An Integrated Framework of Balance Scorecard-PESTLE-Smart and Green Port for Boosting the Port Performance

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Abstract

The occurrence of long dwelling times, lack of investment to support port sustainability, environmental pollution, and the lack of advanced technology used are still common in Indonesia. Developing comprehensive port performance is essential to boost the results. This study aims to model an integrated framework to boost port performance. The design conceptual framework integrates performance measurement using the BSC and PESTLE methods with the concepts of sustainability, smart and green port. The BSC method is used as a measure of the company's overall performance but focuses more on internal, while PESTLE is used as a measure of the external performance of ports. Based on the literature study result, these methods are proven to be used as a port performance measurement tool, so they need to be integrated because the company must be in a competitive position with the required internal and external information. Therefore, the conceptual framework is expected to boost port performance in a complex manner.

Keywords
Balance scorecard, PESTLE, Smart Port, Green Port, Port Performance

1. Introduction
Port is one of the maritime sector's leading facilities, which has functions related to loading and unloading of goods, arrival and departure of ships, storage of goods, and others. In recent years, all world regions mostly carry out the process of exchanging goods by sea (Siroka et al. 2021). The port is a complex entity that faces several problems. The first problem faced by Indonesian ports is long dwelling time, which affects port operating costs such as increased inventory costs and shipping uncertainty. Per 2018, Indonesia has a dwelling time of 5.08 days. This number is higher than neighboring countries such as Singapore, which has a dwelling time of 1.5 days, Malaysia has a dwelling time of 4 days, and Thailand has a dwelling time of 5 days (Hassan et al. 2020). According to Ministerial Regulation No. PM 116 in 2016, international ports in Indonesia have a maximum dwelling time of three days (Utami et al. 2020). It shows that Indonesia's dwelling time is still below the standard of the Ministerial Regulation that made. Therefore, ports must strive to reduce dwelling time to improve their performance so that ports can continue developing and competing with overseas ports.

Second, port development is profitable for investors as well as regional economic development. However, unfortunately, the investment provided has not met the funding target needed to support port sustainability (Aurora et al. 2020). On the other hand, significant infrastructure development can have adverse effects on the environment. One of the most significant environmental problems that ports need to pay attention to is the reduction of greenhouse gas emissions (Christodoulou and Cullinane, 2019). Air pollution caused by greenhouse gas emissions harms human health and the environment in the port area. Other impacts arising from greenhouse gas emissions are flooding, famine, and economic instability that can even lead to global warming. Based on the explanation above, it is known that environmental problems need to be considered because they are related to sustainable port plans and port growth.

The third problem faced by the port is related to the technology used. The growth in container volume requires strategic development that focuses on capacity and increases its operational performance to satisfy customers. Thus, the pressure that increased cargo flows has weighed operating costs has prompted loading and unloading companies to implement automation and process improvement (Vrakas et al. 2021). At the Patimban Port, the dwelling time is for less than two days which will undoubtedly affect the cost reduction because supported by the existence of automated facilities such as an automotive port. (Hikam, 2021). Lastly, as we know, most operational systems at ports always involve transportation and high-powered equipment, which produces emissions and pollution that can endanger human health and the surrounding environment. Port activities affect air, noise, light, odour emissions, waste accumulation, and water pollution (Siroka et al. 2021). Furthermore, the existence of the port may cause a loss of habitat (Darbra et al. 2004; Chen and Pak, 2017).

Several problems mentioned above showed that port authority needs to be aware of problems and prepare an excellent strategy to make the port agile in the face of any uncertainty. There are few studies available that stated the important of Balance Scorecard (BSC), PESTLE, sustainability, smart and green port in boosting port performance. BSC as the measurement tools is known has a significant relationship with organizational performance and the proper implementation of BSC will leading the high performance result. Implementation of a performance measurement system is needed to achieve the company's strategic objectives. BSC can identify, qualify, and develop methods for port development. In Alesinskaya et al. (2017), BSC helps ports assess current conditions to make it easier to make policy strategies. As a tool for measuring the company's overall performance, BSC is the right tool to be applied to ports (Li and Yip, 2016). Performance measurement and strategy implementation with the BSC improve port performance in providing the best public services (Iklina et al. 2018) and increase 67% competitive advantage at ports (Hamid, 2018). Besides, to apply the concept of port development, PESTLE analysis is needed. According to Sridhar et al. (2016), the PESTLE approach can produce valuable information about future viability, especially for the purposes of making effective management decisions. Casan et al. (2021) argue that PESTLE analysis can provide a way to include sustainability in strategic analysis. PESTLE analysis provides information about the relationship between factors and the state of the macro-environment to facilitate decision-making (Yunkel in Aurora et al. 2020; Christodoulou and Cullinane, 2019). PESTLE can also be used to measure the external performance of ports, particularly related to political, economic, social, technological, legal and environmental factors, whether they have a positive or negative impact on the port (Christodoulou and Cullinane, 2019). In the Industrial 4.0 era, ports need to adapt to automation systems and achieve maximum results. Therefore, the implementation of the smart concept in the port sector is significant, so companies can be faster, cheaper, and flexible in responding to the trends (Gonzales et al. 2020; Lendel, 2013; Jankalová and Jankal, 2018; Holubčík dkk, 2021). The implementation of Green Port in ports is essential because the sea transportation industry handles more than 85% of the volume of global trade, which means that this concept not only affects the country's overall emissions but also makes a significant contribution to reducing emissions globally, besides to increase customers satisfaction, improving corporate image, and protecting the surrounding environment (Lam, J. 2019; Chen and Pak, 2017; Teerawattana, 2019).

However, based on the literature study results, not many journals integrate BSC, PESTLE methods and incorporate the sustainability, smart and green port concept. These tools and concepts have proven to be decisive in measuring and improving port performance. Each tool and concept has its strengths and weaknesses, so the author try to cover the gap by integrating BSC, PESTLE, sustainability, smart and green ports to formulate a comprehensive framework to improve or even boost port performance. Efficient implementation requires effective management integration. Although the BSC provides effective implementations and measurement, it is necessary to control the company to know about its competitors and external factors, namely, self-assessment, competitor position, industry trends, etc. (Kopecka, 2015). BSC and PESTLE methods with the concept of sustainability, smart and green port require to be integrated because the company must be in a competitive position with internal and environmental information required (Iklina et al.2017; Hui et al. 2019; Oh et al. 2018; Azhar et al. 2018)

2. Literature Review

2.1. Balance Scorecard

Kaplan and Norton first proposed the Balanced Scorecard (BSC) in 1990 as a tool to transform organizational strategy into a measurement system that is communicated to all employees of the company so that they can realize their mission through concrete actions (Kaplan and Norton, 1996 (in Li and Yip, 2016)). According to Kaplan and Norton (1992) in the journal Hamid (2018), there are four dimensions of performance measurement in the Balanced

Scorecard: financial, customer, learning and growth dimension, and internal business process dimension. Each of these dimensions is divided into several sub-dimensions consisting of interrelated performance measurement indicators as follows:

- Financial dimensions, such as profitability (Revenue Growth, EBIT, and net profit margin) (Ha, 2017; and Pham, 2020), Liquidity and Solvency (Current Ratio, Debt to Total Assets, and Debt to Equity) (Ha, 2017), Cost of Poor Profitability (demurrage costs, repair costs, and cargo loss costs) (Ridwan and Noche, 2018)
- The Customer Dimension consists of the Service Fulfillment sub-dimension with indicators measuring overall service reliability, cargo damage, and service delay incidents (Ha, 2017). In addition, there is also a Service Cost sub-dimension with measurement indicators including overall service costs, cargo handling costs, and additional terminal service costs (Ha, 2017 and Ha, 2018).
- Internal business process dimensions, including Leadtime sub-dimensions (Vessel Turnaround and Container Dwell Time) (Ha, 2017 and Ha, 2018), traffic sub-dimensions (Number of annual vessel calls, Average tonnage per vessel, Total annual throughput, Annual TEUs, Annual bulk commodities, annual non-bulk commodities, Annual Vehicle Traffic) (Morales, 2016), Logistics and Operations Performance sub-dimensions (Berth Productivity, Maritime Connectivity (Liner), Short Sea Connectivity, Average dock access time Average, Gate productivity, Transportation cost per container) (Karakas, 2020)
- The learning and growth dimensions consist of Human Capital sub-dimension with indicators (Ha, 2017 and Ha 2018), the Organization Capital sub-dimension with leadership and teamwork indicators (Ha, 2017 and Ha, 2018)

According to Lesinskaya et al. (2017), by justifying the causes and effects of each BSC indicator, companies can develop a port performance strategy map to increase the Port and Industrial Complex. Not only that, the implementation of the balanced scorecard in the strategic management process is very effective so that it can increase 67% of competitive advantage at the Pelindo IV port, especially in clarification, strategy description, strategic communication to business units, organizational alignment, and finally, objectives and strategy learning (Hamid, 2018). According to Iklina et al. (2018), the strategy's implementation can be categorized as successful and following performance measurement if it provides benefits, improves performance, and gets the best public services in the management of Muara Angke Port. The social and economic benefits of implementing the strategy include improvements in quality life, environmental quality, and local government performance. Table 1 described the dimensions and sub-dimensions of BSC method that can be used by ports based on literature studies.

Table 1. The Dimensions and sub-dimensions using the BSC Method

Dimensions	Sub-Dimensions	References
Financial	Profitability, Financial Performance (FP), Liquidity & Solvency, The Cost of Poor Profitability	Ha(2017); Karakas(2020); Ridwan(2018); Ha (2018), Shetty(2018)
Customers	Service Fulfilment, Service Cost	
Internal Business Process	Productivity, Output, Lead Time Logistics and Operational Performance (LOP)	
Learning and Growth	Human Capital, Organization Capital, Corporate Social Performance (CSP)	

2.2. PESTLE-Sustainability

PESTLE is a tool used to plan business strategies by providing a strategic framework that evaluates and understands the influence of external factors, including political, economic, social, technological, legal, and environmental (Christodoulou and Cullinane, 2019). To provide a competitive advantage, PESTLE can be combined with the concept of sustainability, particularly related to sustainable ports. A sustainable port is a concept for carrying out port operations using three main pillars: economic, social, and environmental (Muangpan and Suthiwartnarueput, 2019). The combination of the two becomes the concept of Port PESTLE-Sustainability. Christodoulou and Cullinane (2019) stated that port policies and the influence of stakeholders are political aspects that exist in ports. According to Oh et al. (2019), the economic aspect involves investment and cargo handling, while the social aspect involves the port's direct or indirect contribution to the surrounding area. Christodoulou and Cullinane (2019) include the development of sustainability technology in the technological aspect, and for the legal category, there is a discussion on compliance with standards and regulations. The last aspect is the environment that considers waste management (Serkan et al., 2019).

PESTLE-Sustainability method is considered capable of bridging the development of the port and the problems it causes. Over the last few decades, the port industry and maritime trade have increased because they play an essential role in the global economy (Oh et al. 2018; Christodoulou and Cullinane, 2019). However, unfortunately, this industry also contributes to emissions that cause environmental damage. Dabra et al. (in Oh et al. 2018) stated that ecosystem damage could occur due to sea, land, and air pollution. Christodoulou and Cullinane (2019) argue that it is necessary to implement an energy management system at the port to overcome this. The obstacle faced in implementing this system is that the port operates reasonably complex and has various characteristics. To overcome these problems, PESTLE-Sustainability has an important role. The six factors contained in PESTLE are considered to make it easier to evaluate and measure the influence of factors originating from outside the port (Christodoulou and Cullinane, 2019). Sakar and Cetin (in Thanyaphat and Kamonchanok, 2019) argue that the concept of sustainability aims to meet the needs of stakeholders while maintaining the sustainability of social and natural resources. Schippera and Vreugdenhila (2017) state that the concept of sustainability is one part of a long-term port management plan that is carried out through KPI evaluation. KPIs link top management and employee engagement (Felix in Hui et al. 2020). Integrating sustainability components with innovation and technology can maximize the potential and strengthen the port (Schippera and Vreugdenhila, 2017; Aurora et al. 2020). Table 2 described the dimensions and sub-dimensions of PESTLE-Sustainability that can be used by ports based on literature studies.

Table 2. The Dimensions and sub-dimensions using the PESTLE-Sustainability

<table>
<tr><th>Dimensions</th><th>Sub-dimensions</th><th>References</th></tr>
<tr><td>Politic</td><td>Stakeholder influence, Port policy</td><td rowspan="6">Christodoulou and Cullinane(2019);
Rijkure(2019); Muangpan and Suthiwartnarueput(2019);
Karakas et al.(2020);
Duru et al. (2020); Oh, Lee, and Seo (2018); Schippera and de Jong (2017);
Hui, Aye, and Dueld (2019); Vioa, Varrialeb and Alvinoa, (2018)</td></tr>
<tr><td>Economy</td><td>Funding and investment, Port Value Added as % of GDP</td></tr>
<tr><td>Social</td><td>Social contribution, Top management commitment, Safety and security, Traffic congestion</td></tr>
<tr><td>Technology</td><td>Latest technology development</td></tr>
<tr><td>Legal</td><td>Institutional
Compliance with standards and regulations</td></tr>
<tr><td>Environment</td><td>Energy consumption rate, Land use for transportation, Technical and Operational, Sediment Quality Assessment</td></tr>
</table>

2.3. Smart Port

The smart port is a port that is fully automatic where all of its equipment, facilities, and services are connected by the Internet of Things (IoT) with an integrated system (Yang et al. 2018; Azhar et al. 2018). Smart ports use technology by adopting innovative and efficient management models to increase the productivity of port operations and minimize costs (Molavi et al. 2019). According to various journals and existing research, there are several dimensions and indicators of smart ports. Phillip (2020) stated that the dimensions of smart ports are divided into 5: management, human capital, functionality (IT), technology, and information. At the same time, Molavi et al. (2019) stated operations, environmental, energy, and safety and security dimensions. Furthermore, Douaioui (2018) mentions two-dimension interconnection and automation. Lastly, González et al. (2020) explained that the main dimensions of smart ports are operational, economic, social, political and institutional, and environmental.

In 2010 at the port of Hamburg, Germany, Smart Port Logistics began to be implemented. IoT connects every data and operation at the port, including ships, trucks, and transformation systems, and helps to monitor the traffic of ships and vehicles at the port. It also helps monitor the long-term response of various assets that help manage preventive maintenance activities (Ferretti and Schiavone, 2016; Heilig et al. 2017; Jun et al. 2018; Zarzuelo et al. 2020). A case study in South Korea shows that smart ports have a significant impact on many industries that positively affect the economic sector in South Korea (Jun et al. 2018). The port in Cartagena also applies smart ports, especially in the technology sector, which causes the exchange of information (such as port operations and traffic conditions of ships and vehicles in and around the port) in the port to be faster (Bojić et al. 2021). Also, another smart port example from Shanghai port, which uses a developed information system that makes all the operations in port can be monitored by the computer. Because of this, the crane's operator can easily control container movement through the monitor inside the crane. The particular truck will receive the command to operate via the terminal computer. The result is that it minimizes the probability of error and container loss (Bisogno et al. 2015; Ilin et al. 2019). Table 3 described the dimensions and sub-dimensions of Smart Port that can be used by ports based on literature studies.

Table 3. The Dimensions and sub-dimensions using the Smart Port

Dimension	Sub-dimensions	References
Operations	Automation, Intelligent infrastructure	Douaioui (2018); Molavi et al (2019); Philipp (2020)
Safety and Security	Integrated monitoring and optimization system	
Energy	Efficient Energy Consumption, Energy Management, Production and use of renewable	

2.4. Green Port

Green Port is a concept where ports tend to behave with a balanced integration of environmentally sustainable and energy-efficient (economy) through an effective strategy. It covers several aspects, including reducing harmful gas emissions from ports and ships, the most prominent factor (Viao et al. 2018; Pettit et al. 2017).

The Green Port concept has different dimensions and sub-dimensions in each port. According to Puig, et al. (2014), there are seven dimensions, including emission to air with measurement indicators such as emission of combustion gases and emission of particulate matter; the second dimension discharged to water/sediments with indicators such as discharges of wastewater, discharges of hydrocarbons, discharges of other chemicals; emission to soil dimension with indicators emission to soil and groundwater; resource consumption dimension with indicators of water, electricity and fuel consumption; waste generation dimension with indicators generation of recyclable garbage and generation of hazardous waste; noise dimension with noise emissions indicator, and biodiversity dimension with effects on biodiversity indicator. Meanwhile, according to Teerawattana and Yang (2018), two dimensions are environmental and social. Environmental dimension using indicators such as water consumption, waste recycling, and noise control. Social dimension with indicators of communication (open-access information) and quality of life in the communities. Viao et al. (2018) use four dimensions, namely technical and operational with indicators of environmental accidents; financial dimension with environmental costs indicators; management dimension with indicators such as environmental management programs and port development (water and land); and the last is the environmental dimension with indicators such as light emissions, shipping emissions, and energy consumption.

Several opinions related to the significance of implementing Green Port on the performance and name of a port: Lam and Li (2019) stated that company orientation on environmental performance could increase port business opportunities by achieving sustainable development, social responsibility, and benefits. The economy in the long term. Chen and Pak (2017) state that the Green Port measurement indicator is a reference and has significant implications for most port stakeholders. Teerawattana and Yang (2019) stated that environmental management is also beneficial for cost savings and port environmental protection. Roos and Neto (2016) stated that the application of Environmental Management is critical to evaluate port environmental criteria and combine environmental indicators with appropriate economic and financial variables in future improvements. Table 4 described the dimensions and sub-dimensions of Green Port that can be used by ports based on literature studies.

Table 4. The Dimensions and sub-dimensions using the Green Port

Dimensions	Sub-dimensions	References
Environment	Air emissions, Noise emissions, Emission to soil, Discharges to water, Waste generation, Liquid pollution management	Puig, et al (2017); Di Viao, Varriale, and Alvino (2018); Chen and Pak(2017); Širokaa et al. (2021); Teerawatana and Yang (2019); Roos and Neto (2016)

3. Modelling of An Integrated Framework

The author developed the conceptual framework for the integration model between BSC, PESTLE, smart port, and green port because the existing literature describing the four models integration has not been discussed so far. The synergy between those 4 models is illustrated in Figure 1 as a conceptual framework to give a clear idea of how to port performance is evaluated.

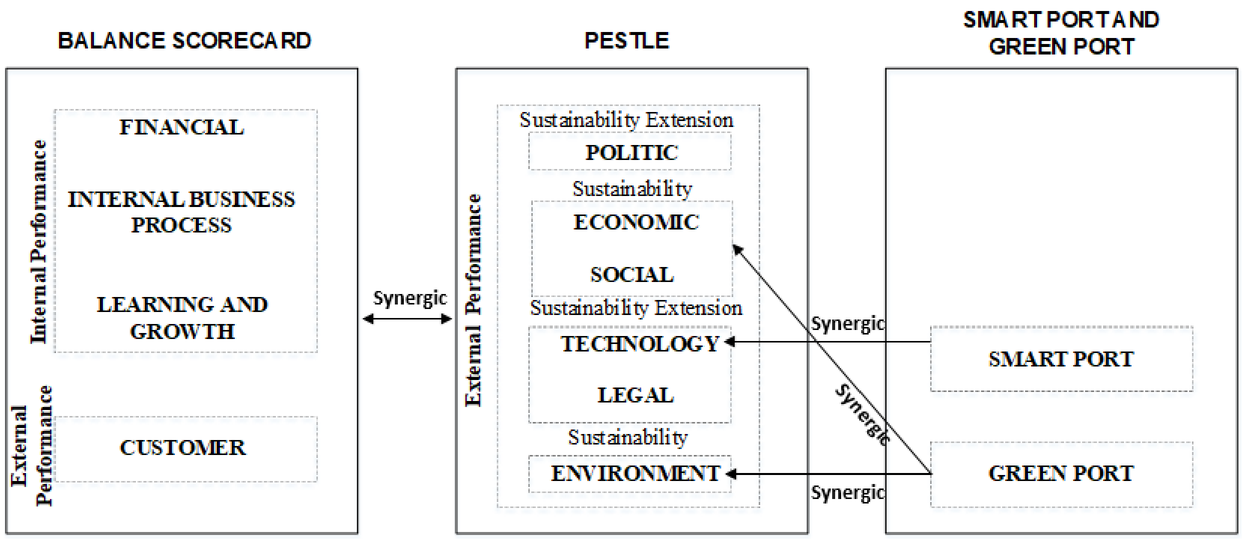

Figure 1. Conceptual Framework

Framework in Figure 1 consists of three parts, a BSC, PESTLE, smart and green port. The framework illustrates the integration model of several methods for measuring port performance. Ports are a complex organization, so it is necessary to determine internal port performance and external port performance. To measure port performance internally, adopting the balanced scorecard method with financial, internal business process, and learning and growth dimension. In comparison, the customer dimension is classified as external performance.

Furthermore, PESTLE is used for measuring external performance and is integrated with the sustainability concept. The environmental, economic, social dimensions are included as sustainability concepts, where technology, legal, and political extension sustainability. In addition, the technology dimension will then synergize with smart port indicators so that the KPIs compiled are more comprehensive from a technological point of view so that ports can persist in fierce competition in the industrial 4.0 era. The environmental dimension will also synergize with the green port indicator to make an environmentally friendly port that does not affect the neighboring environment.

4. Results and Discussion

Detailed performance measurement indicators are needed to provide an overview of port achievements and assist managers in controlling and monitoring strategies. The Balanced Scorecard (BSC) is a framework for measuring the company's overall performance using Performance Indicators that have 4 measurement perspectives, namely financial, customers, internal business processes, and learning and growth perspectives (Li and Yip, 2016). However, the limitation of this method is that it focuses more on internal aspects, so it is unable to evaluate significant changes in external aspects (Mohobbot, 2004; Salem et al. 2012). Therefore, ports need to carry out a more in-depth internal and external analysis that includes a comprehensive assessment of their capabilities and performance relative to competitors and their position relative to industry trends (Kaplan-Norton, 2008).

Ports can design performance measurement indicators by analyzing internal and external aspects because ports must understand environmental competition before forming a strategy. This design requires tools and techniques that are coherent and integrated as an integral part. Kopecka (2015) mentions that integration is one of the important things that companies must choose carefully, taking into account the nature of values, goals, resource allocation, and activities behind them. Thus, companies must be cautious in selecting and integrating the best.

The conceptual model in Figure 1 shows the integration of performance measurement using the BSC and PESTLE methods with the concept of sustainability, smart and green port. The BSC method is a tool for measuring internal port performance, while the PESTLE method measures port external performance. PESTLE analysis is considered comprehensive enough to be integrated because it has six factors in it. These factors include political, economic, social, technological, legal, and environmental (Christodoulou and Cullinane, 2019). The external key factors of PESTLE can provide an overview of the different macro-environments and understand the growth (market growth or decline, business position, potential and direction for the operating factors that the company should consider (Kopecka, 2015).

Integration is used to improve performance at ports due to complex port systems (Ridwan, 2018). This integration is needed because performance measurement can be maximized when paying attention to internal and external aspects of the port with a combination of the concepts of Sustainability, smart and green port. Port sustainability is a strategy and commercial activity carried out to meet current and future port needs and parties who have interests while protecting and supporting human and natural resources (Oh et al. 2019). The concept of Sustainability can be combined with PESTLE because it has similarities in 3 factors, namely economic, social, and environmental. In the concept of PESTLE-Sustainability, the other three PESTLE factors are called sustainability extension, which consists of political, technological, and legal factors.

The concept of industry 4.0 directly affects the maritime, port and logistics sectors (Gonzales et al. 2020). Smart ports are closely related to the sophistication of port technology, where there are dimensions of automation, integrated infrastructure, and so on So that the smart port indicator needs to be considered by the port because it has a synergistic relationship with the external port indicator (PESTLE) on the technology factor. Duran (2016) states that strategic technology can be applied to ports so that port administrators and external and internal port terminals can quickly achieve higher productivity and better value creation in their development. This smart port indicator supports automatic facilities to shorten dwelling time at the port and save operating costs (Yau et al. 2020).

Green Port is a sustainable port that balances environmental, social and economic benefits which reflect Sustainability. The existence of a sustainable port improves the balance of cost efficiency in the port, port environment, and community port (Muangpan and Suthiwartnarueput, 2019). The Green port indicator can synergise with the external port indicator (PESTLE) from an environmental perspective. With the protection of the port environment, it is shown that there is better environmental management, such as reducing the negative impact of port activities on the environment to realize a sustainable port.

The formulation of a conceptual model of integration of performance measurement using the BSC and PESTLE methods with the concept of sustainability, smart and green port can be used as a port for the formation of KPI in the future where this model assesses the internal and external aspects. So that performance measurement at the port can be more complex and detailed from various aspects. Table 5 provided the final indicators from the literature studies, expert feedback and government owned-port resource.

Table 5. Port Performance Indicators

Dimension	Indicators
Financial (11)	Revenue Growth, EBIT (operating profit margin), Net Profit Margin, Operating Cash Flow, Berth Occupancy Revenue per TEU, Current Ratio, Debt to Total Asset, Debt to Equity, Conformance Cost, Non-conformance cost, Opportunity cost
Customers (10)	Overall Service Reliability, Responsiveness to special requests, Accuracy of Documents/Information, Incidence of Cargo Damage, Incidence of Service Delay, Unified Key Account Management, Overall Service Costs, Cargo Handling Charges, Value added service, Overall cost of cargo loading/discharging and (re) stows and other ship operations.
Internal Business Process (22)	Ship Load Rate, Berth Occupancy, Crane Productivity, Yard Utilization, Labor Productivity, Crane Efficiency, Traffic handled (port productivity), Number of vessels handled, Average output per hook per shift, Idling time at berth, Throughput growth, Vessel call size growth, Container Throughput, Non-container Throughput, Vessel Turnaround time, Truck Turnaround time, Cargo Dwell Time, Average pre-berthing waiting time (APBWT), Maritime (Liner) Connectivity, Short Sea Connectivity, Gate Productivity, Transportation cost per cargo
Learning and Growth (13)	Knowledge and skills, Capabilities, Commitment and loyalty, % Female nominated talent, % of millennials (<40 years) in top talent, Technical Skills Standards Program, Culture, Leadership, Teamwork, Millennial successor setup, Effective personnel ratio, Employee turnover rate, Training hours per employee
Politic (5)	The level of availability of information regarding the expansion project to the public, Level of engagement between port authorities and policy makers, Port KPI success rate, Level of

	implementation of sustainable port policy, Level of implementation of security policies at ports
Economy (6)	Amount of Foreign Direct Investment (FDI), Value distributed to shareholders, Investment level, Level of achievement of project milestones related to funding initiatives (%), Port's value added contribution rate to GDP, Port related jobs
Social (9)	Corporate Social Responsibility (CSR) cost, Level of management support for worker safety conditions, Commitment to environmental management, Number accidents at the port, amount of time wasted due to accidents, number of deaths at the port, level of availability of access infrastructure to the port, Average time in hinterland, Traffic volume
Technology (25)	Level of achievement of project milestones related to technology initiatives (%), Smart ships, Smart container or connected container, Automated operations, Port road management system, Intelligent railway, Vessel traffic management (VTM), Smart WMS System, Localization Technologies (GPS, RFID, etc.), Cloud Computing (SaaS, PaaS, IaaS), parking space management, Sensors (Humidity, Temperature, etc.), Web-based Communication Platform, Gate management, The connectivity hardware such as cameras, wireless technology, sensors, RFID tags, The availability of software for data gathering, visualization, analysis, and optimization, Direct energy consumption, Indirect energy consumption, Monitoring and optimization energy consumption, Energy management system, Use of wind energy, Use of solar power, Use of biomass energy, Use of wave and tidal energy
Legal (3)	Number of collaborations with external parties, Institutional communication level, Number of standards or regulations enforced related to external policies
Environment (23)	Electricity consumption rate, fuel consumption rate, water consumption rate, Land use rate, Emission of combustion gases, Emission of particulate matter, Odour emission, Monitoring system for noise level, Reducing noise and vibrating from cargo handling equipment and vessels, Lden – noise pollution, Emission to soil and groundwater, Environmental accidents, Dredging frequency, Number of environmental complaints, Discharges of wastewater, sediment quality assessment, Generation of hazardous waste, Generation of non-hazardous waste, Generation of recyclable garbage, Fuel spill contingency plan, Sewage Treatment, Hazard waste management, Ballast Water Pollutant Control, Waste dumping management

5. Conclusion

This study presents the design of conceptual framework integrates performance measurement using the BSC and PESTLE methods with the concept of sustainability, smart and green port. The proposed framework represent an effective measurement to boost port performance. The BSC method is a tool for measuring internal port performance, while the PESTLE method measures port external performance. This conceptual framework is integrated to more easily understand the growth or decline of the market, business position, potential and direction for the operating factors that the company must consider to become a sustainable port. Previous studies has discussed the uses of BSC, PESTLE, sustainability, a smart and green port in a separate journal. Most of them only discuss one tool and concept in one journal. However, each tool and concept has strengths and weaknesses, so it is necessary to integrate it to cover the gap in order to obtain a complete framework.

This integration is needed because performance measurement can be maximized when paying attention to internal and external aspects of the port with a combination of the concepts of sustainability, smart and green port. This performance measurement design is expected to achieve higher production efficiency quickly, shorten dwelling time in ports, and reduce labour and cost reductions. In addition, it is improving better environmental management by reducing the negative impact of port activities on the environment to realize a sustainable port. In the future, this design can be used as a port KPI that measures port performance in a more complex and detailed manner from various aspects.

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