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Application of Environmental and Social Sustainable Measures by Port of Koper: The Basis for the Regional Approach

Aplikacja środowiskowych i społecznych inicjatyw w porcie Koper: przykład podejścia regionalnego

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Abstract
This paper aims at identification of environmental initiatives and measures that affect maritime ports. The first part of the article describes the trend and drivers towards application of environmental measures in port sector. The second part describes the application of environmental measures and social elements at Port of Koper and analyses the main fields of environmental development. The Port of Koper can be used as the case platform for other similar and equally sized ports in the region, therefore a six pillar environmental with a social pillar platform is presented. The study results could help port management to define a scenario for a faster introduction of environmental and social objectives and measures in order to follow sustainable development and position itself in the future green and sustainable supply chains.

Key words: ports, environmental initiatives, social pillar of sustainable development, green policy

Streszczenie
Artykuł ma na celu identyfikację inicjatyw i działań, które mają wpływ na środowisko portów morskich. Pierwsza część artykułu opisuje trend i działania podejmowane w kierunku ochrony środowiska w sektorze portowym. Druga część opisuje przykład portu Koper, analizując wprowadzane rozwiązania odnoszące się do aspektów społecznych i środowiskowych. Koper stanowić może punkt odniesienia dla innych portów w regionie Adriatyku o porównywalnej wielkości, dlatego wyznaczono składający się z 6 elementów model środowiskowy, uwzględniając także uwarunkowania społeczne. Wyniki badań mogą pomóc w zarządzaniu portami, określając wzorcowy scenariusz dla szybszego wdrażania celów i działań tak środowiskowych, jak społecznych, zgodnych ze zrównoważonym rozwojem.

Słowa kluczowe: porty, inicjatywy środowiskowe, społeczny filar rozwoju zrównoważonego, zielona polityka

Introduction

The green logistics approach is more and more evident also in managing philosophies of ports. The management of the port must adopt new approaches in order to find measures against environmental impacts on the sea and land used by the system. Moreover, ports are important intermodal nodes for other transport modes and trades and as a result they have to consider the impacts of climate change caused by their operations and create the necessary adaptation (Vidal, 2010).

Consequently, the environment issues are becoming one of the strategic pillars in port development, supported also by the entire industry. Namely, key executives in port and transport industry within Europe believe that the green strategy is an important element of a company's strategy (Eyefortransport,

2008). Climate change, CO_2 emissions, waste collecting, reprocessing and finally redistribution are significant factors in logistical decision-making (Murphy, 2000; de Bruto & Dekker, 2004; Darnall et al., 2008). At the same time the transport industry is still focused on economical delivery times and high safety standards. To some extent, such directions may contradict the green logistics approach (Mollenkopf, 2010).

Ports are under pressure to adopt green initiatives, which has forced some ports to implement green thinking in management's decisions and long-term development strategy. The process is mostly valid for port systems in Western economies. Emmett and Sood (2010) see benefits from such an approach, mostly in a reduced impact on the ecosystem and on wider environmental degradation, in the enhanced safety in the port and in overall better health environment. In order to encourage other ports Van de Voorde et al. (1998) claim that focused researches in port's responsibility regarding environment and maritime safety are needed. Kontovas and Psaraftis (2011) propose to include and combine analysis of the role of ships in the green port policy. According to Eden (2011) their GHG emissions, produced waste, noise pollution and energy consumptions affect ports significantly.

Koper port is one of the port systems that can be classified as one of the most advanced ports in green thinking and developing social sustainable environment. The port has already implemented various measures in different environmental and social areas, which makes it a model basis for other ports in the region or even globally. An in-deep analysis of past activities and the future orientation has been performed. The survey gives directions of further environmental improvements and important directions for social sustainable development of ports in the region. Port systems in South-East Europe will soon be forced to introduce green consciousness and invest in environment friendly technology (Beškovnik & Jakomin, 2010).

Environmental drivers and initiatives for ports

Understanding drivers and initiatives

Green port initiative can be classified as a new approach versus traditional management philosophy of the 1990s. According to the port environmental review conducted by ESPO's EcoPorts (2009), the environmental goals were not listed in the top 10 developing priorities in mid-nineties of the last century. During the last two decades the environmental consciousness evolved and completely new drivers influence a port's development strategy. Results of the ESPO's survey expose that air quality, noise pollution, produced waste and energy consumption are among top goals in the managing port systems.

The environmental drivers for ports vary between different ports according to their position, size and layout of terminals, operational work, infrastructure and supra-structure in use, etc. All environmental drivers can have direct impacts on short-term economic operations, on costs effectiveness, on establishing new markets and alliances. The port can benefit from green measures, especially where the strong competition is present by the neighbouring ports. Nijkamp (1994) sees the environment friendly operations and transportation as drivers for a positive competition between ports. In regions with low competition the ports are more oriented towards higher performances and cost effectiveness resulting in a better financial outcome. Adams et al. (2009) expose that regulatory compliance and court-ordered activities might force such systems into carrying out the required environmental investments to follow legal recommendations. Since the top-down approach is not business friendly, the bottom-up approach where ports are interested in developing green measures is preferred by the entire port and shipping industry.

Consequently, it proves beneficial for ports to understand, follow and gradually apply different environmental initiatives. Some of them can be easily adopted, whereas significant investments are requested for some of them. The initiatives can be divided into the following groups:

- Green shipping, with use of green ships,
- Energy consumption and recycling processes,
- Water and land quality,
- Sustainable and clean manipulation and internal transport,
- Sustainable hinterland transport,
- Sustainable accompanying actions in port development, dredging, maintenance, etc.
- Improvements in community and environmental involvement.

Following green port performances

The passive role of ports regarding environmental issues has gradually turned into an active one as ports follow green initiatives related to port communities Goulielmos (2000). The degree of green measures implementation is not equal in all ports, and essential differences exist among port systems. Therefore, states, governments and independent organizations establish an adequate model of monitoring and evaluating the port's environmental performance. Adams et al. (2009) point out the port's certification as a proper way with light top-down approach to stimulate ports in environmentally friendly thinking. The certification and assessment of environmental measures are made possible through Environmental Management Systems (EMS) at ports, including ISO 14001 and 14064 certificates, Environmental Management Handbook (EMH), Port Environmental Review System (PERS), and Eco-Management and Audit System (EMAS). The following measures which are of special importance are analysed:

- supporting green ships and ship/shore interface;
- traffic and transportation;
- clean air and Greenhouse Gas (GHG) emissions and reduced noise pollution;
- energy conservation and efficiency;
- water and land resources management, with purchasing and construction practices;
- waste and recycling management.

Goulielmos (2000) exposes the fact that introducing environmental measures in ports operation influences the economic and financial performance. Namely, environmental measures request investments in environmentally friendly technologies and sustainable development, with long-term benefits. Consequently, in a shorter period of time the investments might cause a lower profit, but in the future the port is expected to benefit from the increased new business generated by green logistics corridors and green supply chains respectively.

Social sustainable development of ports

According to Peris-Mora eta al. (2005) the port management must develop not just environmental measures for sustainable development but social ones as well. The social perspective is an important sustainable pillar that complements economic and environmental sustainability. The concept of social sustainability that includes approaches towards social responsibility, liveability, community development, social support, worker's rights, cultural development and community resilience, spatial development, is more and more present in managing philosophies of port systems.

The social responsibility is particularly present in developed economies, with higher social awareness, higher quality of life and higher labour standards. This perspective was highlighted by western port communities during last ten years. Nowadays ports are more social oriented manifesting in higher concern for labour force and their health situation, extensive financial support of sport, cultural and humanitarian organizations, and by co-financing town infrastructural projects.

To some extent the social and environmental initiatives are complementary. Investing in environmental development the port at the same time develops social responsibility and in some cases *vice-versa*. As the port systems are still very dependent on labour they must strengthen their communication and cooperation through different pillars of social sustainable development. The same is valid for port-city relation, as both can benefit from a sustainable development (Daamen, 2007).

Application of environmental measures and social perspective at Koper port

The Port of Koper is a multipurpose port with 11 specialised terminals and an excellent location at the head of the Adriatic Sea. The port throughput in 2013 exceeded 18 million tons of cargo, with a constant increase in the past years. Due to the port's complexity and throughput increase, the port management is under strong environmental pressure from the local community. The community supports the port's further development, but demands environmental considerations to be taken into account. Consequently, the port has to assume increasing responsibility in terms of environmental protection.

The Port of Koper has already obtained important environmental certificates, which prove that the port already meets the requested environmental standards. The survey gives a view on the port's evolution towards the environment friendly maritime system. The port can be classified as one of the leading port systems in Europe in taking environmental actions and measures, and it can be used as a case model for other ports in the Adriatic area.

Introducing environmental initiatives

The Port of Koper strives to incorporate sustainable development and environmental protection into the system's environmental policy. In this way the port prescribes measurable goals in different environmental fields and performs regular inspections of the same. Activities within environmental policy can be divided into the following areas:

- Technology modernisation with energy-efficient machinery;
- Reduction of emissions and continuous monitoring processes on different points within port area;
- Prescribing preventive measures at workplaces;
- Following changes in environment management system and implementation of changes into the company's regulations;
- Building close partnership with companies working inside the port area and with local community.

The five orientations are the platform for a pallet of different actions within the following fields of environment protection: air pollution, noise pollution, waste management, illumination pollution, energy and fuel consumption; waste and potable water; safety of the sea and interventions in the local environment. In each field various environmental goals are defined, including measurable values that are in accordance with the environmental standards EMAS (Environmental Management and Audit Standards) and ISO 14001:2004 standard as presented in Table 1 (Luka Koper, 2012).

The environmental policy and orientation towards high environmentally standards are visible also through various certificates accredited to the port. The EMAS certificate confirms that the port adjusts its operations according to high standards. The port was also accredited with ISO 14001:2004 certificate,

Table 1. Environmental measures and objectives by Port of Koper

Environmental measure	Objective	Value of the objective	Achieving possibility
Air pollution	Decrease dust particle emissions from manipulation (mg/m^2/day) for each measurement	< 250 mg/m^2/day	Difficult
Air pollution	PM_{10} emissions across the entire port zone (µg/m^3)	< 30 µg/m^3	Moderate
Noise pollution	Night-time noise level in the direction of Koper city (dB)	48 dB	Moderate
Energy consumption	Energy consumption in the provision of port services (kWh/t cargo handled)	Decreasing by 3%	Moderate
Waste management	The percentage of separately collected waste (excl. waste from vessels)	> 84%	Moderate
Potable water consumption	Decrease potable water use in the provision of port services (l/t of cargo handled)	Decreasing by 3%	Difficult
Illumination pollution	Adjustment of illumination of facilities and operations to reduce light pollution	95%	Moderate

which confirms the environmental protection through ongoing modernization of supra-structure used by different terminals. Besides, the port obtained OHSAS 18001:2007 certification for occupational health and safety management system and HACCP ISO 22000:2005 certificate for a preventive management system. The latter confirms port's orientation in handling perishable goods that meets high standards posed by the certification process. Finally, the port was accredited with SEVESO II environmental certificate that is applied to the management of large quantities of dangerous substances in congruence with the Council of Europe Directive 96/82/EC.

Improving air quality

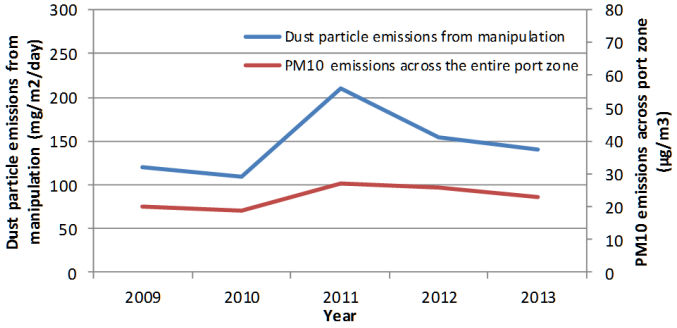
The port follows two measures related to quality of air in the port area and its surrounding. The first measure follows the concentration of dust particle emissions deriving from manipulation at ten points inside the port area. The objective posed at 250 mg/m^2/day is much lower when compared to German guidelines with limit values of 350 mg/m^2/day. The average result of one year was not overpassed in the last five years. The measurements performed in 2011 and 2012 show significant increase if compared to results from 2009 and 2010, but they do not reach the predefined frameworks. In 2013 the average result was at 140 mg/m^2/day, which is close to the results from 2009 and 2010 (Figure 1).

The second measure follows the average annual emission of PM_{10} particles (size of up to 10 µm). The annual results of measurements in the last five years do not reach the level as defined by the guidelines, which stands at 40 µg/m^3. The port uses even a lower value at 30 µg/m^3, which has been achieved from 2009 onwards. According to the port's report the measurements at three points in 2013 were in the range between 19 µg/m^3 and 23 µg/m^3 (Luka Koper, 2013). For comparison following green European ports obtain higher average results such as Antwerpen 34 µg/m^3, Barcelona 33 µg/m^3 and Valencia 26 µg/m^3.

The principal activities bringing good results in the past years are mainly related to investments in new technologies and infrastructure on bulk and liquid terminals. The port invested in a retaining enclosure, which has been erected around the dry bulk cargo deposits. Moreover, water sprays were used to prevent dust generation and dust spreading, but later a protective paper sludge film on the coal depot was introduced. This technology shows better results in unfavourable weather conditions and in periods of strong winds.

The port also invested in new filtering systems for handling cereals and in prevention of volatile liquids to evaporate in the air during the loading and unloading process.

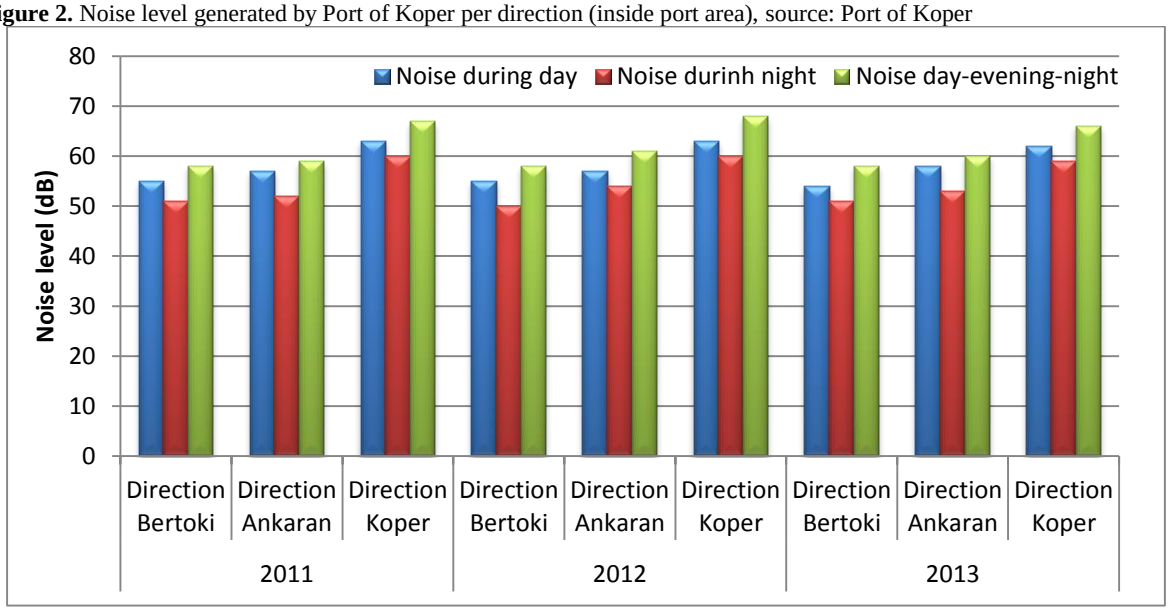
Figure 1. Measures for air pollution from port activity
Source: Port of Koper



Reducing noise pollution

The Port of Koper is close to the city area. To the north it neighbours Ankaran and Koper to the south. In the west the town of Bertoki is expanding rapidly. Consequently, Port of Koper must pay attention to the noise pollution mainly generated by cargo handling operations, the use of machinery and vessel's generators during the stay at the port area. The port is ranked in group IV as industrial facility, where the maximum level of noise pollution must not exceed 63 dB. The areas close to the port zone are classified as type zones III, where the maximum noise is set at 48 dB.

Figure 2. Noise level generated by Port of Koper per direction (inside port area), source: Port of Koper



According to the results of monitoring for the years 2011, 2012 and 2013, the noise pollution is mainly generated by the container terminal and terminal for coal manipulation. The noise pollution affecting the city area of Koper is close to limit values, and results for 2013 are slightly lower when compared to those from 2012 (Figure 2). Based on reports by Port of Koper the noise pollution close to the port area did not exceed the defined max value of 48 dB in the last three years. Some other European ports achieve higher results. Namely port of Valencia registered noise pollution of 66 dB, Livorno 60 dB, Antwerpen 55 dB, Bremerhaven 50 dB.

The port has implemented various measures to keep noise pollution in the defined frameworks. Further reduction of noise pollution is possible by further relocation of noise-producing manipulations away from the city area but still within the port area, modernisation of handling and transport equipment, reducing speed limits, resurfacing manipulation area and roads close to the city area, and installation of visible warning devices instead of audible alarms for machinery operating during the night. With these activities the port shall keep noise pollution level below the defined maximum levels, despite the possible increase of throughput.

Illumination pollution

A maritime port uses artificial lights during the night, in order to perform handling operations in handling areas and transport routes in the third shift. With the port expansion in the last five years new storage areas and new transport routes were built. Consequently, the need for additional illumination has increased, which calls for two segments to be closely analysed. The first one embraces the standard of external illumination according to the legislative requirements and the second one analyses the energy consumption for illumination.

According to the first package of activities till 2011, the port significantly invested in modernisation of lights which has resulted in approximately 80% of external illumination to be in compliance with the legislation, which is not due before 2016. Until 2013, the additional 5% of lights were replaced, so the port has already 85% of lights that are in line with higher environmental standards. In reference to the energy consumption the port has decreased the share of consumed energy for illumination to 15%. This percentage should be further reduced by new investments till 2016, as posed by the new legislation frameworks. The same is valid also for other European ports, in order to be in-line with new legislation.

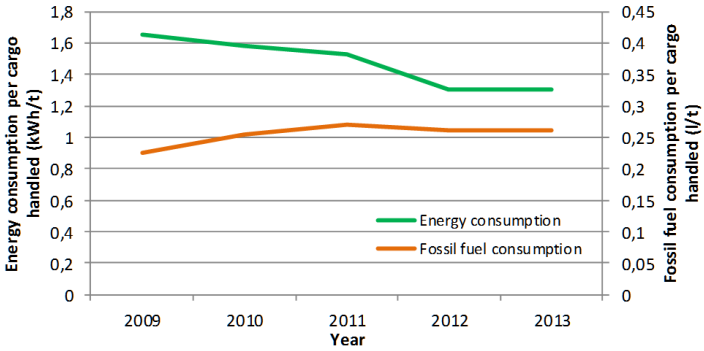
Following energy and fuel oil consumption

The green concept encourages the reduction of energy and fuel oil consumption as one of the crucial environmental issues. Ports shall reduce the consumption per ton of cargo handled. It is possible to achieve this goal by introduction of new technologies and modernisation of machinery in use. The Port of Koper has been decreasing consumption of energy per manipulated ton of cargo since 2009. Namely, in 2009 the consumption of energy was around 1.63 kWh/t of cargo and in years 2012 and 2013 decreased to the target level standing at 1.3 kWh/t of cargo handled (Figure 3). The reduction was possible through investment in new equipment on the container terminal that is the biggest consumer of energy in the port. One of the biggest energy consumers is also the Fruit Terminal that uses electricity for cooling processes in the specialised warehouses.

On the other hand, port handling and transportation processes consume a significant quantity of liquid

hydrocarbon fuels. The target value set at 0,2 l/t of handled cargo was set years ago when the port's throughput was 30% lower than the actual present result. In the last five years the port exceeded the target value. The higher consumption of fuel oil is primarily connected to port expansion, where storage areas are placed farther from the berth subsystem. The port will use the new methodology of collecting and analysing the fuel oil consumption, taking into consideration other external elements, such as the outside temperature, working hours, transported kilometres, etc.

Figure 3. Fossil fuel and energy consumption per ton of handled cargo (2007-2011), source: Port of Koper



Waste management

Waste management is one of the important fields in a port's environmental policy, because the port performs service also to the vessels calling the port. Collected waste from vessels is mainly qualified as hazardous waste including oil-contaminated materials and oil wastes, galley waste, ash and batteries. The port has established a Waste Management Centre (WMC) for the collection and sorting of refuses. Some waste materials are administered by the WMC, while some are dispatched to authorised agents for further processing. Wastes in the port area handled by WMC are classified in three main groups:

- Waste generated by port's operations, such as packaging wastes, metal scrap, cargo remnants, timber wastes, and regular municipal waste,
- Waste generated by other business entities in the port, and
- Waste from vessels berthing in the port as oil-contaminated water, waste waters, galley waste and regular municipal wastes.

According to the analysed data the port increased the quantity of collected waste from 2008 to 2011, whereas in the last two years the quantity of waste decreased to 4546 t.

In the period from 2009 to 2013 the increase at Koper port was of 10%, where the increase is mainly generated by the waste from the ships. In 2009 the port collected approx. 4050 t of waste and approx. 18% was contributed by waste from the ships. In 2013 the share of waste from the ships increased to 30%, totalling 1387 t. Over 86% of waste produced in the port is collected separately. Namely, sorted waste materials accounted for 2675 t, while 481 t are unsorted municipal wastes. The port wants to keep separately collected waste above 84%.

According to analyse of 40 European ports provided by EMSA (EMSA, 2012) Koper can be classified as one of the best ports in collecting and processing waste. Namely, the study shows that 92% of analyses ports accept sewage; 70% accept nox. liquid substances; 47% accept oily cargo residues, and 80% accept Annex V liquid cargo residues. The Koper port provides all services.

Waste and potable water

Port systems are important consumers of potable water as it is used for different operations such as timber processing, cooling foodstuffs, reducing dust from handling bulk cargo, washing vehicles handed by the car terminal and washing of machinery in use by the port. The Port of Koper reduces the use of potable water by building internal water networks that can be fed by water drawn from boreholes and collected rainwater. In the light of new technology introduced by the port, an objective to consume 5.8 litres of potable water per ton of cargo handled by the entire system was set. According to the results obtained for the last five years, the port consumed higher amount of potable water per ton of cargo handled in 2009 and 2010 when the consumption exceeded 8 l/t of cargo handled. In 2011 the consumption decreased to 4.8 l/t of cargo handled and in 2012 it increased to 6.36 l/t of cargo handled.

In 2013 the consumption exceeded the target value by 10%, which is mainly related to the infrastructure restoration inside the port area. Investments are planned also for the waste water system where cesspits are going to be completely replaced by the port's own smaller sewage treatment plants and new buildings will be connected to the public network.

Social pillar of sustainability

The Port of Koper intensively develops social pillar of sustainability. The port is seeking a balance between economic, environmental and social considerations in system development. Under social responsibility the port is focused on following three segments:

- Employees,
- Community and environment,
- Sponsorship and donations.

Employee satisfaction is one of the crucial elements of system's excellence. The port motivates employees by rewarding innovation and useful suggestions, as well as the provision of in-house training and mentorship. Every year the port promotes five exemplary employees, one employee as the leader of the year, one innovator and one quality operative, that achieve above-average endeavours and affinity.

Moreover, the port supports their employees by paying between 70% and 90% of their supplementary pension insurance premium.
Workers are further supported with following social activities by the management:

- employees are informed with monthly in-house journal, where important news and other internal operations are published;
- education and training programmes are organized and funded;
- sporting activities through the Luka Koper Sports Club are encouraged;
- organises the annual Luka Koper Sport Games in which the seaport's sports-men and -women compete against one another;
- workers can benefit from subsidised holiday apartments.

The Port of Koper is well connected with the local community and supports various cultural activities, sport clubs and humanitarian organisations. Besides, the port is co-financing town infrastructure projects and is directly engaged in the preservation of natural heritage close to the port's eastern border. Every year the port is making donations in national areas of culture, public health, humanitarian aids and sport.

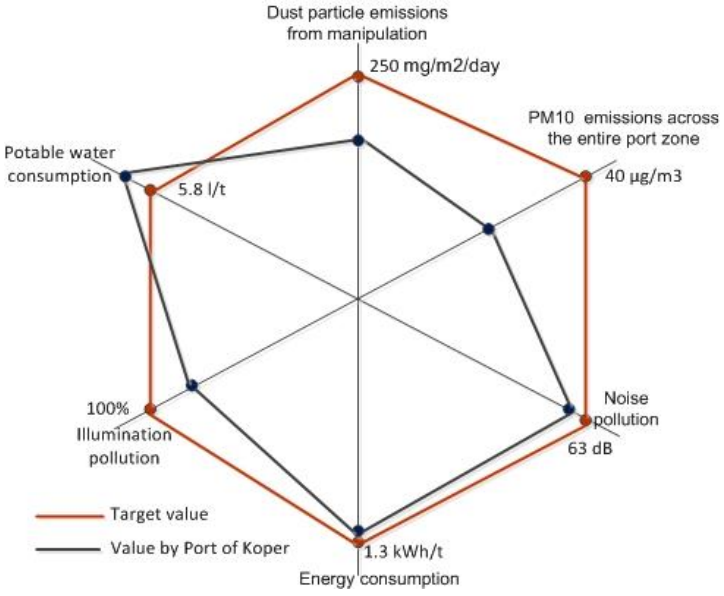
Six pillars of environmental measures and a social pillar for sustainable development

The application of environmental initiatives and measures by Port of Koper can be used as a case model for the same-size port systems or mid-size ports with different terminals and important national and regional position. To be specific, the complexity of port system, its role in international industry and globally might affect environmental measures and the set environmental objectives. Consequently, the six pillars of environmental policy in use by Port of Koper might be the platform for other similar port systems in the Adriatic Sea, where the environmental awareness is gradually developing but is still not at the same level. Namely, according to Ecoport study (Ecoport, 2013) of environmental measures in force in Southern Adriatic ports such as Durres, Bar, Bari, Patras etc. are in the initial phases and further development of environmental and sustainable initiatives are needed. Other ports like Ploce, Split and Rijeka can be added to this group of ports with just developing environmental and sustainable measures. The six pillar platform consists of six environmental fields important for a port's sustainable development and environmental approach. Each pillar has a measurable target value to be achieved by the port. The model uses target values defined by Port of Koper (Figure 4), but can be set at a different level, based on the port's objectives and posed standards:

- dust particle emissions from manipulation ($mg/m^2/day$) less than 250 $mg/m^2/day$;
- annual average emission of PM_{10} particles (size of up to 10 μm) less than 40 $\mu g/m^3$;
- maximum allowed noise pollution up to 63 dB;
- 100% of external illumination in compliance with the EU legislation;
- Energy consumption up to 1.3 kWh/t of cargo handled;
- Potable water consummation up to 5.8 litres per tonne of cargo handled.

Ports in the Adriatic Sea such as Rijeka, Split, Ploce, Bar and Durres might apply the defined six environmental pillars. The objectives can be achieved only by the long-term environmental policy. Firstly, an in-deep analysis of current situation is needed, and based on first measurements of the defined six pillars the target values should be defined by each port. Consequently, a range of different activities should be listed and later applied by the port management, in order to improve environmental results.
Meanwhile for the social pillar of sustainable development those systems have different attitudes and policy due to different organisation, economic performance and social situation in the local community. The example of Port of Koper can serve as the base for developing social responsibility. Consequently the six environmental pillars and a social pillar present the platform for sustainable port development. The entire region should benefit from port's sustainable development.

Figure 4. Six pillar environmental model for sustainable port's development



Conclusion

The role of a maritime port in a global green supply chain is becoming more important than ever. To be specific, environmental pressure on ports is becoming very strong, therefore port managements are forced to implement green policy in their long-term strategy. Ports have already taken important steps to-

wards environment friendly logistics and transportation operations. During last decade a social sustainable responsibility took an important role in port's sustainable development. The port has to be responsible not just to the owners through economic results, but also to the local community and environment. Some ports especially from the western economies already developed their sustainable platforms.

One of such port systems is Port of Koper, where sustainable development and green policy has been one of the development focuses for over a decade. For this reason, Koper port is classified as one of the greenest ports in Europe, with important social responsibility. According to the analysed case of Koper port different environmental initiatives are followed by a number of measures. The main focus is on air pollution, noise pollution, energy consumption, waste treatment, illumination pollution and potable water consumption. A set of measurable values are defined for each environmental initiative, where the results are periodically observed and at least once per year published to the port community. Through a set of social sustainable responsibility the port supports three main segments such as employee's satisfaction and health condition, community and environment responsibility and financially supporting local community through sponsorship and donations.

Based on the analysis and the results, achieved by the Port of Koper, it is possible to build a commonly used platform for a port's environmental and social sustainable development, even if a certain port has not been following the sustainable and environment friendly development so far. A six pillar environmental model, which can be used by ports in the region in setting-up their environmental measures, is introduced. The proposed value per each pillar is in accordance with high international environmental standards, therefore it can be modified according to a short-term policy. The model promotes also social sustainable approach as one of the most important pillar in sustainable development. With the right attitude ports might achieve important environmental results and sustainable development already by 2020.

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