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Facility Integration for Handling Container at the Makassar New Port

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Abstract: *Container flow and the number of loading and unloading equipment affect the integration of container handling facilities which are important factors in the smooth running of container loading and unloading activities. Increased container flow in Makassar New Port which occurs every year, will affect the need for loading and unloading equipment at Makassar New Port. This study aims to determine the level of productivity and integration of container handling facilities in Makassar New Port long-term (20 years) by analyzing the needs of container handling facilities covering from ships to docks (Container Crane), docks to stacking fields (Truck Head), in the field buildup (Rubber Tiret Gantry). The method used to determine the integration of loading and unloading tools is linear regression and optimization methods. The results of this study indicate that in 2019 the productivity level of the facility is 25 B / C / H and the integration of the facility for the long term (20 years) required the addition of loading and unloading types of equipment such as 8 units of Container Crane (CC), 7 units Rubber Tiret Gantry (RTG)) and 5 units of Truck Heads (HT) to ensure that the loading and unloading activities run smoothly and on time.*

Keywords*: Equipment loading-unloading, container, productivity, utilities*

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I. Introduction

Transportation is one of the most important elements for human needs, both for individuals and for supporting economic life in an area as a gateway to the economy in Eastern Indonesia [1]. The presence of the Makassar port, especially the Makassar Container Terminal and the Makassar New Port Container Terminal, has a very important role in the distribution of logistics in Eastern Indonesia. [2].

The high rate of container flow growth in Makassar Container Terminal reaches an average of around 4.58% per year [1]. Where in 2016 the realization of container flow has reached 606,759 TEU's and the capacity available at the Hatta Terminal is 700,000 TEU's [1]. Makassar Port container is not good, so the Makassar New Port terminal is being built [3]. Makassar New Port is expected to be a solution for handling container loads which are increasing in Makassar.

Makassar New Port (MNP) began operating in November 2018 and is currently entering phase 1A development. The availability of facilities and facilities for phase 1A development is that the total land area for MNP is 1,428 hectares [4]. MNP's existing facilities include a dock with a length of 360 m, a stacking field with a capacity of 500,000 TEU's and a causeway with a length of 2,125 m, in addition to that, loading and unloading facilities include CC 4 units, RTG 18 units, Reach Stacker 2 units and 25 truck heads [5]

The performance capacity of a port can be measured from several things including the number of loading and unloading equipment, the number of containers, container service time, and related management [6]. The cargo service at the Makassar New Port Container Terminal starts when the container is transported from the ship to the dock, from the pier to the stacking field (CY), at the stacking field and from the stacking field to the outside of the terminal or vice versa [7]. Makassar New Port Container Terminal uses Container Crane (CC), Truck Head (HT), and Rubber Tiret Gantry (RTG) as loading and unloading equipment [5].

The integration of container handling facilities is an important factor in the smooth loading and unloading activities. Does the number of loading and unloading equipment meet the requirements to serve container flow volume along with the construction of Makassar New Port long-term (20 years)? Therefore, an analysis of the loading and unloading equipment at Makassar New Port Container is needed.

II. Materials And Methods

Research location and design

The research location is Makassar Port, specifically the Makassar New Port Container Terminal, South Sulawesi Province. This type of research is descriptive using qualitative and quantitative methods.

Method of collecting data

Data collection is done by observation or direct observation of the process of loading and unloading of containers from beginning to end by measuring the time of loading and unloading containers using a stopwatch. In addition, interviews were conducted with related parties to obtain data and information about the research object.

Data Analysis

Determination of the productivity of container loading and unloading equipment is based on the number of boxes that can be served by the equipment within one hour [8], whereas the forecasting of loading and unloading currents at the Makassar New Port Container Terminal in the long term (20 years) uses a linear regression analysis approach, where years are the independent variable and the GRDP value as the dependent variable [10]. In order to obtain the integration of container handling facilities for the long term (20 years).

III. Results Dan Discussion

Port Facility Productivity

Port productivity is a reference to know the level of port services for port users [8]. The high level of port productivity shows that the port has provided good services [10]. The formula for calculating the loading and unloading productivity is as follows [8]:

$$Productivity = \frac{60\ (minute)}{\text{average time around one trip}} \quad (1)$$

The results of the analysis of the each container loading and unloading equipment are as in the Table 1.

Table 1. Productivity of the Makassar New Port Container Handling Facility

No.	Facility	Productivity
		box/hour
1	*Container Crane (CC)*	27
2	*Head Truck* (HT)	10
3	*Rubber Tiret Gantry* (RTG)	11

Source: Research Results, 2020

From the analysis it was found that the quality of service / productivity of facilities at the Makassar New Port Container Terminal for 2019 were quite good, seeing that the Port Operational Service Performance Standards were set by the government at 25 B/C/H [10].

Container Flow Projection

Based on container flow data in Makassar Container Terminal from 2010-2019 is analyzed using linear regression method [9]. The container flow projection is obtained at Makassar Container Terminal for the next 20 years. The projection is used for the assumption of container flow projection at Makassar New Port Container Terminal for each stage of development, namely IA stage 15%, IB 40%, IC 80% and phase II is closed with Makassar Container Terminal closed so that the amount of current used is 100%. The results of the container flow projection at the Makassar New Port Container Terminal are in the construction stage as in Table 2.

Table 2. Results of loading-unloading current projections at the Makassar New Port

Number	Development Stages	**TPM** Unloading and loading **TEU'S**	**MNP** Unloading and loading **TEU'S**
Stage I A	2018	637.366	1.261
	2019	681.802	99.403
Stage I B	2020	715.928	214.779
	2021	755.278	226.583
Number	Development Stages	**TPM** Unloading and loading **TEU'S**	**MNP** Unloading and loading **TEU'S**

Stage I C	2022	796.622	637.297
	2023	840.106	672.085
	2024	885.889	708.711
	2025	934.141	747.312
	2026	985.043	788.034
	2027	1.038.792	831.033
	2028	1.095.597	876.477
	2029	1.155.683	924.547
	2030	1.219.294	975.436
	2031	1.286.690	1.029.352
Stage II	2032	1.358.148	1.358.148
	2033	1.433.971	1.433.971
	2034	1.514.478	1.514.478
	2035	1.600.017	1.600.017
	2036	1.690.958	1.690.958
	2037	1.787.700	1.787.700
	2038	1.890.672	1.890.672
	2039	2.000.332	2.000.332

Source: Research Results, 2020

Long-term Port facility utilities (20 years)

The utility is the time of a device where the device actually performs activities according to its function stated in% [7]. To find out the utility value of each loading and unloading facility is using the following formula [7]:

$$U = \frac{X}{Nrtg\ .Yrtg\ .BWT\ .Wd}\ x\ 100\%(2)$$

Where:

U = Utility (%)
X = Number of TEUs transported
Nrtg = Number of Tools
Yrtg = Number of TEUs transported by Tools/hour
BWT = Working hours per day (24 hours)
Wd = Available working days per year (365 days)

The results of each container loading and unloading utility are as in the Table 3.

Table 3. Long-term utility for Makassar New Port (20 years)

Development Stages	Year	MNP Unloading and loading TEU'S	UCC	URTG	UHT
Stage I A	2018	1.261	0,13	0.07	0,06
	2019	99.403	10,51	5,52	4,57
Stage I B	2020	214.779	22,70	11,92	9,87
	2021	226.583	23,95	12,57	10,42
Stage I C	2022	637.297	67,36	35,36	29,30
	2023	672.085	71,04	37,29	30,90
	2024	708.711	74,91	39,33	32,58
	2025	747.312	78,99	41,47	34,36
	2026	788.034	83,29	43,73	36,23
	2027	831.033	87,84	46,11	38,21
Stage I C	2028	876.477	92,64	48,64	40,30
	2029	924.547	97,72	51,30	42,51
	2030	975.436	103,10	54,13	44,85
	2031	1.029.352	108,80	57,12	47,33
Stage II	2032	1.358.148	143,56	75,36	62,44
	2033	1.433.971	151,57	79,57	65,93
	2034	1.514.478	160,08	84,04	69,63
	2035	1.600.017	169,12	88,78	73,56
	2036	1.690.958	178,73	93,83	77,74
	2037	1.787.700	188,96	99,20	82,19
	2038	1.890.672	199,84	104,91	86,93
	2039	2.000.332	211,43	111,00	91,97

Source: Research Results, 2020

From the calculation, the Container Crane (CC) loading and unloading utility in 2026 will experience overload usage where the utility value is 83.29%, Rubber Tiret Gantry (RTG) in 2034 will overload the usage where the utility value is 84.04% and Head Truck (844%) HT) in 2037 there will be an overload of usage where the utility value is 82.19%. It is said to be overloaded because it is in accordance with the standard table of utility facilities for the Directorate General of Sea Transportation equipment, that the Standards for the Performance of Tool Operational Services at the Port are 80% [10].

Port Facility Integration

The unloading of loading and unloading equipment is the performance of services provided by the port party which impacts on service users [11]. The efficient and effective loading and unloading service performance can be seen based on the service performance of all loading and unloading equipment [11]. Measurement of service performance can be seen based on the criteria for cohesiveness as follows:

Service Time

The container loading and unloading service time can be seen from the loading and unloading speed of the equipment and the time between container loading and unloading tools [11], as in Table 4.

Table 4. Time lag between container loading and unloading equipment

No.	Facility	Pause time
		minute
1	Container Crane (CC) - Head Truck (HT)	2,02
2	Head Truck (HT) Rubber Tiret Gantry (RTG)	3,31

Source: Processed Data Results, 2020

From the table 4, it can be seen the small intermission time between loading and unloading tools because the availability of equipment, for the time being, is sufficient to serve the flow of container loading and unloading in or out of the port area so that the loading and unloading service time of containers at the Makassar New Port Container Terminal is stretched well and smoothly.

Tool Capacity

Tool capacity is the ability level of a time unit tool, the capacity of each container loading and unloading device [8] at the Makassar New Port Container Terminal as in Table 5.

Table 5. Capacity of Container handling equipment at Makassar New Port Container Terminal

No.	Facility	Capacity
		box/year
1	Container Crane (CC)	236.520
2	Head Truck (HT)	87.002
3	Rubber Tiret Gantry (RTG)	100.119

Source: Processed Data Results, 2020

Tool capacity shows that the number of Container Crane (CC), Truck Head (HT) and Rubber Tiret Gantry (RTG) loading and unloading equipment is sufficient to serve the flow of containers in 2019 of 89,727 boxes.

Efficient

The level of efficiency of a container loading and unloading tool can be measured based on the level of the container loading and unloading utility, where the level of tool efficiency is said to be good if the number of available tools is sufficient to serve the loading and unloading currents [11].

From the above calculation, it is found that in the long term (20 years) the unloading of the loading and unloading equipment is not achieved due to the utility of the equipment, therefore it is necessary to increase the loading and unloading of each container so that the number of existing devices is able to handle the flow of containers up to the next 20 years as in Table 6.

Table 6. Number of equipment needs for the long term (20 years) at the Makassar New Port

Development Stages	Year	MNP	Day	Hour	B/C/H	Receiving	Delivery	CC	RTG	HT
		TEU'S			Hour	Hour	Hour	Unit	Unit	Unit
Stage I A	2018	1261	360	24	25	30	45	4	18	25
	2019	99403	360	24	25	30	45	4	18	25
Stage I B	2020	214779	360	24	25	30	45	4	18	25
	2021	226583	360	24	25	30	45	4	18	25

Stage I C	2022	637297	360	24	25	30	45	4	18	25
	2023	672085	360	24	25	30	45	4	18	25
	2024	708711	360	24	25	30	45	5	18	25
	2025	747312	360	24	25	30	45	5	18	25
	2026	788034	360	24	25	30	45	5	18	25
	2027	831033	360	24	25	30	45	5	18	25
	2028	876477	360	24	25	30	45	5	18	25
	2029	924547	360	24	25	30	45	6	18	25
	2030	975436	360	24	25	30	45	6	18	25
	2031	1029352	360	24	25	30	45	6	18	25
Stage II	2032	1358148	360	24	25	30	45	8	18	25
	2033	1433971	360	24	25	30	45	9	18	25
	2034	1514478	360	24	25	30	45	9	20	25
	2035	1600017	360	24	25	30	45	11	22	25
	2036	1690958	360	24	25	30	45	11	22	25
	2037	1787700	360	24	25	30	45	11	24	28
	2038	1890672	360	24	25	30	45	11	24	28
	2039	2000332	360	24	25	30	45	12	25	30

Source: Research Results, 2020

The table shows that the need for additional equipment for the next 20 years in Container Crane (CC) is 8 units, for Rubber Tiret Gantry (RTG) it is necessary to add as many as 7 units and for Truck Head (HT) it is necessary to add as many as 5 units.

IV. Conclusion And Recommendation

The productivity level of container storage facilities in 2019 is quite good at 25 B/C/H equal to the Port Operational Service Performance Standards set by the government. The growth of container flows at the Makassar New Port Container Terminal for 2020-2039 or long-term (20 years) continues to increase in container flows. In 2020, container loading and unloading flow in Makassar New Port reached 207,364 TEUs and in 2039 and increase of 2,000,332 TEUs for stage II in the development planning process.

The integration of container loading and unloading facilities at the Makassar New Port Container Terminal is currently generally quite good based on the criteria of cohesiveness and for the long term (20 Years) it is necessary to add 8 container cranes (CC), for Rubber Tiret Gantry (RTG) needs as many as 7 units were added and 5 truck heads were needed.

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