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OPTIMAL CAPACITY ANALYSIS OF CONTAINER YARD IN MAKASSAR NEW PORT

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Abstract

Indonesia is an island nation whose two-thirds of its territory is water and is located in a strategic location because it is on a cross of world trade routes; therefore, the role of the port as a marine transportation system is crucial in supporting economic growth. The stacking field used to serve container cargo is one of the main port facilities to store containers originating from ships or going to ships. A buildup field is needed to prevent the risk of ship delay, which results in decreased loading and unloading production and the time of ships and goods being ported for a prolonged time. Makassar New Port is the largest seaport in the Eastern Region of Indonesia. Located in the Makassar Strait, Makassar New Port holds a leading role in the distribution of goods equipped with loading and unloading facilities to and from the ship to the receiving warehouse. This study aims to analyze the fertilization field's capacity for both the operator and the user. The result of this study obtained for the short-term optimum cost Container Yard in Makassar New Port is IDR 1.687.795.482.144 with the width of field dimension is 530.000 m^2 . While for the Medium Term optimum cost is IDR 1.688.202.882.750 with the width of field dimension is 530.000 m^2 and Long Term is IDR 1.689.520.940.921 with the field dimension is 535.000 m^2.

Keyword : Container yard, level usage, optimal

1. INTRODUCTION

As one of the transportation infrastructures, ports play an important role in the economic, political, social, cultural, defense and security fields. Transportation services will enable connectivity between regions, saving time and costs, as well as fulfilling community needs. However, in essence, ports as transportation infrastructure in Indonesia, especially in the eastern part of Indonesia, are still relatively weak.
Apart from the fact that the facilities are lagging behind those of other regions, there is also a weakness in interconnection between existing economic gateways, which in turn results in price disparities within one area. This happened because shipping goods by sea transportation from Makassar to a number of other areas in Eastern Indonesia was very expensive, due to the dependence on the Port of Tanjung Perak in Surabaya.
PT manages the Makassar New Port, Pelindo IV is one of the ports blocked as a new gateway to the entry of ships and goods both domestically and export-import and is a first-class port in Indonesia. Previously, the loading and unloading process was carried out at Soekaro Hatta Makassar Port Container Terminal. As the largest seaport in the East Region of Indonesia located in the Makassar Strait, Makassar New Port significantly distributes goods with loading and unloading facilities from and to ships to receiving warehouses
A container yard is where containers are collected, stored, and stacked for loading or unloading from ships. It is important to analyze container arrivals and deliveries monthly to ensure efficient loading and unloading. This helps optimize container yard usage and forecast container throughput for future months. Historical data

must be interpreted through forecasting and YOR calculations to achieve this. By optimizing container yard usage, the movement of hazardous or classified containers can be prevented.

2. METODE

2.1. Object of Reserch

The research is conducted at the PT Port Indonesia IV Makassar New Port Branch, which is situated on Jalan Sultan Abdullah Raya, Tallo District, Makassar City, South Sulawesi Province. Its geographical location is at coordinates 05 09' 81" LS and 119° 41' 07' BT. The data collection period is from November to December 2022.

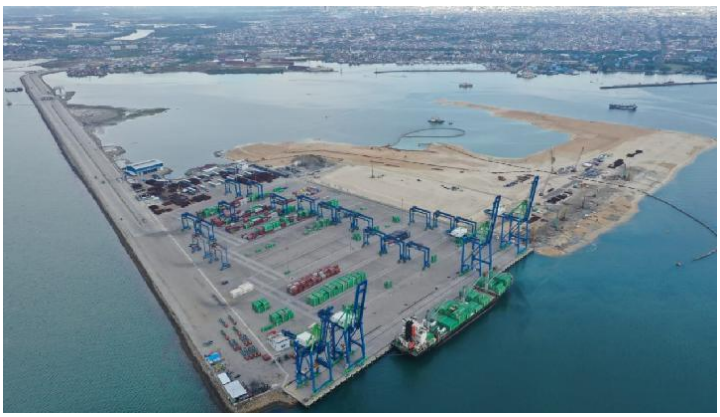

Figure. 1 Makassar New Port [2]

2.2. Data Analysis

At this level, it is possible to determine the ideal cost of the Foundation Field in Makassar New Port by evaluating operator and service user expenses in the short, medium, and long run. Our primary data includes the Piling Field Area's size and the buildup field's tier number. In contrast, secondary data sources include the port's operational management system report, investment report, annual packaging flow report, and relevant literature studies based on observations at Makassar New Port. With the data obtained, the accumulation field optimization cost at Makassar New Port can be calculated :

a. The build-up field capacity per unit time (TEUs/year)

$$\text{Available capacity} = \frac{(\text{Effective Area/Container Area}) \times \text{Number Of Stacks}}{(\text{Number Of Days In A Year x Length Of Time Containers Are Stacked})} \quad (1)$$

b. The utilization rate of the buildup field (YOR) compares the number of buildup field usage in TEU units and the adequate capacity of the buildup available.

$$\text{YOR} = \frac{\text{Capacity Used}}{\text{Capacity Avalaible}} \times 100\% \quad (2)$$

c. To analyze the best way to use available space in a field by using optimization techniques that consider both the port manager (operator) and the owner of the goods or facility user (user), to achieve optimal field utilization, it aims to minimize the total cost between the port manager (operator) and the owner of the goods (user). The cost optimization model of the queue is used to get the level of service with optimal results in terms of both the value of the service and the number of servers. This is achieved by balancing the existing service costs with the waiting costs caused by existing services. (Taha, 1987). Service costs are included in the operation of the facility while waiting costs represent waiting costs for customers. Adding

or improving service means reducing customer waiting time. Figure 2. shows that the higher the level of service, the greater the costs incurred, on the other hand, a high level of service results in smaller waiting costs for customers. Optimal service level is obtained when the total cost between service level costs and customer costs is minimum

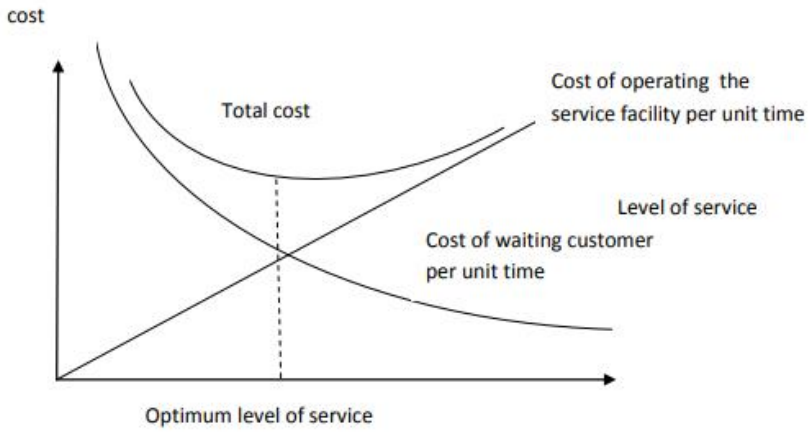

Figure 2. The realitionship between service levels and costs

3. RESULT AND DISCUSSION

3.1. Flow and Growth rate of Container

The packaging flow and growth rate of Makassar New Port increased from 2019 to 2022, but experienced a decrease in 2022. The loading and unloading activities had an average growth rate of 22.75%.

Table 1. Process for Loading and Unloading Containers.

No	Year	MNP Contianer B/M Traffic Teus)
1	2019	89.754
2	2020	116.754
3	2021	162.091
4	2022	161.020

Based on the regression graph, the projection of the progression mass current for the short, medium, long term, data on the progression of the packaging can be found in the following in the Table 2

Table 2. Short, Medium and Long-Term Forecasting

Year	B/M Payload (TEUs/year)	YOR (%)
2019	89754	17.10
2020	116754	22.25
2021	161020	30.68
2022	*161020*	*30.68*
2023	197654	37.66
2024	242621	46.23
2025	297820	56.75
2026	365577	69.66
2027	*448749*	*85.51*
2028	550843	104.97
2029	676165	128.85
2030	829999	158.16
2031	1018831	194.15
2032	*1250624*	*238.32*
2033	1535152	292.53

Year	B/M Payload (TEUs/year)	YOR (%)
2034	1884413	359.09
2035	2313134	440.78
2036	2839393	541.07
2037	*3485380*	*664.16*

3.2. Stacking Field Capacity

The level of stacking yard capacity at Makassar New Port is calculated using container loading data from 2022. On average, containers are stacked up to 4 tiers high. Based on the Dwelling Time data, containers remained stacked in the yard for an average of 5.34 days in 2020. The Makassar New Port Stacking Field Capacity can be summarized as follows:

$$\text{Available Capacity/Year (Current)} = \frac{10.204 \text{ TEUs} \times 360 \text{ days}}{7 \text{ days}}$$
$$= 524.777 \text{ TEUs/year}$$

3.3. Stacking Field Utilization Rate

In Appendix 2, the Container Traffic data indicates that the storage yard can hold an average of 13,418 TEUs per month or 161,020 TEUs per year in 2022. Please note that 1 TEUs equals 1 container box of 20 feet. The utilization rate of the Makassar New Port Container Yard can be calculated as follows:

$$\text{YOR} = \frac{\text{Capacity Used}}{\text{Capacity Avalaible}} \times 100\%$$

$$\text{YOR} = \frac{161.010 \text{ TEUs}}{524.777 \text{ TEUs/year}} \times 100\%$$

$$\text{YOR} = 30{,}68\%$$

3.4. Optimal Field Utilization Rate

The optimum stacking yard utilization rate is calculated by calculating the total minimum cost between operator costs (investment costs for piling yards and container handling equipment) and user costs (container and queuing vessel costs). The optimum costs obtained in the actual, short-term, medium-term, and long-term can be seen in the Table 3, Table 4, Table 5, and Table 6

Table 3. Optimal YOR Calculation Result with Various Fields for the Actual Period

Field Area	B/M (Teus/Year)	Invesment Costs	Queuning Container Yard	Ship Fees	Total Queue Cost	Total Cost of Operators ans Service Users	YOR (%)
480000	4999544	1369064421195	39930179	91560544678	91600474856	1460664896051	3.2%
500000	5555049	1460335382608	36753881	91560544678	91597298559	1551932681166	2.9%
510000	5666150	1521182690216	35306017	91560544678	91595850695	1612778540912	2.8%
520000	5777251	1594199459347	33942059	91560544678	91594486737	1685793946083	2.8%
524777	5830326	1596563811871	33318214	91560544678	91593862892	1688157674763	2.8%
530000	5888352	1596329115113	32655644	91560544678	91593200322	1687922315435	2.7%
535000	5943903	1597241824727	32039692	91560544678	91592584370	1688834409097	2.7%
540000	5999453	1603326555488	31441006	91560544678	91591985683	1694918541172	2.7%
545000	6055004	1609411286249	30858945	91560544678	91591403623	1701002689872	2.7%
547000	6077224	1612453651629	30630638	91560544678	91591175316	1704044826945	2.6%

Table 4. Optimal YOR Calculation Result with Various Fields for the Short-Term Period

Field Area	B/M (Teus/Year)	Invesment Costs	Queuning Container Yard	Ship Fees	Total Queue Cost	Total Cost of Operators ans Service Users	YOR (%)
480000	4999544	1369064421195	134899426	91560544678	91695444104	1460759865299	9.0%
500000	5555049	1460335382608	108201572	91560544678	91668746250	1552004128857	8.1%
510000	5666150	1521182690216	103821072	91560544678	91664365750	1612847055966	7.9%
520000	5777251	1594199459347	99701439	91560544678	91660246117	1685859705464	7.8%
524777	5830326	1596563811871	97819508	91560544678	91658364186	1688222176057	7.7%
530000	5888352	1596329115113	95822353	91560544678	91656367031	1687985482144	7.6%
535000	5943903	1597241824727	93967202	91560544678	91654511880	1688896336608	7.5%
540000	5999453	1603326555488	92165436	91560544678	91652710114	1694979265602	7.5%
545000	6055004	1609411286249	90415023	91560544678	91650959701	1701062245950	7.4%
547000	6077224	1612453651629	89728801	91560544678	91650273479	1704103925108	7.4%

Table 5. Optimal YOR Calculation Result with Various Fields for the Medium-Term Period

Field Area	B/M (Teus/Year)	Invesment Costs	Queuning Container Yard	Ship Fees	Total Queue Cost	Total Cost of Operators ans Service Users	YOR (%)
480000	4999544	1369064421195	456367424	91560544678	92016912101	1461081333296	25.0%
500000	5555049	1460335382608	357724091	91560544678	91918268769	1552253651377	22.5%
510000	5666150	1521182690216	341885529	91560544678	91902430206	1613085120423	22.1%
520000	5777251	1594199459347	327080980	91560544678	91887625658	1686087085004	21.6%
524777	5830326	1596563811871	320347440	91560544678	91880892118	1688444703989	21.5%
530000	5888352	1596329115113	313221959	91560544678	91873766637	1688202881750	21.2%
535000	5943903	1597241824727	306621948	91560544678	91867166626	1689108991353	21.0%
540000	5999453	1603326555488	300229288	91560544678	91860773966	1695187329454	20.8%
545000	6055004	1609411286249	294035347	91560544678	91854580025	1701265866274	20.7%
547000	6077224	1612453651629	291611564	91560544678	91852156241	1704305807871	20.6%

Table 6. Optimal YOR Calculation Result with Various Fields for the Long-Term Period

Field Area	B/M (Teus/Year)	Invesment Costs	Queuning Container Yard	Ship Fees	Total Queue Cost	Total Cost of Operators ans Service Users	YOR (%)
480000	4999544	1369064421195	3148990053	91560544678	94709534731	94709534735	69.7%
500000	5555049	1460335382608	2073413222	91560544678	93633957900	1462698379095	62.7%
510000	5666150	1521182690216	1929197670	91560544678	93489742348	1553825124956	61.5%
520000	5777251	1594199459347	1800376193	91560544678	93360920871	1614543611087	60.3%
524777	5830326	1596563811871	1743609017	91560544678	93304153694	1687503613041	59.8%
530000	5888352	1596329115113	1684737332	91560544678	93245282010	1689809093881	59.2%
535000	5943903	1597241824727	1631281130	91560544678	93191825808	1689520940921	58.6%
540000	5999453	1603326555488	1580465937	91560544678	93141010615	1690382835342	58.1%
545000	6055004	1609411286249	1532112968	91560544678	93092657646	1696419213134	57.6%
547000	6077224	1612453651629	1513424125	91560544678	93073968802	1702485255051	57.4%

4. CONCLUSION

During the actual period, the optimum value was obtained for a field area of 530.000 m^2 where container arrivals were 161,020 TEUs/year, container service capacity was 5.888.352 TEUs/year, and YOR was 2,71%. The optimum cost for users and operators is IDR 1.687.922.315.435. This value is considered optimum by looking at the total cost, which continues to increase in proportion to the increase in a field area. However, in an area of 530.000 m^2, the total costs continued to grow, then decreased and increased again in an area of 535.000 m^2. For the short-term data shows the best results were achieved in a field area of 530.000 m^2. During

this time, container arrivals were 448,749 TEUs per year, with a container service capacity of 5.888.352 TEUs per year and a YOR of 7,62%. In terms of user and operator costs, the optimal value was IDR 1.687.985.482.144. Further increasing the field area increased total costs, but the costs decreased once the area reached 535.000 m^2. While for the medium term the best results were achieved in a field area of 530.000 m^2. During this time, container arrivals were 1.250.624 TEUs per year, with a container service capacity of 5.888.352 TEUs per year and a YOR of 21,24%. In terms of user and operator costs, the optimal value was IDR 1.688.202.881.750. Further increasing the field area increased total costs, but the costs decreased once the area reached 535.000 m^2. And for long term shows the best results were achieved in a field area of 535.000 m^2. During this time, container arrivals were 3.485.380 TEUs per year, with a container service capacity of 5.943.903 TEUs per year and a YOR of 7.62%. In terms of user and operator costs, the optimal value was IDR 1.689.520.940.921. Further increasing the field area increased total costs, but the costs decreased once the area reached 540.000 m^2.

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