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Determinants of port performance: an evaluation and measurement of port services in Indonesia

Inayatur Robbany
Faculty of Psychology, Universitas Airlangga, Surabaya, Indonesia

Fendy Suhariadi
Faculty of Psychology, Universitas Airlangga, Surabaya, Indonesia

Andreas Budihardjo
Faculty of Psychology, Universitas Airlangga, Surabaya, Indonesia

***Abstract*---**One of the main challenges faced by port management in Indonesia is related to performance and service delivery. This quantitative research aims to examine factors that influence performance, through an evaluation and review of port services to establish rightful service measurements of ports across the archipelago. 100 ports in Indonesia were sampled taking 10 respondents from each port who understand port operations. Results from the Confirmatory Factor Analysis computations using SEM revealed that port performance is determined by 7 factors, namely Port Supervision, Port Operations, Port Human Resources, Performance accountability, Port Infrastructure, Maritime environmental protection, and Port services. The findings are expected to contribute to efforts towards port performance measurement and can be useful in determining the extent of a port's success in accordance with targets set in achieving organizational goals effectively and efficiently.

***Keywords*---**Service Delivery, Port Performance, Measurement, Market Trends in Port Management, Business Environmental Performance and Business Organisation**.**

Introduction

For Indonesia, sea transportation plays a major role in both its national and international trade and economic growth (Nistor and Popa, 2014) because it is the largest archipelagic country in the world. The country has a great potential in becoming the world's maritime axis (IME, 2019). It is a maritime country

surrounded by oceans and is strategically located in a very busy world shipping route (IMO, 2016).

Since 1970, the European Sea Ports Organization (ESPO, 2011) and the Port Community Working Group have produced a series of "Facts-Findings" that aim to provide insight into how to regulate Ports (ESPO, 2012). Through the years, this report has been a reference for both port practitioners and policy makers at all levels. In 2011, ESPO published a new version of the 'Fact Finding Report on port governance based on a broad survey conducted among ESPO members in 2010.

The Port Performance Indicators, Selection and Measurement (PPRISM) project governance section refers to the latest ESPO Fact Finding report and efforts to develop and measure several of the port governance indicators (PPRISM, 2012). In addition, analyzing the relationship between port governance indicators and other port performance indicators can provide meaningful insights. The port authority governance indicators adopt several of the relative criteria based on binary (True, False) and are expected to be a culture of monitoring and reporting that develops at the European level (PPRISM, 2012).

Three governance indicators are considered more suitable for the first version of the European Port Performance Dashboard (ESPO, 2012). Integration of port clusters describes the level of port authority initiatives aimed at integrating stakeholders into compiling ports (European Commission, 2013). Just like the European Union, Indonesia needs data for the calculation of appropriate port governance indicators. The indicators are in most cases used to inform investors and the public regarding business climate and the use of public resources (UNDP, 2004), which is one of the measures for efficient management, for the case of this research port management. Since 80% of the world trade is carried by sea, the data must be collected annually and must originate from the port authority (COGEA, 2017).

The present study seeks to examine factors which determine the efficiency of port management in Indonesia with a perspective on the evaluation and measurement of services provided. Performance of ports is evaluated basing on the existing information about maritime traffic, call size, employment, added value, carbon footprint, total water consumption, amount of waste, environmental management, maritime connectivity, intermodal connectivity, quality of custom procedures, integration of port clusters, reporting corporate and social responsibility, and autonomous management. Where 14 of these indicators are grouped into 5 dimensions namely Market dynamics, Logistics performance, Environmental Performance, Socio-economic Performance, and Governance Performance.

According to the United Nations Conference Trade and Development (UNCTAD, 1976), the measurement of port performance is grouped into two broad categories, namely financial indicators and operational indicators. According to Ibrahimi (2009) performance measurement and improvement are fundamentals in the running of Ports, because these indicators are used to increase productivity and competitiveness of ports. However, among such indicators, the financial one is very important, it entails: the size of the Tonnage worked, occupancy revenue

per ton of cargo, Cargo handling revenue per ton, Labor expenditure, Capital equipment expenditure per ton, Contribution per ton of the cargo, and total contribution (UNCTAD, 1976; Esmer, 2008). Meanwhile the Operational Indicator is measured by Late Arrivals, waiting time, Service time, turn around, Tonnage per ship, Fraction of work time per ship, Number employed per ship per shift, Tons per ship-hour in port, Tons per ship hour at berth, Tons per gang hours, Fraction of time the gang is idle (UNCTAD, 1976; Sudarmaji, 1999; Esmer, 2008).

Based on the agreement of the port organizations in Europe, the port performance indicator involves: Selection and Measurement of PPRISM (2012) which is a set of indicators to monitor performance trends in the port sector. This indicator provides insight into the overall performance of European port systems (Dwarakisha and Salima, 2015) environmental, socio-economic and supply chain performance. In addition, it provides the latest overview of the port sector in terms of the governance model and market structure. PPRISM provides a short list of indicators that form the basis of the future European Port (2012). The set of indicators are in five different fields that aim to monitor the performance of trends in the European port sector.

Port organizations are always influenced by the environment under which they operate, therefore must always adapt to changes in operations (Scott, *etal*, 2013). The development of competitiveness and markets, prompts organizations to be better prepared to react to challenges they face, which may threaten their survival. Companies often aim at thriving sustainably. In an environment of turbulence, companies must face many competitors and new players in the industry (Budihardjo, 2013).

Organizational performance management can be seen from two perspectives; the management perspective and the measurement perspective (Farooq, 2014). In the performance management process, companies align with their objectives, and corporate and functional strategies (Bitici, Carrie and McDevitt, 1997). Performance management can be described as a strategic and integrated approach providing ongoing success to the organization. Strategic in the sense that performance management is related to broader problems, facing businesses that function effectively in their environment and achieve long-term goals.

Organizational performance has recently been described as a key interesting phenomenon in management and business research (Richard et al., 2009). Increasing corporate awareness of governance issues and the latest events such as the collapse of the US banking system in 2008 and the subsequent global financial crisis have also led to increased pressure for effective monitoring and measurement of organizational performance (Cascio and Boudreau, 2008; Kanter, 2009; Yeoh, 2010).

Researchers in the Management field often use multi-item perceptual or subjective measurements to measure organizational performance, by asking respondents (key informants) to report on organizational performance (Richard et al., 2009). Recent reviews of organizational performance measures conclude that there is an urgent need for a reliable and valid measure of organizational performance (Hamann, *etal,* 2012). Several studies the use of sophisticated

approach to development and validation (Bartunek and Spreitzer, 2006; Venkatraman, 2008; Venkatraman and Grant, 1986).

According to Gheorghe and Hack (2007), the fundamental problem facing managers when they make day-to-day decisions is an inability to connect their actions with key performance indicators. What managers need is more corporate intelligence, information that can be followed up to enable managers know the real problems they are facing, knowing who the key players are without combing through a pile of reports, knowing how far their company is in danger, and most importantly, to know the process of improving company performance.

Management of organizational performance takes place in a few dimensions. A strategic approach that must consider stakeholder needs and make use of a business performance management system. Sink and Tuttle (1989) state that management of an organization includes five measures: 1). Creating a vision for the future, 2). Planning; determining the current state of the organization, and developing strategies to improve it, 3). Designing; developing and implementing intervention improvements, 4). Redesigning; develop, and implement system measurement and evaluation, 5). Placing a cultural support system to reward and strengthen progress.

The strategic approach in managing organizational performance is by developing a long-term strategy about the direction of the business going on and how to encourage that business to be maintained. The aim is to give direction to turbulent environments so that the business needs of organizations and individuals as well as group collective needs are in line with the development and implementation of performance development and management systems.

The performance management strategy is based on a resource-based view, where the development of organizational strategies is still scarce, tendencies are emulated, and it is difficult to replace human resources that have unique characteristics and create competitive advantage. Its strategic goal is to create companies that are smarter and more flexible than their competitors, by developing staff talent by expanding their basic expertise and this, is the right step to take in managing performance (Boxall, 1996; Armstrong and Ward, 2005).

2. Literature Review

The "Market Trends and Structure" indicator is relevant given the changing nature of the competitive environment and market structure at the seaport. This creates a need for performance measurement that describes market trends. Performance indicators on market trends and structures have high practical relevance used by industry, especially by port authorities. However, in practice there are differences in data collection and definition methods. Therefore, in the pilot project two indicators of Maritime Traffic and Call Size are the most widely used indicators for port and industrial shipping.

Socio-Economic Impact

From a historical perspective, indicators of socio-economic impacts such as employment and value added are important to show the contribution of port development both locally, regionally and nationally. The indicators are relevant, both for making public acceptance of port activities, and budget allocations for public infrastructure funds and licensing that allows port authorities and port companies to operate. Employment and value added are chosen as indicators, because they are most relevant for convincing stakeholders about the need for port development and operations in their region or country.

Environmental Performance

Port operations and activities can affect air, water, soil and terrestrial sediments and the marine environment. As environmental awareness increases in society, effective environmental management is very important so that stakeholders are expected to provide support for the management of the port environment. At present, growth and environmental impacts are developing, rules relating to environmental impacts are increasing, while renewable energy and Carbon Footprint are priority issues at ports. Therefore, ports must demonstrate compliance and continuous improvement through scientific-based approaches, such as EcoPorts. In Indonesia the concept of EcoPorts is believed to be able to overcome a few environmental problems, ranging from decreasing the quality of sea water, air pollution and noise, decreasing biodiversity, health, to work safety.

This Environment Performance identifies three quantitative measures, namely Carbon Footprint, Waste Management and Water Consumption; and qualitative measures, namely the ability of the port authority to provide effective and sustainable environmental protection through an adequate environmental management system.

Logistic Chain and Operational Performance

In this category, performance indicators emphasize connectivity, transportation costs, reliability and ease of transaction. Maritime connectivity shows how well port systems in Europe are connected to overseas destinations. Likewise, intermodal connectivity shows its quality from ports in Europe.

Governance

Over the past years, the issue of port governance has become increasingly relevant. Changes in the economic and political environment have led to changes in the structure of port governance and ongoing debate about governance models.

The performance measurement above is a performance measurement that emphasizes more on operational aspects and objective measurement. In contrast to the above view, a recent review of measures of organizational performance, that there is an urgent need to make a measure of organizational performance that is reliable and valid (Richard, et al., 2009). Management researchers often use multi-item perceptions or subjective actions to measure organizational

performance, namely by asking respondents (key informants) to assess their organization's performance. (Richard, et al., 2009). In contrast to the objective and specific measures of organizational performance, perceptual measures tend to measure the concept of performance more broadly (Wall et al., 2004) for example incorporating aspects of financial and non-financial performance. By using perception, it can compare the performance of the organization with other organizations in their industrial environment or combine the benchmarking process with other organizations (Kalleberg and Moody, 1994). Shea and Fiorina (2012) research developed psychometric properties of Delaney and Huselid on organizational performance scales, using Rash model analysis, which uses perceptions in measuring organizational performance.

In this study using the assessment of organizational performance using the perceptions of leaders and members of the organization to assess the performance of the organization. The indicators made to develop port performance scales are based on the Strategic Plan study and the results of Focus Group Discussion to determine the determinants of port performance. Based on the results of the Focus Group Discussion it can be concluded that port performance is determined by 7 factors, namely: 1) Port Supervision, 2) Port Operations, 3). Port Human Resources, 4). Performance accountability, 5). Port Infrastructure, 6). Maritime environmental protection, and 7). Port services.

Port Supervision

Port Supervision is one of the tasks and functions of the Port Operator, which is related to guaranteeing and order at the port. The supervision function at this port is very important in order to maintain security, order and smooth flow of ships, goods and passengers who enter, exit the port.

Port supervision includes activities including a) supervision of vehicle control in and out of ports, (2). DLKr and port DLKp supervision, (3). supervision of port control outside of operations, (4) supervision of goods traffic from and ports, and (5). supervision of embarkation / debarkation of passenger ships. Activities related to port safeguards include: (1) anticipating harbor security disruptions, and (2) handling port security disruptions.

Port Operations

Operational Service Performance Indicators are service variables, use of port facilities and equipment. The indicator consists of Waiting Time (WT) or ship waiting time, Approach Time (AT) or guiding service time, Effective Time compared to Berth Time (ET: BT), Work Productivity (T / G / J and B / C / H) , Receiving / Delivery Container, Berth Occupancy Ratio (BOR) or level of dock usage, Shed Occupancy Ratio (SOR) or warehouse usage level, Yard Occupancy Ratio (YOR) or level of stacking use, Readiness of equipment operation.

Port operational service performance standards and utilization are determined by considering the level of quality of ship services, goods service, facility utilization, readiness of port equipment and adapted to the characteristics of each terminal location at the port. While the service standards for the operation of sea transport

vessels, the performance of loading and unloading of non-container and container goods is determined for each terminal / port. The function of port organizers in this case is to supervise the implementation of operational activities, establish operational service performance standards and conduct evaluations and report to the Director General of Sea Transportation.

Port Human Resources

Port human resources are the main thing as an activator of the organization. The performance of an organization depends on the success of how to manage human resources effectively and efficiently. Improving the quality of port human resources through port technical education, non-technical education, increasing levels of education and increasing managerial education in education will greatly help improve port services.

Performance Accountability

Performance accountability of government agencies is one form of media to report on the success or failure of a government agency for implementing organizational goals and objectives. The performance report is an overview that explains in a concise and complete manner the performance achievements compiled based on the determined work plan achieved based on the use of the allocated budget each year. Performance accountability in this case is related to improving administration both technically and administratively, increasing performance accountability, and related to budget accountability and PNBP (Non-Tax State Revenues).

Port Infrastructure

In general, facilities and infrastructure are supporting tools for the success of a process of efforts carried out in public services, because if these two things are not available then all activities carried out will not be able to achieve the expected results in accordance with the plan.

Facilities and infrastructure basically have the following main functions: 1). speed up the process of carrying out work so that it can save time; 2). increase productivity, both goods and services; 3). the work results are more qualified and guaranteed; 4). easier / simpler in the movement of the users / actors; 5). the accuracy of the stability structure of workers is more secure; 6). raises a sense of comfort for those who have an interest; 7). lead to satisfaction with interested people who use it.

Fulfilment of port infrastructure, including port facilities, buildings, office equipment / equipment, and operational vehicles. Port facilities include port facilities to support operational activities, namely docks, stacking fields, warehouses, port pools and other supporting facilities.

Maritime Environmental Protection

Sea transportation as one of the modes of transportation, in addition to having a role as a means of transportation which nationally can reach all regions through the waters so that it can support, encourage and drive the growth of regions that have large natural resource potential in an effort to improve and equalize development and results. but also has the potential for environmental pollution and / or destruction in the sea, both caused by the operation of the ship and from port activities.

Protection of the maritime environment is any effort to prevent and overcome pollution of the aquatic environment originating from activities related to shipping. Pollution prevention is all actions that are carried out quickly, precisely, and in an integrated and coordinated manner to control, reduce, and clean up oil or toxic liquid spills from ports to waters to minimize community losses and damage to the marine environment. Activities related to the protection of the maritime environment: reception facilities, handling of waste, handling oil spills, handling marine pollution (port ponds).

Port Services

In order to improve service to the community in order to create reliable, competitive services through cooperation between the government and the private sector in the provision of infrastructure, increase in concessions, utilization cooperation and cooperation in the operation of ports.

Improving services in meeting the needs and demands of the community for safe, comfortable, safe and affordable services, various policies have been taken including transportation services in supporting connectivity, improving transportation services in disaster-prone areas, national borders, outermost islands and other non-commercial areas.

This research is different from the measurement of performance carried out in general, namely looking at the operational aspects or economic aspects / profit orientation, but in this study the psychological approach was used. The reason is that for now there are no measures that can compare one port with another port, because it is very difficult to compare because there are differences in operational, infrastructure, port conditions and so on. What can be done is to compare the extent of the success of one port with another port based on predetermined performance indicators, namely the Key Performance Indicator (KPI). In the future, it is hoped that there will be other studies that are more comprehensive so that they can be used as comparative measures for ports with each other.

Results and Analysis

The subject of this study is the organization of ports in Indonesia, with a total sample of 100 ports. Port performance is the achievement of organizational work results in a certain period in accordance with predetermined strategic targets.

The main performance indicators were obtained based on the Strategic Plan and Focus Group analysis, obtaining 7 factors that influence port performance, namely: port supervision, port operations, port human resources, performance accountability, port infrastructure, maritime environmental protection, and port services. The following is a picture of the CFA model from Port Performance.

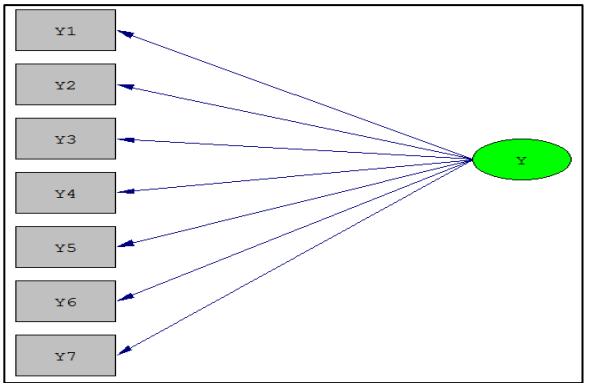

Figure 1. CFA Model on Port Performance

To ascertain whether the seven indicators are valid in measuring port performance factors, the Confirmatory Factor Analysis (CFA) method is used. Next refer to the model, following the research hypothesis:

H1: Port performance is built by port supervision performance factors.
H2: Port performance is built by the operational performance factor of the Port (Y2)
H3: Port performance is built by the port human resource factor (Y3)
H4: Port performance is built by the factor of performance accountability (Y4)
H5: Port performance is built by port infrastructure facilities (Y5)
H6: Port performance built by Maritime Environmental Protection factors (Y6)
H7: Port performance is built by the port service factor (Y7).

Determining the CFA Model's Goodness of Fit (GOF): Port Performance

Before checking the test results confirm the indicators of Port Performance by testing the CFA model. Then check the goodness of the CFA model of Port Performance by looking at the goodness of fit value. A CFA model is considered 'fit' if it meets several GOF index criteria:

Table 1
Criteria for the CFA model Goodness of Fit (GoF) model

Goodness of Fit (GoF) Value	Criteria index
1. Chi Square (λ^2)	chi Square count < table $\lambda^2_{(\alpha;df)}$
2. Sig. Probability	sig. ≥ 0.05
1. RMSEA	RMSEA ≤ 0.05

2. GFI	GFI ≥ 0.90
3. AGFI	AGFI ≥ 0.90
4. CFI	CFI ≥ 0.90

Based on the results of the CFA model processing with Lisrel calculations, the following can be seen in full comparison of the goodness of fits index with the criteria, in the initial CFA model and the final CFA model of Port Performance, as in the table below.

Table 2
Comparison of indexes of goodness of fit from the initial models and final models of CFA Port Performance with criteria

Goodness of Fit (GoF) index	Criteria	Initial CFA Model		Final CFA Model	
		Comparison of GoF Value Test Results	Test Results	GoF Value Comparison	Test results
Chi Square (λ^2)	$< \lambda^2_{(\alpha;df)}$	145.36 > $\lambda^2_{(5\%;14)}$ = 23.68	Not fit	12.76 < $\lambda^2_{(5\%;9)}$ = 16.92	Fit model
Sig. Probability	≥ 0.05	0.0000	Not fit	0.1737	Fit model
RMSEA	≤ 0.08	0.306	Not fit	0.064	Fit model
GFI	≥ 0.90	0.741	Fit	0.965	Fit model
AGFI	≥ 0.90	0.482	Not fit	0.891	Fit model
CFI	≥ 0.90	0.879	Fit	0.997	Fit model

Based on the conclusions of the results of the goodness of fit test on the initial model CFA Port Performance above, there are still those who do not meet the criteria for model fit, so the initial model modification is done so that the Chi-square value is smaller and fit, where some of the criteria for goodness of fit above can be fulfilled.

Based on the instructions from software Lisrel in modifying the model by connecting cavernously between error measurement parameters: Y1 with Y2; Y2 with Y5; Y3 with Y7; Y4 with Y5; and Y6 with Y7, so the final CFA model of Port Performance can be obtained. Based on the criteria, it can be concluded that the final CFA model contains the criteria for goodness of fit that have been fulfilled. The final CFA model is then as the final CFA model, which means that the CFA model of Port Performance formed by the indicators above is already in accordance with existing data. The following is a picture of the initial CFA model and the final CFA model from Port Performance.

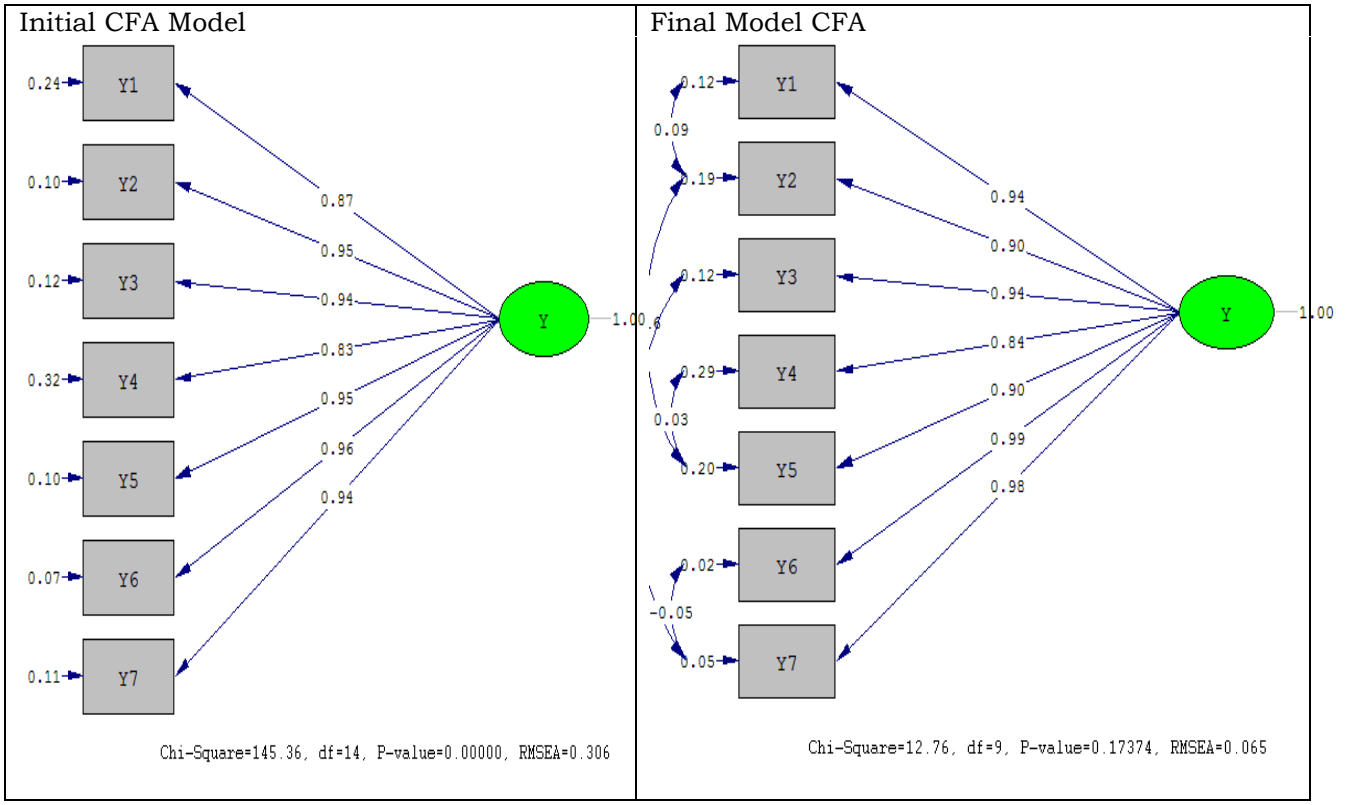

Fig 2. The initial CFA model and the final CFA model on Port Performance

Testing Confirmation of the Compiler Factors of Port Performance

Testing for confirmation of Port Performance factors is to use the results of the final CFA model above. The aim of the CFA method is to test the validity of port performance factors, and test the reliability / reliability of each of these factors. The following are the test results from the validity and reliability tests, as in the following table:

Table 3
Validity Test Results and Reliability of Port Performance Factors

Variable	Indicator	Loading Factor (LF)	*Average Variance Extracted* (AVE)	Composite Reliability (CR)
Port Performance	Y1. Port Supervision	0.937	0.857	0.977
	Y2. Port Operations	0.898		
	Y3. Port Human Resources	0.936		
	Y4. Performance Accountability	0.840		
	Y5. Port Infrastructure Facilities	0.897		
	Y6. Maritime Environmental Protection	0.988		
	Y7. Port Services	0.975		

Based on the table above, it is known that the loading factor (LF) of port performance is ranging from 0.84 to 0.99. Where these values are more than the criteria limit of 0.5, it is concluded that the factors of Port Performance are valid factors measuring / explaining Port Performance. This is also supported by the value of Average Variance Extracted (AVE) which is worth 0.86 where more than the valid criteria of 0.5, the more convinced that the factors of Port Supervision, Port Operations, Port Human Resources, Performance Accountability, Port Infrastructure, Maritime Environmental Protection, and Port Services are valid in measuring / explaining Port Performance.

Based on the table above, it is also known the Coefficient Reliability (CR) value of the Port Performance factor variable which is equal to 0.98. Where this value is greater than the criterion 0.6, it can be concluded that the factor of Port Performance is a reliable / reliable factor.

Based on the value of loading factors above, we know the value weight of each port performance factor. The highest weight value is the Maritime Environmental Protection factor (Y6) and Port Service (Y7), where both are relatively the same, which are 0.99 and 0.98 respectively. Then the factor of Port (Y3) Human Resources, and Port Supervision (Y1), which has the same weight i.e.: 0.94. Next is the Port Operational factor (Y2) and Port Infrastructure (Y5), which has the

same weight of 0.90. and the last factor is Performance Accountability (Y4) of 0.84.

Conclusion

Based on the results of testing the final model CFA Port Performance reviewed above, the following can be concluded. The final / CFA model Port Performance is a model fit, meaning that the existing data is in accordance with the CFA model formed. This is concluded based on the results of the comparison of the value of Goodness of Fit for the final model of Port Performance which has fulfilled several criteria, namely Chi-square, RMSEA, GFI, PGFI and CFI.

Port Performance is explained / measured by 7 factors namely Port Supervision (Y1), Port Operations (Y2), Port Human Resources (Y3), Performance Accountability (Y4), Port Infrastructure (Y5), Maritime Environmental Protection (Y6), and Port Services (Y7). This is based on the results of the validity test by looking at the results of the comparison of the Loading Factor value; Average Variance Extracted (AVE) which is greater than the criteria value. Besides being valid, the Port Performance factor also proved reliable. This is based on the results of the reliability test by comparing the Coefficient Reliability (CR) value which is greater than the criterion value.

The weight value of the Port Performance Factor constituent indicator, it is known that the highest weight value is the Maritime Environmental Protection (Y6) and Port Service (Y7) factors, both of which are relatively the same. Then the factor of Port (Y3) Human Resources, and Port Supervision (Y1), which has the same weight. Next is the Port Operational factor (Y2) and Port Infrastructure (Y5), which has the same weight, and the last Performance Accountability factor (Y4).

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