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Green measures for sustainable sea ports: A case study of the sea port in Gdynia

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Abstract

The aim of this article is to present the results of research on solutions that can be implemented by the Gdynia Sea Port to allow it to obtain the title of a Green Port. The conducted research concerned a broad area, i.e., the identification of initiatives taken by seaports distinguished as Green Ports and other possible solutions consistent with the ideas of sustainable development. The article focuses on solutions for the Gdynia Sea Port, which, despite the implementation of many pro-ecological initiatives, does not have the official title of a Green Port. Seaports serve many modes of transport, but they are currently dominated by road transport. The activities of seaports located in urban agglomerations significantly contribute to the emission of air pollutants, noise, congestion, and other factors, which directly affect the health and quality of life of its inhabitants. The research process involved a critical literature analysis, the method of deduction, and a structured interview with representatives of the seaport in Gdynia. Based on the conducted research, areas important for obtaining the title of Green Port were identified, including increased investments in renewable and alternative energy sources, as well as a focus on the implementation of intelligent solutions.

Introduction

Seaports are an important part of the economy, both at regional and national levels. They are the dominant factor in integrated transport infrastructure networks and enable trade between overseas countries and continents. Numerous international reports have indicated that this branch of transport accounts for nearly 80% of the volume of world trade, and as much as 90% in some developed countries (United Nations, 2014). According to the European Commission, around 400 million passengers use port services each year. Ports employ nearly 1.5 million people, and at least twice as many people work in port-related sectors (European Commission – Mobility and Transport, 2015). Therefore, seaports, apart from their strategic importance in the transport infrastructure network, are also a significant generator of value for national, local, and regional economies.

Although maritime transport is seen as important an environmentally friendly mode of transport (Bjerkan & Seter, 2019), in the case of the location of seaports in urban areas, it can aggravate pollution

problems, thus affecting the quality of life and health of the population, global climate, and marine environments (Poulsen, Ponte & Sornn-Friese, 2018). Despite the potential of seaports to reduce emissions in the maritime sector and move towards sustainable development, the actions taken may be problematic due to the role of maritime transport in the international trade of goods (Bjerkan & Seter, 2019; Hossain, Adams & Walker, 2021). In the literature on the subject, maritime transport, including emissions from ships, significantly contributes to the deterioration of air quality in port cities (Yigit & Acarkan, 2018).

The implementation of an effective plan to reduce the negative impact of maritime transport on urban environments requires the involvement of many actors. One of the activities in this area is undertaken by the European Sea Ports Organization created to promote a friendlier environment for seaports. The environmentally-friendly ports initiative undertaken by the European Sea Ports Organisation (ESPO) and EcoPort contributed to the development of a system for assessing and certifying green ports. Polish Seaports of national importance are members of ESPO, but none have been certified by the Port Environmental Review System (PERS) – only the ports of Szczecin and Świnoujście have been certified by the International Organization for Standa (Port of Szczecin–Świnoujście, 2020). These certificates represent a specific added value for seaports. First, they confirm that a port is trying to be modern and follow the global trend of sustainable development (WCED, 1991). Therefore, the authors attempted to identify the reasons for the lack of environmental management certification in a selected seaport, namely the Port of Gdynia. For this purpose, a literature analysis and structured interview with the port management were carried out. These undertakings made it possible to indicate actions that could be taken to obtain the certificate.

The article is organized as follows: introduction and literature review, which outlines the activities of seaports in the era of sustainable development and focuses on the essence of green ports, whose activities aim to obtain one of the certificates that determine the status of a Green Port. The next part describes the detailed methodology of the conducted research. The next chapter is divided into two parts. The first subchapter lists examples of good practices implemented in selected green ports. The collected data are presented in a table divided into five main areas of activity: air quality management, energy conservation and climate change, noise management, waste management, and water management (consumption and quality). In the second subchapter, the authors present pro-ecological activities when planning the development of seaports resulting from the literature review and the results of an in-depth interview with representatives of the Port of Gdynia Authority. The last part of the article formulates and presents the main conclusions.

Literature review

The competitiveness of seaports is associated with the implementation of measures to improve the exchange of information of individual entities in the logistics chains by taking into account the changing requirements of ecological, technical, technological, and other factors. One of the basic determinants of seaport development is that it develops in accordance with the concepts of sustainable development (Ministry of Maritime Economy and Inland Navigation, 2018).

Caring for air quality is a key determinant when undertaking activities consistent with the concept of sustainable development for both port cities and urban areas in general. Air pollution each year causes about 400,000 premature deaths throughout the European Union and increases external costs related to citizens' health (European Court of Auditors, 2018). The European Union and its member states are taking action in this area, which has resulted in the emergence of new legal provisions. Of all European ports, more than 90% are city ports, and the implementation of these activities by their managers is obvious (ESPO, 2019).

One of the goals of sustainable development is to improve society's quality of life while respecting the environment and climate. The key issue is to change the strategy of economic development, which once depended on the unrestricted use of natural resources, which resulted in negative changes in the global climate (UNIC Warsaw, 2018).

The most important seaports are located in urban spaces, so they use the local labor market and infrastructure. As a result, they are subject to local policies. Of the 76 major world port complexes handling containerized and bulk cargo, 52 are located in urban agglomerations with 1 million inhabitants or more. The development of seaports in cities mainly depends on the emergence of global supply chain systems, logistics in line with Just-in-Time principles, urbanization and urban development, as well as international and other operators (Hall & Jacobs, 2012).

Seaports are an important factor in a city's pursuit of sustainable development due to their negative impact on the natural environment. This is mainly due to water and air pollution, exceeding the standards of permissible noise levels, expansion and modernization of port infrastructure that affects marine ecosystems and the urban environment, and contributing to traffic congestion. Hence, the sustainable development of port logistics seeks to maintain a balance between individual environmental, technical, and economic aspects (Twardy & Zanne, 2020). This concept has been adopted in various environments and is characterized in a similar way; however, there are differences between the approach to strategy selection and its implementation depending on the managing entities. As in a seaport, one can distinguish between taking positions to achieve objectives in accordance with the concept of sustainable development by city authorities, port companies, seaports, and other interested parties (Wagner, 2019).

The activities of seaports directed at development in accordance with the concept of sustainable development are spread over time due to the long duration of strategy implementation and financial outlays. The measures applied to reduce negative impacts on the environment are investments in infrastructure on the waterside that enable the reception of vessels with larger capacities. This translates into the expansion of the port's land infrastructure, adapting it to the increased transport volume. In addition, relocation of the most environmentally burdensome activities outside of the city translates into the purchase of low-emission means of transport used at the seaport. Other solutions, e.g., used in Slovenia at the port of Koper, include photovoltaic cells located on the roofs of solar energy storage facilities, as well as the use of port waste to create biofuels (Kotowska, 2016).

The concept of green ports in Europe has been known for a long time. The European Sea Ports Organization has been working to create more environmentally friendly seaports in the European Union since the 1990s. ESPO was founded in 1993 and is an independent organization representing the authorities, management boards, and associations of sea ports of the European Union and Norway. Other non-EU countries may also be members of such organizations with observer status (ESPO, 2020a). ESPO closely monitors EU actions in the transport sector and is developing an Environmental Code for seaports. The current code is called "ESPO Green Guide; Towards excellence in port environmental management and sustainability" (Teerawattana & Yang, 2019). In 2011, ESPO integrated with EcoPorsts, an environmental initiative for pro-ecological European seaports. Raising awareness about environmental protection through the cooperation and exchange of knowledge between ports is the overarching principle of this initiative. As part of the above concept, associated seaports carry out internal pro-ecological activities. In the published environmental report, ESPO highlights the 10 environmental priorities of European ports, which are presented in Figure 1. ESPO together with EcoPorts implemented an ecological assessment and certification system, the so-called Green Ports. It is based on the self-diagnosis method (SDM), which is a concise checklist that allows port managers to assess their port's environmental management program against sector and international standards. Once the requirements are met, the port can apply for the Port Environmental Review System (PERS) standard, which is adapted to specific seaport environmental management (EcoPorts Tools, 2020).

One way to achieve green port status is to obtain a verified certificate. The EcoPorts organization recognizes three main certificates that make ports known as "green": the PERS certificate, ISO 14001, and EMAS (Eco-Management and Audit Scheme). On its website, EcoPorts has placed a map with 105 ports in the world marked with the above-mentioned certificates (EcoPorts Network, 2020).

The ISO 14001 certificate testifies the conscious and effective elimination of adverse environmental factors, and thus an efficient environmental management system. The main purpose of this standard is to support an organization in managing the environmental impact of its activities, minimizing its harmful effects, and using available resources (PCBC, 2021). In addition, in the era of broadly understood globalization and increased environmental awareness, legislative units have introduced many restrictions related to environmental protection and permissible emission standards for harmful factors for the environment. The implementation of environmental management standards in a port helps ensure compliance with these provisions. EU legislation pursuant to Regulation (EC) No. 1221/2009 of the European Parliament and of the Council of 25th November 2009 introduced the EMAS certificate, i.e., Eco-Management and Audit Scheme (Regulation (EC) No. 1221/2009). This certificate, like the others, applies comprehensive solutions in the area of environmental protection. Thanks to the guidelines contained in each of the above-mentioned

Figure 1. Environmental priorities of European ports (ESPO, 2020b)

certificates, operations in a port should strive to optimize the costs incurred, effectively manage energy and resources, and conduct an open dialogue with interested parties and the local community. Ports that have environmental management certificates have introduced solutions to reduce the negative impacts of the port on the environment and local community (ESPO, 2013).

Methods

The article poses a research question: Why does the Port of Gdynia, despite implementing pro-ecological initiatives, still not have the Green Port title? The article looks for gaps in the activities undertaken and planned by the Port of Gdynia. It also attempts to answer the question, "What tools can the authorities of the Port of Gdynia use to apply for its first certificate and thus obtain the status of a Green Port?"

The article is based on information made publicly available by ESPO, EcoPort, Green Ports, IMO, and the European Commission. The selection of the subject literature in the context of the aim of the study allowed the authors to show similarities and differences in the activities of the Port of Gdynia and Green Sea Ports. In this part, the authors used reports published by both ESPO and the Green Sea Ports themselves. Moreover, in order to most accurately identify the trends and activities that are most important in the context of pro-environmental activities, the authors made a critical analysis of scientific articles on the subject. This allowed for a comparative analysis in which trends and activities were compared with the actual state of the Port of Gdynia. An in-depth interview, addressed to representatives of the Port Authority in Gdynia, was used to assess this state. The survey questionnaire asked 12 detailed questions about current and future pro-ecological activities undertaken in the Port of Gdynia. The literature analysis and survey allowed the identification of the most important weaknesses in the port of Gdynia. The survey was conducted in January 2020.

Results: Possibility of implementing good practices to achieve the green port certificate by the Port of Gdynia

Pro-ecological solutions implemented in green seaports

Examples of good practices in EU seaports have been published in Annex 1: Good Practice examples in line with the 5Es, which is an integral part of the ESPO Green Guide: Towards excellence in port environmental management and sustainability (ESPO, 2013). The annex lists five main areas of activity: air quality management, energy conservation and climate change, noise management, waste management, and water (consumption and quality) management. The specified spheres of maritime activity are qualified as external effects that constitute external costs for society. Table 1 presents

some solutions used in selected pro-ecological ports implementing sustainable solutions in at least four areas mentioned above.

Economic activities, including transport and industrial and commercial activities, carried out in seaports and near port areas, contribute to the degradation

Table 1. Examples of good practices in pursuit of sustainable development in selected seaports (own study based on (ESPO, 2013))

Environmental issue	Port	Response	Examples of pro-ecological solutions
Air quality management	Port of Dover, United Kingdom	Enable	The port and its main approach road, the A20, is immediately adjacent to the town center. Over 4,000 freight vehicles per day travel along A20 to the Ro-Ro ferry berths resulting in high levels of nitrous oxides. Reconstruction of access to the terminal in such a way as to smooth the movement of vehicles, thereby eliminating congestion.
	Port of Trelleborg, Sweden	Exemplify, Engage	State-of-the-art terminal tractors- Equipping terminal tractors with a particulate filter, thereby reducing PM emissions by almost 100%.
	Ports of Stockholm, Sweden	Enable, Encourage	Differentiated port fees. Discounts for shipowners/operators applying relevant environmental standards. Discounts for sorting waste.
Energy conservation and climate change	Port of Rotterdam Authority, The Netherlands	Exemplify	As one of the largest ports in the world, it needs many vehicles, buildings, and employees for its daily operations. With this in mind, the port authorities are investigating the port's carbon footprint, taking into account both direct and indirect operational activities, and seeking to reduce CO_2 emissions.
	Port of Bremen/ Bremerhaven, Germany	Exemplify, Enable, Engage	The port management installed photovoltaic panels on the roofs of port buildings. Almost 100% of the energy consumed in the port comes from ecologically-renewable sources.
	Port of Dover, United Kingdom	Exemplify, Enable, Encourage, Engage	Design and control of lighting in such a way that it is most efficient with the lowest possible consumption.
	Port of Valencia, Spain	Exemplify, Engage	CO_2 footprint calculator. Developing a methodology to accurately estimate the carbon footprint that will allow targeted action to be taken to eliminate harmful effects.
Noise management	Port of Tallinn, Estonia	Exemplify	Construction and installation of acoustic barriers to reduce noise resulting from the operational activities of the port.
	Ports of Bremen/ Bremerhaven, Germany	Exemplify, Enable	Noise management in Bremerhaven. Installing innovative noise-measuring devices throughout the entire port and remaining in constant dialogue with the local community. In a situation where the permissible noise norm is exceeded within 30 seconds, a specific station sends information to the control panel. Then, it is possible to directly identify the noise source and eliminate it.
	Ports of Stockholm, Sweden	Exemplify, Enable, Engage	The port management, through intensive dialogue with both the local community and contractors, encouraged port users to use soundproofing materials on ramps to reduce noise resulting from metal impact on metal or concrete. Thanks to this, the noise was reduced by up to 15 dBA.
	Port of Trelleborg, Sweden	Exemplify, Engage	Noise reduction of the terminal fleet. Reachstackers and terminal tractors in the port have modern and innovative solutions that dampen their work-related noise.
	Port of Tallinn, Estonia	Exemplify	Mobile Technological Handling Station (MTK) for liquid oil-containing waste is based on new innovative technology and energy-saving solutions for the optimum handling of oil-containing waste (bilge, slops, sludge, etc.) and is built in 10 standard 20-feet sea containers installed in two levels.
Waste management	Port of Dover, United Kingdom	Exemplify, Enable, Encourage, Engage	Updating the tariff for garbage collection and recycling and continuous notification of port users about the need to segregate garbage. In 2011, 82% of all wastes produced by the framework were recycled.
	Ports of Stockholm, Sweden	Exemplify, Enable, Encourage	The port of Stockholm has special facilities for collecting used water from ships. Cruise ships can unload used water at each berth for free. In addition, the fee for collecting used water is not a special fee and is included in the general port fee.
	Port of Antwerp, Belgium	Enable, Encourage	Incentive-based fee system for waste delivery by ships and a state-of-the-art monitoring system. The fee system includes a strong incentive for the maximum delivery of ship-generated waste, without limits in terms of maximum volumes.

Table 1. (cont.)

Environmental issue	Port	Response	Examples of pro-ecological solutions
Water (consumption and quality) management	Port of Trelleborg, Sweden	Exemplify, Enable	Construction of filter equipment in surface water drains in the port's terminal and traffic areas aimed at reducing harmful substances.
	Port of Dover, United Kingdom	Exemplify, Enable, Encourage, Engage	The port of Dover has special drainage systems to prevent any unwanted surface water from entering the sea. It also has a system to prevent possible oil spills. The boatyard includes a cutting-edge closed-loop washdown area, where over 95% of the water utilized is recycled and reused within the state-of-the-art system, as well as reducing pollution by preventing debris from draining back into the harbor. In addition, the water quality in the port is monitored once a week throughout the bathing season. The state of the river, whose outlet is directly in the port, is also examined. Organizing garbage collection from the nearby river with the local community.
	Port of Valencia, Spain	Exemplify	The port has an innovative monitoring system for various port activities. It takes water samples and constantly tests its quality.

of the environment through the contamination of water, air, soil, and increased noise emission, vibrations, congestion, and accidents. Environmental problems initially posed a problem for port managers; however, with increasing public awareness of environmental protection, various simple solutions have begun to be implemented, such as waste recycling, ship waste collection, and saltwater treatment plants, which significantly contribute to environmental protection and improve the quality of life of coastal residents. Contemporary ports see their activities much more widely and are aware that both their activities and the regular activities of their employees leave a carbon footprint. For this reason, many initiatives have been taken to reduce energy production and, thus, CO_2 production, which directly impacts climate change in their immediate surroundings, especially in the city. Ports efficiently renovate and build new offices and warehouses, which means reducing the need for heating or air conditioning. They use recyclable materials to reduce waste production. Operations that take place in a port can be a nuisance to residents who are not far from their territory. For this reason, noise, water quality, and air quality are measured, among others; therefore, systematic measurements are made to react on an ongoing basis when permissible standards are exceeded (ESPO, 2013).

Green measures important for the development of green ports and pro-ecological measures in the Maritime Port of Gdynia

Seaports play a key role in transforming the entire maritime sector into a sustainable enterprise. Environmental initiatives of green ports should focus on three main areas: environment, economy, and society (Lawer, Herbeck & Flitner, 2019). Efforts to reduce harmful emissions should go hand-in-hand with development and should not hamper economic growth or international trade (Carpenter et al., 2018). Following an extensive review of sustainable development activities presented in the scientific literature, the authors identified the nine most-cited areas: environmental management, monitoring, concessions, port charges, cooperation, renewable energy sources, efficient ship handling, modal shift, automation, and smart solutions. On this basis, a structured questionnaire was developed, which was then sent to representatives of the seaport in Gdynia. Even though the Port of Gdynia has not officially been granted the status of a Green Port, it has applied many pro-ecological solutions. In Table 2, in the Literature Review column, specific activities most often discussed in the literature are indicated. A review of the information published by the Port of Gdynia Authority and the collected intelligence data indicate both the activities undertaken in this port and also the lack of steps taken in important areas.

As a result of the conducted research, the seaport in Gdynia should additionally indicate the pro-ecological activities it has undertaken. Among other things, this should include the 24-hour protection of port basins in the event of an oil spill by an external company and the Port Fire Department. With the help of specialized vessels, the waters of the port basins, canals, and avanport are monitored to clean them of solid contaminants. One of the terminals of the HES Gdynia Bulk Terminal Sp. z o.o. has many certificates, including ISO 9001 and ISO 45001. Container terminals have successively implemented electric cranes to reduce noise emissions. It seems important to indicate in the interview that the Gdynia Port Authority has commenced activities in 2021 to implement the environmental management standard and obtain the ISO 14001 certificate. From the

Table 2. Areas of operation of green ports and the Gdynia port (own study based on literature sources in the table and own research)

Area of action	Review of the literature	The areas of activity in the Sea Port of Gdynia
Environmental management	Green initiatives should begin with the development of the management strategy (Acciaro, Ghiara & Cusano, 2014). The outlined long-term management plans may allow for the effective implementation of pro-ecological solutions. In the literature, we can find many proposals indicating the development of plans that will enable effective environmental management. Several plan proposals can be identified, such as pollution prevention and reduction plans, green port plans (Anastasopoulos, Kolios & Stylios, 2011), plans for environmental protection, climate initiative (Schipper, Vreugdenhil & de Jong, 2017). In addition, an active dialogue with all seaport stakeholders is an important element for developing a modern port management strategy.	The Port of Gdynia Authority has adopted the Port plan for the management of waste and cargo residues from ships in the Port of Gdynia (Port of Gdynia Authority S.A, 2018). This document characterizes the types and specificity of waste considered mainly by the International Convention for the Prevention of Pollution from Ships (MARPOL), as well as the manner of handling them in accordance with legal restrictions and requirements. The port of Gdynia has implemented a "Plan to combat threats and pollution of port waters", whose purpose is to quickly identify events that could adversely affect the natural environment within the seaport (Port of Gdynia Authority S.A., 2016). The Port of Gdynia participates in the Water Innovation System Amplifier (WISA) project: Test-beds for water innovation, co-financed by the European Union under the Interreg South Baltic 2014–2020 program. The main goal of the project is to reduce the amount of pollutants entering the Baltic Sea with rainwater and sewage. Due to the high pollution in rainwater, tire washers were installed in the port for all vehicles leaving the area, so that they would not spread accumulated dirt. In order to avoid possible dusting of the load, a coal water spray system was used, which significantly reduced the amount of harmful pollen in the air (Port of Gdynia Authority S.A., 2018).
Monitoring	Monitoring possible externalities of port activities to support the assessment of the environmental footprint (Fenton, 2017) and addressing key environmental performance indicators (Chen, Pak & Delphi, 2017). In addition, it allows the development or modification of possible strategies to manage its environmental impact and environmental risks (Kang & Kim, 2017).	In the eastern part of the Port of Gdynia, continuous measurements of PM_{10} and $PM_{2.5}$ dust emissions are conducted. The system consists of six Yetibox sensors and software that analyzes, based on forecasted meteorological conditions, the risk of increased dust in the areas where the port meets the city. The measurement points are located near the HES Gdynia Bulk Terminal Sp. z o.o. and on the border with urban areas. Information about the air condition is available online on the website of the Port of Gdynia.
Concessions	Port managers can exert this influence on their tenants through appropriate provisions in concession contracts (Poulsen, Ponte & Sornn-Friese, 2018). For example, agreements may include provisions related to technological and environmental standards, particularly those related to various emissions, additional pollution charges, and reporting obligations (Acciaro, Ghiara & Cusano, 2014).	The seaport in Gdynia does not use diversified concession contracts.
Port charges	Differentiated port charges can enhance a port's competitiveness and act as an effective means to prevent marine pollution from ships (Lam & Notteboom, 2014). Port charges are mainly related to the environmental characteristics of a ship, including the Environmental Ship Index (ESI), the Energy Efficiency Design Index (EEDI), or the Clean Shipping Index (CSI) (Gibbs et al., 2014). Environmental certificates standardise environmental requirements and can serve as a rewarding element for shipowners and entitle ships to reductions in port charges.	The Port of Gdynia has implemented an environmental fee for ships entering ports in the amount of PLN 0.17 per 1 GT. Ships that have the current Environmental Ship Index (ESI) certificate issued by the World Ports Climate Initiative (WPCI) can receive a discount of up to 50% of the rate. The ESI certificate confirms that a ship has achieved better results in reducing emissions to the air than required by the current emission standards of the International Maritime Organization (Port of Gdynia Authority S.A., 2020).
Cooperation	Cooperation and dialogue with all port stakeholders is a confirmation of the pro-environmental orientation of seaports and indicates internal sustainability management in a port organisation (Lu, Shang & Lin, 2016). Many examples of such cooperation can be found in the literature. Ports that have environmental certification are characterized by an active dialogue with all stakeholders and follow the idea of responsibility in business (ESPO, 2019).	Since 2014, the Port of Gdynia Authority has conducted a Corporate Social Responsibility report, in which it accurately describes the areas of its pro-ecological activities for the local community (Port of Gdynia Report, 2018). The Gdynia Port Authority includes in its strategies cooperation with local society and the implementation of joint pro-ecological initiatives.

Table 2. (cont.)

Area of action	Review of the literature	The areas of activity in the Sea Port of Gdynia
Renewable energy sources	This mode of transport accounts for 3% of global carbon dioxide (CO_2) emissions (Gibbs et al., 2014). Wind energy is already used by European ports, including Rotterdam, Hamburg, and Zeebrugge. The construction of flat-roof facilities makes it possible to install solar panels. The ports of Antwerp, Hamburg, and Genoa, among others, have experience in the use of solar energy. Solar energy is mainly used for the operation of administrative buildings. Other energy sources used by ports include wave and tidal energy. One of the ports where tidal energy is used is the port of Dover (Ramos et al., 2014; Bjerkan & Seter, 2019).	The Port of Gdynia Authority supports activities related to the development of renewable energy sources located in the administrative area of the port. 53 photovoltaic panels with a total electrical capacity of 17.49 kWp were installed on the roof of the office building in the port. The Port of Gdynia Authority is planning other similar solutions in the near future (Renewable Energy Sources, 2020). Renewable energy in the form of wind energy, waves, and tides is not used in the port area.
Efficient ship handling	A system of shore-side electricity supply to ships, called cold-ironing. A port equipped with cold-ironing infrastructure allows ships to connect to the shore-side electricity grid to meet their electricity needs at berth. The improvement of the operational efficiency of port facilities allows to shorten the time of berthing ships in the port and handling trucks, which at the same time reduces the emission of pollutants into the environment (Adamo et al., 2014; Bjerkan & Seter, 2019).	The Port of Gdynia Authority is carrying out an investment entitled "Construction of port infrastructure to receive sanitary sewage from ships in the Port of Gdynia". The project consists of the construction of new and the adaptation of existing sewage infrastructure to receive sanitary sewage from ships and also their discharge into the sanitary sewage system of the city of Gdynia. Implementation of the investment "Construction of a public ferry terminal at the Port of Gdynia". The project consists, *inter alia*, of the construction site of a dedicated cable sewage system to supply ships with electricity from shore, which will help eliminate power generators on ships. The planned commissioning of the sewage pre-treatment plant and the terminal was in the third quarter of 2021. The Port of Gdynia Authority is planning to build additional on-shore power supply points for ships.
Modal shift	Modal shifts involve shifting some cargo from heavy-goods vehicles to, for example, rail or short sea shipping. The seaport, which is a multimodal transport hub, should encourage stakeholders to use intermodal transport. Modal shifts can increase the capacity of quays, which will directly affect the capacity of seaports (Bergqvist et al., 2015).	In its development strategy, the Sea Port of Gdynia included points related to the modernization and expansion of the railway network on its territory. This is also in line with the assumptions related to the pan-European TEN-T corridors, one of the links of which is the sea port in Gdynia (Regulation (EU) No. 1316/2013).
Automation and smart solutions	Intelligent solutions that implement mathematical modelling to improve the efficiency of automatic terminals. The European port in Hamburg has implemented automated guided vehicles (Port of Hamburg, 2018).	The Port of Gdynia has invested in the modernization and purchase of new traditional handling equipment. There are no plans to invest in autonomous and intelligent solutions in the near future.

point of view of the Sea Port Authority, obtaining the Environmental Management certificate is an important element that indicates care for the natural environment and the port's competitiveness.

Pro-ecological measures taken by the port of Gdynia are mainly aimed at reducing noise and emissions of substances polluting the air, including greenhouse gases. Moreover, these activities are based on reducing the pollution of sea waters and protecting the biodiversity of the Baltic Sea, which also have a positive impact on the city's inhabitants.

Conclusions

To obtain more information about the development prospects of the sea port in Gdynia and to identify possible reasons for its lack of a Green Port certificate, a structured questionnaire was prepared. The most important actions that have already been taken in the port of Gdynia were selected from the responses received, including monitoring, development of management systems, cooperation, and port fees. Certain shortcomings have been identified, which the Port of Gdynia Authority should pay attention to when applying for its first certificate. Diversified concession contracts are an important element that should be implemented. Exerting an additional influence on stakeholders in the form of special provisions and environmental requirements in concession contracts could contribute to the more effective enforcement of pro-ecological attitudes, and thus would support a more environmentally friendly

industry (Bjerkan & Seter, 2019). The implementation of renewable solutions and alternative energy sources is important to improve the efficiency of green ports, and investing only in solar energy seems insufficient (Anastasopoulos, Kolios & Stylios, 2011). Another area where major shortcomings are visible in the port of Gdynia is automation and intelligent solutions, which involve investing in modern autonomous infrastructure and port superstructures and also in models that improve urban freight transport. The development of an efficient mathematical model, which would operate based on the advice of motor vehicles in relation to and from the port, could reduce congestion in cities, thus helping reduce harmful emissions of pollutants and noise (Bjerkan & Seter, 2019). Importantly, increasing freight transport in a city contributes to the intensification of transport problems in city transport systems, thus affecting society and the natural environment. Certificates regarding environmental management and thus obtaining the title of a green port for the Port of Gdynia Authority are important elements of a pro-ecological policy. For many reasons, the port should strive to achieve them.

The presented analysis is an introduction to further research, which will be continued to monitor the changes taking place and actions planned in the context of sustainable development in the coming years. Due to the increasing role of maritime transport and the increase in international trade in seaports, the intensification of activities in this field seems to be a priority. It is important to conduct interviews with representatives of green ports with a focus on/guided by the pro-ecological activities they have implemented. It is also worth considering whether only those ports that have obtained an environmental management certificate can be called a Green Port. Taking the Port of Gdynia as an example, one can clearly see its commitment to reducing its negative impact on both the environment and society; however, without the appropriate certificate, it cannot be officially called a Green Port.

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