



FULFILLMENT OF SMART PORT CRITERIA FOR THE EXISTING TERMINAL 2 OF THE NEW MAKASSAR CONTAINER PORT

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Abstract

Smart port is an innovative solution for the world's port industry in the application of integrated technology and environmental sustainability to increase the efficiency and effectiveness of operational services. The smart port concept is usually adapted to container ports because most of the world's trade is transported by containers. Terminal II Makassar New Container Port which is a new international container port in Indonesia and is expected to develop into a gateway for world trade in Eastern Indonesia. To support the development of the New Makassar Terminal II Container Port into a smart port, a study was conducted to determine the extent to which the existing port meets the criteria for a smart port. The research was carried out by direct observation to the location and interviews with port stakeholders according to their respective fields and authorities. Respondents will explain the existing conditions and development of the port and then correlate it with the smart port criteria. Based on the results of observations it is known that Terminal II of the Makassar New Container Port has fulfilled the productivity criteria in the operational realm and the criteria for a safety and security management system as well as an Integrated Monitoring and Optimization system. So that port stakeholders and managers can develop a port development strategy to become a smart port by focusing on other domains and overseeing the consistency of the criteria that have been met. However, if the smart port criteria in each domain are not met, then this can have a negative impact on the services provided to customers and Makassar New Container Port Terminal II will be an international port that is lagging behind in the use of technology, so it is necessary to upgrade as quickly as possible to maintain existence.

Keyword: *Container port, Criteria, Fulfillment, Observation, Smart port.*

1. INTRODUCTION

The port is the entry point for trade as well as other goods distribution channels to an area so that it is necessary to have an adequate container port that is useful to accommodate the distribution process [1]. answering these challenges, smart port is here to be a new solution in the port industry. "Smart port" is the concept of a port that is designed and managed efficiently and effectively. This smart port can cover various advanced technologies such as the use of automation systems, robotics, Internet of Things (IoT) [12], and data analytics [7]. Container ports are ports that have widely adapted the smart port concept to increase productivity and efficiency and ensure competitiveness. This is because almost 80% of world trade is transported by sea [13] using containers in the form of containers [5].



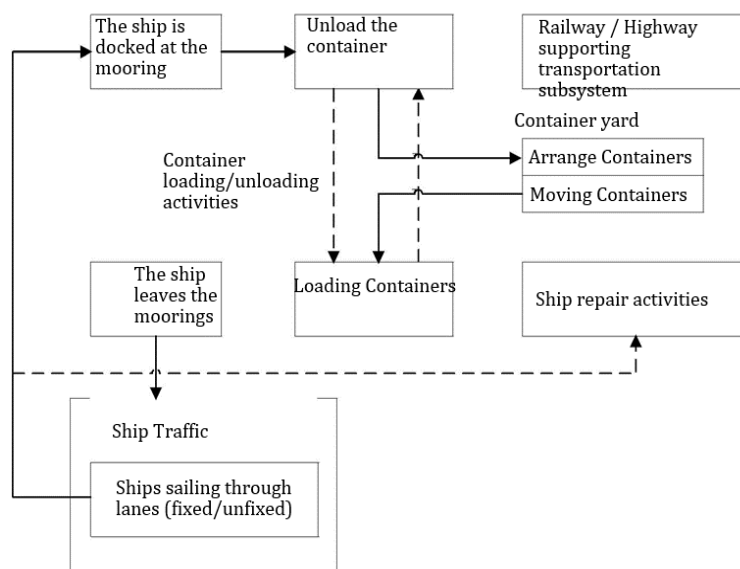


Figure 1. The basic components of the container terminal transportation system [11]

Smart ports are ports that have adopted advanced technologies to optimize their operations, enhance their efficiency, and reduce costs. To fulfill the criteria of a smart port, an existing container port should meet the following requirements pada Table 1.

Table 1 Smart port criteria in every domain [8]; [3]; [12]

Domains	Criteria
Operational	a. Productivity: the first factor in the operational domain includes an assessment of the productivity of port services, namely the port's ability to meet applicable operational standards.
	b. Automation: The next factor in the operational domain is automation i.e. Ports should have automated systems that can handle various tasks such as container handling, cargo tracking and berth management. This includes the use of technology such as automated cranes, cargo tracking systems and automated guided vehicles (AGVs).
	c. Intelligent infrastructure : Increased productivity and the use of digital technology, both of which are necessary for automatic port operations, are the goals of the intelligent infrastructure. Intelligent traffic patterns ensure the smooth and effective movement of moving assets, such as remotely piloted aquadrones, trucks (including driverless trucks), and automated guided vehicles (AGVs), around the port and hinterland areas. To explain, intelligent transportation systems (ITS), sensors, video cameras, a geographic information system (GIS), and driverless trucks and aquadrones would help autonomous vehicles such as AGVs, driverless trucks, and aquadrones maintain continuous traffic flows at the port.
Energy	a. Energy consumption efficiency: Ports should be designed and operated in an energy efficient manner, utilizing renewable energy sources where possible, to reduce their carbon footprint and operating costs.
	b. Producing and using renewable energy: Renewable energy is energy that can be recharged from natural processes. Port energy production can utilize wave, wind, or solar cell power.
	c. Energy management: planning for effective use of environmentally friendly energy to support the effectiveness of port operations.
Environment	a. Environmental management system: is a tool to help organizations improve their environmental performance. This objective is achieved through monitoring and controlling port operations by considering their environmental impact.



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Domains	Criteria
Safety and Security	<p>b. Emission and pollution control: Port activities and the shipping industry can cause three main types of pollution: air emissions, noise pollution, and water pollution. Therefore, ports are required to minimize pollution output by utilizing technology such as integrated sensors and surveillance.</p> <p>c. Waste handling management: Accommodate and process waste and waste from ports and ships that rely on it, so that the waste does not go to the community waste collection site.</p> <p>a. Safety management system: Safety Management System (SMS) is a comprehensive business management system designed to manage safety principles in the workplace</p> <p>b. Security management system : Ports must have robust security measures in place to prevent unauthorized access, theft, and damage to cargo and infrastructure. This includes the use of advanced technologies such as facial recognition and access control systems.</p> <p>c. Integrated monitoring and optimization system: The port must have the ability to analyze data generated from multiple sources, such as sensors, CCTV cameras and other devices, to identify patterns and optimize operations. This includes using big data analytics, machine learning, and artificial intelligence (AI) to make better decisions and increase efficiency.</p>

By meeting these criteria, an existing container port can transform into a smart port which can lead to increased efficiency [3], reduced costs, and improved customer satisfaction [10].

If a port does not meet the criteria for a smart port, it will be left behind in utilizing the latest technology to increase the efficiency and productivity of its operations. This could have a negative impact on the services that the port provides to customers. Some of the impacts of ports that do not meet the smart port criteria include [6][10]:

- Longer loading and unloading times, due to lack of automation and efficient management systems.
- Higher operational costs, because they still rely on manual processes and old technology which are more expensive to operate.
- Lower level of security, because it does not have a sophisticated security system to prevent potential threats such as theft, terrorism, and so on.
- Low competitiveness in the global market, because other ports that have implemented advanced technology will be more efficient and able to provide better services. Previously, research related to the implementation of smart ports has been available in several major ports in the world.

One of them is about implementing the smart port concept and optimizing the green port concept at Tanjung Priok Port by Zhafirah Azhar. Based on this research, it is known that port digitization helps the implementation of Smart ports as a solution in improving the economy and trade in Indonesia and the way to improve it is to implement an Online Delivery Order (DO) system at the Port of Tanjung Priok. The DO system serves to reduce congestion at the port and reduce time wastage. Smart Port supported by IT and the Internet, as well as the maximum implementation of the Tanjung Priok port will produce an effective and efficient port output as well as a Green Port due to the reduction and elimination of waste [2].

Terminal II of the New Makassar Container Port is a new container port in Indonesia which initially functions to handle the overflow of container loads from the overloaded Terminal I of the New Makassar Container Port. But now, Terminal II of the New Makassar Container Port has been enabled to receive ship services directly from other ports, both domestic and international ships.

Terminal II of the New Makassar Container Port is one of the strategic projects of the Indonesian government which is equipped with several advantages. Among them is the depth of the port pool which is 16 meters so that it can serve giant ships (post panamax). In addition, even though until now, the Terminal II of the New Makassar Container Port is still under construction at several points, but the concept of green port (environmental sustainability) has begun to be implemented such as providing office waste processing technology, using electrical energy in loading and unloading equipment, and providing green open spaces at the port.



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Based on the advantages possessed and in order to support Terminal II of the New Makassar Container Port to become a container gateway in Eastern Indonesia, Terminal II of the New Makassar Container Port needs to innovate and keep abreast of industrial developments. Therefore, this research was carried out by evaluating the fulfillment of the criteria for a smart port with the aim that it could become one of the references in developing a port to become a smart port in Indonesia.

2. METHOD

This research was carried out using the direct observation method at Terminal II of the New Makassar Container Port. Field observations include documentation in the field and interviews with predetermined respondents [8]. The research locations are shown in Figure 2 and Figure 3.

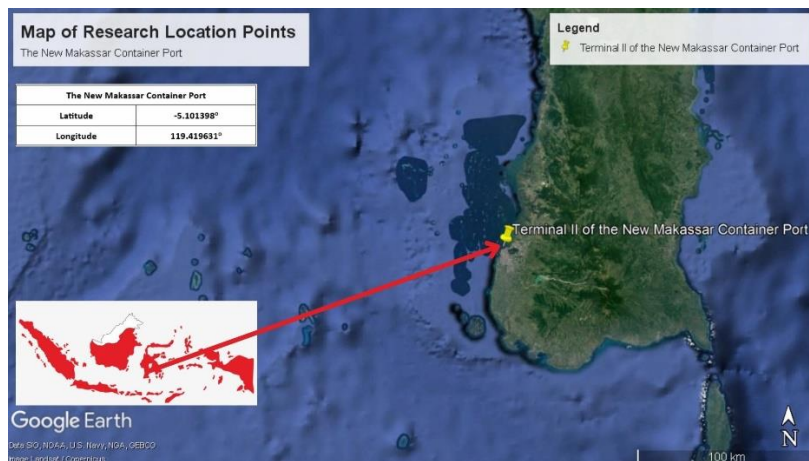


Figure 2 Port location in map [4]

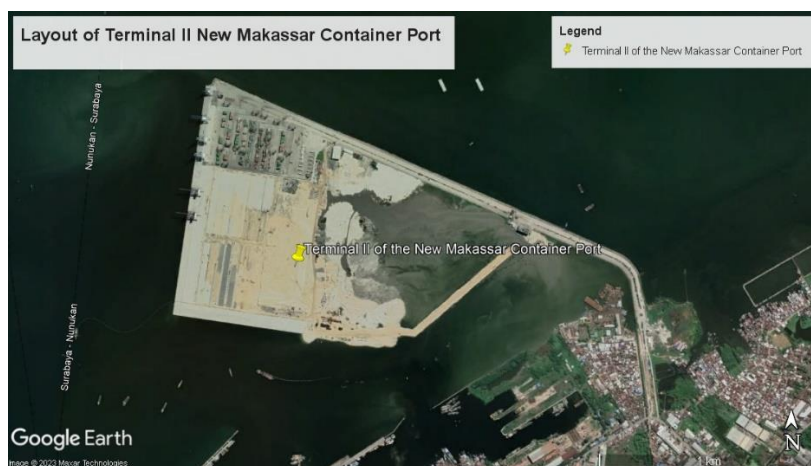


Figure 3 Layout of Terminal [4]

Based on the research method conducted, the data obtained are as follows.

2.1. Primary data

Primary data consists of field documentation data with observation method and direct interviews with selected respondents [8] representing stakeholders at Terminal II of the New Makassar Container Port consisting of port authorities, port administrators and service users. Selected respondents are respondents who are in accordance with the field of expertise in the port and are considered to understand port conditions.

2.2. Secondary Data

Secondary data consists of port operational data for the last 5 years, port layouts, and national and international journals to support research.



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2.3. Data processing

Based on the primary and secondary data obtained, an assessment was then carried out by the researcher with reference to the information of the selected respondents and the existing conditions of the port with the conditions as shown in Table 3. Next, the criteria for a smart port were determined which had been fulfilled and had not been fulfilled.

3. RESULTS AND DISCUSSION

Based on the results of field observations made, the following results were obtained.

3.1. Existing Terminal II of the New Makassar Container Port

The existing port which is the scope of the research consists of four domains according to the smart port criteria, namely operational, environmental, energy, and port safety and security.

3.1.1. Operational Domain

The operational domain consists of three smart port assessment criteria, namely productivity, automation and intelligent infrastructure criteria. Based on the results of observations and interviews with Terminal II stakeholders of the New Makassar Container Port, it is known that:

a. Productivity

Productivity criteria are assessed based on the performance of container loading and unloading services at the port with an average dwelling time of 2.48 days. This record for dwelling time is the fastest in Indonesia. In addition, BOR and YOR performance data for Terminal II of the New Makassar Container Port range from 30% -42% according to Minister of Transportation Decree No. 48 of 2020 and UNCTAD' Rules which is 70%. so that it meets the criteria. Port performance data in 2021 is shown in Table 2.

Table 2 Port Performance in 2021

Months	cal 1	Average of LOA (m)	Container Yard		Unload	Load	Total	ET:BT	Trend		Equip ment Readin ess
			Wide	Capacity					BOR	YOR	
January	31	143,13	46.996	13.746	6.898	5.786	12.684	82,36%	40,29	38,13	99,43
February	33	142,12	46.996	13.746	7.287	5.404	12.691	85,92%	35,33	38,15	99,48
March	37	137,14	46.996	13.746	7.261	6.567	13.828	85,46%	31,40	41,57	99,77
April	36	138,11	46.996	13.746	6.966	5.456	12.422	83,49%	36,74	37,34	99,88
May	30	141,00	46.996	13.746	6.220	4.836	11.056	84,19%	29,20	33,24	99,88
June	36	131,62	46.996	13.746	7.104	5.754	12.858	85,47%	37,14	38,65	99,72
July	38	134,10	46.996	13.746	7.623	6.089	13.712	83,26%	38,11	41,22	99,03
August	38	131,58	46.996	13.746	7.051	6.616	13.667	82,06%	34,93	41,09	93,67
September	40	126,45	46.996	13.746	7.264	6.411	13.675	80,84%	32,03	41,11	91,44
October	37	127,30	46.996	13.746	6.864	6.835	13.699	84,96%	29,40	32,52	92,92
November	40	125,73	46.996	13.746	8.144	7.405	15.549	85,71%	32,38	36,65	94,14
December	45	127,38	46.996	13.746	8.166	8.078	16.244	84,48%	35,19	39,12	95,58
Total	44 1	133,80	563.952	164.95 2	86.848	75.237	162.085	84,02%	34,35	38,23	97,08

Based on Table 2, it can be described in Figure 4 and Figure 5.



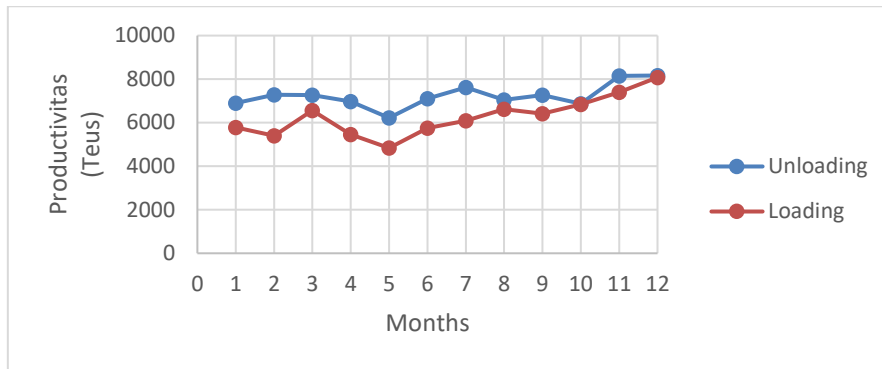


Figure 4. Container loading and unloading activities

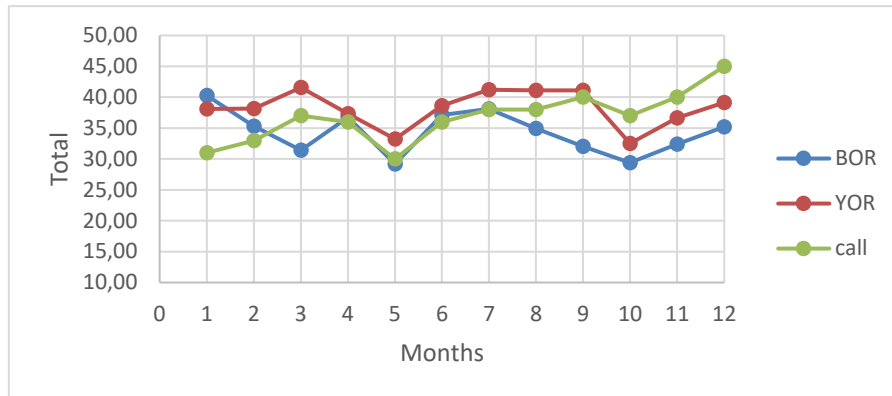


Figure 5. Port performance and ship calls

Based on Figure 4, it is known that the growth of loading and unloading activities at Terminal II of the New Makassar Container Port in 2021 had decreased in May but in June, the intensity of container loading and unloading continued to increase. these conditions show that the port of New Makassar has the opportunity to maintain its existence in the port industry.

The port performance as described in Figure 5 shows that the BOR and YOR values have fluctuated but are still within safe limits (below 70%). In addition, ship calls at Terminal II of the New Makassar Container Port also continue to increase.

b. Automation

The automation criteria are assessed based on the availability of loading and unloading equipment that is integrated with the system and allows for minimization of humans in the container loading and unloading area. Based on the observation results, it is known that Terminal II of the New Makassar Container Port operational equipment is still in the semi-automation stage. Where the equipment (CC, RTG, RS) still has an operator. All activities carried out by the operator in the field are regulated by the planner who is in the control tower. Port loading and unloading equipment can be seen in Figure 6 to Figure 9.



Figure 6. Eksisting container crane dan Terminal II of the New Makassar Container Port



Figure 7. Eksisting Rubber Tyred Gantry (RTG) dan Container Yard Terminal II of the New Makassar Container Port



Figure 8 Eksisting Reach Stacker Terminal II of the New Makassar Container Port



Figure 9 Eksisting Head Truck and Chassis Terminal II of the New Makassar Container Port

c. Intelligent Infrastructure

The Intelligent Infrastructure criteria are assessed based on the integrated information system used. Based on the results of observations, after the merger, the development of internet-based technology continues to develop at Terminal II of the New Makassar Container Port. Every activity, starting from the processing of port entry agreement documents to the loading and unloading process and ships leaving the port, has been integrated with IOT and compiled in a cloud system. However, based on information from the service user community, the new system still has several problems and errors that require improvement.

3.1.2. Environment Domains

The environmental domain consists of four smart port assessment criteria, namely:



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- a. Environmental management system
Based on the results of the assessment it is known that the environmental impact monitoring facility utilizes CCTV and routine monitoring and measurement of pollution levels at the port every 6 months. However, because the port is still under construction, the environmental management system cannot be applied to all terminals.
- b. Emission and pollution control
In addition, most of the operational equipment of Terminal II of the New Makassar Container Port, both in the wharf area, seaway and in the office, has used electricity, although some equipment still uses diesel energy. In addition, the existing port which is still under construction causes noise pollution and air pollution that cannot be completely overcome.
- c. Waste handling management
Terminal II of the New Makassar Container Port already has waste treatment facilities for the port, but for ships it still uses the waste treatment facilities installed on the ship to be discharged into the sea (there are no ship waste treatment facilities at the port).
- d. Water management
Terminal II of the New Makassar Container Port has provided facilities for processing sea water into fresh water. However, currently it cannot be utilized optimally because the water produced tends to be brackish so that for water supply, ships still buy it from third parties.

3.1.3. Energy Domains

The energy domain consists of three assessment criteria for the smart port concept, namely:

- a. Energy consumption efficiency
Terminal II of the New Makassar Container Port has utilized electrical energy for most of its operational equipment and some are still using diesel fuel.
- b. Producing and using renewable energy
Terminal II of the New Makassar Container Port does not yet have sustainable energy sources sourced from nature. The port's electrical energy utilizes supplies from the state electricity company in Indonesia.
- c. Energy management
For sustainable energy management efforts, Terminal II of the New Makassar Container Port is in the process of utilizing electrical energy for all equipment besides utilizing an integrated technology system to facilitate every operational process.

3.1.4. Safety and Security Domains

The Safety and Security domain consists of three assessment criteria for the smart port concept, namely:

- a. Safety management system
Terminal II of the New Makassar Container Port implementing the ISM Code safety management system for each fleet of ships, implementing ISM Code audits and ship inspections, implementing ship maintenance plans and carrying out work activities according to procedures as well as evaluating the delegation of pilotage and tug of ships.
- b. Security management system
Terminal II of the New Makassar Container Port applies the ISPS Code in the port security and safety management system in accordance with ISO-based International Maritime Organization (IMO) provisions, especially for ISO 9001, ISO 14001, ISO 27001 and 20001, ISPS Code and SMK3.
- c. Integrated monitoring and optimization system
The international standard security and safety surveillance system is supervised using CCTV which is directly connected to the security room and control tower. Installation of sensors at the gate and integrated document inspection.

3.2. Fulfillment of smart port criteria

Based on the results of observations at Terminal II of the New Makassar Container Port, an assessment was made regarding the fulfillment of the smart port achievement criteria. The scoring is done according to the table as follows.



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Table 3 Fulfillment of existing and smart port criteria

Score	Information
1	Not yet meet the criteria
2	the process of fulfilling the criteria
3	Fulfills the criteria

Using the assessment in Table 3, an assessment of the fulfillment of the smart port criteria at the existing port is carried out. The results are in accordance with Table 4.

Table 4 The results of observing the fulfillment of the smart port criteria

Domain	Criteria	Score
Operasional	Productivity	3
	Automation	2
	Intelligent infrastructure	2
	Environmental management system	2
Environment	Emission and pollution control	2
	Waste handling management	2
	Water management	2
	Energy consumption efficiency	2
Energy	Producing and using renewable energy	1
	Energy management	2
	Safety management system	3
Safety and Security	Security management system	3
	Integrated monitoring and optimization system	3

Based on Table 4, graphically it can be described on Figure 10 as follows.

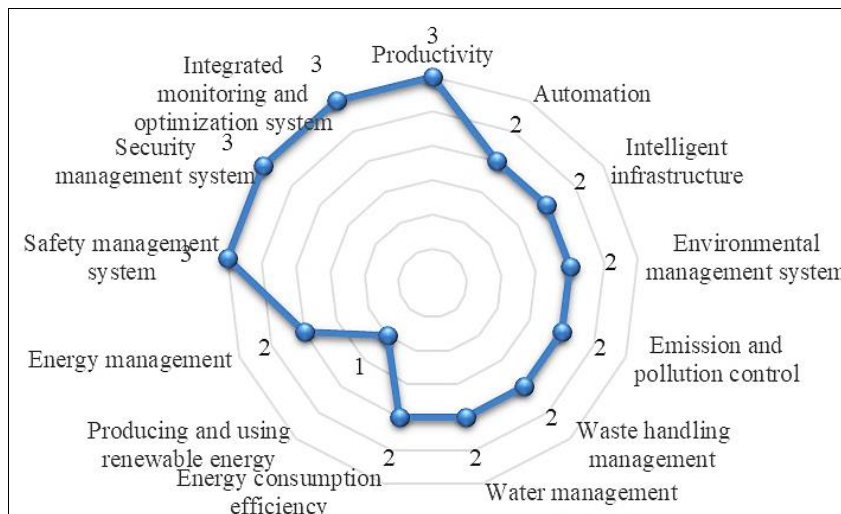


Figure 10 Graph of fulfillment of smart port criteria

Based on Figure 10, it is known that Terminal II of the New Makassar Container Port has fulfilled the safety and security domain which consists of 3 sub-criteria namely safety management system, security management system, and integrated monitoring and optimization system. Fulfilment of these criteria can be proven by certificates of national and international scale standardization port security and safety sector owned by Terminal II of New Makassar Container Port such as ISM Code and ISPS Code. In addition, an integrated monitoring system via CCTV and automatic sensors has been implemented. Supervision can be carried out in real-time by the port operator and security team. In addition, routine training and simulations are routinely carried out. Fulfilment of the criteria is also found in the productivity sub-criteria as measured by service activities and loading and unloading operations at the port. In addition, productivity can be determined by



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calculating the performance of services performed compared to Indonesian and international laws and regulations.

4. CONCLUSION

Based on the research conducted, it is known that Terminal II of the New Makassar Container Port fulfills 4 (four) criteria for a smart port, namely productivity criteria in the operational domain and overall criteria in the safety and security domain. The criteria for a smart port which is still under development at Terminal II of the New Makassar Container Port are the criteria for automation and intelligent infrastructure in the operational domain as well as all criteria in the environmental and energy domains. The criteria with the lowest score are found in the energy domain, namely the criteria for the production and use of renewable energy.

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