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Model Development of Main Commercial Port Operational Service in Indonesia (Case Study : Makassar Container Terminal)

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Abstract

The objectives of this research are to know (1) Makassar port characteristic as the main commercial port in Indonesia providing ship and goods service, (2) performance level of port operational service with port operational performance standard, and (3) ports, moorings and timing of container loading and unloading activities. The research was conducted in container Terminal Port of Makassar (TPM). The research method is a field survey during 91 days calendar, the data is analyzed by using statistical regression analysis method. The results showed that (1) three characteristics identified port of Makassar significantly strongly influence the operational services performance, namely: characteristics of port location; characteristics of port infrastructure, and characteristics of port service system. (2) the level of actual performance achievement of operational services in accordance with operational performance standards are divided into three categories, namely: performance indicators of good value category services are WT 0.88 (hours / ship), AT 0.89 (hours/ship), BCH 26.14 (box/cc/hours), BOR 55.13%, YOR 56.44% and Delivery 25.4 (minutes); indicator of service performance of good enough value category is Receiving 30.0 (minutes), and service performance indicator with bad value category that is ET:BT 69.16 (%); and operational readiness of equipment 61.95%; and (3) there are three alternative models of the relationship between TRT requirement of the boat during the tour a round time, the timing of dock service delivery and the service time of container loading and unloading activities at the dock. The relation between independent variable and significant dependent variable marked with value F-table = 2,6737 <F-count = 575,3046 then Berthing Time (BT = X_2) free variable, Berth Working Time (BWT = X_5) and Non Operation Time (NOT = X_6) simultaneously affect the bound variable of Tour a Round Time (TRT = Y) of the vessel during its stay at the port is; Y_1 = 1,1054 + 0,9756 X_2 + 0,0640 X_5 + 0,0537 X_6; Y_2 = 1.1484 + 0.9903 X_2 + 0.005 X_5 + 0.0519 X_6 and Y_3 = 1.0843 + 0.9952 X_2+ 0.0044 X_5 + 0.0144 X_6.

Keywords : Performance, service, ship, berth, terminal, truck, container.

INTRODUCTION

Indonesia as a maritime country, desperately needs a port sector that is developed and managed efficiently. The competitiveness of producers in both national and international markets, the efficiency of internal and external distribution, integration and integrity of the national economy is strongly influenced by the pattern or model of operational services as indicators and benchmarks of port sector performance. Although ports have a very important role for the national economy but performance indicators for all major commercial ports in Indonesia show that the entire port system is very inefficient and requires a high degree of quality. The data on the mooring occupancy rate, the average turn- around and the working time as a percentage of turn-around time is below international standards and indicates that ships spend too much time in moorings or to queue outside the harbor.

The above conditions reflect the poor performance of some key performance indicators such as Berth Occupancy Rate (BOR) float rate ratios, turn-around time or Turn-a Round Time (TRT) vessel and Waiting Time (WT). There is concern that the growth of container volumes that are not offset by an adequate quality improvement in capacity will lead to increased ship delays and waiting times. Objective conditions related to low port productivity include low freight availability, low performance, minimum operational time of 24 hours, infra and superstructure support of low and very limited ports.

In line with the issue, the research aims to identify the characteristics of Makassar port as the main commercial port in Indonesia in providing ship and goods services; 2) To analyze performance level of port operational service of Makassar with standard operational performance of port; and 3) Model a relationship between the level of the vessel's time requirements during the port, with the time of the vessel in the mooring and the need for container loading and unloading time at the dock.

METHODOLOGY

Research Object

This research was conducted at Terminal Container Makassar (TPM). This selection was taken based on the consideration that this container terminal has been operating for a long time and has a qualified facility as a container terminal with a standard full container system. The type of research is quantitative to the value of operational service performance indicator to service standard and to model the relation of ship service and goods service level performance.

Figure 1: Research Location

Analysis Approach

The analysis approach used indicator performance of services related to port services, in this study is limited to three (3) segments include; 1) the operational performance of marine transport vessels overseas and domestic; 2) the performance of the loading and unloading of container and receiving / delivery; 3) utilization of facilities and equipment operation readiness. Methods and weight and performance assessment of each service segment used is based on the standard indicators of the performance and location of the port of Makassar, in Table 1;

Tables 1: The value of the minimum standards of performance indicators in Makassar.

Service Performance Indicators									
Ship			Loading And Unloading			Facilities		KOP	
WT (Jam)	AT (Jam)	ET:BT (%)	UTPK (Box/cc/Jam)	*Receiving* (Menit)	*Delivery* (Menit)	BOR (%)	SOR (%)	YOR (%)	(%)
1.00	*2.00*	*70*	*25*	*30*	*45*	*70*	*65*	*70*	*80*

Source:Kep. Dirjen Hubla No. UM.002/38/18/DJPL-11

Rate Indicator ET: BT, performance and readiness for operation of loading and unloading equipment classified either if its achievement over the standard 100%, good enough if the achievements of 90-100%, and less good if performance is less than 90%. Indicators WT, AT, BOR, Yor, SOR, and receiving / delivery of containers is considered good if the outcomes are smaller than standard, considered good if the achievements of 0-10% larger than the standard, and judged less Excellent if the achievement is greater 10% of the standard.

Formulation of indicator- performance indicators used to measure the service level of port operations as follows;

TRT	=	WT+AT+BT
WT (gross) (PT)	=	WT (net) + Postpone Tome
BT	=	ET+ IT + NOT
ET+NOT	=	BWT sehingga
BT	=	BWT + IT

The berth ship service time will affect the utilization indicators (utility), known as BOR. Because the whole of the service time indicator will be the basis for calculating the ratio of the use of the pier (BOR).

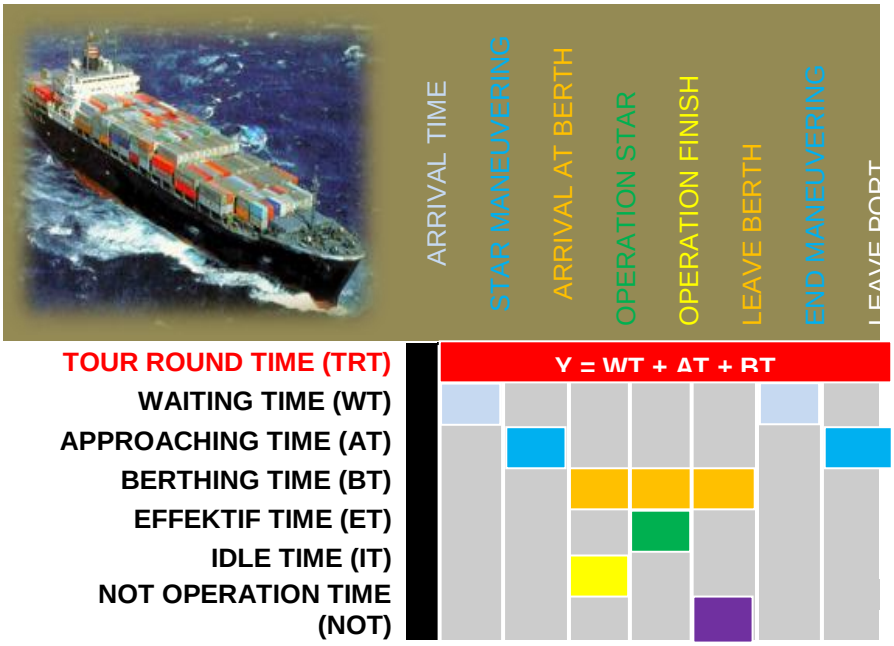


Figure 2: The total requirement of service time of ships in port.

RESULTS AND DISCUSSION

Makassar Port Characteristict

Port geographical characteristics

The Port of Makassar is located at coordinates 05 ° 07'18 " LS and 119 ° 24'27 " BT. The exact position of the harbor within the city, the geographical boundary of the Makassar harbor position lies between the Tallo river which lies to the north of the port and the Je'neberang river in the southern port. Hydrographic, the condition of seashore beach is generally sloping, the seabed consists of mud and sand; Time, standard time using GMT + 08; Ups and downs, the direction of the tide to the south with the highest tide of 1.80 m and the lowest pair of 0.9 m; Waves, wave height in the city pool between 0 sd 1 m and between 0 sd 2 m in the area of anchor lego; The current, the dominant current direction in the harbor pool from north to south extends to the dock at speeds between 0 and 2 knots, influenced by the flow of Tallo River which leads to the harbor work environment; Wind, the average speed between 5 sd 25 km / h, and can occur the maximum speed in December to January ranged between 60 sd 70 km / hour; Tempratur, the average temperature reaches 240 ° C to 310 ° C with air humidity between 60 to 85%; and Air pressure, air pressure atmosphere ranges from 1,003 mb to 1,013 mb.

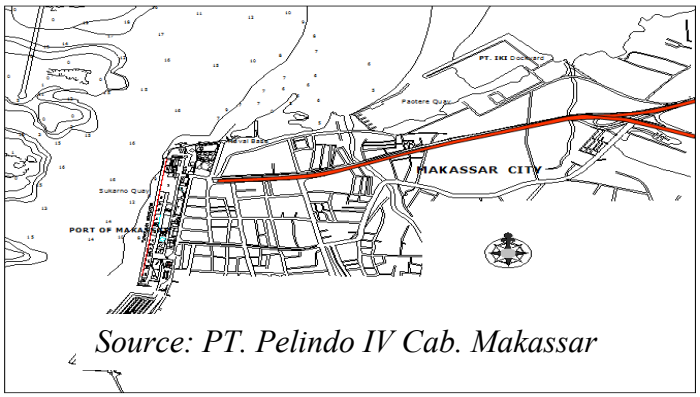


Figure 3. Lay Out Makassar Port

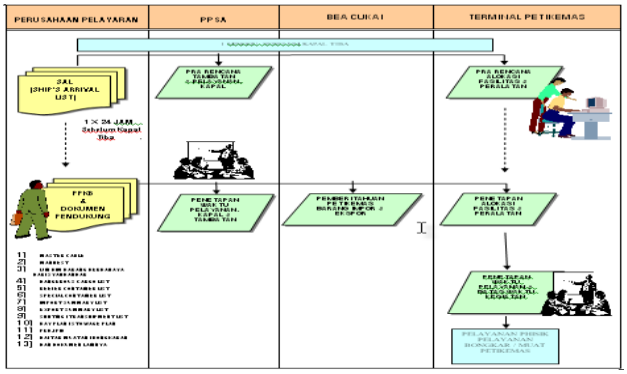
Characteristics of port infrastructure

Port operational activities are supported by facilities and infrastructures in the form of port facilities both in the water side and on the harbor mainland and equipment as supporting facilities for its production as follows; Facilities of the Makassar sea side include the length of 2.5 Mill sea cruises, 150 meters of cruise line width, 16 meters LWS depth and minimum depth of 9.7 meters with a harbor area of 315.20 Ha. Completed with a Sailing Navigation Support Facility (SBNP) consisting of 1 unit of Lighthouse, 3 Suede Beacon, and 8 Suar Buoy units supported by facilities and pilot power of the compotent; and Facility of mainland side of Makassar container port has provided facilities and infrastructure and equipment specifically handling container loading and unloading activities with a Makassar Container Terminal (TPM), where in the implementation of its activities is supported by modern facilities and equipment as in figure 2, as follow;

Figure 4: Makassar Container Terminal (TPM) existing

Port operational characteristics

Makassar container port operational services apply International standardized service system (ISO 9002: 1994 certificate) the services provided are oriented to cost efficiency and time and customer satisfaction. Characteristics of operational services provided are based on the system and procedures as Standard Operational Procedures (SOP) service in Makassar port as in figure 5, as follows;



Surce: PT. Pelindo IV Cab. Makassar

Figure 5: Ship and goods service system and procedure at Makassar container port.

Analisis Kinerja OperasionalPelabuhan

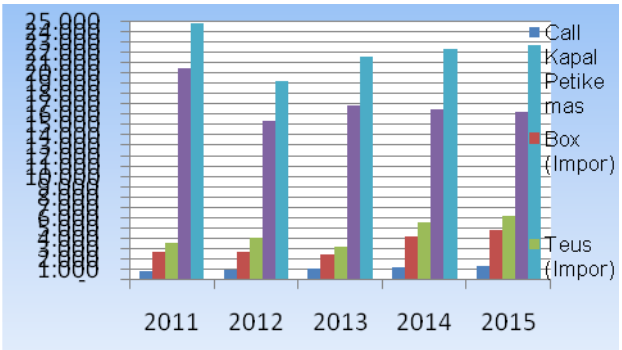
Traffic flow of ships and containers

Visits of container vessels in the port of Makassar for the last five years (2011-2015) as shown in figure 6 where there is an average increase in the number of container ships increased 36.09% per years.

Source; Results of secondary data from 2011-2015

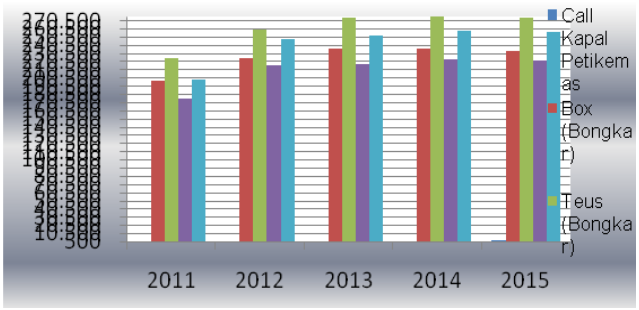
Figure 6: Flow of container vessel traffic in Makassar port period 2011-2015

Export flows of container imports for overseas and domestic container loading and unloading in the port of Makassar for the last five years (2011-2015) as shown in FIGS. 6 and 7as follows;



Source; Results of secondary data from 2011-2015

Figure 7: The flow of ship visits and the export of overseas container imports in Makassar port in 2011-2015

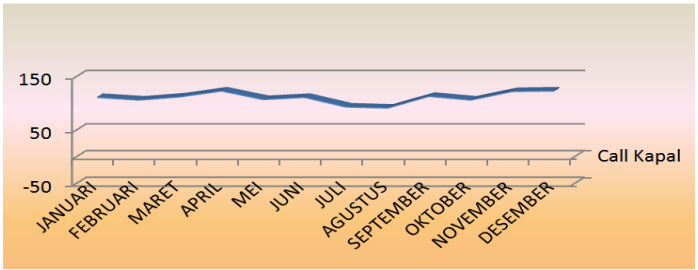


Source; Results of secondary data from 2011-2015

Figure 8: Flow of domestic container vessel loading and unloading at port of Makassar in 2011-2015

Performance of port operational services

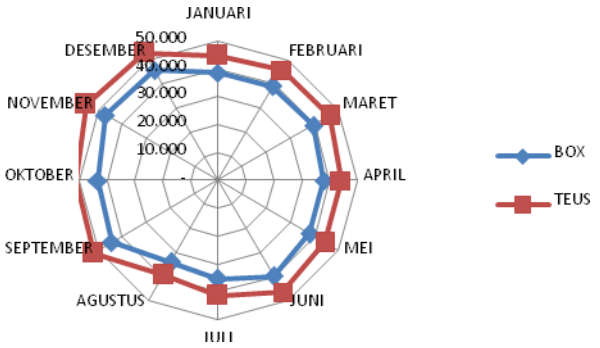
Traffic flow of container arrivals is a daily visit of container vessels that will carry out container loading and unloading activities in Makassar harbor. The condition of ship traffic flow (ship call) container period 2015 as in figure 9, as follows:



Source: Results of secondary data processing.

Figure 9: The condition of ship traffic flow (ship call) container period 2015

Flow of container loading and unloading during the period of January to December 2015 as in figure 10 as follows;



Source: Results of secondary data processing.

Figure 10: The condition of container loading and unloading flows from January to December 2015

The measurement of container vessel service performance during the port is following the time flow distribution pattern of the process mentioned above. To know the value of each of the above mentioned variables, the data of Green Spirit ship service arriving on the first day of April 01, 2016 as an example of calculation with the data of calculation result as in table 2, as follows;

Table 2. Service of container vessels at Makassar port at Hatta Base dock: 01 April Year: 2016

Nama kapal	***Hijau Semangat***	***Vertikal***	***Bali Sanur***	***Sitc Tokyo***
Length of the ship, (m)	121	188	97	134
Ship arrives, Ta (hours)	10.00	10.30	15.15	23.00
Shiple off, Bto (hours)	11.30	11.45	16.15	00.01*
Mooring position, (m)	210-340	520-640	890-990	675-820
Start work, (hours)	13.00	13.00	16.30	01.00*
Finish work, (hours)	18.00	20.00	22.50	07.30*
Ships leave, (hours)	22.50	00.10*	01.50*	09.00*

Source: Field survey data 01 April 2016

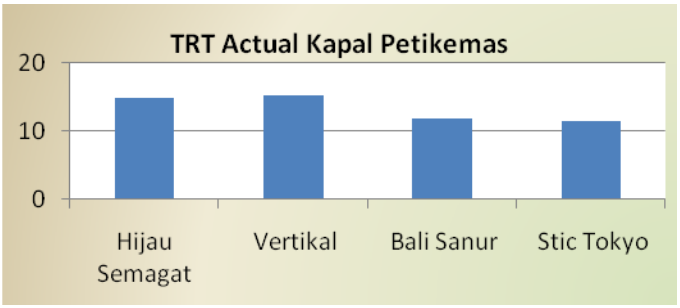
Service Performance of Container Vessel

The service time of each container vessel during its stay at the Hatta base pier for 01 April 2016 can be seen in table 3 as follows;

Table 3. Realization of Timing of Container Ship Service at Port Hatta Port of Makassar Makassar Period April 2016

Nama kapal	*Hijau Semangat*	*Vertikal*	*Bali Sanur*	*Sitc Tokyo*
Berth Working Time, BWT (jam)	**5**	**7**	**6,20**	**6,30**
	0	**0**	**0**	**0**
***Idle Time, IT* (jam)**	**1.30**	**1.15**	**0.15**	**0.59**
***Non Operation Time, NOT* (jam)**	**3.30**	**5.45**	**6.05**	**5.31**
	11.20	**12.25**	**9.35**	**8.59**
Effective Time, ET (jam)	**1.30**	**1,25**	**1**	**1,01**
	4.50	**4,16**	**3**	**1,5**
Berthing Time, BT (jam)	**12.50**	**13.40**	**10.35**	**10**
***Waiting Time on berth, WTb-in* (jam)**				
***Waiting Time on berth, WTb-out* (jam)**				
***Turn Round Time on berth, TRTb* (jam)**				

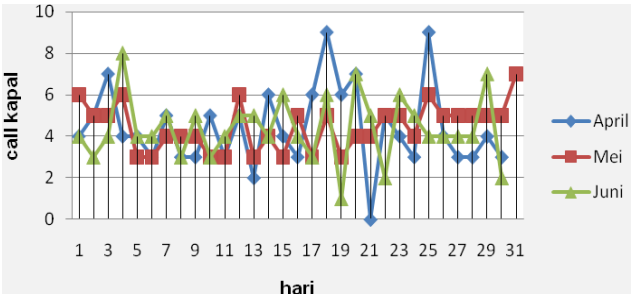
Source: Primary data analysis results, 2016



Source: Results of primary data of April 1, 2016

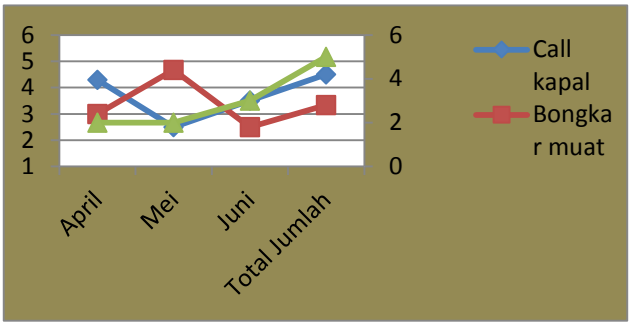
Figure 11: Graph realization of the total time of each container vessel during its stay in the port of Makassar period of 1 April 2016

The actualization of the vessel traffic and container loading in Makassar harbor from the field survey in April lasted from 132 call ships with total loading and unloading of container 43,066 boxes, May from 131 call vessels with total loading and unloading of 42,174 boxes and June from 138 Call ship with total loading and unloading of container 43,039 boxes. The conditions are as in Figures 12 and 13 as follows;



Source; Primary data exercise 2016

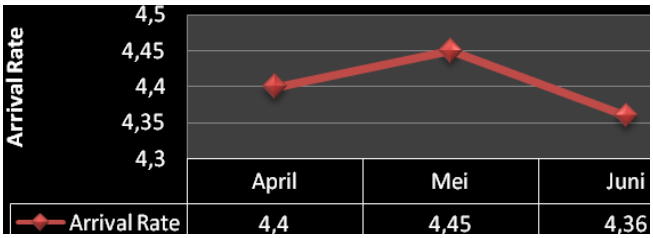
Figure 12: Graph of container vessel traffic conditions in Makassar container port (Call / day)



Source; primary field survey data (2016)

Figure 13: Graph of vessel traffic and container loading conditions at Makassar's container port.

The productivity level of Makassar's container port is the average of the arrival rate on the Makassar port per day for April 2016, the calculation of the average number of container ships visiting each day in the port of Makassar for April, May and June 2016 (table attached), the actualization is described as shown in Figure 14 as follows;



Source; results of field survey data 2016

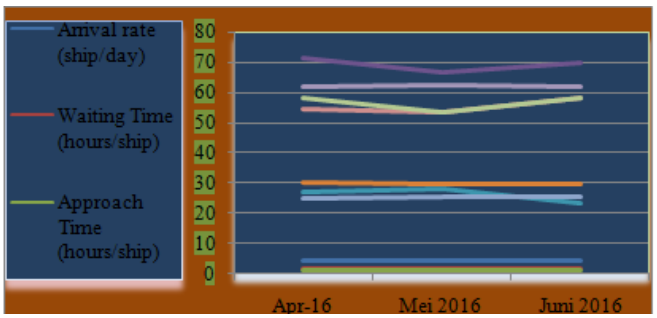
Figure 14: Graph of average container ship traffic (kpl / day) in Makassar port for April, May and June 2016 periods.

The result of the analysis of the relation of variables to the performance of ship service during the port of Makassar above can be in table 10, as follows;

Table 4: Percentage of service performance of Makassar container port.

Indikator	April 2016	Mei 2016	Juni 2016
Arrival rate (ship/day)	4,40	4,45	4,367
Waiting Time (hours/ship)	0.91	0.85	0.9
Approach Time (hours/ship)	0.75	1	0.93
Effective Time (ET:BT)%	71,37	66,47	69,66
Produktivitas (BCH)%	27,10	27,98	23,35
Receiving (menit)	30.5”	30.0”	29.57”
Delivery (menit)	25.0”	25.07”	25.50”
Berth Occupancy Ratio (BOR)%	54,09	53,25	58,07
	58,01	53,25	58,07
Yard Occupancy Ratio, (YOR)%	61.86	62,25	61,74
Kesiapan Operasi Peralatan, (KOP)%			

Source: primary data processing results, (2016)



Source: primary data processing results (2016)

Figure 15: Graph of performance appraisal results of operational services of Makassar container port.

From Figure 15, it can be seen that the percentage of performance achievement of operational service of Makassar container port is divided into three categories according to the operational performance standard of port. 1) Good category service performance indicator is WT 0.88 (hours / ship), AT 0.89 (hours / ship), BCH 26.14 (box / cc / hours), BOR 55.13%, YOR 56.44% and Delivery 25.4 (minutes); 2) Indicators of good service category performance are Receiving 30.0 (minutes), and 3) Indicators of service performance with poor category that is ET: BT 69.16 (%); and operational readiness of equipment 61.95%.

Relationship Model between Ship Time Requirement Level at Port

Establishment of a model of the relationship between the time requirement of the container vessel in the TRT's Turn Round Time port with the BT time Berthing Time (BT) berth timing factor factor, the need for service delivery activities of BWT Berth Working Time and service preparedness factors the AT (Approaching Time) AT and Waiting Time (WT) ship as independent variables has a significant effect. The result of F-table = 2,6737 <F-hitung = 575,3046 then Berthing Time (BT) free variable, Berth Working Time (BWT) and Non Operation Time (NOT) jointly influence the variable effect of Tour a Round Time (TRT) ships during the port.

Table 11: Alternative model of the relationship between the level of demand for the vessel in the port, the timing of dock service preparedness, service time of container loading and unloading activities at the pier.

NO	*MODEL PERSAMAAN*	*R^2*
1	$Y = 1,1054 + 0,9756\,X_2 + 0,0640\,X_5 + 0,0537\,X_6$	*0,929*
2	$Y = 1,1484 + 0,9903\,X_2 + 0,0055\,X_5 + 0,0519\,X_6$	*0,995*
3	$Y = 1,0843 + 0,9952\,X_2 + 0,0044\,X_5 + 0,0144\,X_6$	*0,999*

Source; Result of model analysis

Note:

Y = Rate of time required for the vessel during the Tourn Round Time of TRT vessel;

X2 = Usage level of vessel during stay at Berthing Time (BT);

X5 = Rate of time usage of container loading and unloading services (Berth Working Time) BWT;

X6 = The amount of time that is planned not to carry out activities during the ship is on the pier (Non Operation Time) NOT.

CONCLUSIONS AND RECOMMENDATIONS

The research method is a field survey during 91 calendar days, the data is analyzed by using statistical analysis through regression method. The results showed that (1) identified three characteristics of port of Makassar significantly strongly influence the performance of operational services, namely: characteristics of port location; characteristics of port infrastructure, and characteristics of port service system. (2) the level of actual performance achievement of operational services in accordance with operational performance standards are divided into three categories, namely: performance indicators of good value category services are WT 0.88 (hours / ship), AT 0.89 (hours/ship), BCH 26.14 (box/cc/hours), BOR 55.13%, YOR 56.44% and Delivery 25.4 (minutes); indicator of service performance of good enough value category is Receiving 30.0 (minutes), and service performance indicator with bad value category that is ET: BT 69.16 (%); and operational readiness of equipment 61.95%; and (3) there are three alternative models of the relationship between TRT requirement of the boat during the tour a round time, the timing of dock service delivery and

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The realization of capacity and service facilities of Makassar port can be used in determining the level of repair service needs of Makassar container services. In an effort to improve the achievement of good category on the operational performance of container port / terminal, especially for management of TPM (Makassar Petikemas) to improve and increase the target of optimal performance achievement and to review and evaluate the factors identified and can develop an analysis of the effect of variables on port operational performance indicators, particularly on factors that affect ship service readiness and readiness for more significant results to operating and productivity pattern management can improve performance and more optimal performance levels.

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REFERENCES

[1] Port Developments, Unctad, Review of Maritime Transport, 2014.

[2] Port Management, Unctad Series Vol.1, 2014.

[3] Port Performance Indicator, SURVEYOR INDONESIA, materi Diklat Kepelabuhanan Jkt-2013

[4] Yeo Gi-Tae, Adolf, K. Y., Paul, T. W. and Z. L. Yang. 2012. *Modelling Port Choice In An Uncertain Evironment Jurnal (Online),* Taiwan

[5] Keputusan Dirjen Perhubungan Laut Nomor: UM.002/38/18/DJPL-11 Tentang Standar Kinerja Pelayanan Operasional Pelabuhan, 2011.

[6] PT Pelabuan Indonesia IV, 2011, *Annual Report 2010,* Kantor Pusat PT Pelabuhan Indonesia IV (Persero), Makassar.

[7] Jin Xin Cao, Der- Horng Lee, Jiang Hang Chen, Qixin Shi, 2010. *The Integrated Yard Truck and Yard rane Scheduling Problem : Benders Decomposition-based Methods.* Transportation Research part E 46 : 344-353

[8] Vacca, I, Salani, M, and Bierlaire, M, 2010. *Optimization of Operations in Container Terminal : Hierarcical apporact, Proceeding of STRC 2010.*

[9] Kiani, M, Sayareh, j, and Nooramin, S, 2010. *A Simulation Framework for Optimizing Truck Congestion in Marine Terminal,* Journal og Maritime Research vol 7 no.1, pp 55-70.

[10] Christian Bierwirth, Frank Meisel, 2010. *A Survey of Berth Allocation and Quay Crane Scheduling Problem in Container Terminals.* European Journal of Operational Research. 202 : 615-627.

[11] EL-Naggar, M. E., 2010. *Application of Queuing Theory to the Container Terminal at Alexander Seaport,* Journal of Science and Environmental Management Vol. 1 (4), pp 77-85.

[12] Karatzas, B. M. 2009. *A Primer on Leasing Transactions in the International Maritime Sector, Jurnal of Equipment Lease Financing* Volume 27, No. 3, (www.leasefoundation.org), diakses 2013.

[13] Qingchend Zeng, Zhongzen Yang, 2009. *Integral Simulation and Optimazation to schedule Loading Operations in Countainer Terminal*. 36: 1935-1944.

[14] Nam-Kyu Park, Branislav Dragonvic, 2009. *A Study of Container Terminal Planning.* FME Transaction vol. 37, No. 4, pp 203-209.

[15] Mathew E. H. Petering, Katta G Murty, 2008, *Effect of Block Length and Yard Crane Deployment System on Overall Performance at a Seaport container Transshipment Terminal,* Computers & Operation Research **36** : 1711-1725.

[16] Henry Y.K. Lau, Ying Zha, 2008, *Integrated Scheduling of Handling Equipment at Automated Container Terminals.* International Journal of Production Economics Aplications in Technology. Vol. 1, pp 246-253.

[17] Jianyang Zeng, Weng-Jing Hsu, 2008, *Conflict-free Countainer Routing in Mesh Yard Layouts,* Robotics & Autonomous Systems 56 : 451-460.

[18] Gurning, R. O. S., Budiyanto, E. H. 2007. *Manajemen Bisnis Pelabuhan,* Makassar.Chin-I. Liu, Hossein Jula, Katarina Vukadinovic, Petros loannou, 2004. *Automated Guided Vahicle System for Two Container Yard Layouts,* Transportation Research Part C 12 : 349-368.

[19] Lamidi (2006)," *Analisis Kebutuhan Container Yard Pada Kondisi Sibuk* (*Studi Kasus Pelabuhan tanjung Emas Semarang*)", MTS, Undip,semarang.

[20] Sudjatmiko F.D.C (2006). " *Sistem Angkutan Petikemas* ", Penerbit Janiku Pustaka, Jakarta.

[21] Begum.H.2003. Impact of Port Efficiency And Productivity- A Case Study of Chittgong Port. (dissetation submitted)

[22] Chuqian Zhang, Jiyin Liu, Yat-wah Wan, Katta G Murty, Richard J Lin, 2003. *Storage Space Allocation in Container Terminals,* Transportation research part B **37**: 883-903.

[23] Performance Indicator: Unctad, TD/B/C.4/131/ Supp.1/ Rev.1

[24] Wayne K. Tally, Optimum Port s Throughput, wktalley@odu.edu.

[25] Wayne K. Tally, Port Performance: An Economics Perspective.ISSN;0739-8859/*doi:*10.1016/S0739-8859(16)17022-5