



DOCKS THE FUTURE

defining the concept of "Port of the Future"

Port of the Future KPI set

Deliverable 3.1

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1. Executive summary

The development of a KPI set starts with finding a suitable structure where objectives that support a similar goal are classified. The KPI design is based on the structure of the World Ports Sustainable Programm (WPSP) as introduced in WP2, while also relating closer to the original UN Sustainable Development Goals (UN SDGs). Based on the initiatives and projects already analysed and categorised in the previous work packages a system linking the grouped objectives with respective UN SDGs ultimately leads to the development of the respective indicators. These quantify the impact of different measures towards the high-level strategic objective.

2. Development of KPI set

The ultimate result of this task is the development of a KPI set and its corresponding subsets that are suitable to evaluate the potential contribution of projects with regard to the aspects that are considered to be important for the Port of the Future. A short definition of the indicator's requirements is provided before reviewing existing port-related KPIs and evaluating their adequacy in this project's context. Based on the previous works of WP1 and WP2 KPIs are derived with a systematic approach that is in line with the project's terminology and framework. The following parts contain a detailed description of the methodology and structure of developing the KPIs.

2.1 KPI requirements

As the Port of the Future concept addresses manifold topics, the assessment of the different aspects requires a broad scope of KPIs. Still, all of them need to meet basic requirements in order to ensure the continuation of the project's output and results. Such characteristics for the port-related KPIs have been formulated already in the Grant Agreement: KPIs shall

- be relevant to and consistent with the "Port of The Future" vision, strategy and objectives;
- focused on the "Port of The Future" wide strategic value rather than on non-critical local business outcomes – selection of the wrong KPI can result in counterproductive behaviour and sub-optimised outcomes.

More precisely, the KPIs were derived following this checklist of criteria:

- representative - appropriate to the "Port of The Future" concept together with its foreseen operational performance;
- realistic - fits into the "Port of The Future" constraints and cost effectiveness;
- specific - clear and focused to avoid misinterpretation or ambiguity;
- attainable - requires targets to be set that are observable, achievable, reasonable and credible under expected conditions as well as independently validated;
- measurable - can be quantified/measured and may be either quantitative or qualitative;
- used to identify trends - changes are infrequent, may be compared to other data over a reasonably long time and trends can be identified;
- timely - achievable within the given timeframe;
- understood - individuals and groups know how their behaviours and activities contribute to overall "Port of The Future" goals;
- agreed - all contributors agree and share responsibility within the "Port of The Future";
- reported - regular reports are made available to all stakeholders and contributors;
- governed - accountability and responsibility is defined and understood;
- resourced - the program is cost effective and adequately resourced throughout its lifetime;
- assessed - regular assessment to ensure that they remain relevant.

2.2 Literature Review

Performance indicators have been developed as a management support tool. They can be divided into performance indicators and key performance indicators (KPIs). The latter are those indicators that an organization focuses on. These indicators can be, for example, physical (e.g. production output) or financial (e.g. stock value, EBITDA). In order to identify performance indicators that are relevant for Docks the Future, the objectives identified in Work Packages 1 and 2 shall be fully covered. Therefore, the focus is much broader than for single organisations, as the 'performance'

of ports must not only be evaluated in organizational terms, but also in societal terms, including environmental performance, port-city relationships and safety/security issues. The UN Sustainable Development Goals have been chosen as the framework for the high-level objectives. However, due to the general formulation of indicators, the contribution of ports cannot always be measured precisely.

In order to strike a balance between the contribution to high-level objectives on the one hand and specific indicators on port performance on the other hand, a specific KPI set is developed for Docks the Future based on the abundant literature on performance indicators.

As regards the environmental performance, there is an abundant literature on measuring environmental performance of organisations.¹ Several dozens of indicators have been proposed on a wide range of environmental issues such as air emissions, water use, waste, use of resources, energy use, and biodiversity. Some of these are interrelated, as the energy use, for example, can be translated into the use of resources when taking into account the energy mix. Several initiatives have applied these indicators to ports, e.g. the ESPO Ecoports Self Diagnosis Method.²

With regard to air emissions, it is important to distinguish between greenhouse gas emissions (global impact) and emissions with a local/regional impact (e.g. sulphur, particles, etc.). The former indicate the ports' contribution to global climate change while the latter plays a significant role for port-city relationships. For the Docks the Future KPI set, those performance indicators will be selected that are most important with respect to ports and their future development.

Regarding the operational performance of ports, the literature on logistics and supply chain indicators proposes a wide range of indicators.³ They include financial indicators and process indicators. The latter include volume indicators (e.g. volume handled in a port), efficiency indicators (volume handled per hectare/per quay metre) and quality indicators (reliability). Here again, the challenge is the choice of indicators relevant for Docks the Future and the link to UN SDGs. The efficiency indicators actually combine several high-level objectives, namely facilitating economic growth and saving natural resources (including land). In order to have a consistent KPI set, the focus of operational performance indicators is on handling capacity.

Estimating the impact of measures on port-city relationship, the AIVP report⁴ was used as a valuable input. It reveals that port authorities and port planners see the port-city relationship as a prerequisite for sustainable port development. In a way, it is hence an intermediate objective, necessary for any type of port development and hence the port's contribution to other goals. While in some cases, port acceptance and other goals may be in conflict (e.g. building new terminals to facilitate economic growth), other high-level objectives mostly coincide with those of the port city community (e.g. emissions reductions). Due to its high relevance for port planning, the port-city relationship and its main goals have been retained as high-level objectives with its own category (see 2.4).

¹ see Hřebíčková, J. et al. (2007), Environmental key performance indicators and corporate reporting. *Environmental Accounting and Sustainable Development Indicators* (2007). 978-980.

² see <https://www.ecoport.com/>

³ see, e.g., PORTOPIA and PPRISM projects as well as UNCTAD (2016): Port Performance: Linking Performance Indicators to Strategic Objectives, *Port Management Series*, vol. 4

⁴ AIVP (2019), *Docks the future survey*, final report.

As regards other objectives relevant for Docks the future, research was done on an ad hoc basis in order to identify single indicators for each high-level objective identified during WP1 and WP2 research.

Wherever possible, indicators have been chosen that fulfil all conditions set out in 2.1. Due to the project's diverse scope, however, not every derived indicator is able to meet all requirements to full extent. These compromises have been made in order to provide a KPI set that covers the full range of Docks the Future objectives.

2.3 Structure of the KPI set

The Port of the Future concept and projects address a wide range of different objectives. In order to structure these, the Macro Agenda of the World Ports Sustainable Programm (WPSP) has been introduced and implemented into the project in WP2. The organisation identified five major areas of interest for ports:

- Climate and Energy
- Community and port-city dialogue
- Governance and Ethics
- Resilient Infrastructure
- Safety and Security

It is suggested that the relevant projects and initiatives can be allocated to the 35 Strategic Objectives that are derived from the WPSP topics. They are grouped into the aforementioned five areas of interest which will be used further on as a structure. All objectives identified in Work Packages 1 and 2 are included, covering a wide range (but not all) UN Sustainable Development Goals (UN SDGs).

For the purpose of the evaluation methodology and KPI development a stronger linkage to the original UN SDGs is needed.⁵ This is done mostly by going back to the original formulation of the UN SDGs and their assignment to the WPSP areas of interest. Each of these fields incorporates a varying number of high-level strategic objectives which correspond to a specific sub-goal of the UN SDGs. The potential contribution of projects will be evaluated based on one or several KPIs for each high-level strategic objective.

In order to have a functioning framework of performance indicators, it is important to distinguish between those that scale single measures and those that are able to quantify multiple objectives. The latter is important in order to compare the effects of different projects and initiatives.

As many effects of a single project may be interconnected with different fields it is important to find a clear and logic scheme to distinguish and differentiate. For instance, a specific measure might contribute to goals in the environmental scope (Climate and Energy), while reducing the negative externalities due to local pollution at the same time. The effects of one measure must then be attributed to two separate fields. One is combating the climate change on a global level and the other are direct negative externalities for the local port community that are now reduced with the same measure. A project or initiative that is presented to serve one specific objective may have positive or negative effects on the attainment of other objectives. One example is the development of additional capacities for port facilities that may contribute to the port community

⁵ UN SDGs which are not addressed by Port of the Future such as "Fighting Poverty" have not been included.

positively and negatively. It creates jobs for the population but may also lead to more noise emission or other negative externalities for the contiguous residents. Therefore, it is important to break down different channels of impact of one measure. The evaluation methodology – and hence the KPI set – will take these interdependencies into account by checking the effects across all relevant areas.

Based on the description of the areas of interest including the “potential topics” and the UN SDGs mentioned, high-level strategic objectives have been identified for each area based on the work of WP2. They have been completed by high-level objectives from WP1 that are potentially relevant for the Port of the Future, but not included in the WSPSP programme.

2.4 Definition of relevant performance indicators

As each of these clusters reverts to a wide range of various objectives, the introduction of concrete UN SDGs as high-level strategic objectives supports the goal of consolidation. This fosters the comparison regarding effectiveness to contribute to the overall aim. The full listing of KPIs is depicted in the table on page 8.

The first of the WSPSP’s areas of interest is **Climate and Energy**. Its major task is combating global warming which is why the main indicator is the *reduction of port-related CO2 emissions* in tons. As there are many ways to contribute to this, it is important to evaluate absolute numbers and stress effective actions. Therefore a logarithmic scale is applied. Efforts in incentivising clean ships may also have a direct impact on the port. The secondary KPI reduction of emissions in port (noise, air, water) captures these side effects. Measures supporting the circular economy contribute to a different UN SDG and are quantified as *reduction in waste*.

The area **Community and port-city dialogue** contains manifold aspects. Measures contributing to the UN SDG of *Inclusive cities* can be assessed via the population’s port acceptance. Efforts to the goal of *Good jobs* may be evaluated with the income development in port-related jobs. However, values for both of these KPIs are not easy to obtain. Secondary KPIs and other alternative indicators must provide suitable evaluation by approximation. In contrast, the effectiveness of measures towards the goal of *Improving the environmental quality* is easier to quantify.

Quantification is even more difficult in the area of interest of **Governance & Ethics**. No single UN SDG covers the manifold aspects that are incorporated. The topics range from transparency in governance, gender equality and anti-corruption efforts to green governance goals. Due to the wide topical clustering, five high-level strategic objectives and their respective KPIs are applied.

The fourth WSPSP’s area of interest is **Resilient Infrastructure**. Four different high-level strategic objectives are identified. However, three main KPIs are sufficient to evaluate the measures due to further clustering. The UN SDG of *Economic growth* captures various efforts regarding the logistic capacity of a port as is quantified as *growth in port’s throughput capacity* in tons or TEU. The UN SDG of *Higher productivity* accounts for the raise in productivity due to digitalization. Aspects of Resilience form two additional high-level strategic objectives. Their impact is quantified as *estimated losses prevented* in Euro.

Ultimately, aspects of **Safety and Security** form the last area of interest according to the WSPSP classification. The field is further divided into the high-level strategic objectives of *Reducing crime* and *Safe working conditions*. The latter emphasises the efforts on the health of the working staff which is why the main KPI has been defined as *Reduction in fatal and non-fatal occupational injuries*. The resistance regarding terrorism, crime and cyber-attacks is measured in *estimated*



losses prevented. As cross-effects between these two areas exist, each UN SDG has a secondary KPI which is the respective one of the other goal.

The overview is represented on the following page.

WPSP areas	high-level strategic objectives	Main KPI	related WPSP topics	Secondary KPI	
Climate and Energy - Combat climate change and approach circular economy	Combat global warming (SDG 13)	reduction of port-related CO2 emissions [tons]	To improve the energy efficiency at ports	reduction of emissions in port (noise, air, water) [respective units]	
			To transit from fossil/based economy to bio-based economy		
To increase the portion of renewable energy in port					
To promote green infrastructure at ports					
To provide systematic incentives for clean ships					
Save natural resources (SDG 12)	waste reduction (plastic, dredging material) [tons]	To have transition towards circular economy	To deploy alternative transport fuels	reduction of port-related CO2 emissions [tons]	
Community outreach and port-city dialogue - Establish sustainable port-city relations and improve quality of life in port cities	Inclusive cities (SDG 11.3)	port acceptance [%]	To transform the port governance into stakeholder management	compensation of port-related CO2 emissions [tons]	
			To set up community outreach		
			To strengthen city-port relations		
			To promote spatial planning		
	Improve environmental quality (SDG 11.6)	reduction of emissions in port (noise, air, water)	To reduce / mitigate the externalities of port operations	To promote the public awareness and port culture	yes/no [binary]
				To publish annual port sustainability report	compensation of port-related CO2 emissions [tons]; port acceptance [%]
	Good Jobs (SDG 8.5)	income development in port- related jobs [%]	To improve employment conditions in the port	To increase the share of nature areas in ports	investment in educational programs [% of revenue]
				To enhance the skills and education of port labour	
Governance and Ethics - Promote good governance practices in port authorities	Transparency (SDG 16.6)	degree of transparency in port governance [%]	To transit towards Transparency and integrity in policy		
	Gender equality (SDG 5.5)	share of women in upper management of port-based enterprises [%]	To have policies with equal rights and opportunities	overall share of women in port-based enterprises [%]	
	Equal opportunity (SDG 10.3)	port open to third-party operators [binary]	To set fair trade regulations for ports or bw ports		
	Restrict corruption (SDG 16.5)	share of persons who experienced at least one incident of attempted bribery over the last year [%]	To put anti-corruption regulations		
Green governance (SDG 15.9)	ISO 14001 [binary]	To establish a Governance towards responsible supply chains			
Resilient Infrastructure - Provide resilient infrastructure to meet demands for maritime transport and sustainable landside logistics	Economic growth (SDG 8.1)	growth in port's throughput capacities [TEU, tons]	To increase port capacity	volume of investments of port-based enterprises [Euro]	
			To encourage port project financing and investments	volume of PPP conducted [Euro]	
			To have an effective public-private partnerships		
	Higher productivity (SDG 8.2)	savings due to optimization [Euro]	To transit towards digitization and automation in port activities		
Resilient Infrastructure (SDG 9.1)	estimated losses prevented [Euro]	To improve resilience of ports			
Account for resilience (SDG 13.2)		To take adaptive measures for climate resilience			
Safety and Security - Establish a framework to ensure safe port operations	Reduce crime (SDG 16.1)	estimated losses prevented [Euro]	To put in place ecosystems management	reduction in fatal and non- fatal occupational injuries	
			To establish cyber-security for port data network and platforms		
			To optimise protection of critical infrastructure		
	Safe working conditions (SDG 8.8)	reduction in fatal and non-fatal occupational injuries	To improve nautical safety	To comply with ISPS code	
				To enhance the port labor safety	estimated losses prevented [Euro]
			To set responsible care Safety and Security		

The KPIs scale accounts for the absolute contribution of a specific measure to the goal wherever possible and thus is expressed in logarithmized form. Some very specific KPIs can only reveal if a specific goal is fulfilled as a binary variable. While the effects of environmental measures can be assessed quite well and are easy to quantify, other KPIs lack such possibilities. Especially when a KPI is expressed as a percentage the direct contribution of a specific measure cannot be tracked correctly. In such cases, an approximation of the measure's impact is conducted and will be expressed in a five-tier scale ranging from "very low" over "medium" to "very high". The further approach will be presented as part of the methodology in task 3.3 of this work package.

2.5 Description of main KPIs

This section will provide a short definition of the specific KPIs as introduced in the section before.

KPI	Measurement unit	Definition
reduction of port-related CO2 emissions	tons	All efforts in order to combat global climate change are connected to a reduction in CO2 emissions. For each measure or action this reduction can be computed as an absolute number.
waste reduction (plastic, dredging material)	tons	The amount of any natural resource that re-enters the economic cycle can be expressed in its respective quantity. To simplify comparison, processed materials should be traced to a related basic resource.
port acceptance	percentage	A representative and balanced sample of the port city's population may be surveyed and asked to which extent they value the port's impact on the community on an ordinal scale ranging from "positive" to "negative".
reduction of emissions in port (noise, air, water)	respective unit	Reduction of negative externalities of the port's operation that have an impact on the local community.
income development in port-related jobs	percentage	The change of the average wages and salaries in port-related occupations over time.
degree of transparency in port governance	percentage	Evaluation to which extent the port authorities processes, decision making and overall governance meet the aspects of traceability and transparency.
share of women in upper management of port-based enterprises	percentage	The share of women in the executive and supervisory board of port-related businesses according to the corporation's statement.
port open to third-party operators	binary, yes/no	Openness is considered when parts of the port's infrastructure can be operated by (foreign) privately run corporations.
share of persons who experienced at least one	percentage	Representative survey conducted among persons with linkage to organisations of port operation or

incident of attempted bribery over the last year		governance and their personal exposure to incidents of bribery.
ISO 14001	binary, yes/no	If the requirements conducted in ISO 14001 are met and the certification is valid this KPI is considered to be satisfied.
growth in port's throughput capacities	TEUs and tons	Change of a port's throughput capacities by a specific action estimated in TEUs and tons.
savings due to optimization	Euro	Computation of savings attained within working processes by an action related to digitalization.
estimated losses prevented	Euro	Computation of the financial losses prevented by a specific action that lowers the risk of the downtime of port facilities.
reduction in fatal and non-fatal occupational injuries	number	The quantity of fatal and non-fatal casualties as reported.

2.6 Other performance indicators and their relation to the KPIs

There are a number of other objectives and related performance indicators that are regularly quoted in projects and initiatives. Some of these have been considered as intermediate and indirectly related to high-level strategic objectives. For example, increasing the productivity of an existing terminal relates to economic growth (allowing more trade), but may also contribute to save natural resources, land use or port acceptance.

Others, like improving/facilitating financing, are transversal. Developing public-private partnerships is not an objective in itself, but it can help to finance new, expensive infrastructure or research and development activities. Research and innovation are also not objectives on their own, but tools for achieving, e.g., lower carbon emissions.

Innovativeness, transferability and implementation costs will hence be analysed as separate dimensions independently from the KPIs as part of the Project Common Index (deliverable 3.3).