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PORT MANAGEMENT 2023

Volume 11

Port Performance Indicators

SUSTAINABLE DEVELOPMENT GOALS

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The PMP promotes the national, regional and international exchange of knowledge and experiences among port professionals and operators, reinforcing talent management and the development of human resources in port communities.

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GLOSSARY

Alternative Fuels: Energy sources that are used as substitutes for conventional fuels, such as oil and coal.

Balanced Scorecard (BSC): A management tool that allows an organisation's performance to be measured and monitored through key indicators and strategic objectives.

Berth: A specified length of quay wall where a vessel can tie up.

Bottlenecks: Points or areas in a process, system or supply chain where capacity or efficiency is limited, leading to a decrease in productivity or flows.

Breakwaters: Physical structures which protect port infrastructures from the sea.

Business Continuity Plan: Set of measures and strategies designed to ensure continuity of operations and minimise the impacts of disruptions or disasters on an organisation.

Carbon Footprint: A measure of the total amount of greenhouse gases released either directly or indirectly by an activity.

Cargo mode: Firstly, goods are classified according to how they are presented at the port: general goods (containerised and non-containerised) and bulk goods (solids and liquids). Secondly, according to how they are handled: Lo-Lo (Lift-on/Lift-off) vessels use cranes to load and unload containers; Ro-Ro (Roll-on/Roll-off) are vessels designed and built to transport wheeled cargo, such as cars, trucks with containers, or even people who get on the vessel by their own means; or to load either solid or liquid bulk goods or break bulk.

Climate Change: Long-term shifts in the Earth's climate, primarily caused by human activities, such as greenhouse gas emissions, resulting in a rise in temperature and adverse effects on the environment.

Decarbonisation: The process of reducing or eliminating greenhouse gas emissions, especially carbon dioxide (CO_2), in energy production and consumption, transportation, industry and other human activities.

Docks: Basic infrastructure required to berth a vessel.

EBIT: Earnings Before Interest and Taxes.

Environmental Management System (EMS): A set of practices and procedures to reduce the effects on the environment.

Greenhouse Gas (GHG) Emissions: Release of gases that trap heat in the earth's atmosphere and contribute to global warming, such as carbon dioxide (CO_2), nitrous oxide (N_2O) or methane (CH_4).

Gross Operating Profit: Earnings before interest, taxes, depreciation and amortisation.

Gross Tonnage: A volumetric measure of the total enclosed spaces of a vessel.

Infrastructure: Fixed and immovable assets of a port, such as land, roads, docks and breakwaters.

Just-In-Time: A management strategy that aims to produce and deliver goods or services exactly when they are needed, minimising waste and optimising resources.

Labour Costs: All company costs associated with worker hiring and retention processes.

Lo-Lo: Lift-on, Lift-off; see <<Cargo mode>>.

Loader: Entity, company or individual that is responsible for loading and shipping goods or products.

Master Plan: Strategic document that establishes the guidelines and long-term objectives for the development and management of a given area, project or entity.

Port Authority: A body established by law to manage a port, or ports, on behalf of the State or other Administration. They are often constituted as corporate entities. The Port Authority may also be the entity responsible for administering and managing a maritime or inland port.

Port Dredging: The process of removing sediment, sand, silt and other unwanted materials from the seabed and navigation channel in a port.

Port Services: The various services provided to vessels and goods in a port, such as towing or stowage services.

Renewable Energy Sources: Those obtained from natural resources that are inexhaustible or continuously renewable.

Ro-Ro: Roll-on, Roll-off; see <<Cargo mode>>.

Sustainable Development Goals (SDGs): The Sustainable Development Goals (SDGs) are a global agenda of goals and actions that aim to address the world's most pressing social, economic and environmental challenges in order to achieve sustainable development for everyone and the planet.

Vessel Draught: Vertical distance between the waterline and the lowest point of the vessel hull, usually measured from the keel.

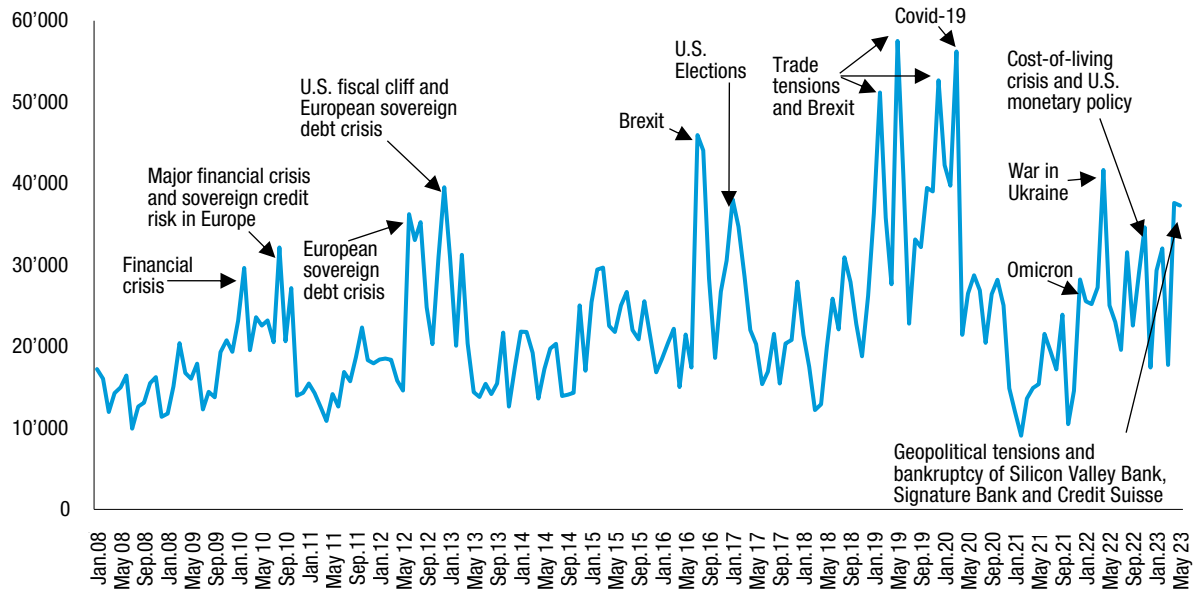
1. INTRODUCTION

In 2016, the United Nation Conference on Trade and Development (UNCTAD) published the fourth volume of its Port Management Series, dedicated to port performance, under the title *"Port Performance: Linking Performance Indicators to Strategic Objectives,"* with the aim of providing a rational basis for decision-making and assessing port operator and manager capabilities. Ever since, the maritime industry, countries and society in general have faced difficult years that have brought about unprecedented challenges and structural changes to the industry, in an environment marked by growing uncertainty (Figure 1).

The COVID-19 pandemic, which began in early 2020, has been the most disruptive phenomenon in the global economy since the end of World War II, and has caused unprecedented economic effects at all levels. In view of this, the maritime and port sectors reached maximum levels of uncertainty over the course of the year. They have been further compounded by a series of unpredictable events of a different nature, which, coined under the term "Black Swan" (Taleb, 2007), have had a major impact on the maritime industry.

All these factors have undoubtedly fuelled each other, creating a scenario full of unknowns in which traditional trade patterns have been altered, with ports and all other agents in the supply chain having to adapt to them and compete within this ever-changing context. In order to deal with this uncertainty, while optimising enticement and loyalty strategies within this new scenario, ports must have a series of reliable and available indicators that allow them to measure their performance and compare it with the performance of similar ports.

Figure 1: World Uncertainty Index



Source: World Uncertainty Index (2023)

There are, undoubtedly, a number of technical challenges to measuring port performance, given that it covers several dimensions, ranging all the way from service quality and value for money to returns on investment and economic efficiency. In addition, the traditional narrative shows that all ports are different in terms of size, trade context, governance models and types of services offered. Therefore, even though port case studies are common, few of them focus on making comparisons, i.e., on benchmarking performance. The difficulties of developing a consistent data exchange process between countries have not changed since UNCTAD published a monograph on this matter in 1987. In this regard, and as explained in Volume 4 of the Port Management Series, the assessment of port performance is challenging due to the factors listed below:

- The sheer number of parameters.
- The lack of updated, objective and reliable published data.
- The absence of generally agreed and accepted definitions.
- The strong influence of local factors on the data obtained.
- Divergent interpretations of identical results by different stakeholders.

At the same time, there is a growing demand for knowledge and information relating to port performance. For example, policymakers may be interested in comparing ports at a transnational level and over time port customers may want to make operational and financial assessments by cargo type. Port authority administrators are interested in measurements that compare the performance of limiting factors specific to their immediate circumstances. Political economists seek data that allow them to propose performance quality explanations from a given data set. Developing tools and establishing uniform criterion to provide consistent comparisons is critical to be able to take measures that add value for future policies, research and industry users. This approach is aligned with that of maritime, engineering and finance professionals, who have proposed measures to benchmark competitors, objectives and technical standards within management areas.

Industry professionals, customers, port managers, among others, also have a need for port performance information. Both port users and regulators are leading this initiative due to the lack of reliable data from the ports themselves. Indicators have been focused on the services offered by the port to increase profitability and reduce costs. For example, one of the main factors that determine costs in maritime trade is time. The longer a vessel stays in port, the higher the cargo transport costs. Therefore, indicators that inform port users about berth waiting times and operating times are particularly valuable. For port managers, port land is a key resource. In this regard, measuring the use of land in terms of cargo volumes and storage time is a useful indicator for assessing performance.

2. NEW PROPOSAL FOR PORT PERFORMANCE INDICATORS

Many areas of port management, such as operations, finance and security, measure port performance as part of commonly accepted practices. Therefore, there already exists a series of relevant indicators that were addressed in previous editions of this publication. The difficulties in obtaining information to assess performance are widely documented in the specialised literature, and are due, in part, to the diversity and dispersion of ownership of the relevant data. However, in this review, and thanks to the advantages of data processing and process automation digitalisation, more information and indicators that can be used to measure port performance are available.

It is also necessary to emphasise the increasing awareness of the climate emergency in recent years and, in response to that, the commitment to decarbonisation and the fight against climate change in the maritime sector. In this regard, multilateral institutions such as the International Maritime Organisation (IMO), as well as national and supranational governments, such as the European Union, are making efforts to promote policies that reduce emissions linked to transportation and to encourage the use of alternative fuels, in some cases introducing carbon emission offset or payment systems. Furthermore, environmental performance is increasingly becoming a key element in the choice of transport alternatives by shippers and end customers. For these reasons, monitoring and measuring sustainability indicators has become a necessity, and therefore it has been deemed appropriate to include a series of indicators related to environmental performance.

Likewise, but from a more cross-cutting perspective, given its role in terms of port management efficiency and transparency, the inclusion of governance indicators has been considered. Similarly, and given the disruptions in recent years, a block of port resilience indicators has also been included, these being key to reassessing and measuring the capacity of ports to resist, adapt and recover from disruptions and exogenous shocks. In light of this, the proposal for port performance indicators is aligned with the **four categories** used in previous editions: **financial**, **human resources**, **vessel operations** and **cargo operations**, with the additional inclusion of **three new blocks related to governance, resilience and environmental sustainability**.

For methodological purposes, it is important to note that the indicators are *a priori* expressed, for the purpose of their calculation, from the point of view of a port authority. However, and although some of them can be calculated for a single port terminal or company within the port community, they can also be aggregated for same-level entities (the ports in a country) or by different types of entity that make up a community.

As for how these indicators are presented, the same structure has been followed for each major group represented, establishing categories within each block of indicators (Table 1). As such, each indicator is described according to both its definition or objective and the formula or form of calculation used. It is worth noting that a classification has been made based on the comparability of each indicator, which is referred to as the "comparability traffic light system." The categorisation is based on how easy it is to compare each indicator among different entities and on how easy it is to gather the information necessary to calculate the relevant indicator. Lastly, a column has been created connecting each proposed indicator to the relevant Sustainable Development Goals (SDGs) published by the United Nations (UN)[1]. Considering all of the above, we are able to establish a series of key port performance indicators that provide a global and structured view of port performance.

[1] For a better understanding, the SDGs are described in **ANNEX** along with a series of specific implementing actions.

Table 1: Groups and Categories of Indicators

GROUP	CATEGORIES
Governance	• Indicators characterising the Level of Management Autonomy • Performance indicators in terms of governance
Human resources	• Equal opportunities • Quality of employment • Social welfare • Productivity
Financial	• Accounting • Activity-related • Financial standing and investment • Financial performance
Vessel operations	• Time • Vessel characteristics
Resilience	• Physical safety • Cybersecurity
Cargo operations	• Operational performance • Service level • Utilisation
Sustainability	• Climate change • Emissions from port activities • Consumption of resources • Waste production • Port development • Impact on biodiversity • Environmental management

Source: Fundación Valenciaport

The classification, which is based on the availability and comparability of the indicators, will allow users to choose the indicators that are most suited to their situation and the purpose of the information, thus establishing a scorecard based on the series of indicators proposed. In terms of comparability, it should be noted that any assessment thereof is relative and will depend on the proximity or, otherwise, of the organisations being compared. Thus, two ports in the same country, managed under the same legal framework, will provide more comparable indicators than others. Given that the goal is not to limit the comparison to the national sphere, the classification has been developed with an international focus. In addition, for the purpose of equivalence between the different entities using the proposed scorecard, it is worth stressing that the indicators listed must be calculated annually, thus giving an annual outcome.

Prior to calculating the proposed indicators and, therefore, establishing the port scorecard, it is advisable to conduct a self-diagnosis and characterisation exercise that allows for the positioning of each port authority in order to, subsequently, make it easier to effectively and validly establish comparisons both for the same body and with respect to similar entities. Thus, there are a series of indicators which may be of interest, such as the definition of the size and type of port, service portfolio, economic regulation, economic development (gross domestic product, gross national income per capita), region, distance, connectivity, economic and political institutions, and role as a transit port, among others. This classification exercise carried out from a higher-level perspective is supplemented by a series of indicators that characterise the level of management autonomy, as explained below with respect to the governance indicators.

We will now describe the different port performance indicators based on the established categories and according to the variables presented above. To better illustrate how it is used, the second section includes a real-life example of the scorecard for the Port Authority of Valencia. A couple of real-life applications in the field of port performance measurement and monitoring are presented at the end of the publication and serve as useful tools for decision-making and strategic planning.

2.1. GOVERNANCE INDICATORS

In port settings, governance indicators are essential for assessing and promoting effective, transparent and responsible port management. These indicators allow for compliance with good governance principles and practices to be measured and monitored, which is crucial to ensuring the efficiency, equity and sustainability of port operations. Port governance is one of the key trends in international trade and shipping and has become a major focus on the agendas of many port management bodies since the 1980s. As macroeconomic and social changes have occurred, so too have reforms, albeit at a slower rate within port governance structures (Pallis, 2020).

The assessment of governance provides a better understanding of the decisions made by those responsible for port management, which contributes to more effective management of a particular port. Although it is a less complex approach in terms of the amount of data required, its success largely depends on the port's governing body understanding its importance and determining the aspects of governance which must be considered a priority (Notteboom, Pallis, & Rodrigue, 2022).

Port governance increasingly points to greater private sector participation, especially in the provision of port services. There is also a trend towards the conversion of port authorities into corporate trade entities. Consequently, the debate on the privatisation of public services can even apply to the port sector. There are several studies conducted across the world that reach the conclusion that maritime access infrastructures are usually financed with public funds (UNCTAD, 2016).

Port governance is defined by two opposing forces: centripetal and centrifugal. Centripetal forces focus on political and jurisdictional controls of port territorial dynamics, stressing the roles of public and private actors in port management and operations from a market economy perspective. Port authorities seek to adopt efficiency-enhancing measures, such as administrative decentralisation and greater freedom for the private economy, consequently adapting to market rules. This entails structural changes aimed at further liberalisation and deregulation, including the creation of multimodal platforms and the expansion of logistics services. Alternatively, centrifugal forces refer to the redefinition of the traditional roles of port authorities, focusing on complementary activities to strengthen vertical and horizontal integration and respond to the growing demands of trade. A central example of this today is the role of space management in ports. (González Laxe, 2008).

Governance indicators in port settings are, therefore, important for several reasons. In the first place, they promote transparency and accountability by facilitating the disclosure of information, stakeholder participation and the level of responsibility of port stakeholders. They also help improve efficiency and productivity by measuring aspects such as the flexibility of administrative processes, efficient resource allocation and the effectiveness of internal control mechanisms. Similarly, they promote equity and inclusion by assessing equal opportunities, the protection of labour rights and equitable access to the benefits generated by the port. Thus, governance indicators also help to manage risks, ensure regulatory compliance and build trust and reputation both locally and internationally.

Lastly, governance indicators measure the contribution of governance to the Sustainable Development Goals (SDGs) proposed by the United Nations and, in particular, to SDG 16: Peace, Justice and Strong Institutions and SDG 17: Partnerships for the Goals (Table 2).

Table 2: SDGs linked to governance indicators

Governance indicators are more cross-cutting in nature, causing the monitoring and tracking of them, in terms of the Sustainable Development Goals (SDGs), to be a broader exercise. Consequently, the measurement of contributions to SDGs which include targets related to transparency as well as information on actions carried out in cooperation with other organisations is allowed by the governing bodies of port management organisations.

In this respect, and as with all the other indicators, governance indicators allow for the measurement of the contribution of governance to **SDG 16** "Peace, Justice and Strong Institutions," which aims to address key challenges related to violence, justice and corruption, and to promote strong, transparent and equitable systems that contribute to sustainable development and the building of peaceful and just societies.

Similarly, governance indicators allow for an assessment of its contribution to **SDG 17** "Partnerships for the Goals," which focuses on strengthening the means of implementation and revitalising the global partnership for sustainable development. This is why SDG 17 encompasses the achievement of the other Sustainable Development Goals established by the United Nations, such as **SDG 6** "Clean Water and Sanitation," **SDG 7** "Affordable and Clean Energy," **SDG 8** "Decent Work and Economic Growth," **SDG 9** "Industry, Innovation and Infrastructure," **SDG 10** "Reduced Inequalities," **SDG 11** "Sustainable Cities and Communities," **SDG 12** "Responsible Consumption and Production," and **SDG 14** "Life Below Water."

Source: Fundación Valenciaport

With regards to the **governance indicators**, given their particular characteristics, it was deemed advisable to divide the section on these indicators into **two main categories**. In this way, and as mentioned in the previous section, the aim is to first characterise the port authority via expressly descriptive indicators, rather than focusing on the actual measurement of performance itself. These indicators have been deemed necessary as a pre-condition for the classification exercise and comparability of the resulting scorecards, taking as a reference both the Trends in EU Ports' Governance 2022 document published by the European Sea Ports Organisation (ESPO) and the book entitled Port Economics, Management and Policy (Notteboom, Pallis, & Rodrigue, 2022). In this regard, the classification followed is shown below:

1. **Indicators characterising the Level of Management Autonomy**
    - The port authority has its own legal status (Yes/No).
    - The port authority develops its own Master Plan (Yes/No).
    - The port authority can outsource the provision of port services to third parties (Yes/No).
    - The port authority is a public entity (Yes/No).

The second block includes those indicators aimed at assessing governance performance. As a next step, it is proposed that an aggregate port governance index be created to collect information based on the indicators proposed, which include the following:

2. Governance Indicators

a. Transparency and Accountability

- The port authority publishes annual accounts (Yes/No).
- Audits of annual accounts are carried out by an external auditor (Yes/No).
- Port fees are publicly available (Yes/No).
- Port traffic data is published on a regular monthly/quarterly basis (Yes/No).

b. Level of Cooperation Between Ports

- The port authority participates in sectoral partnerships with other managing bodies (Yes/No).
- The port authority leads sectoral partnerships involving other managing bodies (Yes/No).
- The port authority participates in joint projects with other port bodies (Yes/No).
- The port authority runs joint projects with other managing bodies (Yes/No).

c. Support to (Industrial and Port) Clusters

- The port authority participates in sectoral partnerships with other managing bodies (Yes/No).
- The port authority has a Business Continuity Plan (Yes/No).
- The port authority contributes to or oversees the resolution of maritime access operational/service bottlenecks as well as administrative bottlenecks (Yes/No).
- The port authority manages an Information and Communication Technology (ICT) system for the benefit of the port community (Yes/No).

d. Port-City Relations or Liaising with Citizens

- There is a Port Centre open to inhabitants who wish to find out how it works and what projects are carried out (Yes/No).
- The port authority promotes cultural/leisure activities for citizens (Yes/No).
- The port authority provides port spaces for public use (Yes/No).
- The port authority carries out activities to foster relations with neighbouring populations (Yes/No).

For methodological purposes, the aggregate port governance index collects the information from the indicators proposed, weighted equally (each of the four indicators having a value of 25%). The aggregate port governance index is thus calculated as follows:

Port Governance Index

*= 0.25 *transparency and accountability*
*+ 0.25 *level of cooperation between ports*
*+ 0.25 *integration with clusters*
*+ 0.25 *Port to City relationship*

In turn, each of the four indicators proposed are weighted equally, depending on the degree of compliance, which is reflected by the number of positive responses (“Yes”). Accordingly, and given that each category contains 4 subsections, a score of 4 is obtained for a level of compliance of 100% (4 positive responses), a score of 2 or 3, respectively, is obtained for a level of compliance greater than 50% (2 or 3 positive responses) and a score of 1 or 0, respectively, is obtained for a level of compliance of less than 50% (only one positive response or none).

In this regard, and when calculating the port governance index as a whole, a score of 4 would indicate an optimal level of governance, a score of 2 would indicate an intermediate level of governance and a score of 0 would indicate a low level of governance. For practical purposes, the level of port governance performance is to be understood in terms of how it compares to the optimal level of performance.

2.2. HUMAN RESOURCE INDICATORS

Human resource indicators are primarily focused on developing human capital in order to further improve the provision of port services, thereby increasing trade flows and, consequently, boosting national economic welfare (UNCTAD, 2016). In this respect, such indicators serve as tools to measure and assess the performance and efficiency of an organisation's human talent, providing both qualitative and quantitative information that allows informed and strategic decisions to be made.

In recent decades, the port sector has focused its attention on the development of technological advances as a means to reducing dependency on human skill and effort while increasing productivity. However, in the recent years, the port industry has stressed the need to pay attention to improving performance through trained and motivated personnel. In this regard, various empirical studies have stressed that port performance and human resource management are positively correlated (Al-Tarawneh, Saadon, & Maqableh, 2021). To this end, we considered classifying the **human resource indicators** (Table 4) into **four different categories**:

1. **Equal Opportunity Indicators:** These indicators are used to assess and monitor equity and fairness, as well as access to employment opportunities. They provide objective data on the representation and participation of different groups of people in the work environment, and serve to identify inequalities and gaps in terms of recruitment, promotion, training, remuneration and career development.
2. **Employment Quality Indicators:** These indicators are used to assess the degree of satisfaction and well-being of personnel, as well as their working conditions in the relevant work setting.
3. **Social Welfare Indicators:** These indicators serve to assess both the level of welfare and the quality of life of personnel in an organisation.
4. **Productivity Indicators:** This set of indicators can be presented as a measure of productivity both in economic and physical terms in relation to the volumes handled by the human capital of the different managing bodies.

With respect to the sources of information needed to gather this data, in general, managing bodies have all the necessary information to develop the indicators proposed, the vast majority doing so through HR departments and their equivalents.

The proposed human resource performance indicators are, undoubtedly, fully aligned with the Sustainable Development Goals (SDGs) proposed by the United Nations and, specifically, with SDG 5: Gender Equality, SDG 8: Decent Work and Economic Growth and SDG 10: Reduced Inequalities (Table 3).

Table 3: SDGs linked to human resource indicators

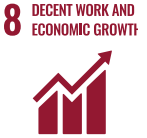
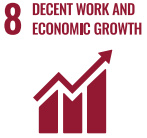
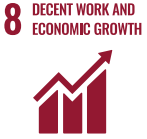
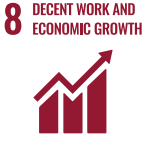
Human resource indicators can be used to measure the contribution of human resources to the Sustainable Development Goals (SDGs) proposed by the United Nations (UN). In addition, and in particular, indicators relating to the equal opportunities category can be used to determine the impacts of equal opportunities with respect to **SDG 4** "Quality Education," as it contributes to ensuring fair and quality education, as well as promoting learning opportunities within the relevant scope of action. It is also worth mentioning that these indicators are monitored and tracked with respect to **SDG 5** "Gender Equality." More specifically, the indicators are linked to the goal of promoting women's participation in decision-making at political, economic and public levels.

Similarly, there is a strong link between contributions towards **SDG 8** "Decent Work and Economic Growth" and the indicators, especially those related to quality of employment, social welfare and productivity. The similarities lie in that both SDG 8 and the indicators seek to promote sustained inclusive and sustainable economic growth, full and productive employment and decent work for all. Along the same lines, it is also worth mentioning that it is possible to monitor how some of these indicators, such as those relating to inclusion policies and wages, contribute to **SDG 10** "Reduced Inequalities". This is especially evident with respect to the goal aimed at reducing income inequality opportunities, which is measured both between and within countries.

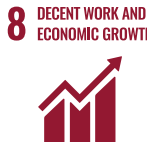
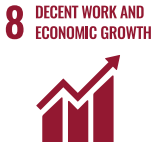
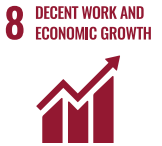
Source: Fundación Valenciaport

Table 4: Human Resource Indicators

NAME	DESCRIPTION / OBJECTIVE	CALCULATION	COMPARABILITY	LINK TO SDG
EQUAL OPPORTUNITY INDICATORS				
Gender Parity by Professional Category*	Proportion of men and women working in the port authority by professional category within the entity (e.g., management/executives, qualified technicians, professionals), measured on the basis of the gender that is least represented.	$\frac{\text{Underrepresented gender (Category i)}}{\text{Total workforce (Category i)}} * 100$		5 GENDER EQUALITY 
Gender Parity by Type of Contract	Proportion of men and women who work in the port management body by type of contract used (permanent/temporary), measured on the basis of the gender that is least represented.	$\frac{\text{Underrepresented gender (Category i)}}{\text{Total workforce (Category i)}} * 100$		5 GENDER EQUALITY 
Distribution of Personnel by Professional Category	Breakdown of the port authority's employees by professional category. Depending on the fiscal year, the following categorisation could be used: – Management/Executives – Qualified Technicians (middle management level) – Professionals	$\frac{\text{Workforce (Category i)}}{\text{Total workforce}} * 100$		8 DECENT WORK AND ECONOMIC GROWTH 
Level of Turnover of the Port Managing Bodies' Workforce	Assessment of the frequency of changes and updates to the average age of the port authority's personnel.	$\frac{\Sigma \text{ Age of each individual}}{\text{Total workforce}}$		8 DECENT WORK AND ECONOMIC GROWTH 
Inclusion Policy Indicator	Measurement of the level of integration of workers with disabilities within the port managing bodies' workforce.	$\frac{\text{Nº of disabled individuals}}{\text{Total workforce}} * 100$		10 REDUCED INEQUALITIES 

NAME	DESCRIPTION / OBJECTIVE	CALCULATION	COMPARABILITY	LINK TO SDG
EMPLOYMENT QUALITY INDICATORS				
Temporary Employment Rate	Proportion of temporary jobs (as opposed to permanent jobs) as a share of total jobs at the port authority, as an indicator of the quality of the jobs created.	$\frac{\text{Nº of temporary personnel}}{\text{Total workforce}} * 100$		
Level of Employment Stability	Demonstration and consistency of job stability offered by the port authority. Assesses how long staff remain in their jobs.	$\frac{(\text{Nº of personnel at the end of the period}) - (\text{Nº of new hires})}{\text{Nº of personnel at the beginning of the period}} * 100$		
Volume of Direct Jobs Generated	Quantification of the number of jobs generated by the port authority.	Σ Direct jobs		
SOCIAL WELFARE INDICATORS				
Volume of Indirect Employment Generated	Quantification of the number of jobs generated by auxiliary companies (better known as outsourcing companies, which provide some type of service outside the company's core line of business) for the port authority.	Σ Indirect jobs		
Training of Human Capital	Using this indicator, managing bodies can report on the strategy and efforts made to train their employees and the level of this investment.	Σ Hours of training		

NAME	DESCRIPTION / OBJECTIVE	CALCULATION	COMPARABILITY	LINK TO SDG
Resources Spent on Education and Training in relation to Wages*	Relevance of training and education costs in relation to employee labour costs.	$\frac{\Sigma \text{ Training costs}}{\text{Total labour costs}} * 100$		4 QUALITY EDUCATION 
Average Wage*	Measurement of the average wages received by port authority employees.	$\frac{\Sigma \text{ Wages and salaries}}{\text{Nº of employees}}$		10 REDUCED INEQUALITIES 
Wage Growth	Measurement of the wage growth in the jobs generated by the port authority.	$\triangle \left[\frac{\Sigma \text{ Wages and salaries}}{\text{Nº of employees}} \right]$		10 REDUCED INEQUALITIES 
Availability of Digital Tools for Advanced Training	Qualitative indicator that measures the availability of an interactive tool that allows the port authority to develop advanced training programmes for its employees.	YES / NO		4 QUALITY EDUCATION 
PRODUCTIVITY INDICATORS				
Productivity per Employee*	Ratio of port traffic channelled through the infrastructure to the workforce.	$\frac{\text{Tons}}{\text{Nº of employees}}$		8 DECENT WORK AND ECONOMIC GROWTH 

NAME	DESCRIPTION / OBJECTIVE	CALCULATION	COMPARABILITY	LINK TO SDG
Gross Operating Profit per Employee*	Ratio of the gross operating profit generated by the infrastructure to the workforce. Gross operating profit measures company operating profits and losses, comparing revenue minus expenses, without taking into account interest, taxes or amortisation.	$\frac{\text{Gross operating profit}}{\text{Nº of employees}}$		
Revenue per Employee*	Ratio of revenue generated by the infrastructure to the workforce.	$\frac{\text{Revenue}}{\text{Nº of employees}}$		
Labour Costs per Employee*	Estimated average personnel costs per employee for each port authority.	$\frac{\Sigma \text{ Total labour costs}}{\text{Nº of employees}}$		

Source: Fundación Valenciaport with data from different sources

* These indicators can be found in Volume 4 of this publication "Port Performance: Linking Performance Indicators to Strategic Objectives" (2016) within the framework of the United Nations Conference on Trade and Development (UNCTAD) TrainForTrade Port Management Programme.

** The sources used to develop human resource indicators are the port managing bodies themselves and the respective departments responsible for managing the organisation's human capital.

2.3. FINANCIAL INDICATORS

Financial performance indicators are particularly important for informed decision-making when allocating resources or investing in projects. In this respect, they are key to assessing the financial health and performance of a company or organisation. A financial performance assessment provides insight into the economic impacts of strategies endorsed by port authorities, management and operational priorities. Financial performance indicators help to determine whether the implementation of specific options has been successful, or whether corrective actions are required instead (Notteboom, Pallis, & Rodrigue, 2022).

These types of indicators offer a wide range of advantages. First of all, they allow the profitability and efficiency of port operations to be measured. This includes assessing the ratio of revenue generated to costs incurred, as well as identifying areas for improvement to optimise financial performance. In this regard, it is crucial for port managing bodies to implement financial indicators in order to assess and monitor their economic performance. These indicators provide a clear and quantifiable view of the financial situation, thus allowing for informed decision-making and efficient resource management. They also enable comparison with port industry standards. This allows port authorities to assess their performance in relation to other similar ports and take corrective action if needed.

For the purposes of this publication, the series of **financial indicators** (Table 6) has been divided into **four broad categories**:

1. **Accounting Indicators:** In order to measure business profitability, a block of absolute accounting indicators has been used, these include financial metrics, such as EBIT and gross operating profit. These are reference indicators in the analysis of financial performance at the highest level, especially considering their usefulness when measuring and comparing the profitability of the organisations themselves, and in relation to similar organisations.
2. **Port Activity Indicators:** Similarly, with the intention of measuring the profitability of the business, this time in relation to the cargo unit, the net profit for the fiscal year per cargo unit is obtained. This is done by taking into account the revenue, derived both from port rates or tariffs and from the use of land, and then deducting expense-related items.
3. **Financial Capacity and Investment Indicators:** These indicators are intended to give an overview of the financial capacity of the port authority in relation to the weight of investments from its own or external sources.
4. **Financial Performance Indicators:** This category covers a series of indicators that allow for the assessment of aspects such as the sources of port revenue, the profitability of the activities carried out and the level of indebtedness compared to the authority's net worth. In short, they provide a comprehensive and quantitative view of the port body's financial health and revenue-generating capacity.

Lastly, the financial performance indicators proposed are completely aligned with the Sustainable Development Goals (SDGs) proposed by the United Nations (UN) and, specifically, with SDG 8: Decent Work and Economic Growth and SDG 16: Peace, Justice and Strong Institutions (Table 5).

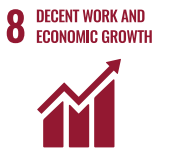
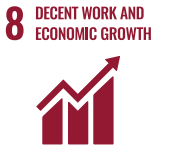
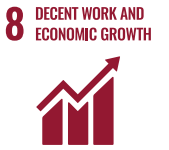
Table 5: SDGs linked to financial indicators

Financial indicators are used to measure the contribution to several of the Sustainable Development Goals (SDGs) proposed by the United Nations (UN). More specifically, they serve to assess their impact on **SDG 8** "Decent Work and Economic Growth." The monitoring of the various financial performance indicators helps to ensure that economic growth can take place in a sustained manner, in such a way that the investments made, after first being analysed, are actually accessible for the organisations concerned.

Similarly, the monitoring of financial indicators allows for the determination of their contribution to **SDG 16** "Peace, Justice and Strong Institutions," since these initiatives are aimed at creating peaceful and inclusive societies for sustainable development. This enables access to justice for all, building effective and inclusive institutions that provide accountability at all levels and results in a high degree of transparency.

Source: Fundación Valenciaport

Table 6: Financial Indicators

NAME	DESCRIPTION / OBJECTIVE	CALCULATION	COMPARABILITY	LINK TO SDG
ACCOUNTING INDICATORS				
Gross Operating Profit*	Gross operating profit measures the operating profit (or loss) of companies, comparing revenue minus expenses, without taking into account interest, taxes or amortisation. In companies with a high volume of fixed assets, e.g. ports, depreciation can represent a considerable volume in the accounts and can affect the interpretation of operating profits.	Operating income + (Depreciation (provisions)) + (Amortisation)		
EBIT*	EBIT (Earnings Before Interest and Taxes) measures the operating net profit of companies, comparing revenue minus expenses without taking into account interest or taxes. Unlike gross operating profit, EBIT includes both depreciation and amortisation.	(Net income) + (Interest) + (Taxes)		
PORT ACTIVITY INDICATORS				
Revenue per Cargo Unit*	The revenue generated by the sale of goods or services, or any other use of capital or assets associated with the port authority's main operations prior to deducting any costs or expenses and expressed relative to total infrastructure traffic, in tons.	$\frac{\text{Revenue from port fees}}{\text{Tons}}$		
Expenses per Cargo Unit	This indicator provides an overview of the total costs associated with port activities needed to obtain revenue. It can include direct operating expenses, as well as maintenance, security, personnel and port service costs, among others. Expressed relative to total infrastructure traffic, in tons.	$\frac{\text{Operating expenses}}{\text{Tons}}$		
Net profit for the Fiscal Year per Cargo Unit	A financial measurement that reflects the profit obtained during a given period for each cargo unit moved, providing highly relevant information relating to business profitability.	$\frac{\text{Net profit for the fiscal year}}{\text{Tons}}$		

NAME	DESCRIPTION / OBJECTIVE	CALCULATION	COMPARABILITY	LINK TO SDG
FINANCIAL CAPACITY AND INVESTMENT INDICATORS				
Total Investment by the Port Authority (PO)	Total financial resources allocated for port investment projects by the port authority (excluding private investment).	Σ PO investment items		8 DECENT WORK AND ECONOMIC GROWTH 
Total Investment by Private Port Operators	Total financial resources allocated for port investment projects by private operators who hold a port concession or lease.	Σ Private operator investment items		8 DECENT WORK AND ECONOMIC GROWTH 
Private Investment relative to Total Port Investment	This indicator shows the % of private financing as a share of total port investments, based on the previous two indicators, as calculated.	$\frac{\text{Private investment i}}{\Sigma \text{ Investment}}$		8 DECENT WORK AND ECONOMIC GROWTH 
FINANCIAL PERFORMANCE INDICATORS				
Revenue from Port Charges relative to Total Port Revenue*	Proportion of the port authority's revenue originating from port charges directly related to the level of port activity, which can be considered as variable revenue.	$\frac{\text{Revenue from port fees}}{\text{Total revenue}}$		8 DECENT WORK AND ECONOMIC GROWTH 
Revenue from Concessions/Leasing of Port Land*	Proportion of the port authority's revenue from operations or concession leases to private operators, not directly related to the level of port traffic, which can be considered as fixed revenue.	$\frac{\text{Revenue from concessions}}{\text{Total revenue}}$		8 DECENT WORK AND ECONOMIC GROWTH 

NAME	DESCRIPTION / OBJECTIVE	CALCULATION	COMPARABILITY	LINK TO SDG
Gross Operating Profit relative to Total Revenue*	The indicator measures the profitability of port activity, quantifying the percentage of revenue that becomes profit.	$\frac{\text{Gross operating profit}}{\text{Total revenue}}$		8 DECENT WORK AND ECONOMIC GROWTH 
Return on Assets	This indicator measures the profitability of total port activity relative to the assets available to the authority to carry out this activity.	$\frac{\text{Net profit for the fiscal year}}{\text{Total assets}}$		8 DECENT WORK AND ECONOMIC GROWTH 
Return on Equity	This indicator measures the profitability of total port activity relative to the net assets of the port authority.	$\frac{\text{Net profit for the fiscal year}}{\text{Net equity}}$		8 DECENT WORK AND ECONOMIC GROWTH 
Debt Ratio	This indicator measures the degree of indebtedness of the authority in relation to its net assets. Although, in the case of ports, changes to this indicator are usually closely tied to investments at each moment in time. It is advisable to monitor the indicator and assess it from a medium-term perspective.	$\frac{\text{Indebtedness (short and long term)}}{\text{Net equity}}$		8 DECENT WORK AND ECONOMIC GROWTH 

Source: Fundación Valenciaport with data from different sources

* These indicators can be found in Volume 4 of this publication "Port Performance: Linking Performance Indicators to Strategic Objectives" (2016) within the framework of the United Nations Conference on Trade and Development (UNCTAD) TrainForTrade Port Management Programme.

** The sources used to develop financial indicators are the port managing bodies themselves and the respective department responsible for managing the organisation's financial accounts. In addition, the use of information provided by the annual accounts, especially the net profit account, can be highly useful when generating these indicators.

2.4. RESILIENCE INDICATORS

Maritime resilience indicators are key tools for assessing and measuring the capacity of maritime systems and infrastructures, given that they allow for the assessment of the ability to withstand, adapt and recover from disruptions, crises or adverse events. Worth noting as an example of a disruptive event, as previously mentioned, is the unprecedented impact that the 2020 COVID-19 pandemic has had on the global economy as the most relevant disruptive event since the end of World War II.

In view of such uncertainty, the maritime and port sector has faced a series of unpredictable events that have been building up in recent years and have had major consequences for the industry. These events have highlighted the complexity and interdependence of global supply chains, as well as their increasing vulnerability to various risks. In the current global context, the importance of shipping and ports has been stressed, as they underpin global economic interconnectedness and global supply chain links. Safeguarding the integrity of the maritime supply chain, especially with respect to ports, has become a sustainable development imperative (UNCTAD).

In response to this volatile scenario, concepts such as risk management and resilience have gained an increasing amount of interest. Applying this paradigm to the maritime and port sectors, port resilience is defined as the ability of ports, and the systems that they are part of, to withstand and adapt to changing conditions, and recover positively from shocks and stresses, according to the report entitled "Resilience4Ports: Gateways to a resilient future," published by The Resilience Shift in January 2021.

In this regard, a port is considered to be resilient when it can continue to provide its essential services, regardless of the internal and external shocks it may face. It is, therefore, essential to have facilities and operations that can quickly recover from setbacks (Brandstäter, 2022).

However, while the concept of resilience has traditionally been tied to issues related to disruptive events such as natural disasters and, more recently, to climate change, it encompasses different facets due to its purely cross-cutting nature. In view of this fact, we narrowed down the concept of resilience, dividing **resilience indicators** (Table 8) into **two categories**:

1. **Physical Safety Indicators:** These indicators allow for the assessment of the organisation's physical safety and ensure the protection of its assets and workers in case of disruptive events.
2. **Cybersecurity Indicators:** Port cybersecurity indicators are metrics and measurements used to assess and monitor the security of information and communication technology (ICT) systems and infrastructure at managing bodies.

Lastly, this series of port resilience indicators is completely aligned with the Sustainable Development Goals (SDGs) proposed by the United Nations (UN) and, specifically, with SDG 3: Good Health and Well-Being and SDG 9: Industry, Innovation and Infrastructure (Table 7).

Table 7: SDGs linked to resilience indicators

Resilience indicators allow for measurement of the contribution to the Sustainable Development Goals (SDGs) established by the United Nations (UN). Specifically, indicators that focus on physical safety allow for measurement of the contribution to **SDG 3** "Good Health and Well-Being," which focuses on reducing child and maternal mortality, preventing disease, strengthening health systems and promoting mental health and well-being in general.

Similarly, the contribution of indicators to **SDG 9** "Industry, Innovation and Infrastructure.", especially those related to cybersecurity, can be monitored. This goal seeks to build resilient infrastructure, promote sustainable industrialisation, encourage innovation and enable access to both technologies and knowledge. Some related goals include increasing access to the Internet, promoting research and technological advancement, improving economic infrastructure and strengthening industrialisation capacity in all countries.

Source: Fundación Valenciaport

Table 8: Resilience Indicators

NAME	DESCRIPTION / OBJECTIVE	CALCULATION	COMPARABILITY	LINK TO SDG
PHYSICAL SAFETY INDICATORS				
Safety Drills	Assessment of simulation activities to test and improve the responsiveness and effectiveness of protection systems.	Nº of drills carried out per year		3 GOOD HEALTH AND WELL-BEING 
Number of Training Hours per Employee	Assessment of the occupational risk prevention training and education provided to workers.	$\frac{\text{Nº of training hours}}{\text{Nº of employees}}$		3 GOOD HEALTH AND WELL-BEING 
Annual Frequency of Accidents	Quantitative measurement of the frequency of workplace accidents.	$\frac{\text{Nº of accidents leading to absence from work per year}}{\text{Nº of total hours worked per year}}$		3 GOOD HEALTH AND WELL-BEING 
Existence of an Occupational Health and Safety Committee	Assess whether or not the port authority has a committee dedicated to the occupational health and safety of its employees.	YES / NO		3 GOOD HEALTH AND WELL-BEING 
Expenditure on Safety and Security	Assess the investment made by the port authority in activities related to the safety and security of its employees, infrastructure and resources.	$\frac{\text{Total security expenses}}{\text{Total expenses}}$		3 GOOD HEALTH AND WELL-BEING 
Activation of Emergency Response Plans	Measure the organisation's responsiveness and preparedness to unexpected events and ensure the safety of both people and assets.	Nº of times per year emergency response plans have been activated		3 GOOD HEALTH AND WELL-BEING 

NAME	DESCRIPTION / OBJECTIVE	CALCULATION	COMPARABILITY	LINK TO SDG
Existence of a Security System in the Supply Chain	Assess whether the organisation has implemented measures and controls to ensure the security of products, materials and data throughout the supply chain.	YES / NO		
CYBERSECURITY INDICATORS				
Cybersecurity Certification	Assess the extent of protection and security of the port authority's systems and data against potential cyber threats based on whether or not the cybersecurity level has been certified.	YES / NO		
Existence of an Information Security Management System	Assess whether or not the organisation has implemented a structured framework or system to protect the confidentiality, integrity and availability of the information it handles.	YES / NO		
Existence of Cybersecurity Attacks	Assess the frequency and severity of port authority cybersecurity incidents by providing information on the effectiveness of security measures implemented and the organisation's ability to detect, prevent and respond to cyberattacks.	Nº of relevant cybersecurity incidents reported per year		
Cybersecurity Training	Assess the organisation's preparedness for potential cyber threats and attacks based on the cybersecurity training and education provided to its workers.	YES / NO		

Source: Fundación Valenciaport with data from different sources

2.5. VESSEL OPERATION INDICATORS

The most widespread and commonly found port performance category in port case studies is cargo operations. A port is, undoubtedly, a complex organisation, with many actors that define its activity in which vessels play a major role, thereby leading to the development of a larger number of operations indicators.

In addition, and at present, these indicators must be construed within the context of rapid world economic growth and in terms of a significant increase in the volume of maritime traffic (Marcu & Gasparotti , 2021). In this regard, the strong competition in many segments of the maritime sector highlight the importance of the search for greater efficiency. Maintaining competitiveness has become an urgent strategy in order to gain a global edge (Turcanu (Marcu) & Gasparotti, 2019).

In this regard, vessel operation indicators serve as tools to assess the performance and efficiency of port activities related to the movement and management of vessels. In turn, these indicators provide both qualitative and quantitative information about the various aspects of such operations. They also help to identify potential bottlenecks, delays and inefficient processes, allowing corrective actions to be taken to improve efficiency and reduce waiting times and delays.

Similarly, although they cannot be used to make a full comparison of the different ports around the world given the major differences between each of them, these indicators can be used to compare developments at a port or terminal over time by flagging inefficiencies in their processes and areas of improvement.

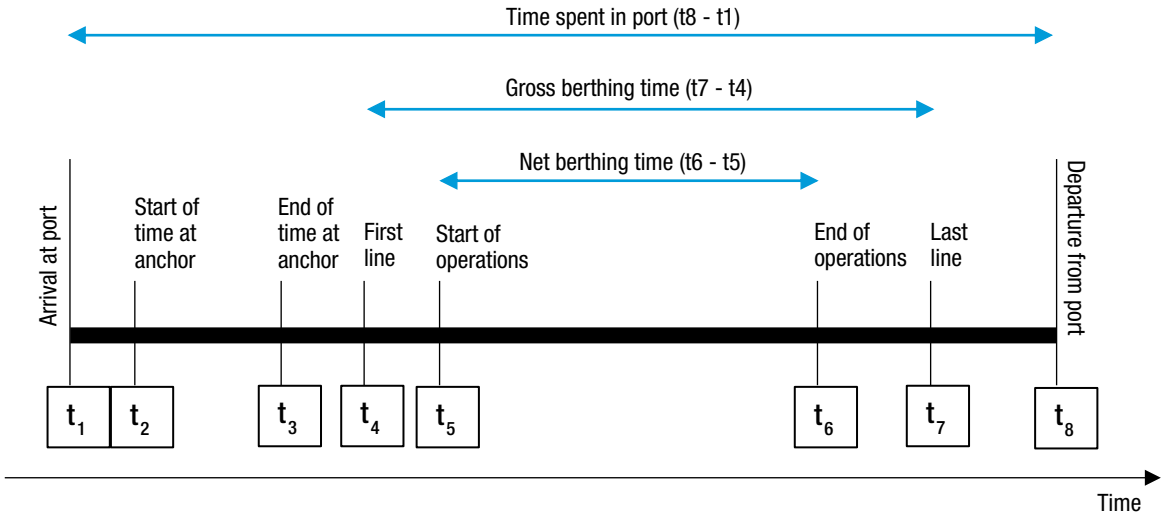
With regard to the **vessel operation indicators** (Table 10) proposed in this publication, we decided to divide them into **two categories**:

1. **Time Indicators:** Reducing waiting times for vessels, thus, minimising the time that vessels spend in ports and, in particular on the quay, is undoubtedly a priority. Vessel waiting time depends on the efficiency of the allocation and scheduling of key resources, such as berthing positions, quay and yard cranes and other cargo handling and transportation equipment. (Siddaramaiah, Karnoji, & Gurudev, 2021).

   In this respect, *Just-In-Time* is playing an increasingly important role in the maritime transport sector, seeking to ensure the scheduling and, thus, precise optimisation of port operations. This, in turn, allows resources to be allocated more efficiently by coordinating both loading and unloading activities and minimising idle times. All of this allows for an improvement in the time indicators by relieving both the utilised port capacity and resource productivity.

   In the same vein, from the arrival of a vessel to its departure from port, there are different phases during which the time efficiency of operations can be measured. Figure 2 shows the whole process of a vessel operation in depth, indicating the main events that take place and serving as a basis to define these indicators for each operation.

Figure 2: Vessel stopover time



Source: World Bank (2007)

2. **Indicators of Vessel Characteristics:** Vessel characteristics play a key role in vessel operations, given that they provide essential information about a vessel's capabilities, dimensions and performance. These indicators may be calculated on an individual scale or averaged for a given period of time. They can also be classified according to vessel categories in terms of cargo type or size.

These vessel operation indicators are also in line with the Sustainable Development Goals (SDGs) proposed by the United Nations (UN) and, specifically, with SDG 9: Industry, Innovation and Infrastructure (Table 9).

Table 9: SDGs linked to vessel operation indicators

SUSTAINABLE DEVELOPMENT GOALS

9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

Vessel operation indicators allow for the measurement of the contribution to the Sustainable Development Goals (SDGs) proposed by the United Nations (UN) and, specifically, with respect to **SDG 9** "Industry, Innovation and Infrastructure," which refers to the need to build resilient infrastructure, promote sustainable industrialisation and foster innovation.

There is no doubt that all indicators related to vessel operations, whether related to time or specific vessel characteristics, contribute to assessing the performance and efficiency of activities related to the movement and management of vessels, helping to achieve optimal operational efficiency.

Source: Fundación Valenciaport

Table 10: Vessel operation indicators

NAME	DESCRIPTION / OBJECTIVE	CALCULATION	COMPARABILITY	LINK TO SDG
TIME INDICATORS				
Average Anchor Time*	Time between the start and end of the stay at anchor.	Σ Hours at anchor / No. of vessels at anchor		9 INDUSTRY, INNOVATION AND INFRASTRUCTURE 
Average Time in Port (t8 – t1)	The time the vessel spends in port, i.e., from its arrival to its departure from the port.	Σ (t8-t1) / Nº of vessels		9 INDUSTRY, INNOVATION AND INFRASTRUCTURE 
Average Gross Berthing Time (t7 – t4)	The time the vessel spends at its berth, from throwing first mooring line to removing the last mooring line.	Σ (t7-t4) / Nº of vessels		9 INDUSTRY, INNOVATION AND INFRASTRUCTURE 
Average Net Berthing Time (t6 - t5)	Time from the start of berthing to the end of berthing.	Σ (t6-t5) / Nº of vessels		9 INDUSTRY, INNOVATION AND INFRASTRUCTURE 
Average Berthing Occupancy Rate	The average gross time the vessel stays berthed at the quay over a given period of time.	$\frac{\Sigma\ (t7\text{-}t4)}{\text{Total time}}$		9 INDUSTRY, INNOVATION AND INFRASTRUCTURE 
Average Idle Time per Shift*	The time during which the vessel is not performing loading/unloading operations due to different types of interruptions (breakdown, lack of equipment, crane positioning, etc.).	$\frac{\Sigma\ \text{time idle}}{\text{Nº of shifts}}$		9 INDUSTRY, INNOVATION AND INFRASTRUCTURE 

NAME	DESCRIPTION / OBJECTIVE	CALCULATION	COMPARABILITY	LINK TO SDG
INDICATORS OF VESSEL CHARACTERISTICS				
Maximum Quay Draught*	The maximum depth available for vessels to berth and operate safely at a given terminal.	Maximum draft in metres		9 INDUSTRY, INNOVATION AND INFRASTRUCTURE 
Average Vessel Length*	The average length of a vessel that can be safely handled at a terminal.	$\frac{\Sigma \text{ length of vessels}}{\text{Total Nº of vessels}}$		9 INDUSTRY, INNOVATION AND INFRASTRUCTURE 
Average Gross Tonnage (GT)*	Calculation of the average Gross Tonnage of vessels berthing at the port.	$\frac{\Sigma \text{ GT of vessels}}{\text{Nº of vessels}}$		9 INDUSTRY, INNOVATION AND INFRASTRUCTURE 

Source: Fundación Valenciaport with data from different sources

* These indicators can be found in Volume 4 of this publication (2016) "Port Performance: Linking Performance Indicators to Strategic Objectives" within the framework of the United Nations Conference on Trade and Development (UNCTAD) TrainForTrade Port Management Programme.

** The source used to develop indicators related to vessel operations are the port managing bodies themselves, shipping companies and terminal operators.

2.6. CARGO OPERATION INDICATORS

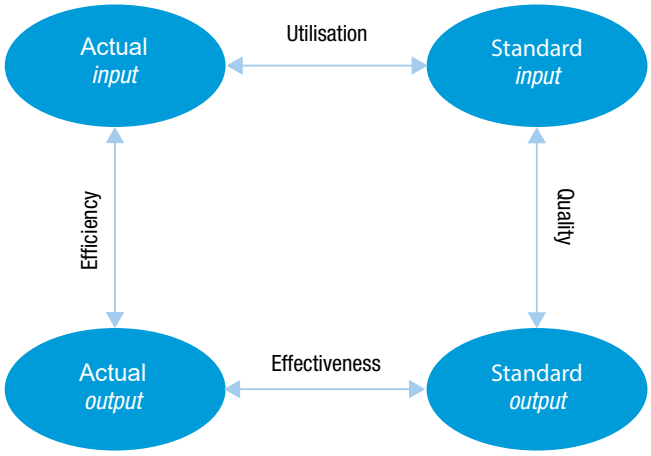
Cargo operation indicators are used to measure and assess the performance, productivity and efficiency of the loading and unloading processes at ports and terminals. These indicators provide a quantitative and objective view of operations, allowing for the identification of areas for improvement and informed decision-making to optimise cargo flows. As the size of vessels increases, so do the competitiveness and capital intensity of port investment. This is why these indicators are crucial for assessing the performance of port cargo operations.

The concepts related to the measurement of port throughput or performance within the framework of port cargo handling operations would be classified into three categories:

1. **Operational performance:** The measurement of production (traffic) indicators and port/terminal productivity, both in technical and economic terms.
   - 1.1. **Production:** The volume of terminal handling in a given period of time, without mentioning the resources used. Financial indicators are generated when monetary units are expressed.
   - 1.2. **Productivity:** The volume of goods handled per unit of resource and per unit of time. It is linked to the work rate of the different resources at the terminal.
2. **Service level:** The perception of quality experienced by port terminal customers.
3. **Utilisation:** The intensity with which resources are used, i.e., the ratio of the use of a given resource as a percentage of the maximum possible use over a given period of time.

In colloquial language, even in technical texts, efficiency, efficacy, effectiveness and productivity are often used as synonyms. In all cases, whether implicitly or explicitly, the assessment of a production process or transformation of resources (inputs) into products or outcomes (outputs) is underpinned by a reference goal. By way of a non-exhaustive example, Bichou (2007) puts forward the matrix in Figure 3 within the context of the aforementioned set of terms related to the measurement of port operational performance. This matrix is different from the one proposed by Brooks and Pallis (2007).

Figure 3: Basic matrix of performance measurement dimensions



Source: Bichou (2007)

In terms of *port performance* or port performance knowledge, the academic concept of **port efficiency** (González & Trujillo, 2006), which is presented below, has been increasingly used since the mid-1990s. The use of ratios expressing the quotient of an output and input (an alternative definition of productivity) has been, and still is in many cases, the usual procedure for assessing the behaviour or "efficiency" of the use of a resource, serving as a basis for resource planning exercises. However, the academic definition of efficiency, in the quest for a better interpretation of reality, which is always complex, considers multiple inputs and outputs in its analysis, as listed below (Medal, 2011):

$$Efficiency = \frac{Weighted\ sum\ of\ outputs}{Weighted\ sum\ of\ inputs}$$

The techniques used for calculating efficiency and, in particular, the so-called DEA (*Data Envelopment Analysis*), are based on linear programming and aim at assessing the efficiency of a set of units — terminals — so that the outcome is the relative efficiency of each unit with respect to all others. This efficiency can be stated in both technical terms and economic terms.

It is important to note that it can be difficult for a terminal to study its efficiency since it needs to know the activity of other terminals with similar characteristics. Therefore, in many cases, efficiency is analysed not in relation to other terminals but instead to itself at different periods of time. This is the so-called intra-centre efficiency (Wang & Cullinane, 2006), as opposed to inter-centre efficiency.

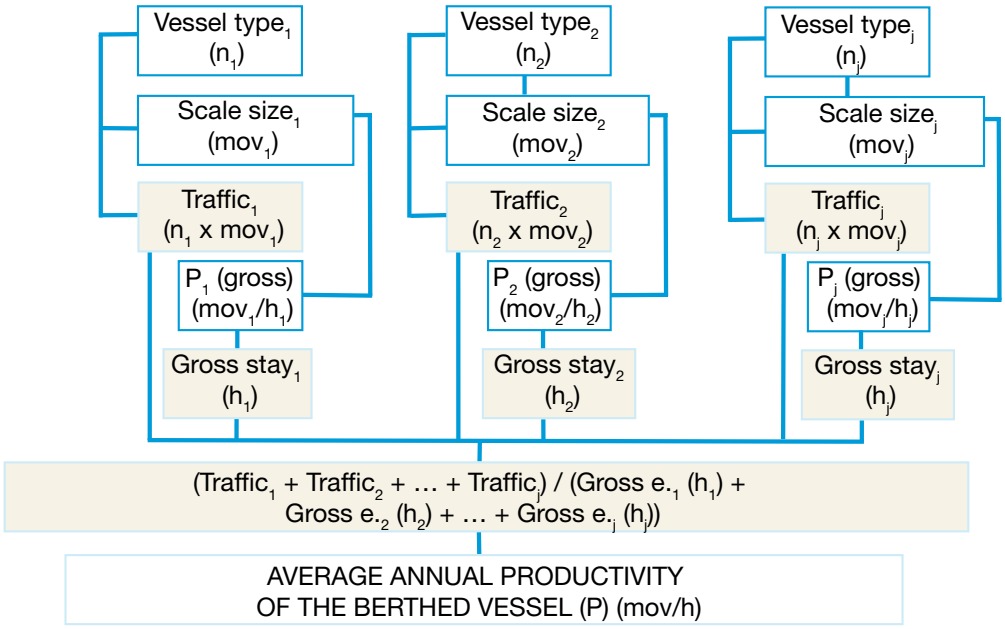
Although the aforementioned techniques may be of interest in analysing the optimisation of some resources and outcomes, the aforementioned efficiency analysis characteristics, in particular, the fact that it includes a relative assessment, significantly limits its applicability when the purpose of the study is to estimate terminal capacity.

Monitoring the indicators helps to identify delays or inefficiencies, allowing timely corrective actions to be taken to improve the flow of cargo and minimise delays. In addition, cargo operation indicators serve as guides to assess current performance and compare it to goals, encouraging continuous improvement and identification of areas for further attention or effort. By measuring and improving performance, ports can strengthen their competitive position and attract more cargo traffic.

Measuring cargo operation indicators involves performing a series of specific calculations for each category of cargo handled since ports offer different facilities depending on the type of cargo handled. In this case, we seek to compare performance indicators in terms of time and space usage. As for time, we focus on productivity, which measures the amount of cargo handled over a given period of time. This indicator provides a measure of productivity and efficiency in terms of speed of cargo handling. Space usage focuses on port traffic in terms of the area of land available and the length of cargo berths. These indicators allow for the assessment of productivity in terms of the use of port space and the capacity to effectively handle cargo volumes (UNCTAD, 2016).

For illustrative purposes, Figure 4 outlines the process of calculating the average annual berthed vessel productivity.

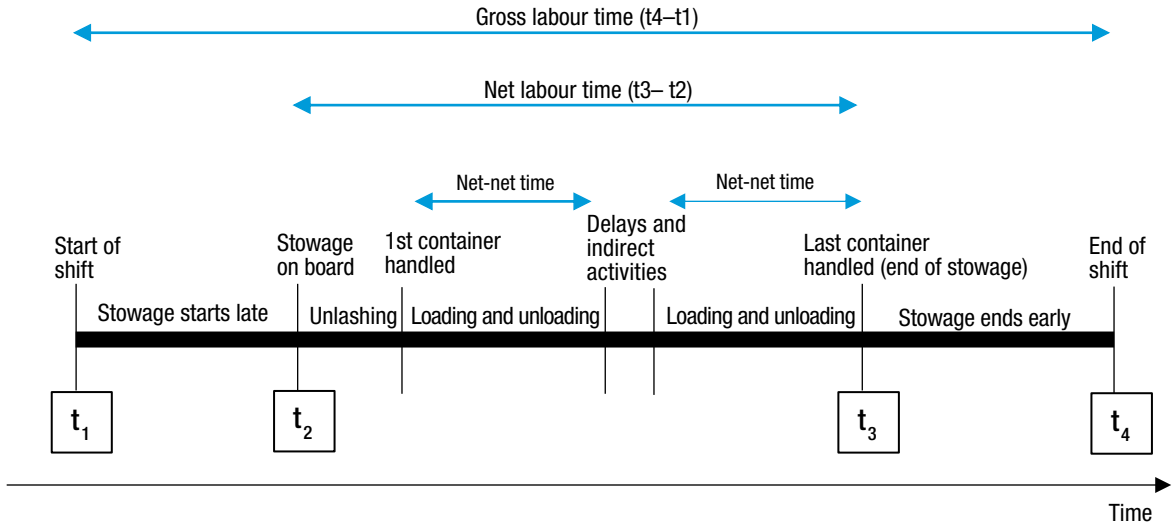
Figure 4: Calculation of the average annual berthed vessel productivity



Source: Monfort et al. (2011)

As with the vessel operation indicators, for the stowage process, there is a chronological order to follow when loading and unloading goods (Figure 5). The process that occurs between the start and the end of the stowage operation is called gross labour time. Net shift time refers to the time between the time when the stevedore gets on board and the time when he handles the last container, i.e., the end of the stowage operation. Lastly, the net-net labour time denotes the net labour time, minus any downtime caused by delays and other indirect activities of the stevedores.

Figure 5: Stowage time



Source: World Bank (2007)

For cargo operation indicators to be particularly useful, they must be relatively easy to both calculate and understand. Also, the indicators should provide clear information to port management about the performance of key areas of operations. These indicators can be used to compare current performance with a previously established goal or standard. This makes it possible to assess the degree of compliance with the goals and to detect any possible deviations that require corrective action. Cargo operation indicators are also useful for observing performance trends over time. By recording and analysing the indicators on a periodic basis, it is possible to identify performance trends and determine whether or not improvements are being achieved or process adjustments are required (Ojekunle, 2022).

As for the SDGs, the indicators related to cargo operations are closely related to SDG 9: Industry, Innovation and Infrastructure (Table 11).

Table 11: SDGs linked to cargo operations

Like vessel operation indicators, cargo operation indicators allow for the measurement of the contribution to the Sustainable Development Goals (SDGs) proposed by the United Nations (UN) and, specifically, with respect to **SDG 9** "Industry, Innovation and Infrastructure," which refers to the need to build resilient infrastructure, promote sustainable industrialisation and foster innovation.

It is clear that all cargo operation indicators, whether related to operational performance, efficiency, capacity or service level, contribute to optimising cargo flow movements.

Source: Fundación Valenciaport

Table 12 shows the proposed cargo operation indicators by operational performance category along with their name, description/objective, calculation formula, comparability and link to SDG.

Table 12: Cargo operation indicators

NAME	DESCRIPTION / OBJECTIVE	CALCULATION	COMPARABILITY	LINK TO SDG
OPERATIONAL PERFORMANCE INDICATORS				
Total Cargo Handled*	Volume of cargo handled by type of goods.	Σ TEU Σ Solid bulk tons Σ Liquid bulk tons Σ RoRo units		9 INDUSTRY, INNOVATION AND INFRASTRUCTURE 
Total Number of Ferry Passengers	Ferry passenger trends at a port over time. Important for island ports.	Σ Ferry passengers		9 INDUSTRY, INNOVATION AND INFRASTRUCTURE 
Total Number of Cruise Ship Passengers	Cruise ship passenger trends at a port over time. It gives an idea of the port's impact (whether positive or negative) on tourism in a city.	Σ Cruise ship passengers		9 INDUSTRY, INNOVATION AND INFRASTRUCTURE 
Gross Productivity	The average goods moved during operations (tons, movements or TEUs) between the start and end of operations or, in other words, the total amount of time it takes a crane to load and unload goods, also known as gross crane time.	$\frac{\Sigma \text{ (tons, movements or TEUs)}}{\Sigma \text{ gross crane time (h)}}$		9 INDUSTRY, INNOVATION AND INFRASTRUCTURE 
Net Labour/Crane Time (t3 - t2)	The amount of time from the start of stowage on board to the last container handled (or end of stowage).	Σ (t3-t2) / Nº of shifts		9 INDUSTRY, INNOVATION AND INFRASTRUCTURE 
Net-Net Labour/Crane Time	The net-net labour/crane time, minus idle time due to delays or other indirect activities.	(Net labour / crane time) – (Time due to delays and indirect activities) / Nº of shifts		9 INDUSTRY, INNOVATION AND INFRASTRUCTURE 

NAME	DESCRIPTION / OBJECTIVE	CALCULATION	COMPARABILITY	LINK TO SDG
Productivity per Berthing Line*	The efficacy of the movement of goods along the quays built for specialised terminals in order to determine the level of port infrastructure use.	Tons, containers or TEUs per year / Terminal berthing line (m)		9 INDUSTRY, INNOVATION AND INFRASTRUCTURE 
Average Berthing Productivity	Tons handled per hour that the vessel remains at the quay.	Tons, containers or TEUs per year / Total dwell time of berthed vessel		9 INDUSTRY, INNOVATION AND INFRASTRUCTURE 
SERVICE LEVEL INDICATORS				
Relative wait	The ratio of waiting time to service time.	Average waiting time (approx. time at anchor) / Average service (gross berthing)		9 INDUSTRY, INNOVATION AND INFRASTRUCTURE 
Average Container Dwell Time at the Terminal*	The dwell time of goods. Consequently, possible delays can be identified to enhance dynamic storage capacity and reduce strain.	Σ Hours container spends in the port yard / Nº of containers		9 INDUSTRY, INNOVATION AND INFRASTRUCTURE 
Average Truck Turnaround Time	Estimates the turnover time of a truck, i.e., the total amount of time that a truck spends in the port area, from its arrival to departure, for the purpose of picking up and/or dropping off a container.	(arrival time of truck at port area) – (departure time of truck from port area)		9 INDUSTRY, INNOVATION AND INFRASTRUCTURE 
UTILISATION INDICATORS				
Tonnes per Hectare*	The efficiency and productivity of the loading and unloading of goods in relation to the available surface area, which measures the efficiency of the use of port space.	Tons / Total surface area of port (Ha)		9 INDUSTRY, INNOVATION AND INFRASTRUCTURE 

Source: Prepared by the authors with data from different sources

* These indicators can be found in Volume 4 of this publication "Port Performance: Linking Performance Indicators to Strategic Objectives" (2016) within the framework of the United Nations Conference on Trade and Development (UNCTAD) TrainForTrade Port Management Programme.

2.7. ENVIRONMENTAL SUSTAINABILITY INDICATORS

The purpose of these indicators is to help understand the port's environmental impacts, to determine whether the operational control of environmental aspects is effective and if the environmental management applied secures good environmental performance for these maritime infrastructures (PORTOPIA, 2016). In turn, these indicators are key tools for measuring and quantifying the impact of port activities on the environment, as well as for identifying areas for improvement and promoting more sustainable management.

Several factors drive investments in the environmental performance of ports. The increase in port activities and the increasing environmental impacts contribute to this trend. Market development has led to the increased socio-economic relevance of the environmental performance of ports, as well as more public awareness and the enactment of related legislation that seeks to promote the mitigation of the environmental consequences of port activities and, in certain respects, make it mandatory. For ports, environmental sustainability has also become a competitive factor. There has been a marked increase in the number of ports that face operational challenges due to climate change. They are, thus, focused on monitoring these trends to strengthen the resilience of their current infrastructure and adapt to climate change, which is taken into account when planning their future infrastructure projects (Notteboom, Pallis, & Rodrigue, 2022).

There is no doubt that an increasing numbers of indicators are being developed and used as management tools to address the efficacy of sustainability policies and measures. These types of indicators are recommended for several reasons. First, they allow for the assessment of port compliance with environmental regulations and international standards. This is particularly relevant in a context in which environmental protection is a global concern and environmental regulations are becoming increasingly stringent. Furthermore, environmental sustainability indicators give ports a clear picture of their environmental performance over time. This allows them to identify trends, set goals for improvement and assess the effectiveness of measures implemented to reduce their impact. Accurate data and metrics allow ports to make informed decisions and develop effective strategies to minimise their carbon footprint.

In turn, they are also crucial for accountability and transparency. By providing quantitative and qualitative information on the environmental performance of ports, these indicators allow managing bodies, operators and other stakeholders to effectively assess and report on progress made in the area of sustainability (WPSP, 2020).

Given the fact that the information provided by indicators is broad and diverse, they must be divided into different categories. The **environmental sustainability indicators** (Table 14) proposed can be divided into the **seven categories** listed below:

1. **Climate Change Indicators:** These indicators seek to identify and assess the procedures used by managing bodies to monitor and measure the various environmental aspects arising out of port activity, and which have an impact on climate change.
2. **Indicators of Emissions from Port Activity:** These indicators encompass accurate emission-related data, which in turn allows for more effective strategies to be implemented to mitigate the environmental impact.
3. **Resource Consumption Indicators:** Measuring and assessing the efficiency with which ports use natural resources is critical to identifying opportunities for improvement and promoting more sustainable practices that minimise the excessive and unnecessary use of these resources.
4. **Waste Production Indicators:** As with the preceding indicators, waste production indicators enable accurate data to be collected and, thus, allow for the assessment of the quantity and quality of waste generated by a specific activity. Ports are strategic hubs for passenger transport and host a variety of industrial activities. These activities entail the generation of different types of hazardous and non-hazardous waste which needs to be properly managed by ports (PORTOPIA, 2016).

5. **Port Development Indicators:** The expansion of global maritime trade has given rise to the need to improve and expand ports by building deeper channels and new docks, among other developments. Furthermore, limited unoccupied land and increased industrial concentration in port areas may require ports to expand into surrounding areas (PORTOPIA, 2016).
6. **Impact on Biodiversity Indicators:** Given the nature of their operations, ports are usually located in coastal areas or near rivers or estuaries, i.e., in areas of special environmental interest. They are usually found on land near areas of high biodiversity and even in nature protection areas. Therefore, it is essential to monitor the impact that port activity may have on these areas in order to reduce and mitigate any possible associated risks. In doing so, the goal is to ensure their preservation and minimise the adverse effects on these natural environments.
7. **Environmental Management Indicators:** These indicators provide a comprehensive view of a port's environmental performance. These include aspects such as employee training, regulatory compliance, complaint resolution and resource allocation for environmental protection. Monitoring and analysis help identify areas for improvement and assess the effects of actions taken to reduce the port's environmental impact.

The proposal of the above-mentioned indicators highlights the importance of harmonising the environmental practices of ports. This includes implementing common legislation, enabling the exchange of information and promoting the adoption of Environmental Management Systems (EMS), as well as drawing up environmental reports for ports. Nonetheless, it should be noted that, in many ports, environmental management systems (EMS) are still under development and there is no common practice in this regard. Also worth noting is that ports differ in size, location, culture, organisation, jurisdiction, economic activities and environmental performance. This means that there is no common practice in terms of monitoring environmental performance, using environmental information for internal improvement or communicating environmental information to stakeholders. In addition, ports compete with each other and, sometimes, ports with poor environmental performance may have a competitive advantage over those that operate under stricter environmental standards (EPCEM, 2003).

Lastly, the environmental sustainability indicators are aligned with the Sustainable Development Goals (SDGs) proposed by the United Nations (UN) and, specifically, with SDG 6: Clean Water and Sanitation, SDG 7: Affordable and Clean Energy, SDG 11: Sustainable Cities and Communities, SDG 12: Responsible Consumption and Production, SDG 13: Climate Action, SDG 14: Life Below Water and SDG 15: Life on Land (Table 13).

Table 13: SDGs linked to environmental sustainability indicators

In a context in which environmental protection has become a necessity, the environmental sustainability indicators, which have been divided into different categories by focus area, measure the contribution to several Sustainable Development Goals (SDGs) proposed by the United Nations (UN). As previously noted, they act as a tool for understanding the port's environmental impacts, thus helping to identify areas for improvement while promoting more sustainable management.

In particular, it is possible to monitor the impacts with respect to **SDG 6** "Clean Water and Sanitation", which, among other things, aims to improve water quality worldwide, as well as in respect of **SDG 7** "Affordable and Clean Energy," by improving energy efficiency and taking measures such as substantially increasing the percentage of renewables in the energy mix. These indicators can also be tracked and monitored with respect to **SDG 11** "Sustainable Cities and Communities," given that they indirectly aim to make cities and human settlements inclusive, safe, resilient and sustainable.

Their contribution can also be measured with respect to **SDG 12** "Responsible Consumption and Production," through the efficient management of natural resources, as well as with respect to **SDG 15** "Life on Land," given that it indirectly promotes the protection, restoration and sustainable use of land ecosystems, thus halting biodiversity loss.

From a more general perspective, it is also possible to monitor the contribution to **SDG 13** "Climate Action," which aims to mainstream climate change into the policies, strategies and plans of countries, companies and civil society, improving response times to the problems it causes, as well as promoting education and awareness of this phenomenon among the whole population. Furthermore, given its scope, **SDG 14** "Life Below Water" can also be monitored via environmental sustainability indicators, given that it relates to a relevant set of ocean and sea-related issues.

Source: Fundación Valenciaport

Table 14: Environmental sustainability indicators

NAME	DESCRIPTION / OBJECTIVE	CALCULATION	COMPARABILITY	LINK TO SDG
CLIMATE CHANGE INDICATORS				
Carbon Footprint: Total greenhouse gas emissions with respect to cargo handled	Estimated greenhouse gas emissions (direct and indirect) produced as a consequence of port activity. This is a measurement that relates to the volume of goods handled at the port.	$\frac{CO_2 \text{ emissions, eq. (t)}}{\text{Goods handled (TEU/t)}}$		
Adapting to Climate Change	Assessment of the existence of a climate change adaptation plan implemented by a port. The goal is to measure the port's ability to cope with both present and future climate change effects on its operations, infrastructure and services.	YES / NO		
INDICATORS OF EMISSIONS FROM PORT ACTIVITY				
Air Quality	Measurement of the concentration of the air pollutants listed below: • Suspended particulate matter (PM10 and PM2.5). • Sulphur oxides (SOx) • Nitrogen oxides (NOx) • Carbon monoxide (CO) • Ozone (O3)	Number of hours per year when the air quality is good or very good This categorisation can be established based on the European Air Quality Index (EAQI) or equivalent, which defines quality levels based on the concentration value of polluting substances in the air		
Water Quality	Main physical, chemical and microbiological parametres, for example: • Salinity • Dissolved oxygen • Turbidity • Pollutant concentration (e.g., nitrates, phosphate or benzene) • Microbiological pollution (e.g., E. Coli or intestinal enterococci).	Number of indicators with at least moderate quality in annual campaigns for each location based on the physical chemical and microbiological parametres established		

NAME	DESCRIPTION / OBJECTIVE	CALCULATION	COMPARABILITY	LINK TO SDG
Noise Pollution	Tracking or monitoring underwater and ambient noise using sound-level metres.	Number of hours per year with a very low noise level. This categorisation is established on the basis of the limits and parametres laid down in EU Directive 2002/49/EC or other similar legislation		14 LIFE BELOW WATER 
RESOURCE CONSUMPTION INDICATORS				
Energy Consumption	Estimated energy consumption required for the normal operation of facilities and services. Estimated energy consumption as a result of port activity. This is a measurement that relates to the volume of goods handled at the port.	$\frac{\text{Energy consumed (GWh)}}{\text{Goods handled (TEU/t)}}$		7 AFFORDABLE AND CLEAN ENERGY 
Percentage of energy consumption from renewable sources	Estimated energy consumption from renewable sources arising out of port activity.	$\frac{\text{Renewable energy consumed (GWh)}}{\text{Total energy consumed (GWh)}} * 100$		7 AFFORDABLE AND CLEAN ENERGY 
Water Consumption	Measurement of water consumption by activities arising out of port operations.	$\frac{\text{Water consumption (m}^3\text{)}}{\text{Goods handled (TEU/t)}}$		6 CLEAN WATER AND SANITATION 

NAME	DESCRIPTION / OBJECTIVE	CALCULATION	COMPARABILITY	LINK TO SDG
WASTE PRODUCTION INDICATORS				
Characterisation of waste generated at the port (other than MARPOL)	Classification and estimation of waste managed by type. A possible categorisation could be: – Own waste – Waste from the port area – Waste from the vessel (other than MARPOL)	Σ tons of waste by type		
Characterisation of MARPOL waste (waste generated on-board vessels)	The International Convention for the Prevention of Pollution from Ships (MARPOL) is the main international convention that deals with the prevention of pollution of the marine environment from the operation of vessels or due to accidents. **MARPOL 1:** Oil pollution. **MARPOL 2:** Pollution by noxious liquid substances in bulk. **MARPOL 3:** Pollution by harmful goods. **MARPOL 4:** Pollution by discharge of sewage from vessels. **MARPOL 5:** Pollution by garbage from vessels.	Σ m^3 of waste classified according to MARPOL Annex i		
Percentage of Port Waste by Waste Management Method	Estimation of the management methods used to collect waste from the port area, based on the percentage of waste assigned to each method (recovery, recycling and/or disposal).	Based on the volume of tons per year disposed of by each waste disposal method. The indicator is calculated as follows: % of waste disposed by each method (recovery, recycling and/or disposal)		
Waste Collected from Port Surface Waters (Anthropogenic Waste)	Amount of solid waste collected from the surface waters of the port by specialised vessels or other means.	Total tons collected per year from the surface of port waters		

NAME	DESCRIPTION / OBJECTIVE	CALCULATION	COMPARABILITY	LINK TO SDG
PORT DEVELOPMENT INDICATORS				
Annual Volume of Sediment Dredged	Estimated annual volume of sediment dredged in the port area.	Volume of sediment dredged per year, expressed in cubic metres		
IMPACT ON BIODIVERSITY				
Port activities in or around protected areas or areas of high biodiversity	Estimation of the area inside which port activities take place and which is either in or near natural habitats or areas of high biodiversity.	Total protected port area expressed in square metres		
Existence of Invasive Species from Ballast Water	This indicator assesses the presence and prevalence of invasive species that enter a port through vessel ballast water. It also measures, in parallel, the efficacy of ballast water management measures. Existing species in the port environment will be inventoried beforehand.	YES / NO		
ENVIRONMENTAL MANAGEMENT INDICATORS				
Environmental Training of Port Employees	Port managing bodies can use this indicator to draw up reports on the training given to their employees in environmental awareness to provide them with the necessary knowledge to promote sustainable lifestyles and improve the work environment.	$\frac{\sum \textit{average hours of training per year}}{\text{No. of workforce for the whole period}}$		

NAME	DESCRIPTION / OBJECTIVE	CALCULATION	COMPARABILITY	LINK TO SDG
Implementation of the Environmental Management System	Qualitative indicator that measures Port Authority's provision of an Environmental Management System, integrating the port authority's sustainable management responsibilities.	YES / NO		
Cost of significant fines and number of non-monetary penalties for failing to comply with environmental regulations	The information provided by this indicator helps to assess the port authority's performance in respect of its capacity to act in accordance with the requirements of the environmental regulations.	Total amount of administrative or judicial penalties received for failing to comply with environmental regulations		
Environmental Complaints Received and Resolved	Number of environmental impact claims or complaints received in order to measure the port authority's effectiveness in managing environmental claims and its ability to address and resolve issues raised by society.	Annual number of Environmental complaints received and resolved		
Annual Resources Allocated to Environmental Protection	Planned investments and expenditure by the port authority to finance activities with the primary purpose of preventing, reducing and eliminating pollution and other forms of environmental damage.	∑ funds allocated and committed in the annual budget for activities related to environmental protection		

Source: Fundación Valenciaport with data from different sources

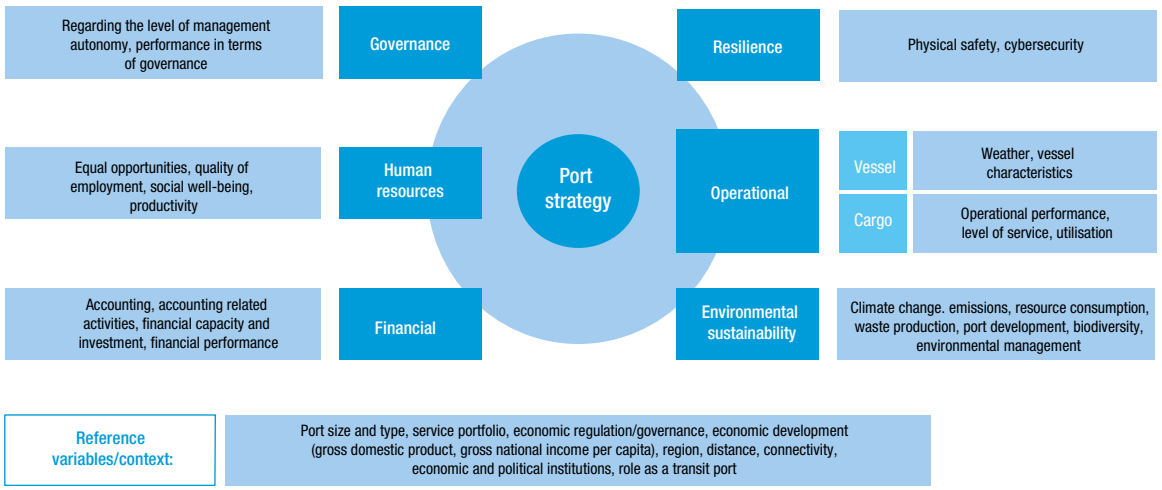
3. EXAMPLE OF THE APPLICATION OF PORT PERFORMANCE INDICATORS; THE CASE OF THE PORT AUTHORITY OF VALENCIA

As previously explained, this document includes a series of performance indicators that can be applied to each port body insofar as their respective situation and characteristics allow for this. To this end, the final *output* obtained is a set of indicators that can be used by each port authority insofar as it believes that the indicators are more or less suited to its distinctive features. This set of indicators will allow for its own situation to be monitored and compared with its counterparts.

In this respect, and although the broad range of port performance indicators proposed should not be seen as a balanced port scorecard in itself, the purpose of this exercise is aligned with the balanced scorecard proposed by Kaplan and Norton (1996), a tool used to link strategy with performance. Within this framework, we intend to use the set of indicators proposed based on their relevance and degree of comparability. Thus, the final output can be regarded as a kind of port scorecard, which can be reconfigured and adapted to the particular features of each user.

To this end, and as explained throughout the document, seven strategic dimensions (Figure 6) — governance, human resources, resilience, finance, cargo operations, vessel operations and environmental sustainability — have been adopted and adapted to align with modern port performance dynamics. In addition, and in general, as already noted at the beginning of this document and in line with Volume 4 of this publication (UNCTAD, 2016), there is a set of variables that serves as a contextualisation tool. These variables, along with the first set of governance performance indicators, allow for the positioning of each port authority with respect to the port performance scorecard in order to subsequently establish a comparative exercise. These are usually publicly available data, such as macroeconomic conditions over time, connectivity and distance between markets, and the set of rules underpinning the political economy of local maritime trade. The latter includes capital controls, customs procedures, labour standards, investment regimes and trade facilitation, as well as the relative openness of the political system. By including these contextual variables, port performance can be compared to other ports, taking into account conditions outside the direct control of management.

Figure 6: Diagram of the adapted port scorecard



Source: Fundación Valenciaport

For instance, below is an exercise relating to the applicability of the adapted port scorecard to the Port Authority of Valencia based on a selection of all port performance indicators shown above. The Port Authority of Valencia (APV in Spanish), operating under the name of Valenciaport, is the public body responsible for the operation and management of three state-owned ports located along 80 km of the Mediterranean coast in Eastern Spain: Valencia, Sagunto and Gandía. It plays a key role in international trade, as well as within the local and regional economy, generating employment and promoting economic development.

Thus, as exemplified in the following section, along with other practical cases from different bodies, the APV has been making major efforts to measure port performance, proof of which are the various indices that it has developed with the aim of making strategic decision-making easier and implementing improvement measures, as well as seeking to promote enhanced transparency in its management.

To revert to the exercise of applying a selection of the different possible port performance measurement indicators presented in the previous sections (Table 15 to Table 21), said indicators have been primarily selected from the Port Authority of Valencia Sustainability Report, thus demonstrating the usefulness of indicators in promoting transparency. The indicators are not only used as measurement tools, but they also play a key role in the transparent communication of outputs and progress achieved in port management.

Table 15: Governance indicators (Port Authority of Valencia)

1. Indicators characterising the Level of Management Autonomy		2021
• The port authority has its own legal status (Yes/No).	YES	1
• The port authority develops its own Master Plan (Yes/No).	YES	1
• The port authority can outsource the provision of port services to third parties (Yes/No).	YES	1
• The port authority is a public entity (Yes/No).	YES	1
2. Performance indicators in terms of governance		**2021**
a. Transparency and Accountability		
• The port authority publishes annual accounts (Yes/No).	YES	1
• Audits of annual accounts are carried out by an external auditor (Yes/No).	YES	1
• Port fees are publicly available (Yes/No).	YES	1
• Port traffic data is published on a regular monthly/quarterly basis (Yes/No).	YES	1
b. Level of Cooperation Between Ports		
• The port authority participates in sectoral partnerships with other managing bodies (Yes/No).	YES	1
• The port authority leads sectoral partnerships involving other managing bodies (Yes/No).	YES	1
• The port authority participates in joint projects with other port bodies (Yes/No).	YES	1
• The port authority runs joint projects with other managing bodies (Yes/No).	YES	1
c. Support to (Industrial and Port) Clusters		
• The port authority participates in sectoral partnerships with other managing bodies (Yes/No).	YES	1
• The port authority has a *Business Continuity Plan* (Yes/No).	YES	1
• The port authority contributes to or oversees the resolution of maritime access operational/service bottlenecks as well as administrative bottlenecks (Yes/No).	YES	1
• The port authority manages an Information and Communication Technology (ICT) system for the benefit of the port community (Yes/No).	YES	1
d. Port-City Relations or Liaising with Citizens		
• There is a Port Centre open to inhabitant who wish to find out how it works and what projects are carried out (Yes/No).	NO	0
• The port authority promotes cultural/leisure activities for citizens (Yes/No).	YES	1
• The port authority provides port spaces for public use (Yes/No).	YES	1
• The port authority carries out integration activities with the environment (Yes/No).	YES	1

Port governance index

*= 0.25 *transparency and accountability (4) +*
*0.25 *level of cooperation between ports (4) +*
*0.25 *integration with clusters (4) +*
*0.25 *Port to City relationship (3) = 3.75*

In other words, a port governance rating of 93.75%.

Source: Fundación Valenciaport with data from different sources

Table 16: Human resources indicators (Port Authority of Valencia)

INDICATOR	CALCULATION FORMULA	2021 VALUE	SOURCE
EQUAL OPPORTUNITY INDICATORS			
Gender Parity by Type of Contract	$\frac{\text{Under represented gender (Contract i)}}{\text{Total workforce (Contract i)}} * 100$	19% women (86/457) 81% men (371/457)	2021 Sustainability Report
EMPLOYMENT QUALITY INDICATORS			
Temporary Employment Rate	$\frac{\text{Nº of temporary personnel}}{\text{Total workforce}} * 100$	14%	2021 Sustainability Report
Volume of Direct Jobs Generated	Σ Direct Jobs	18000 (data from 2020)	2023 Economic Impact Study
SOCIAL WELFARE INDICATORS			
Volume of Indirect Jobs Generated	Σ Indirect Jobs	9000 (data from 2020)	2023 Economic Impact Study
Training of Human Capital	Σ Hours of Training	$\frac{\text{Within Agreement: 6,812.25 hours}}{\text{Outside Agreement: 512.75 hours}}$	2021 Sustainability Report
PRODUCTIVITY INDICATORS			
Productivity per Employee*	$\frac{\text{Tons}}{\text{Nº of employees}}$	84,850,755/457= 185,669.05	2021 Sustainability Report

Source: Fundación Valenciaport with data from different sources

Table 17: Financial indicators (Port Authority of Valencia)

INDICATOR	CALCULATION FORMULA	2021 VALUE	SOURCE
ACCOUNTING INDICATORS			
EBIT*	(Net income) + (Interest) + (Taxes)	35,422,915.89 euros	2021 Consolidated Annual Accounts
INDICATORS PER LOAD UNIT			
Revenue per Cargo Unit	$\frac{\text{Revenue from port fees}}{\text{Tons}}$	$\frac{\text{123.538.999,60 euros}}{\text{85.269.726 tons}} = 1,45$	2021 Consolidated Annual Accounts / Statistical Bulletin
Expenses per Cargo Unit	$\frac{\text{Operating expenses}}{\text{Tons}}$	$\frac{\text{(22.414.433,25 euros+47.546.398,82 euros)}}{\text{85.269.726 tons}} = 0,82$	2021 Consolidated Annual Accounts / Statistical Bulletin
Net Profit for the Fiscal Year per Cargo Unit	(Net profit for the fiscal year) / Tons	$\frac{\text{30.859.538,99 euros}}{\text{85.269.726 tons}} = 0,36$	2021 Consolidated Annual Accounts
FINANCIAL PERFORMANCE INDICATORS			
ROE (Return on Equity)	(Net profit for the fiscal year) / (Net Equity)	$\frac{\text{30.882.941,21 euros}}{\text{1.399.369.450,42 euros}} = 0,02$	2021 Consolidated Annual Accounts

Source: Prepared by the authors with data from different sources

Table 18: Resilience indicators (Port Authority of Valencia)

INDICATOR	CALCULATION FORMULA	2021 VALUE	SOURCE
PHYSICAL SAFETY INDICATORS			
Annual Frequency of Accidents	$\frac{\text{Nº of accidents leading to absence from work per year}}{\text{Nº of total hours worked per year}}$	5.43 accidents per 1 million hours worked	2021 Sustainability Report
Existence of a Security System in the Supply Chain	YES / NO	YES	2021 Sustainability Report
CYBERSECURITY INDICATORS			
Existence of an Information Security Management System	YES / NO	YES	Relevant department 2021 Sustainability Report

Source: Prepared by the authors with data from different sources

Table 19: Vessel operation indicators (Port Authority of Valencia)

INDICATOR	CALCULATION FORMULA	2021 VALUE	SOURCE
INDICATORS OF VESSEL CHARACTERISTICS			
Maximum Terminal Draught	Maximum Draught in Metres	16 m	APV Web
Maximum Berthing Length	Metres of Berthing Line at the Quay	1,440 m	APV Web
Average gross tonnage (GT)*	$\frac{\Sigma \text{ GT of vessels}}{\text{Nº of vessels}}$	35,041.95 GT	2021 Statistical Bulletin

Source: Prepared by the authors with data from different sources

Table 20: Cargo operation indicators (Port Authority of Valencia)

INDICATOR	CALCULATION FORMULA	2021 VALUE	SOURCE
OPERATIONAL PERFORMANCE INDICATORS			
Total Cargo Handled*	Σ TEU Σ Solid bulk tons Σ Liquid bulk tons Σ RoRo units	5,428,307 TEU 1,859,496 SLD BLK 2,673,188 LQD BLK 402,228 ITU	Statistical Bulletin
Total Number of Ferry Passengers	Σ Ferry passengers	26286	Statistical Bulletin
Total Number of Cruise Ship Passengers	Σ Cruise ship passengers	130869	Statistical Bulletin
INTENSITY OF USAGE INDICATORS			
Tons per Hectare	$\frac{\text{Tons}}{\text{Total port area (Ha)}}$	84,850,755/652.6135= 130016.85	2021 Sustainability Report

* As noted, this is a limited selection of performance indicators in the area of cargo operations, given the nature and, therefore, the confidentiality regarding the disclosure of the data in question.

Source: Fundación Valenciaport with data from different sources

Table 21: Environmental sustainability indicators (Port Authority of Valencia)

INDICATOR	CALCULATION FORMULA	2021 VALUE	SOURCE
CLIMATE CHANGE INDICATORS			
Carbon Footprint: Total greenhouse gas emissions with respect to cargo handled	$\frac{(CO_2 \text{ emissions (t)}}{\text{Goods handled (TEU/t)}}$	163,052 T CO2 Eq	2021 APV Environmental Report
Adapting to Climate Change	Is there a climate change adaptation plan? YES / NO	NO	2021 APV Environmental Report
RESOURCE CONSUMPTION INDICATORS			
Percentage of energy consumption from renewable sources	$\frac{\text{Renewable energy consumed (GWh)}}{\text{Total energy consumed (GWh)}} * 100$	100%	2021 APV Environmental Report
WASTE PRODUCTION INDICATORS			
Characterisation of port waste generated (other than MARPOL)	Σ tons of waste	24,72 T Hazardous 255,47 T Non-Hazardous	2021 APV Environmental Report
PORT DEVELOPMENT INDICATORS			
Annual Volume of Sediment Dredged	Cubic Metres (m^3)	No dredging was performed in 2020.	2021 APV Environmental Report
IMPACT ON BIODIVERSITY			
Existence of Invasive Species from Ballast Water	YES / NO	NO	2021 APV Environmental Report
ENVIRONMENTAL MANAGEMENT INDICATORS			
Implementation of the Environmental Management System	YES / NO	YES	APV Environmental Report
Annual Resources Allocated to Environmental Protection	The indicator is calculated as the sum of all allocated and committed funds (investments and expenditure) in the annual budget for activities related to environmental protection.	4,820,425.46 euro	2021 APV Environmental Report

Source: Fundación Valenciaport with data from different sources

4. OTHER CASE STUDIES

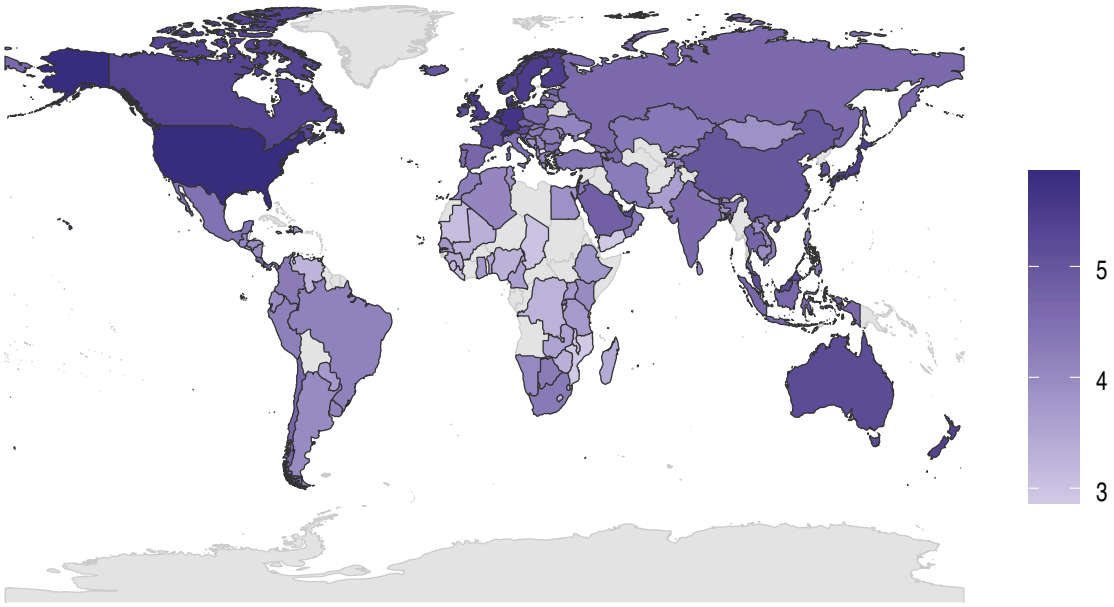
As previously mentioned, ports use their port performance outputs to make the strategic, structural, operational or other adjustments necessary to improve their competitiveness. Furthermore, the interest in measuring port performance is increasing, with efforts to measure both port and supply chain performance, thus encompassing a distinct and diverse group of stakeholders (Notteboom, Pallis, & Rodrigue, 2022).

In this regard, international intergovernmental organisations like the World Bank, the Organisation for Economic Co-operation and Development (OECD), the European Commission and UNCTAD itself have been working on developing indicators that measure aspects of port performance at global and regional levels. These initiatives are designed to enable decision-makers to have a better understanding of the linkages involved in improving the competitiveness of a major industry that is critical to trade prosperity, i.e., the maritime and port industry, by monitoring and understanding trends at ports all over the world and/or within broader groups.

While much of the work undertaken is qualitative in nature, some initiatives with a more quantitative purpose can be observed. From a more general perspective, the most striking is **the World Economic Forum's Global Competitiveness Index** (GCI), which assesses the competitiveness of countries and global economies.

This index is based on a wide range of factors that are deemed crucial for sustainable economic growth and development, for which a quantitative methodology is used that allows for the collection of data from reliable sources, enabling comparative analyses between the different countries assessed. The GCI uses different pillars or categories to assess a country's competitiveness (Figure 7). Each pillar reflects a key aspect of the economy and business environment. Some of these pillars include institutions, infrastructure, the macroeconomic environment, health and primary education, higher education and training, labour market efficiency, financial market development, technological readiness, market size and business orientation. A quantitative methodology is used to collect data from reliable sources and perform a comparative analysis between the countries assessed.

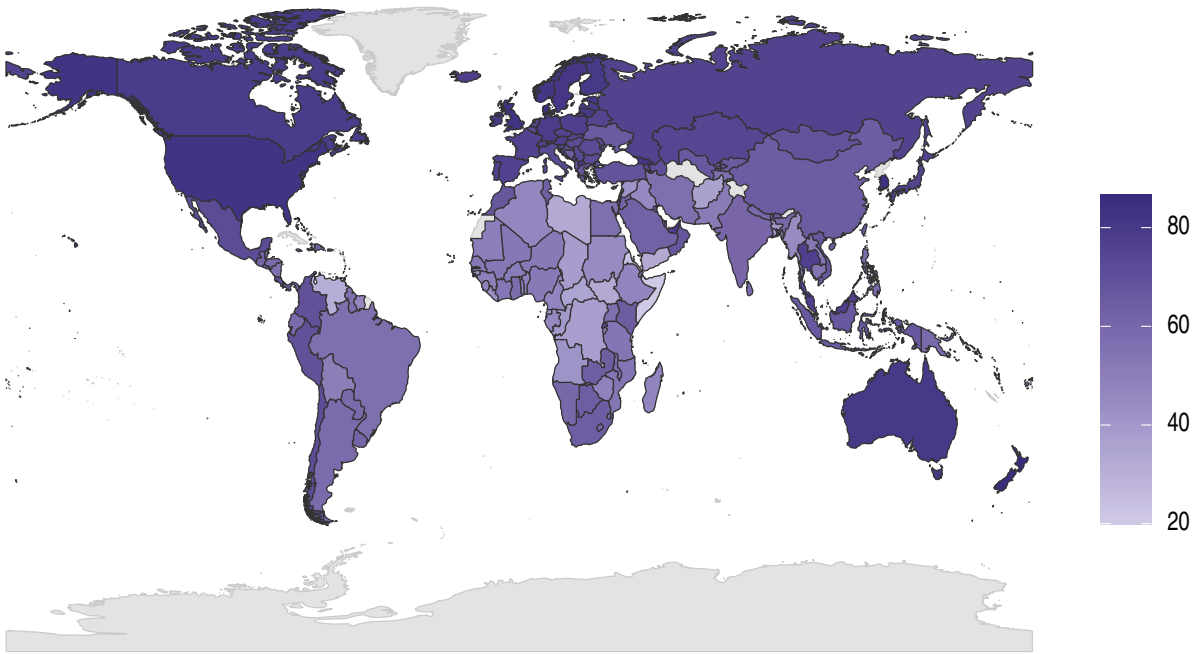
Figure 7: Global Competitiveness Index (2017-2018)



Source: World Economic Forum (2018)

In the same vein, the World Bank's **Ease of Doing Business Index** measures just one of the several aspects that make up competitiveness: the ease of doing business. In this regard, the assessment of ease of doing business is determined on the basis of a hypothetical simulation of the procedures that would have to be carried out to start up a company, obtain a building permit, register a property or demand performance of a contract, etc., based on each country's local legislation. Economies are given an ease of doing business ranking of between 1 and 190. A higher ranking, i.e., closer to 1, means that the economy's business regulations make it easier to start a local company and its activities. The rankings are determined on the basis of the average scores obtained for the indicators that make up the index in question. The outputs are compiled in a Report that is prepared and published by the World Bank.

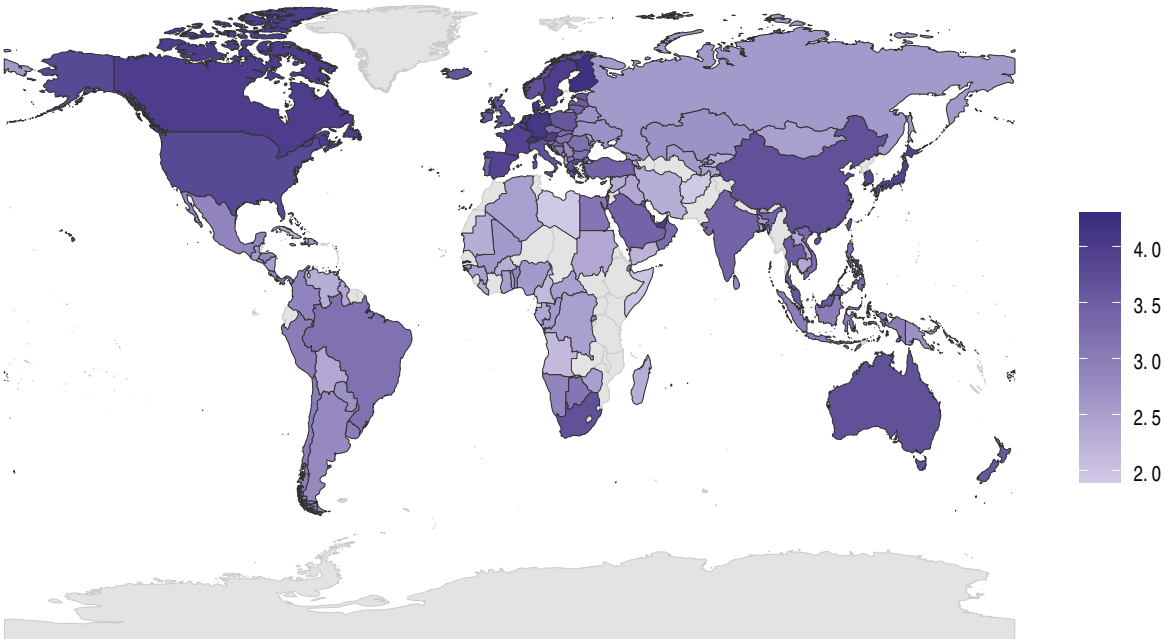
Figure 8: Ease of Doing Business Index



Source: World Bank (2020)

The **World Bank's Logistics Performance Index** (LPI), however, constitutes a more focused approach. It is a tool that assesses and compares the efficiency and effectiveness of logistics systems in countries all around the world. This index aims to provide a global view of logistics performance and help countries identify areas for improvement in their logistics infrastructure and processes. The LPI assesses various key aspects of a country's supply chain and logistics. These aspects include efficiency of customs procedures, quality of transportation infrastructure, ease of international shipping, standard and quality of logistics services, ability to track and trace shipments, as well as timeliness and reliability of delivery services. The LPI uses scores from 1 to 5, 1 representing poor logistics performance and 5 representing high-quality logistics performance (Figure 9).

Figure 9: Logistics Performance Index

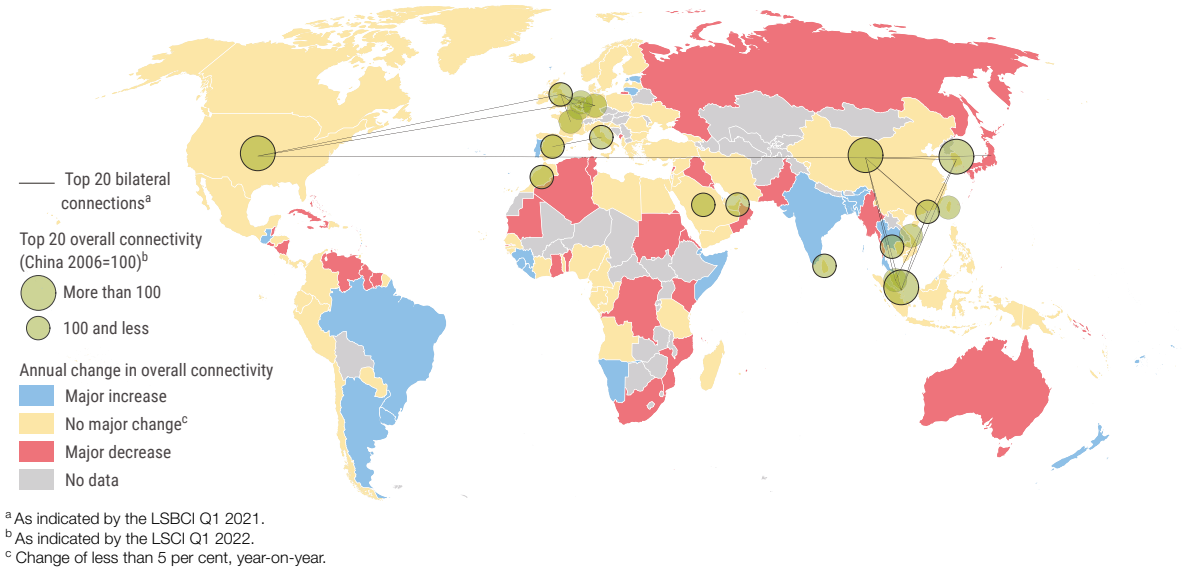


Source: World Bank (2022)

Another example of an important initiative is the UNCTAD **Liner Shipping Connectivity Index** (LSCI), a measurement that assesses the connectivity and accessibility of ports and liner shipping routes worldwide.

The purpose of the LSCI is to provide information on the efficiency and quality of liner shipping services, as well as to identify connectivity patterns in international trade. The LSCI is based on data from major shipping companies and uses quantitative indicators to assess the frequency, capacity and geographical coverage of regular liner shipping services. It also considers other factors, such as the size of the vessels used, transit time and the availability of connections with other modes of transport, such as rail and road transport. This index ranks countries and ports based on their level of connectivity with scores from 0 to 100 (Figure 10). A higher score indicates greater connectivity and accessibility in regular liner shipping.

Figure 10: Liner Shipping Connectivity Index



[a] As indicated by the LSBCI Q1 2021.
[b] As indicated by the LSCI Q1 2022.
[c] Change of less than 5 per cent, year-on-year.

Source: UNCTAD (2022)

Another milestone to highlight is the funding provided by the European Commission for two projects focused on measuring the performance of ports across Europe. Firstly, the "**Port Performance Indicators: Selection and Measurement**" (**PPRISM**) project, aimed at identifying a set of sustainable, relevant and feasible port performance indicators to be implemented at EU level to measure and assess the impact of the European Container Port System on society, the environment and the economy. To this end, a classification of types of port performance indicators was created. Its validity and the availability of data were assessed and it was submitted to key stakeholders for assessment in terms of its suitability for implementation within the EU. The final outcome of PPRISM was a set of port performance indicators that give an overview of the European Container Port System's environmental, socio-economic and supply chain performance. The project was the first systematic attempt at the EU level to determine a set of relevant port performance indicators that were widely accepted and commonly defined by the entire port sector and other relevant key stakeholders (including port users, societal groups, etc.).

In 2013, the European Union funded a monitoring project coordinated by the Vrije Universiteit Brussel known as **PORTOPIA**, which ended in November 2017 and had two main goals: (1) support the European port industry by providing relevant performance data to improve individual port and port shipping system performance; and (2) support policy formulation and monitor policy implementation. PORTOPIA resulted in the creation of an integrated knowledge base and a European port performance management system that focuses on five port performance indicator categories: (1) market trends and structure, (2) socio-economic performance, (3) the environment, occupational health and safety, (4) logistics and operating chain efficiency, and (5) governance, finance and user perceptions of quality. Inland ports were included in the project, which also aimed to foster a performance management culture in the European port sector.

There is no doubt that each port now has an external port performance measurement and/or analytical tool that will allow it to assess itself and position itself with respect to its competitors. In this regard, another milestone to highlight is the UNCTAD **TrainForTrade Port Management Programme**, which helps port communities provide more efficient and competitive services. The programme creates networks through which ports can share their knowledge and expertise, strengthen talent management and the development of human resources.

Ever since 2012, member countries and *partner* ports within the TrainForTrade network have been completing the annual Port Performance Survey, which collects data in a secure and confidential manner to produce a Port Performance Scorecard (PPS)[2], thus allowing port administrations not only to compare their performance over time but also to see where they stand with respect to other ports locally, nationally, regionally and globally.

Based on the input of data from 48 port bodies, the 26 PPS indicators were divided into the following categories: Finance, Human Resources, Gender, Vessel Operations, Cargo Operations and Environment. Table 22 shows the average annual values for the period from 2016 to 2022.

Table 22: Port Performance Scorecard

Indicator		Median values						
		2016	2017	2018	2019	2020	2021	2022
Finance	EBITDA/revenue (operating margin)	34,4%	36,7%	44,6%	40,9%	33,7%	40,4%	43,8%
	Labour/revenue	14,9%	19,0%	16,8%	18,0%	20,5%	16,4%	16,8%
	Vessel dues/revenue	15,4%	16,4%	19,2%	14,9%	14,8%	15,8%	12,7%
	Cargo dues/revenue	36,3%	34,1%	26,7%	31,6%	35,7%	32,6%	27,6%
	Concession fees/revenue	2,0%	6,6%	14,3%	13,3%	10,2%	21,2%	16,5%
	Rents/Revenue	3,1%	2,7%	3,3%	3,3%	3,6%	2,7%	0,6%
Human resources	Tonnes/employee	14 091 t	15 500 t	36 288 t	34 647 t	27 265 t	35 018 t	32 331 t
	Revenue/employee	129 813 USD	112 527 USD	143 113 USD	169 912 USD	162 933 USD	268 501 USD	226 522 USD
	EBITDA/employee	46 411 USD	41 851 USD	59 844 USD	74 174 USD	52 835 USD	61 898 USD	88 035 USD
	Labour cost/employee	23 231 USD	21 753 USD	21 355 USD	25 074 USD	25 938 USD	23 370 USD	19 573 USD
	Training cost/wages	0,9%	1,0%	1,1%	0,7%	0,3%	0,3%	0,3%
Gender	Female Participation Rate - All categories	13,7%	14,5%	15,7%	16,2%	16,9%	15,4%	16,1%
	Female Participation Rate - Management	34,0%	35,0%	40,7%	38,8%	42,9%	40,1%	40,7%
	Female Participation Rate - Operations	23,8%	21,1%	6,4%	7,4%	10,7%	6,4%	10,5%
	Female Participation Rate - Cargo Handling	0,0%	3,1%	5,9%	4,4%	2,3%	4,5%	0,5%
	Female Participation Rate - Other employees	28,6%	24,8%	26,9%	31,2%	29,3%	26,1%	23,7%
Vessel operations	Average waiting time	4 h	8 h	14 h	5 h	8 h	7 h	10 h
	Average gross tonnage per vessel	16 163	14 952	16 759	16 298	16 525	16 322	22 543
	Average of Oil Tankers arrivals	4,0%	4,7%	7,7%	9,6%	6,4%	6,6%	6,3%
	Average of Bulk Carrier arrivals	5,4%	6,1%	5,0%	6,6%	7,6%	8,3%	5,8%
	Average of Container Ship arrivals	35,6%	40,9%	26,7%	26,8%	28,2%	24,2%	20,8%
	Average of Cruise Ship	0,3%	0,3%	0,2%	0,3%	0,0%	0,0%	0,0%
	Average of General Cargo Ship	15,4%	15,8%	21,3%	22,0%	20,6%	24,6%	26,8%
	Average of Other Ship	13,0%	11,8%	12,9%	8,8%	14,6%	6,2%	13,9%
Cargo operations	Average tonnage per arrival (all)	5 360 t	7 945 t	7 008 t	7 190 t	5 469 t	5 253 t	5 623 t
	Tonnes per working hour, dry or solid bulk	244 t	219 t	261 t	191 t	229 t	147 t	95 t
	Tonnes per hour, liquid bulk	737 t	222 t	186 t	201 t	166 t	140 t	120 t
	Containers Lift Per Ship Hour at Berth	22	26	18	20	22	21	18
	Average container dwell time in days	5	4	5	5	5	5	3
	Tonnes per hectare (all)	141 091 t	109 608 t	94 226 t	93 205 t	86 171 t	94 271 t	95 563 t
	Tonnes per berth meter (all)	3 071 t	3 125 t	3 325 t	2 990 t	2 833 t	2 905 t	2 796 t
	Total Passengers on Ferries	1211 915	1396 864	1172 711	1145 084	302 213	147 170	1055 517
	Total Passengers on Cruise	32 700	23 880	32 054	25 585	1 275	0	5 470
Environment	Investment in Environmental Projects/Total CAPEX		1,3%	1,2%	0,9%	0,1%	0,2%	0,3%
	Environmental expenditures/Revenue		0,2%	0,2%	0,8%	0,3%	0,2%	0,2%

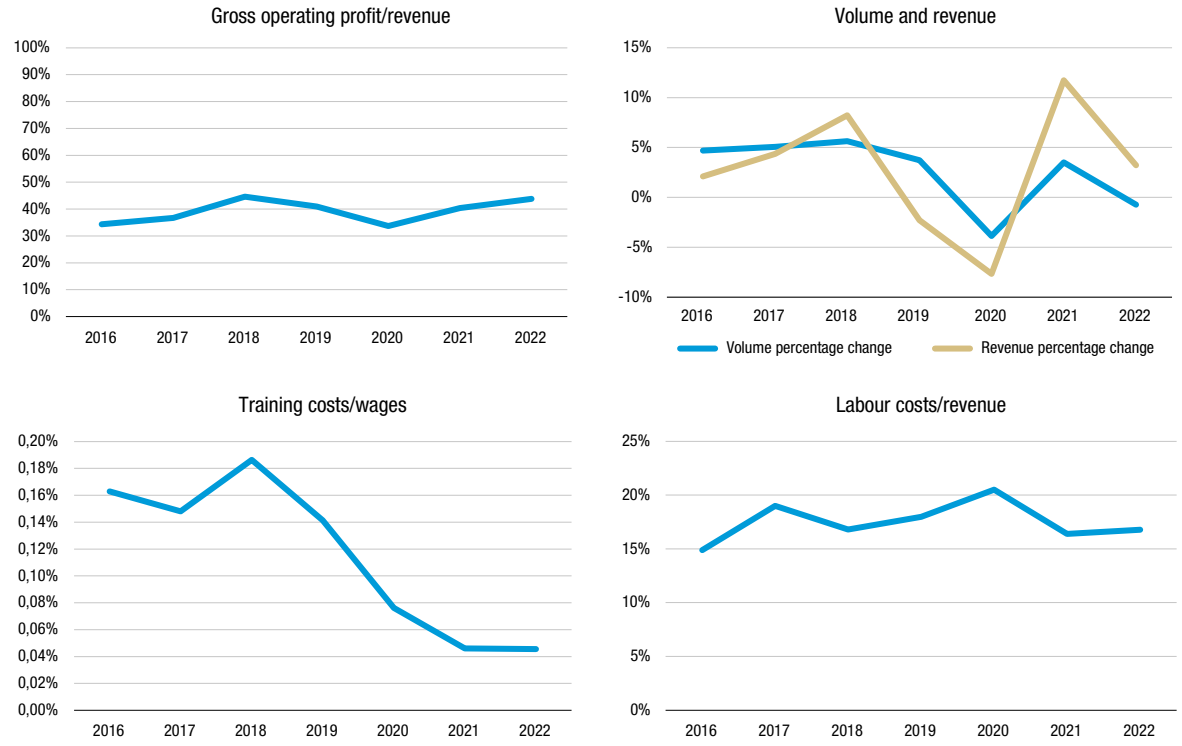
Source: TrainForTrade Programme (UNCTAD)

[2] https://pps.unctad.org/

Most of the ports included in the survey are small to medium-sized. Medium-sized ports handle just over 10 million tons per year, generating average annual revenues below $60 million USD.

Over 80% of these ports are state-owned, and most are established as corporate entities. As for the combination of port infrastructure and services, they vary considerably in terms of types of vessels and cargo. For example, in a medium-sized port, approximately 20% of arrivals are container vessels, 27% are general cargo, and 15% are bulk carriers and tankers. Other vessels, such as passenger and cruise ships, account for the remainder. Revenue varies partly depending on the level of port service privatisation and the size of the area under its management.

Figure 11: Information on a few selected indicators - average values (2016-2022)



Source: UNCTAD calculations based on data from port bodies that report to the PPS/TrainForTrade platform

* Note: Volume and revenue values were calculated as the median year-to-year percentage change across all ports in order to minimise bias due to data availability from participating port bodies.

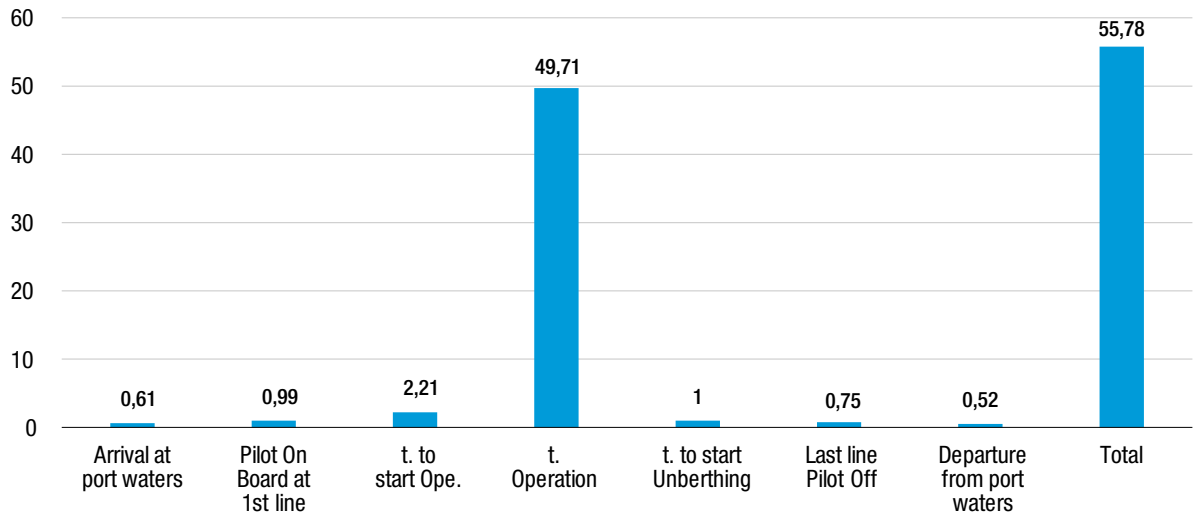
Reverting to initiatives implemented or carried out by the port authority itself, as demonstrated in the previous section, the Port Authority of Valencia, as part of its commitment to excellence and continuous improvement, regularly and openly shares various proprietary statistical indices used to measure and assess port performance in different areas.

By using these statistical indices, the Port Authority of Valencia obtains a precise and up-to-date picture of port performance, thereby facilitating strategic decision-making and the implementation of improvement measures. Furthermore, as explained in the previous paragraph, these indices offer port users and economic stakeholders a clear and reliable insight into port performance, thus fostering trust and the development of robust business relationships.

Noteworthy among these indices is the **Average Stopover Time Index** at the Port of Valencia[3], an indicator used to assess port efficiency and operational performance in terms of stopover times. To compile this index, detailed information on vessel movements in the port is collected and recorded by the Vessel Traffic Control Service. This data is then analysed, structured and supplemented with additional information provided by the port's Operations Department. As a result, a periodic report is generated, reflecting the average times of the different stopover phases for the most relevant vessels that operate in the Port of Valencia.

The periodic reports include graphs that show Average Stopover Times by phase, enabling the identification and comparison of average times at each stage of the stopover process, from vessel arrival to departure (Figure 12). These graphs provide a clear and concise visual representation of the port's operational efficiency, providing valuable information for decision-making and the implementation of improvement measures.

Figure 12: Stopover times (h) by phase for ULCS (36 stopovers)[4]



Source: Port Authority of Valencia

Another relevant index developed by the Port Authority of Valencia, along with Fundación Valenciaport, is the Port Connectivity Index[5] (PCI), aimed at measuring connectivity between Spanish ports, specifically focusing on regular Short Sea Shipping (SSS) services according to the definition established by the European Shortsea Network. In other words, the index focuses on regular services between Spanish ports and ports in EU countries, as well as non-EU countries that have a coastline on the seas adjacent to Europe.

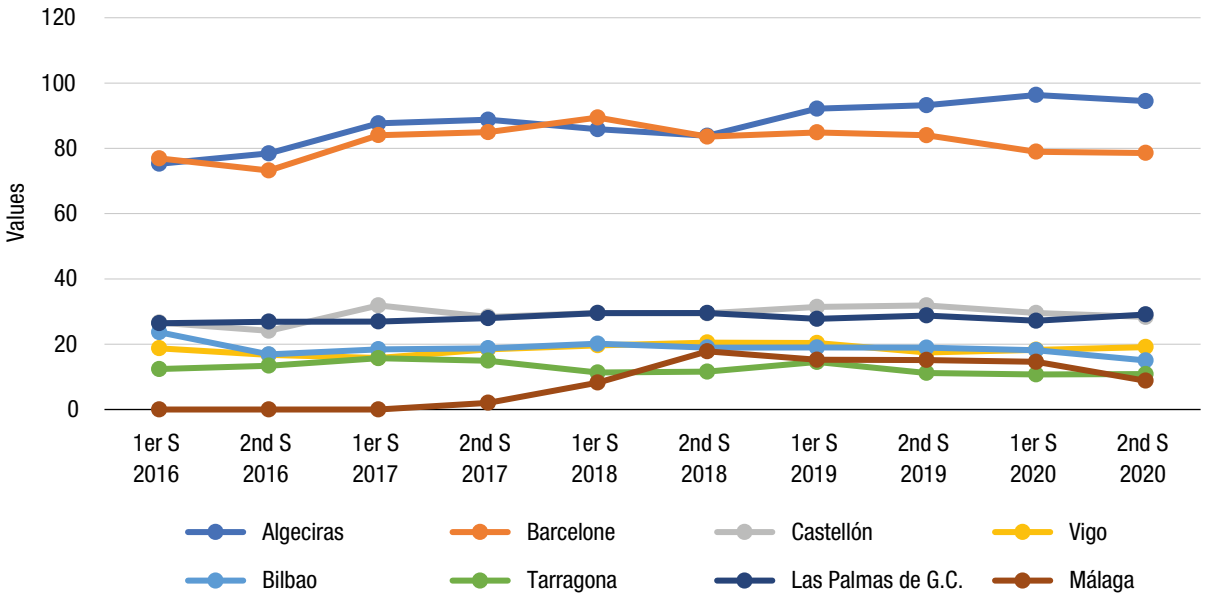
[3] For more information, see: https://www.valenciaport.com/datos/indices/tiempos-medios-escala-puerto-valencia/

[4] Data corresponding to the second quarter of 2022

[5] For more information, see: https://www.valenciaport.com/datos/indices/tiempos-medios-escala-puerto-valencia/

Based on the previously-explained methodology of the UNCTAD **Liner Shipping Connectivity Index** (LSCI), this index provides a comprehensive view of port competitiveness in short sea shipping and contributes to the strategic development of the Port of Valencia and other ports in Spain (Figure 13). To this end, the PCI provides a quantitative assessment of port connectivity, taking into account several aspects such as the frequency of liner shipping services, the number of shipping lines operating at the port, the capacity of the vessels used and other relevant indicators.

Figure 13: Port Connectivity Index (PCI)



Source: Port Authority of Valencia

5. CONCLUSIONS AND RECOMMENDATIONS

The use of port performance indicators is crucial for gaining a comprehensive understanding of the fundamental aspects of port operations. To this end, it is an essential tool for decision-making and devising and monitoring strategic plans and management policies to ensure efficient and sustainable port operations. In this respect, the proper use of indicators will facilitate:

- **Efficiency, effectiveness and productivity:** Port performance indicators provide a standardised framework for measuring and tracking the efficiency, effectiveness and productivity of port operations. They allow ports to assess their performance over time and identify trends.
- **Decision-making:** Port performance indicators provide valuable information for decision-making processes. Clear performance metrics help port authorities, operators and policymakers to identify areas for improvement, prioritise investments, effectively allocate resources, optimise port operations and improve overall performance.
- **Performance benchmarking:** By benchmarking performance with other port communities and industries at the local, regional, or global levels, areas in which the port excels and areas that require improvement can be identified, as can those of other ports. The appropriate use of benchmark outcomes can boost continuous improvement and foster healthy competition among ports.
- **Communication with port community stakeholders:** Port performance indicators provide a common language for communication between various stakeholders in the port community, including port authorities, operators, shipping companies, logistics providers and government agencies. They facilitate transparent and objective discussions on port performance, promoting cooperation and enabling collective efforts to address challenges and achieve common goals.
- **Accountability and transparency in port communities:** Port performance indicators foster accountability and transparency in the port sector. By establishing clear metrics and reporting mechanisms, ports are accountable for their performance. The transparent and reliable disclosure of information helps to build trust among stakeholders, attract investments and enhance the reputation of the port and its associated services.
- **Policy and regulation development:** Port performance indicators support the development of policies and regulations that seek to improve overall port performance and sustainability. Governments and regulatory bodies can use performance indicators to set goals, define regulatory frameworks and monitor compliance with standards, ensuring the development of a strong and competitive port sector.

6. ANNEX I

The Sustainable Development Goals (SDGs) were adopted by the United Nations in 2015 as a universal call to action to end poverty, protect the planet and ensure that by 2030 all people enjoy peace and prosperity.

The 17 SDGs are integrated and form part of the new Development Agenda. They are also a planning and monitoring tool for countries both nationally and locally, acknowledging that action in one area will affect outcomes in others and that development must balance social, economic and environmental sustainability (Figure 14). Countries have committed to prioritising progress for those who are furthest behind. The creativity, knowledge, technology and financial resources from all of society are necessary in order to achieve the SDGs in every context.

Figure 14: Sustainable Development Goals

Source: UNCTAD

The implementation of the SDGs in ports is a critical component of the new Development Agenda. To meet these goals, the World Port Sustainability Programme (WPSP), published by the International Association of Ports and Harbours (IAPH), has developed an awareness and learning tool for SDG implementation in ports. This tool, known as the *Port Endeavor* game, is a collaborative effort involving APEC (Antwerp/Flanders Port Training Centre) and UNCTAD.

The purpose of the game is for each group to take appropriate decisions to address a series of critical situations that arise in their port communities by implementing the SDGs. The team that scores the most points by achieving the SDGs wins the game.

As part of this initiative, a series of specific actions that have already been implemented in different port communities, which are in line with the SDGs and can be implemented by ports have been compiled. These include:

No poverty (SDG 1): End poverty in all its forms everywhere.

As drivers of economic growth and major intersecting points in global supply chains, ports can help reduce poverty by implementing actions to:

- Establish a good minimum wage for port employees and encourage similar practices in the port community.
- Apply ethical standards for supply chain management, including working conditions and human rights in developing countries.
- Include sustainability requirements in purchasing, e.g. Fairtrade label.
- Support local communities through social projects aimed at sustainable growth.
- Support local social institutions, e.g. schools, orphanages, NGOs.
- Establish a financial support programme for low-income port workers to improve their living conditions and reduce poverty.
- Support local and global charities and humanitarian initiatives that provide aid to those in need.
- Take action to improve the employability of people in neighbouring communities in need.

Zero hunger (SDG 2): End hunger, achieve food security and improved nutrition and promote sustainable agriculture.

Through their important role in the shipping, storage and trade in food, fish and agricultural products, ports can contribute to reducing hunger by taking action to:

- Encourage the donation of surplus food from the port area (e.g. warehouses, food terminals, canteens) to food aid organisations so they can distribute it to people in need.
- Support the trade in and storage of eco-friendly agricultural products.
- Source Fairtrade-labelled food products for staff catering.
- Establish community gardens or farms in the port area to promote sustainable food production and provide fresh products to local residents.
- Support food banks, community kitchen initiatives and local charities.

Good health and well-being (SDG 3): Ensure healthy lives and promote well-being for all at all ages.

Positive actions that ports can take include:

- Improve health and safety awareness among personnel as a whole and in local communities, e.g. through training and transparent communication about health and safety risks.
- Take action to reduce environmental impacts, such as decreasing air, water and noise pollution, and greening port and urban areas.
- Implement and participate in sustainable and secure mobility projects that reduce congestion.
- Improve port security and minimise risks.
- Raise awareness and take measures to combat the consumption of addictive substances such as tobacco, alcohol, drugs, etc.
- Protect habitats and biodiversity in and around the port area.
- Develop and implement a health and wellness programmes for port personnel, including initiatives such as on-site fitness facilities, the use of bicycles, health screenings and education on healthy lifestyles.

Quality education (SDG 4): Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

Ports can play an active role by implementing the following initiatives:

- Developing skills and talent policies for port personnel.
- Providing lifelong learning opportunities in ports.
- Cooperating with local schools, universities and research centres to provide educational programmes, internships and port visits.
- Offering training to port professionals through dedicated institutions.
- Creating synergies with universities within the framework of port research and development projects.
- Establishing a scholarship programme so that students can pursue higher education in fields related to port operations, such as logistics, engineering or environmental sciences.

Gender equality (SDG 5): Achieve gender equality and empower all women and girls.

This is a very important goal and one which ports are currently striving to achieve. Ports have historically been male-dominated, which is why specific efforts are required, including, but not limited to:

- Implementing gender-neutral recruitment and pay policies.
- Promoting women in leadership positions.
- Training and hiring more women for port operational positions, e.g. crane operators.
- Ensuring an equal share of men and women in operational and management positions at ports.
- Adopting measures to make the port's working environment more attractive to women, e.g. separate toilets, promotional campaigns, family-friendly human resources policy, etc.
- Conducting gender impact assessments to identify and address any gender-based biases or barriers in port operations, policies and practices, and to ensure that women have equal access to employment, training and promotion opportunities.
- Developing and implementing workplace harassment and discrimination prevention policies by training and educating port personnel to ensure a safe and respectful work environment for women.
- Supporting local gender equality organisations and social institutions.

Clean water and sanitation (SDG 6): Ensure availability and sustainable management of water and sanitation for all.

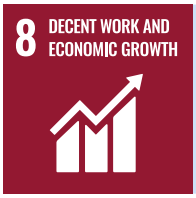
Thanks to the direct link between ports and water, highly effective initiatives are possible, including, but not limited to:

- Providing safe drinking water and clean sanitation facilities for port personnel and visitors, e.g. vessel crew, truck drivers.
- Minimising and optimising water consumption in the port area, e.g. by collecting rainwater to be used in the port.
- Protecting water-related ecosystems, e.g. estuaries, wetlands, mangroves in and around the port area.
- Participating in projects that protect freshwater resources, e.g. wastewater and stormwater treatment.
- Installing water treatment and purification systems to ensure that drinking water provided to port personnel and visitors meets or exceeds local health and safety standards.
- Taking measures to combat soil pollution, which can reach and affect underground freshwater supplies.

Affordable and clean energy (SDG 7): Ensure access to affordable, reliable, sustainable and modern energy for all.

Ports are often important energy hubs for transportation and many of them also produce energy. Port activities themselves also require a significant amount of energy. Ports can promote and generate affordable and clean energy alternatives and:

- Produce and/or source renewable energy locally.
- Support research and development of clean energy technologies and take proactive steps towards achieving the energy transition.
- Produce and/or recover energy from industrial waste streams.
- Promote clean energy initiatives by third parties (vessels, lessees and operators) through appropriate instruments, e.g. incentives, clauses in lease or concession agreements, etc.
- Invest in energy-efficient infrastructure, e.g., LED lighting, solar panels on buildings and roofs, energy-efficient HVAC systems.
- Implement energy management systems to monitor and reduce energy consumption.
- Ensure the availability of zero-carbon fuels and their safe and efficient supply at the port.



Decent work and economic growth (SDG 8): Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.

Relevant port initiatives include:

- Achieving economic growth through diversification, innovation and technological modernisation.
- Ensuring that economic growth has a positive economic and social impact on local communities.
- Promoting employment, including opportunities for disadvantaged groups and youth.
- Striving for a healthy and safe working environment for the entire community, including specific actions related to safety, ergonomics, and achieving a good work-life balance.
- Generating a sustainable model for cruise ship tourism.
- Enforcing ethical standards throughout the supply chain, e.g., working conditions and human rights in developing countries.
- Providing opportunities for entrepreneurship and innovation within the port area through business incubators and accelerators.

Industry, innovation and infrastructure (SDG 9): Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.

Industry, innovation and infrastructure are the foundation of any port, and ports can contribute to this strategic objective through the following actions:

- Digitally optimising port infrastructure, operations, processes and services.
- Experimenting, testing and implementing innovative digital and IT technologies at the port for both public and private use.
- Anticipating the adaptation of port infrastructures to withstand climate change.
- Adapting port infrastructure and processes to meet market demands, e.g., increasing vessel size.
- Monitoring and ensuring the sustainability of all new port development projects.
- Investing in infrastructure for all modes of transport to enable a balanced modal distribution.
- Promoting innovation and entrepreneurship within the port community, including start-ups and small- and medium-sized enterprises (SMEs).
- Encouraging the research and development of new and sustainable construction materials and methods for port infrastructure and buildings.
- Mainstreaming innovation into port business, constantly seeking to enhance performance and increase efficiency.

Reduced inequalities (SDG 10): Reduce inequality within and among countries.

Initiatives that ports can implement to contribute to this goal are:

- Ensuring equal opportunities regardless of gender, origin, beliefs or convictions.
- Adopting community initiatives that have a positive impact on the community as a whole, regardless of socio-economic background, e.g., by supporting vulnerable social groups.
- Implementing recruitment, wage and remuneration policies that do not vary based on social origin.
- Enforcing ethical standards throughout the supply chain, e.g., adequate working conditions and respect for human rights in developing countries.
- Applying ethical investment and banking practices.
- Providing equal access to training and development opportunities for personnel in an inclusive and non-discriminatory manner.
- Developing programmes to increase the participation of under-represented groups in both the port workforce and leadership positions.
- Supporting local communities in need, minority groups and indigenous populations.
- Empowering youth and the local community through science and environmental education programmes.

Sustainable cities and communities (SDG 11): Make cities and human settlements inclusive, safe, resilient and sustainable.

Cities and communities are key stakeholders and shareholders in ports and share common sustainable development goals. Ports can contribute as follows:

- Improving sustainable mobility and reducing congestion for both the workforce and goods.
- Restoring ecosystems and making the port accessible and appealing to people living in neighbouring urban areas.
- Minimising the environmental impact of port operations, such as air, water and noise pollution.
- Ensuring resilience and business continuity through emergency response planning.
- Launching community engagement programmes and initiatives, e.g., open days, port festivals, establishment of a Port Visitor Centre.
- Supporting local social institutions, e.g., schools, orphanages, NGOs.
- Working with local authorities and stakeholders to promote sustainable tourism.

Responsible consumption and production (SDG 12): Ensure sustainable consumption and production patterns.

As hubs in the global and local supply chain, ports can implement the following actions:

- Sustainably manage natural resources, chemicals and (hazardous) waste streams.
- Implement responsible purchasing policies.
- Make eco-friendly investments in the management and development of the port area, as well as in the end-to-end supply chain.
- Promote the circular economy, industrial reuse and mutually beneficial use of resources in the port community.
- Optimise port operations, processes and services.
- Reduce food waste and loss in the production and supply chain, e.g., connect the cruise industry with a poverty-fighting NGO in the local region or city.
- Encourage eco-design and environmentally friendly production techniques in the port community.
- Actively promote and enable the reduced use, reuse and recycling of resources and materials in the port area and supply chain.

Climate action (SDG 13): Take urgent action to combat climate change and its impacts.

All ports can play a key role in this sustainable development goal. Some of the most critical actions that ports can take include:

- Improving the energy efficiency of port operations, processes and services.
- Ensuring climate resilience by adapting port infrastructure and operations to changing climate conditions.
- Producing and/or sourcing renewable energy.
- Encouraging third parties (vessels, lessees and operators) to adopt clean energy initiatives, e.g., providing incentives and adding clauses to lease and concession agreements.
- Facilitating and incentivising the use of low-carbon modes of transport, such as rail and barges, to reduce road transport emissions.
- Participating in carbon capture, storage and use initiatives.
- Ensuring the availability and promoting the use of zero-carbon fuels and technologies at the port.
- Setting ambitious goals for carbon neutrality and the progressive reduction of greenhouse gas emissions in the port area.

Life below water (SDG 14): Conserve and sustainably use the oceans, seas and marine resources for sustainable development.

Life below water is intrinsically affected by port activity and can be protected — and even enhanced — by the following initiatives:

- Taking measures to prevent waste from ending up in the oceans, e.g., port reception facilities, waste fishing, clean-up actions.
- Promoting responsible fishing activities.
- Supporting research on the sustainable use of marine resources.
- Reducing CO2, SOx, NOx, NH3 emissions from port activities to prevent ocean acidification.
- Minimising water pollution through adequate wastewater treatment facilities.
- Protecting coastal and estuarine ecosystems.
- Minimising disruptive factors, e.g., underwater noise for marine mammals.
- Implementing measures to reduce the accidental release of oil and other hazardous materials at sea.
- Encouraging the use of eco-friendly anti-fouling paint on vessels and port infrastructure.
- Implementing responsible ballast water management practices to prevent the introduction and spread of invasive species.

Life on land (SDG 15): Combat desertification, halt and reverse land degradation, halt biodiversity loss.

The life of terrestrial ecosystems provides goods and services that must be protected by implementing the following actions:

- Supporting local projects that promote nature and biodiversity development.
- Restoring and protecting nature and biodiversity in the port area.
- Preventing deforestation by using and acquiring sustainably-certified timber and paper.
- Providing nature and environmental education programmes for employees.
- Ensuring that port area development does not disrupt ecosystems.
- Minimising the environmental impact of port operations, such as air and noise pollution.
- Applying ecological land use practices to the development of the port area, including the preservation of green spaces and the use of native plant species in landscaping.
- Implementing measures to prevent the introduction and spread of invasive species in the port and its surroundings.

Peace, justice and strong institutions (SDG 16): Promote peaceful, just and inclusive societies.

Ports can contribute to this goal by taking the following actions:

- Facilitating constructive dialogue between businesses and the workforce.
- Implementing peace initiatives, such as peace education programmes in the workplace and efforts to prevent illegal arms trafficking, etc.
- Enhancing security, including through cybersecurity measures, data protection for business and operational purposes, and improving the protection and responsible use of personal data.
- Encouraging open dialogue and cooperation with all stakeholders (including emergency services, customs and the armed forces) and establishing a hotline for complaints and enquiries.
- Maintaining transparent internal and external communication.
- Developing a code of conduct and training programmes for personnel and contractors on human rights, anti-corruption and other ethical issues.
- Exhibiting leadership in encouraging sustainable best practices among clients, lessees and operators through port incentive schemes and/or clauses in contractual agreements.
- Ensuring inclusive port decision-making with the participation of relevant stakeholders from the port and local community.

Partnerships for the goals (SDG 17): Revitalise the Global Partnership for Sustainable Development.

Some of the actions that ports can take include:

- Involving local communities in port-city initiatives.
- Organising joint projects of common interest with other ports and parts of the logistics chain.
- Establishing public-private partnerships to provide funding and implement sustainability projects.
- Establishing supply chain partnerships to ensure Corporate Social Responsibility (CSR) values throughout the chain.
- Cooperating with other ports for educational and training purposes, e.g., joint port training programmes and centres.
- Implementing joint research and development projects that involve stakeholders from the port, the academic world, industry and authorities.
- Working with NGOs and civil society organisations to address sustainability challenges.
- Engaging in international partnerships with other ports and organisations to share best practices.

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