The Mundel and Objective Matrix Model of Productivity Measurement at PT Adi Perkapalan

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The Mundel and Objective Matrix Model of Productivity Measurement at PT Adi Perkapalan

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Abstract. The development of shipping sector especially in ship construction project is ship building or ship production will continue to increase from time to time. The productivity management is needed because it is important. The productivity calculation by using Mundel Model can be known from the decreasing of productivity index which is Galley part. The result of calculation by using the objective matrix (OMAX) method shown that there is an enhancement in the percentage of productivity total in 2017 but it is for the weight ratio of service which is services area and the third part. The improvement and evaluation are needed to be done to achieve a better productivity standard. There some proposals to the management to do an action to improve the productivity.

1. Introduction

The development of the ship construction model in the shipping sector especially for the ship building and the ship production will continue to increase and it is important to increase its productivity of the management. By fulfilling the company's orientation to the increased profitability, the company has to improve its efficiency and productivity of production by fulfilling the production capacity in order to absence of waste due to additional working hours and other costs.

The shipyard industry is the most important industry in supporting sea transportation within the framework of maritime development. Shipyard industry as a provider of ships for sea transportation. In addition, the ship industry also helped repair the ship (repair). In 2015 the ASEAN free market was put in place, therefore trade in Indonesia will grow rapidly. This spurred the shipyard industry to further increase the productivity of this industry both in the fields of maintenance, repair and new shipbuilding. Therefore, it is necessary to measure productivity which aims to increase productivity that has been obtained and is the basis of planning for increasing productivity in the future.

So far, there is no particular method used to measure productivity used in the construction of new vessels. Therefore, there needs to be an appropriate productivity measurement model for the construction of new vessels, in this study the model used is the objective matrix (omax) model, which is a productivity measurement that continues to use its physical measurements without being transformed into financial measures. basic work units such as workers, time spent, material and amount of use of the machine. Then the Mundel Model method from the form of the index proposed by Marvin E. Mundel, namely by measuring input productivity is calculated according to each stated that basically the Mundel model can use one formula in the application of productivity measurements at the enteIDRrise level which can also contribute to benchmarking from the Omax model.

The formulation of the problem in this study is How to determine the productivity measurement of the construction of new ships using the mundel and omax models at PT. Adi Shipping, what factors influence the increase in productivity decline.

The puIDRose of this research is to identify the factors that influence the increase and decrease in productivity in the construction of new vessels, also to know the factors that cause delays in the construction of new ships.

The benefits of this study are to add insight and knowledge and understand more about increasing productivity in the construction of new ships using the Mundel and Omax models; As input or input for companies to take policies related to productivity as well as additional references related to achieving productivity in the construction of new vessels.

2. Literature Review

2.1. The meaning of productivity

Sumanth (1984) The word "productivity" appears in 1766 that means human desire and effort to improve quality of life [1]. In 1883, Litre said that productivity means an ability to produce based on the sources that have been used introduced a formal concept which is cycle productivity to be used to increase the productivity continually. There are 4 steps of the cycle concept, which are productivity of measurement, productivity of Evaluation, productivity of planning and productivity of improvement.

2.2. Mundel Model

This model is used by company to measure its productivity from the standard time to work. The strength and the weakness of this model is appropriate to be implemented to the company by seeing its output and input. The company will be measured by it productivity by having the standard time to work like job order. Productivity index (IP) is determined by the formula:

$$IP = (\text{Output Index} / \text{Input Index}) \times 100\%$$

2.3. Objective Matrix (OMAX) Method

The objective matrix (OMAX) is a partial productivity measurement system developed to monitor productivity in every part of the company with productivity criteria that are appropriate with the existence. This measurement model has a characteristic which is the performance criteria of the work group incoIDRorated into the matrix. Each performance criterion has a target in the form of a special repair menu and it has the quality with the important level of productivity goals. The final result of this measurement is a single value for the work group. The advantages of OMAX a tool of productivity measurement, a tool to solve the productivity problems and productivity growth monitor

The performance factor is based on the productivity of objective matrix that each unit has special different dimensions. The way to measure dimension can be done by measuring its influenced factor. Objective matrix can be used to measure work units from small scale and the whole company. But, the results of measuring the performance of the units cannot be linked addictively to present the performance of the big units. All of the organizations should do a process for the quality of related units.

2.4. Form and Arrangement of Objective Matrix (OMAX)

The structure of objective matrix model consists of [2]:

1 Productivity criteria; the events and factors that support the productivity of work unit that is being measured and it is known by comparison.
2 The level of achievement; it is done by measuring to monitor the amount of performance achievement for every criterion and the successful achievement is filled through the performance lines available for all criteria.
3 Matrix scale cells; before determine the standard level 3 (average), level 0 (bad performance), and level 10 (targeted achievement), matrix scale cells should be determined first.
4 Score; it is the results of achievement of ratio performance whether the achievement is appropriate with the targeted achievement, under the target or the standard scale.
5 The quality; every criterion has its own different influenced to the measured productivity. Therefore, it needs to know the quality in degree of importance (in percent) that shows the relative influence of criteria work unit productivity that has been measured because the total of the criteria are 100%.

6 The grade; those of the grades that has been got from every period can be by multiplies the score on certain criteria
7 Indicator; the total grades of each criterion is included in the performance indicator box. The number of the indicator is 300 because the entire criterions get 3 when the matrix is operated. Also, the increasing of productivity is determined with the performance indicator.

The measurement of OMAX is done to the 3 groups of objective matrix, which is :

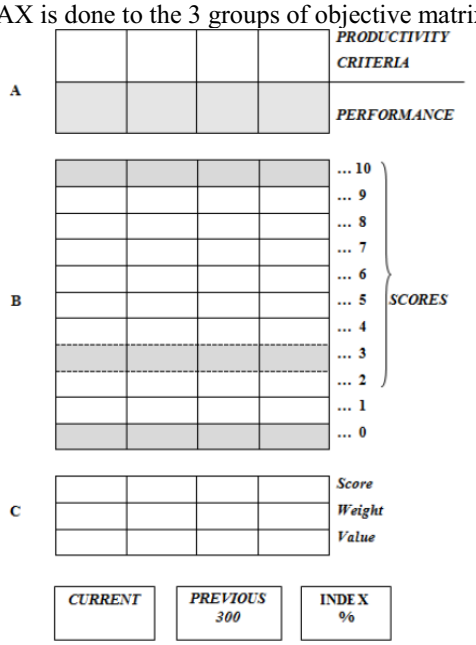

Figure 1. Mode structure of OMAX

2.5. Productivity Evaluation

After the productivity measurement is done, the next step that should be done is productivity cycle (evaluation step). Productivity evaluation needs to be done to know the productivity is increasing or decreasing to the short and long term plans. If the evaluation cannot be done, the judgment to the results of the measured productivity becomes fail. It cannot be said the grade of productivity is good or bad. There are some good ways how to evaluate, which are:

a. It needs to plan a determination that leads to changes in the grade of productivity in two consecutive periods and it should be developed to a way that allows making the change happen.
b. The method should be improved to get the productivity grade based on the budget and it can be compared with the present results.
c. A good preparation is needed from stage to stage to evaluate the productivity of grade with the sequential and given measurement period.

2.6. Fishbone Diagram

Fishbone diagram is called Ishikawa diagram that shows the relation of the cause-effect. It is related with the total productivity management the diagram can be used to show the factors of the cause-effect. The diagram is often called as fishbone diagram because it is same with the fish skeleton. This diagram is introduced by Prof. Kaouru Ishikawa from Tokyo University in 1953.

3. Methodology

This research will use secondary data and it is given from the company such as company profile, history of company production data, production data, and steel plate consumption data.

After the data are collected, data processing will be done by discussing the results with the company about the ratio indicator to do measurement and the quality of each ratio.

Then, the next step that should be done is OMAX method in order to know the level of productivity and the level of performance every month. After that, the data will be revised by using quality tools which are traffic light system, cause-effect diagram, and tools5W+1H.

4. DISCUSSION

Table 1. The production cost for each unit of pioneer ship with the type 750 DWT in 2016 and 2017 Adi Perkapalan company.

No	Job Type / Material	Vol	Unit	Cost 2016	Cost 2017
1	**Hull**	1	LOT	IDR 5,478,620,775.00	IDR 5,664,737,743.00
2	**Hull Equipment**	1	LOT	IDR 2,782,864,903.00	IDR 2,865,090,905.00
3	**Galley and Mess Room Equipment**				
	Galley	1	LOT	IDR 21,095,382.00	IDR 22,912,911.00
	Room Equipment	1	LOT	IDR 36,704,707.00	IDR 37,025,781.00
4	**Engine Installation**	1	LOT	IDR 3,629,929,168.00	IDR 3,753,866,547.00
5	**Auxiliary Motors and Pumps**	1	LOT	IDR 883,905,718.00	IDR 906,240,229.00
6	**Tanks Outside the Hull**	1	LOT	IDR 52,344,149.00	IDR 53,969,783.00
7	**Equipment**				
	Installation of the PeIDRlexing System (Valve, Flends & equipment)	1	LOT	IDR 476,781,281.00	IDR 484,052,188.00
	Electrical installation	1	LOT	IDR 530,840,353.00	IDR 540,111,446.00
	Firefighters	1	LOT	IDR 176,367,052.00	IDR 181,855,633.00
8	**Mooring and Anchoring**	1	LOT	IDR 348,319,155.00	IDR 359,132,964.00
9	**Safety Equipment**	1	LOT	IDR 410,300,897.00	IDR 418,223,030.00
10	**Other Equipment**	1	LOT	IDR 759,524,945.00	IDR 779,331,368.00
11	**Engines Deck**	1	LOT	IDR 961,532,476.00	IDR 993,998,177.00
12	**Development Services and Third Parties**			IDR 3,548,169,031.00	IDR 3,679,451,295.00
	Total Input (Cost)	1		IDR 20,097,299,992.00	IDR 20,740,000,000.00
	Total Output (Selling Price)	1		IDR 30,145,949,988.00	IDR 31,110,000,000.00

Table 2. The results of productivity calculations based on Mundel theories

No	Job Type / Material	Productivity	Increase / Decrease
1	**Hull**	100.19	0.19
2	**Hull Equipment**	100.23	0.23
3	**Galley and Mess Room Equipment**		
	Galley	95.01	-4.98
	Room Equipment	102.3	2.3
4	**Engine Installation**	99.79	-0.21
5	**Auxiliary Motors and Pumps**	100.65	0.65
6	**Tanks Outside the Hull**	100.08	0.08
7	**Equipment**		
	Installation of the PeIDRlexing System (Valve, Flends & equipment)	101.64	1.64
	Electrical installation	101.42	1.42
	Firefighters	100.08	0.08
8	**Mooring and Anchoring**	100.09	0.09
9	**Safety Equipment**	101.24	1.24
10	**Other Equipment**	100.57	0.57

No	Job Type / Material	Productivity	Increase / Decrease
11	**Engines Deck**	99.82	-0.17
12	**Development Services and Third Parties**	99.51	-0.48

Table 3. Job Weight in 2017 and 2016

No	Job Type / Material	Job load	Achievement (2017)	Realistic Target	Minimum Target	Achievement (2016)
1	**Hull**	27.31%	87%	88%	73%	80%
2	**Hull Equipment**	13.81%	97%	97%	84%	90
	Galley and Mess Room Equipment					
3	Galley	0.11%	100%	100%	95%	95
4	Room Equipment	0.18%	100%	100%	95%	95
5	**Engine Installation**	18.10%	77%	79%	70%	72
6	**Auxiliary Motors and Pumps**	4.37%	80%	86%	75%	78
7	**Tanks Outside the Hull**	0.26%	83%	89%	75%	79
	Equipment					
8	Installation of the PeIDRlexing System (Valve, Flends & equipment)	2.33%	88%	90%	80%	85
9	Electrical installation	2.60%	81%	91%	80%	87
10	Firefighters	0.88%	98%	100%	95%	98
11	**Mooring and Anchoring**	1.73%	94%	100%	90%	96
12	**Safety Equipment**	2.02%	100%	100%	99%	99
13	**Other Equipment**	3.76%	92%	97%	90%	91
14	**Engines Deck**	4.79%	79%	87%	75%	81
15	**Development Services and Third Parties**	17.74%	86%	93%	80%	85

Table 4. The results of calculation between traffic light system and OMAX method

Job Type / Material		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Achievement (2017)		87%	97%	100%	100%	77%	80%	83%	88%	81%	98%	94%	100%	92%	79%	86%
Achievement (2016)		80%	90%	95%	95%	72%	78%	79%	85%	87%	98%	96%	99%	91%	81%	85%
	Score															
	Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Realistic Target	10	88%	97%	100%	100%	79%	86%	89%	90%	91%	100%	100%	100%	97%	87%	93%
	9	87%	96%	100%	100%	78%	85%	88%	89%	90%	100%	99%	100%	97%	86%	92%
	8	86%	95%	99%	99%	78%	84%	87%	89%	89%	99%	99%	100%	96%	85%	91%
	7	85%	94%	99%	99%	77%	84%	86%	88%	89%	99%	98%	100%	96%	84%	90%
	6	84%	93%	99%	99%	76%	83%	85%	87%	88%	99%	97%	100%	95%	84%	89%
	5	83%	92%	98%	98%	76%	82%	84%	86%	87%	98%	96%	100%	95%	83%	88%
	4	82%	91%	98%	98%	75%	81%	83%	86%	86%	98%	96%	100%	94%	82%	87%
Average Target	3	81%	91%	98%	98%	75%	81%	82%	85%	86%	98%	95%	100%	94%	81%	87%
	2	78%	88%	97%	97%	73%	79%	80%	83%	84%	97%	93%	99%	92%	79%	84%
	1	76%	86%	96%	96%	72%	77%	77%	82%	82%	96%	92%	99%	91%	77%	82%
Minimum Target	0	73%	84%	95%	95%	70%	75%	75%	80%	80%	95%	90%	99%	90%	75%	80%

2017 Score		9	10	10	10	7	2	4	7	0	5	2	10	2	2	2
Score of 2016		2	2	1	0	1	1	1	3	5	5	5	2	1	3	2
Weight		27.31%	13.81%	0.11%	0.18%	18.10%	4.37%	0.26%	2.33%	2.60%	0.88%	1.73%	2.02%	3.76%	4.79%	17.74%
2017 Value		246%	138%	1%	2%	127%	9%	1%	16%	0%	4%	3%	20%	8%	10%	35%
Value of 2016		55%	28%	0%	0%	18%	4%	0%	7%	13%	4%	9%	4%	4%	14%	35%

Performance Indicator	Current		Previous		Index	
	2017	2016	2017	2016	2017	2016
	620%	196%	300%	300%	207%	65%

Notes:

- The green color with the threshold (level 7 up up level 10) means the target has been achieved.
- The yellow color with threshold (level 3 up to level 6) means that the target has not been achieved but it is almost near with the targeted performance.
- The red color with the small threshold from level 3 means the performance is under the target

Those of the problem are analyzed by using cause-effect diagram. The following is the cause-effect Diagram:

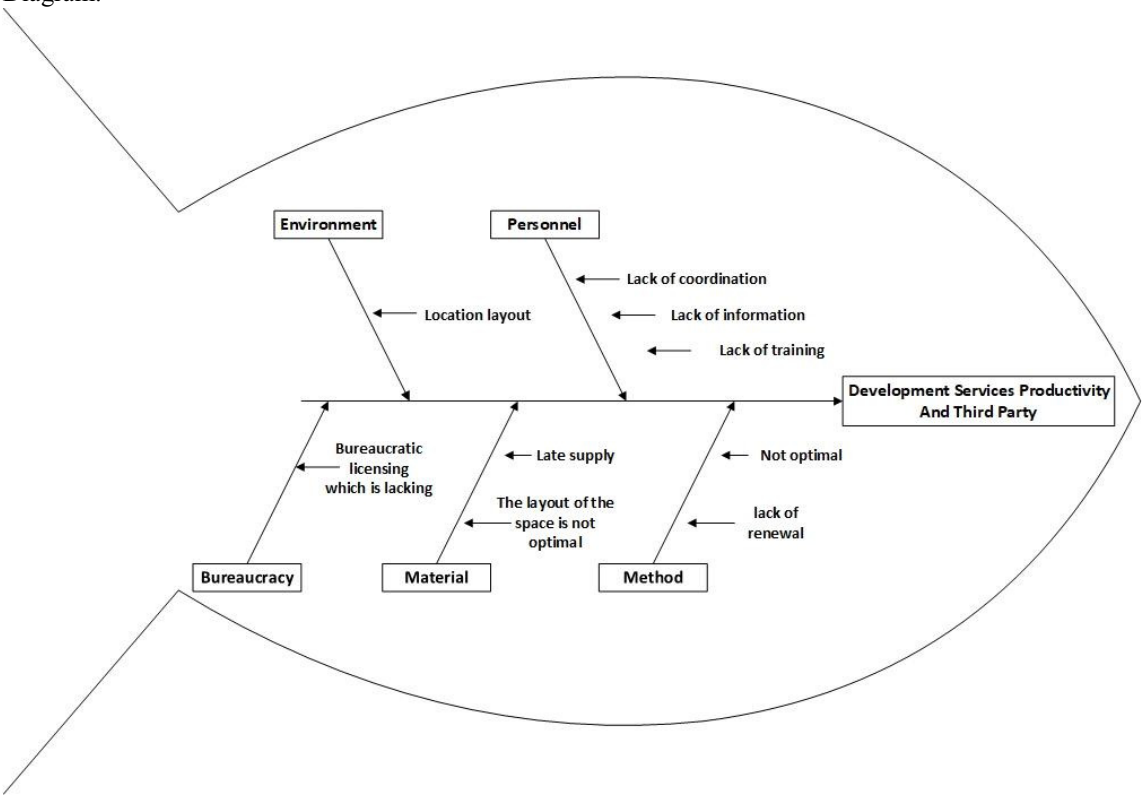

Figure 2. Cause-effect diagram toward the decreasing of performance to develop services and the third part.

Table 5. The proposals of 5w+1H for the development services and the third part

No	Factors	What	Why	Who	Where	When	How
1	Personal	Lack of coordination	The coordination is more increased to achieve the target	All personnel	All division	every day	A good Socialization can be done to the employees in or de to avoid miscommunication and it is needed to have training continuously
		Lack Of Information	Because integrated information is a key	All personnel	All division	every year	Hold information technology training
		Lack Of Training	Because knowledge and deepening of the field is very important	All personnel	All division	every year	hold training in each scientific field in each division

No	Factors	What	Why	Who	Where	When	How
2	Method	Not Optimal	In order the management of the company increase the management services and the third part	Production manager	Production division	Every day	Coordination to remind each other for the services and the third part in making standard rules
		Lack Of Renewal	in order to better carry out developments in the current industrial era 4.0	Quality control	Production division	Every renewal	One of them follows ISO rules
3	Materials	Late supply	The supplier can be on time by following the schedule	Supplier manager	Production manager	When the products are produced	Standardization needs to be done to check the material, monitor the schedule routinely from supplier
		The layout of the space is not optimal	So that the material arrangement is more optimal in its operation	warehousing manager	Warehousing division	When there is a lot of material buildup	Arrangement or redesign
4	Environment	Less of the warehousing and the access	To reduce the time of delay and the placement	warehousing manager	Warehousing division	When it is supplied and saving	Making a plan for the request and save it well.
		Location layout	To reduce the time of delay and the placement	warehousing manager	Warehousing division	When it is supplied and saving	Making a plan for the request and save it well.
5	Bereaucracy	Bureaucratic licensing which is lacking	So that there is no document stack queue	Head of the company	Both sides	Every year	Evaluate and change the flow of licensing better

5. CONCLUSION

1 There is a decreasing to the productivity calculation by using Mundel Model which is Galley. It is very significant for the decreasing of productivity index which 4.98%. But, Mundel Model is not really accurate to be used because the factors are not appropriate to be implemented and the Galangan kapal company is monitoring its wide production.

2 The results of the calculation by using the objective matrix method (OMAX) showed that the increasing of the total of its productivity in 2017 and 2016. But, the management service and the third part keep decreasing and there is no any change. It can be seen through the red color to the table that the threshold is smaller from level 3. It means that the progress is under the achieved target. In addition, management service and the third part did not increase from 2016 and 2017 which is 84 % under the average 87%.

3 Improvement and evolution are needed to be done to achieve a better standard productivity. Some suggestions from management to do some enhancement to improve its productivity for the services and the third part. Those of the solution are: a. the employees should be given

clear information to avoid the miscommunication and training can be done continually from the personal. b. Coordination to remind each other for the services and the third part in making standard rules. c. Standardization needs to be done to check the material, monitor the schedule routinely from supplier, d. making a plan for the request and save it well.

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