answers from 28 different ports. The respondents were from Denmark, Estonia, Finland, Germany, Latvia, Poland and Sweden.

In the Baltic Sea area the management of environmental effects varies in each ports. In the EU area the legislation is equal to all ports, but geographical situation and conditions makes each port some kind of unique. The different management practices can affect ports’ daily operations, development and expansion plans, and possibly competitiveness as well.

2.1. Ports and legislation

During the questionnaire, the responding ports were asked about their views on national and EU legislation. This question gives an overview how ports perceive the impact of legislation in their port operations. The first question was whether the ports consider national legislation to be stricter than EU legislation in their country. Over half of the respondents (approximately 54 %) replied that national legislation is stricter in their country. Correspondingly 46 % told that national legislation and EU legislation are at the same level. None of the respondents saw that national legislation was less strict than EU legislation.

Danish ports were unanimous in their responses and all of them considered national legislation to be stricter than EU legislation. Correspondingly Polish and Latvian ports were also unanimous and they all saw that in their country national and EU legislation is at the same level. The majority of Finnish and Estonian ports considered national legislation to be stricter even though few ports considered it to be at the same level as EU legislation. The responses of the Swedish and German ports were divided equally.

The respondents were also asked whether they consider EU legislation to be highly restrictive. Approximately 36 % respondents answered yes and 64 % answered no. The respondents were also asked to elaborate their answers and thus we received 13 arguments on the strictness of EU legislation. Three of the respondents who considered EU legislation to be highly restrictive referred to SO_x limitations in the Baltic Sea SECA area as an example of highly restrictive EU legislation and thus sulphur requirements

was the most common answer. The problem with the “sulphur directive” is that it is not applicable in the whole EU area. For example, the sulphur directive can influence the competition between ports. Another respondent pointed out that the directive may have an opposite environmental impact than what was initially intended, as the directive might cause a modal shift from shipping to road and rail transportation and as ship operators install scrubbers, which causes an increase in consumption of the fuel and, consequently, an undesired increase in CO₂ emissions.

The ports also pointed out that, because EU legislation is generalized to cover all kinds of ports, it might be too restrictive to some ports. One respondent replied that, because of EU legislation there are too many overlapping plans and licences that are required from the ports. One respondent pointed out that environmental performance criteria are constantly getting stricter. One port saw that EU legislation is partly blocking the port’s investments. In addition, one port replied that it is challenging to handle ships and cargoes within the required environmental limits at all times. One of the responding ports stated that even though environmental issues should be one of the top priorities in EU legislation and benefits to public are primary concerns and need to be addressed through stringent regulations, it should be noted that the legislation has to be also economically feasible, since only such legislation is actually sustainable.

Also the respondents, who replied that EU legislation is not highly restrictive, gave arguments on the strictness of EU legislation. Some of ports pointed out that they want to have a cleaner world also in the future and thus they don’t consider EU legislation highly restrictive. One of the responding ports saw that EU legislation is not restrictive and includes only relevant demands. Especially Finnish ports pointed out that, national legislation is more restrictive than in EU.

In the questionnaire, the responding ports were also asked whether they consider national legislation to be highly restrictive. Approximately 61 % respondents answered no and approximately 39 % responded yes. The respondents were also asked to elaborate their answers and thus we received 15 arguments on the strictness of national legislation.

Especially Finnish ports considered national legislation to be highly restrictive. They considered the legal permit processes to be too long and the conditions to be too strict. In addition, there are too many overlapping plans and licenses required. Because of the operational environmental permits, the ports are not able to react to new business opportunities, such as new cargo flows, as fast as they should, which can affect the ports’ competitiveness. In addition, one Finnish port claimed that Finnish legislation includes some stricter rules than other countries in the Baltic Sea area have.

Correspondingly, one Danish port replied that it is a challenge to handle ships and cargoes within environmental limits at all times. Two of the

three Estonian ports that answered the questionnaire replied that Estonian legislation is too focused on protective and preserving methods and that environmental performance criteria are constantly getting stricter. Two Swedish ports that considered national legislation not to be highly restrictive replied that contrary to EU legislation, national legislation is based on local circumstances and conditions and its demands are more relevant.

We get also answers, how EU and national legislation have affected their ports' operations. One of the responding Swedish ports replied that, based on the legislation, they have legal permits that give the frame on the environmental work. Another Swedish respondent pointed out that the rules and regulations cover all parts of the port operations, working environment and work times, building standards etc. thus EU and national legislation affect all parts of the port. Another respondent from Sweden also mentioned annual reporting, waste handling and construction projects to reduce noise level as effects that EU and national legislation has had on their port.

The responding ports from Finland wrote about the required environmental permits. Some ports told that, because of EU and national legislation, a lot of resources are spent that could otherwise be used for more effective environmental activities, since all of the investments are not always justified. The ports also have to be more aware of their environmental effects and also constantly follow the development of legislation. Also one Danish port replied that, due to EU and national legislation, they have to invest in costly environmental protection.

One responding port from Estonia told that fortunately so far there have not been any big direct negative effects, but there is a very clear trend that in future development projects the amount of bureaucracy is increasing. Some responding Estonian ports told that the cost of services can increase as the environmental monitoring increases in different areas and more expensive technologies have to be adopted. In addition, one Danish port also pointed out that, due to legislation, their port has to invest in, for example, noise reducing walls and equipment.

The responding Polish ports replied that environmental issues have to be taken into consideration during all port's operations. As an example of direct effects of legislation, one port wrote that due to the new sulphur rules, bunkering facilities will have to be adapted to offer low sulphur fuel and LNG and also the refuelling infrastructure has to be reconsidered.

2.2. Ports and Ten-T network

During the questionnaire the ports were also asked about their Ten-T status and status has been affect ports' environmental assessment and management. 64 % of the responding ports belonged to the Ten-T network and

responding ports replied that no such effect has come up so far and they do not see a direct link between Ten-T and environmental development.

One of the responding ports saw that there stricter regulations from EU level for Ten-T ports may come up later on, but only for Core ports. Another port did not see any immediate effects, but suspected that, in the long run, being a Ten-T port can make it somewhat easier to obtain financial support to infrastructure projects from governments. One Danish and Swedish Ports wrote that they have conducted a study on implementing LNG as a part of their duty as a Core Port. Another port also stated that every project, even those related to being a Ten-T port, requires an environmental permit based on national legislation.

2.3. Measurement of environmental effect in ports

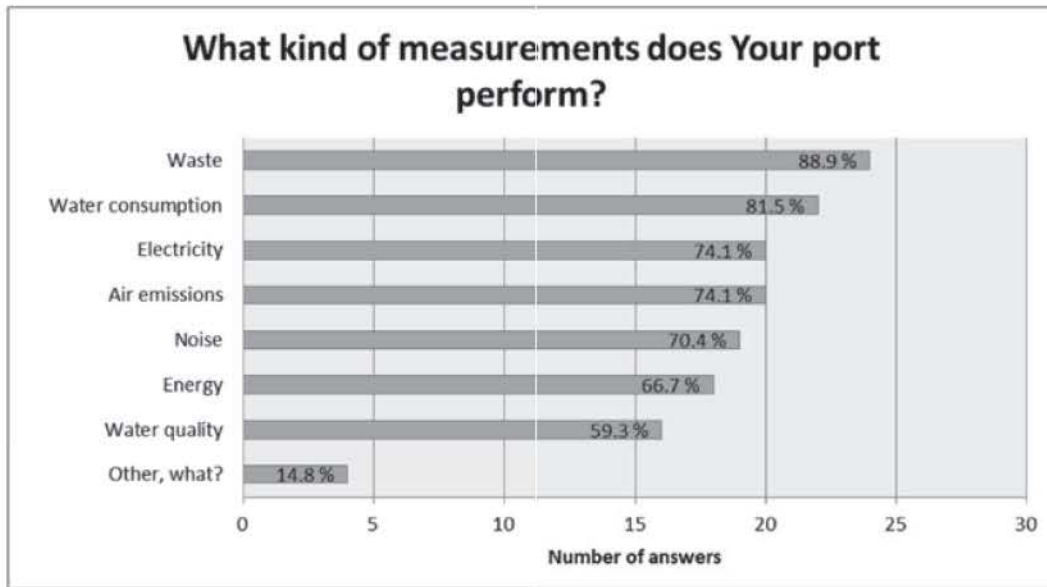
According to the survey, almost 79 % of the ports that answered the question told that they measure the state of their surrounding environment. Measuring the state of a port's surrounding environment might be necessary, for example if there is a nature reserve in the proximity of the port. In addition, stakeholder pressure from citizens or cities located near ports can urge the ports to perform additional, voluntary environmental actions, such as the measurement of the state of the surrounding environment.

According to the results of the questionnaire, over 82 % of the responding ports measure their environmental impacts. Only three respondents replied that their port does not measure its environmental impacts and one respondent did not know the answer. The ports in the Baltic Sea area are often obliged to measure some of their environmental impacts. This may be based on legislation, environmental permits or it may also be based on the certificates or standards that the ports have adopted.

In Finland the port's environmental permit may require regular noise level measurements or it may include emission limits, the control of which usually requires measurements (Environmental Protection Act 527/2014). ISO 14001 requires that the organization documents a procedure for monitoring and measuring the operations that can have a significant environmental impact (ISO 14001).

The most common measurements the ports performed were related to waste (88,9%). The most second common measurement target was water consumption (81,5%) and the third most common were electricity and air emissions (both 74,1%). The ports also gave some answers outside the given options. According to those answers, the ports also measure soil, sediments and dumping sites.

Figure 1: different measurements the ports perform in their operations



The ports’ environmental practices can depend on, for example, the port’s country of origin or the port’s relation to the TEN-T Network. In this study, we conducted an e-mail questionnaire directed at commercial maritime ports located in the Baltic Sea region. During the questionnaire the ports were asked, for example, about their best practices and environmental initiatives.

In general, all ports that participated in this research were committed to environmental issues and complied with environmental legislation. Some of the participating ports applied best practices and did also voluntary environmental initiatives in order to improve their environmental image, increase their operation cost-effectiveness, and also purely in order to improve the state of the environment. Several of the participating ports stated that they would operate at the same environmental level even without environmental legislation. In addition, the ports have realized that they can also achieve cost savings with best practices and green solutions.

2.4. Best practices in ports

Approximately 64 % of the responding ports replied that they do apply best practices. Some of the best practices used in the ports are listed below as an example:

- Environmentally differentiated harbour fees
- Exchange of information with other Baltic Sea ports
- Using the latest best environmental techniques
- Best practices based on ESPO Green Guide

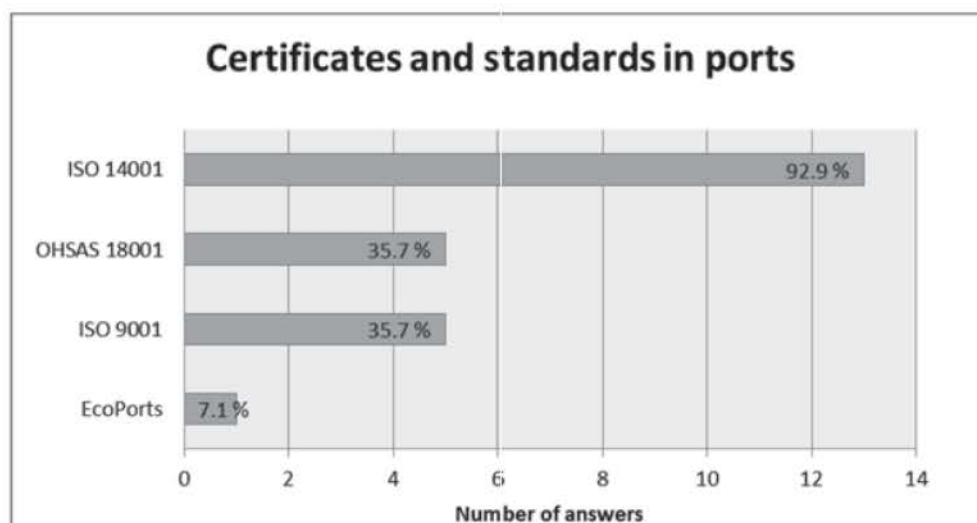
- Dimming lights
- Environmental issues included in the mandatory Port Safety Training
- Gas recuperation system in liquid chemical terminal
- Dust-free loading system of dry bulk

The responding ports also mentioned that they have best practices in the field of air emissions, waste management, building, noise management, waste separation and wastewater treatment. Some differences in executing best practices can be found when the port sizes are compared. 70 % of the responding bigger ports, with an annual cargo volume of over 10 million tonnes, and 67 % of ports, which annual cargo volume is 1-10 million tonnes, use best practices in their operations. Only 33 % of ports, with an annual cargo volume of under 1 million tonnes use best practices. The reason for that might be that usually the bigger ports have more economic and human resources for the development of best practices and they also have resources to participate in different kinds of research projects. Smaller ports may have to concentrate more on port operations and they might not have enough resources to go beyond the compulsory legislative requirements.

2.5. Certificates and standards in ports

In the questionnaire study, ports answered that certificates of standards are very important in port operations and especially if something an accident or an incident happens in port area. Still approximately 43 % of the ports replied that they do not have certificates or standards. Correspondingly, approximately 57 % of the ports had acquired some certificate or standard or were working on getting quality and environmental certificates. The Certificates and standards in use can be seen in the figure below.

Figure 2: Certificates and standards what Ports in Baltic Sea area use.



Out of those ports 13 (approximately 93 %) had the ISO 14001 certificate. In the case of eight (approximately 57 %) of those ports, it was the only certificate they had. Five of the 14 ports that revealed the type of the certificates and standards they have had all three certificates, that is ISO 14001, ISO 9001 and OHSAS 18001 certificates. One of the responding ports had the “EcoPort” status.

2.6. Participation in projects

The responding ports were also asked if they have conducted or participated in projects, the goal of which has been the assessment and management of the port’s environmental effects. Half (14) of the responding ports wrote that they have conducted or participated in such projects. The named project include, for example:

- Clean Baltic Sea Shipping
- LNG in Baltic Sea Ports
- Baltic Master I and II
- Joint monitoring of the sea area
- ECODUMP
- Cruise Baltic – Port Service Standards
- New Hansa
- SMOCS

In addition the ports revealed that they have conducted or participated in projects regarding on shore power supplies and new territories and infrastructure.

3. Results and discussion

environmental protection is very important to all stakeholders who are connected to the port or are positioned nearby. Often the ports only act as landlords and the private companies that operate in the port area produce the majority of the ports’ emissions. In order to get the necessary environmental information, the ports have to measure their emissions, use calculation models and different kinds of other computing systems to fulfill the requirements of their environmental permits and EU and national legislation. When the environmental information is compiled, used and collected, cost-effectiveness and the size and type of the organization must be taken into consideration. It is important to collect all the necessary data and fulfill the existing obligations of the environmental permits and legislation.

Even though a lot of environmental data is collected for, for example, the environmental permits and for the different stakeholders, the biggest problem is the comparability of the collected data. There are no systems or instruments with which emissions could be compared between ports. The amount of environmental information is sufficient, but reporting methods vary between ports. There are differences in units and codes and in some cases the information is not sufficient and can even be unreliable.

Based on the questionnaire and interview studies it can be stated that ports in the Baltic Sea area consider environmental issues to be important and value their own environmental image. Nevertheless, when it comes to competitive advantage, other issues not related to the environment have a greater role. Ports operate on a business-to-business level and thus then environmental issues are not the most important factor or a marketing method. Factors that affect the competitiveness of the port are rather the location of the port, the port's infrastructure, such as the depth of the waterways, road and railway connections to the port, shipping routes and connecting ocean lines and available port facilities. These issues affect the ports' competitiveness more than the ports' environmental image.

In practice, environmental permits and legislation affect all Baltic Sea ports to some extent. Even though port operators are not necessarily required to have environmental permits in all countries, certain operations or certain operators in the ports may require a permit. In addition, usually, if there are changes in operations or new cargo, the environmental permits must be updated. Because of the operational environmental permits, the ports are not able to react to new business opportunities, such as new cargo flows, as fast as they should, which can affect the ports' competitiveness. Thus, it would be more rational to define general operating instructions, rules and limits in the environmental permits instead of defining the specific cargo types that can be handled.

In order to achieve better results in environmental protection, support the ports' voluntary environmental initiatives and simultaneously maintain the competitiveness and equality of the ports, all EU member countries should have unified legislation for ports. In practice, this would mean that every EU member country should apply the same environmental legislation, environmental procedures and emission calculation systems. The unit for emission measurements could be handled cargo volume tonne per produced emissions tonne. This would also enable the comparison of emission levels between ports. In addition, especially Finnish ports see that it would benefit the ports and authorities, if decision making would be more centralized. That way all of the ports would be treated equally. In addition there is necessarily no need for localized decision making, if the legislation is the same to all ports. Nowadays, the different practices of different local and national authorities put the ports in different competitive positions.

According to the results of the study, in all of the participating ports some environmental protection work has been done. Generally all of the ports have taken environmentally friendly initiatives or strive to act responsibly. Investments to environment are done mainly because of requirements in legislation or environmental permits. Almost 79 % of the ports that replied to the questionnaire told that they measure the state of their surrounding environment.

Measuring the state of a port's surrounding environment might be necessary, for example if there is a nature reserve in the proximity of the port. In addition, stakeholder pressure from citizens or cities located near ports can urge the ports to perform additional, voluntary environmental actions, such as the measurement of the state of the surrounding environment. In addition, over 82 % of the responding ports told that they measure their environmental impacts.

The most common measurements the ports performed were related to waste, water consumption, electricity and air emissions. Sometimes ports may not consider that, for example, water, energy and electricity consumption measurements are related to the environment. Instead they might see that the measurements are aimed at preserving resources and improving the cost-effectiveness of the ports. The resulting environmental benefits are merely a positive side effect.

The responding ports saw that some obligatory measurements are futile, since the results of the measurements do not change if nothing has changed in the port operations. In addition, sometimes the ports are required to measure emissions that the ports do not even produce. Authorities were also criticized, since they do not always seem to understand the whole port operation processes.

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