Analysis the Efficiency and Productivity Measurement of PT Mariana Bahagia Shipyard using OMAX Method

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Abstract – **The progress of the maritime industry, particularly in ship construction projects such as ship building or ship manufacture, will continue to expand throughout period. Productivity and profitability criterion for evaluating the success rate of a dock and shipyard's manufacturing process, whether in ship repair or new construction. The OMAX productivity measurement method will be utilized to calculate the productivity rate in this research on PT. Bahagia Mariana Shipyard. OMAX is a method for displaying a certain performance level by combining a production indicator with a weighing procedure to produce a complete achievement indicator. According to the findings of this study, the elements that influence productivity are material man-hour machine usage workforce usage effective work-hour actual work-hour and employee absence rate. Efforts to boost productivity may be made by focusing on productivity factors that have a high priority, with each priority determined by the weight of each productivity component. Productivity is improved by adjusting the productivity factor ratio.**

Keywords – **effective; efficiency; productivity;omax; shipyard performance**

I. INTRODUCTION

A shipyard is an Engineer To Order (ETO) firm that creates and manufactures items in response to requests from shipowners. Thus, in this project-oriented business, where multiple activities spanning from order to design, acquisition, procurement, and manufacturing are conducted concurrently, planning and controlling procedures are critical. Planning and systematic management are especially critical for manufacturing, which takes up the majority of the project's period. The maritime sector is very significant to Indonesia because it encompasses a wide variety of elements such as economy, law, defense, security, the environment, and sociocultural effects. The condition of the various islands necessitates the need for marine transportation infrastructure, which are key components of national and global economic growth. The port is an important piece of infrastructure

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for the area's economic growth, notably in terms of industrial distribution [1].

Productivity is one indicator of the company's success in empowering its resources to produce targeted products [2]. Productivity is related to production efficiency [3] in the form of a ratio between the products produced and the resources used. This ratio will show the level of productivity of a company and can be used as a management evaluation material for ongoing operational processes in creating more effective and efficient company activities [4].

One of the methods used to measure productivity in manufacturing companies is the Objective Matrix (OMAX) method. OMAX is a partial productivity measurement method for monitoring the productivity of each section [5] by weighting to obtain a total productivity index [6]. This measurement model has the characteristic of combining the productivity criteria of work groups in a matrix [7]. The results of this measurement become an objective performance assessment in each section and solutions can be found for the cause of the decline in productivity [8]. The OMAX method is able to evaluate existing performance by referring to predetermined indicators to improve the performance process for the better [9].

The deployment of a framework known as the objectives matrix (OMAX) is carried out to accomplish the following tasks:

(1) Translate strategy objectives to critical success factors (CSFs).

(2) Determine weights that prioritize strategy objectives.

(3) Define appropriate measurement scales for performance related to the CSFs, in physical, economic or other units.

(4) Calculate a performance indicator that combines all weighted values for the individual measurements for the CSFs.

(5) Determine a general performance index by comparing performance in successiveperiods and interpreting the results.

(6) Mobilize human resources at all levels through effective teamwork to reach higher goals through improvement projects.

The main research will be conducted on PT. Mariana Bahagia performance was established in August 1980 and has steadily developed to become an industry leader, employing personnel that are both experienced and professional. Experts that work for the organization have constructed a number of different ships. It have excellent facilities with a capacity of up to 5000 DWT, which makes it possible to compete with other shipyards on an international scale and win business. Construction of new ships with an annual production capacity of 8 units Repair and maintenance of ships with a capacity of 50 units per year are provided.

Figure 1 Launched of KMP Bahtera Nusantara 01, 1500-GT class Ro-Ro passenger ferry at PT. Mariana Bahagia Shipyard, Palembang

In this study, the productivity of the production department of PT Mariana Bahagia Shipyard in Palembang will be measured, and the researchers will investigate for ways of improving the department's current productivity. In order to enhance productivity as a result of using the OMAX approach, leaders may use these findings to their benefit.

II. METHODS

The research method that will be used is the case study method, with examples of productivity measurement cases at the PT. Mariana Bahagia, Palembang. This productivity measurement is measured using the Objective Matrix (OMAX) method.

The general productivity analysis approach starts with defining measurement objectives. Then each target must be given a set of criteria. To determine the objectives and criteria, first determine the two primary stages. Because computation begins after this stage of the model. Management must approve the criteria's scale and weights. The entire productivity index can then be calculated.

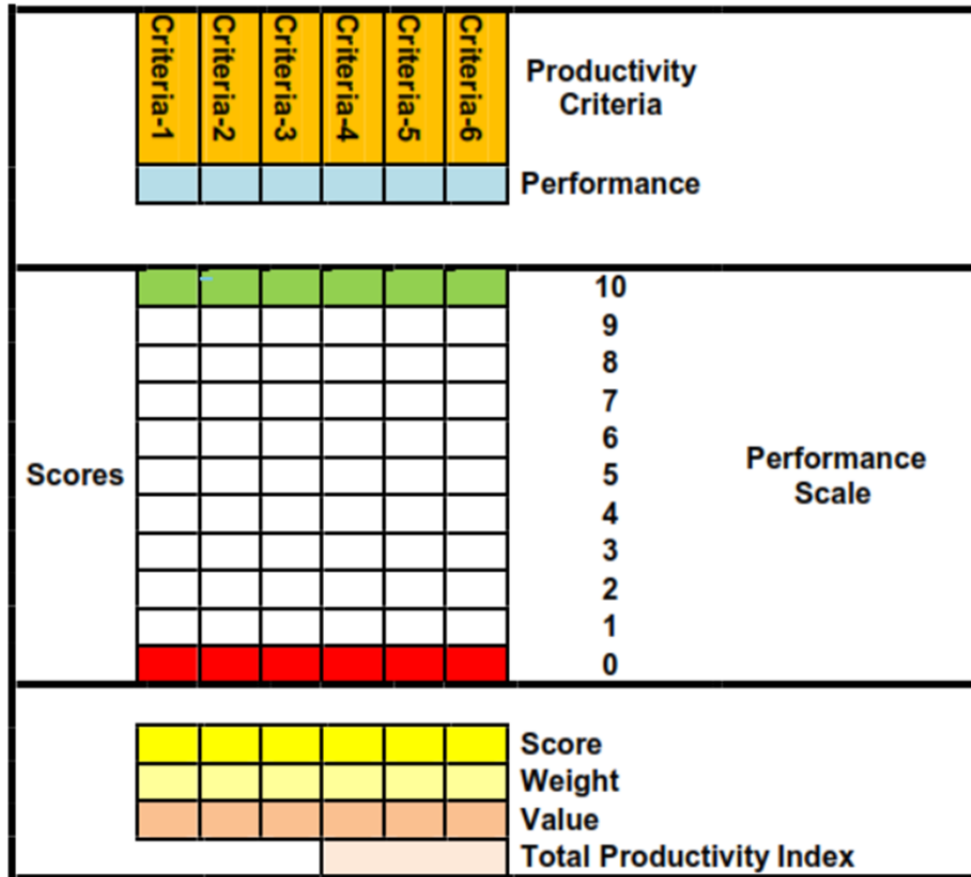Figure 2 shows the OMAX approach in its general form.

Figure 2 OMAX approach in its general form

The data obtained is then processed and analyzed using the Objective Matrix (OMAX) model, with the following steps:

Step 1 : Determination of criteria

The criteria used in calculating productivity using the OMAX model are efficiency, effectiveness, and inferential criteria. The criteria used after conducting interviews and filling out questionnaires to the company's management team obtained only seven performance indicators that was used. The seven indicators are presented in Table 1. The criteria for performance indicators refer to the seven performance indicators.

Table 1 The criteria for measuring productivity

Criteria	Working Indicators
Effciency	Man Hours (kg/MH)
Effetiveness	Actual working of production (%)
Inferential	Machine Downtime (%)

Step 2 : Standard performance measurement

Standard performance is obtained from the average ratio of each criterion in a predetermined period. The period that has been set in this research is the last four years, from 2017 to 2020 of PT. Mariana Bahagia Shipyard

Step 3: Final goal setting

The final determination was obtained from the results of questionnaires and interviews. The final determination is determined by the shipyard management after obtaining standard performance scores. The final determination consists of 3 (three) score scales. The scores are a score of 0, a score of 3 and a score of 10. A score of 0 is the lowest level of the worst possible ratio. A score of 3 is the initial achievement, and a score of 10 is an achievement to be achieved in the future.

Step 4: Target matrix formation

After determining a score of 0, 3, and 10, a score of 1, 2, 4, or 9 remains. The items on a score of 1, 2, 4, or 5 to 9 represent intermediate levels of achievement necessary to earn the final level of achievement, or a score of 10. attained. For the purpose of constructing the target matrix, interpolation is used to determine the residual score. The increase in scores for scores 1 and 2 is accomplished using interpolation asa following equation (1):

$$\frac{Score\ 3-\ Score\ 0}{3-0} \tag{1}$$

The increase in scores from 4 to 9 is done by interpolation using following equation (2):

$$\frac{Score\ 10-\ Score\ 3}{10-3} \tag{2}$$

Step 5: Determation of Score : Actual, Performance Indicator and Productifity Index

The actual score is determined based on the results of the measurement of the ratio of each criterion in a certain period which is converted into a score on the appropriate target matrix. Each score obtained for each criterion or ratio is multiplied by the amount of each weight.

The determination of the performance indicator is the sum of the actual values of all the measurement criteria carried out. then, calculate the value of the productivity index (IP) using the formula below (3):

$$IP = \frac{P_t^c - P_t^b}{P_t^b} \tag{3}$$

Where, IP is Index of Productivity, P_t^c is current period measurement result of Productivity, P_t^b is Productivity measurement results of the previous period

The increase in productivity is determined by the magnitude of the increase in achievement indicators that occur between the new and the old.

III. RESULT AND DISCUSSION

A. Shipyard Performance

Measurement with the OMAX (Objective Matrix) model combines shipyard productivity criteria into an integrated form and

relates to each other. PT. Mariana Bahagia shipyard productivity criteria are activities and factors that support the productivity of shipbuilding activities. The measured criteria include efficiency, effectiveness and inferential criteria.

1) Criteria for effectiveness of work results (productivity criteria 1)

This criterion is a measurement of the productivity of the actual number of production results with the standard output that must be achieved, this criterion was chosen to determine the comparison between the amount of production that has been produced and the production target that has been set. The ratios that make up the criteria for production effectiveness:

$$\frac{Actual\ Result\ of\ Job\ Schedule\ (Man\ hours)}{Standart\ Job\ on\ Schdule}\ x\ 100\% \tag{4}$$

2) Effective working hours criteria (productivity criteria 2)

This criterion is a measurement of the productivity of available working hours with idle machine hours, this criterion was chosen to determine the comparison between available working hours and the number of idle machine hours. The ratios that make up the criteria for efficiency working hours:

$$\frac{Available\ working\ hours}{Equipment\ working\ hours}\ x\ 100\% \tag{5}$$

3) Machine Downtime Criteria (productivity criteria 3)

This criterion is a measurement of machine downtime with machine working hours. This criterion was chosen to compare downtime with machine working hours. The ratios that make up the criteria for the Amount of Downtime:

$$\frac{Actual\ Downtime}{Maching\ Workin\ hours}\ x\ 100\% \tag{6}$$

Table 2 Productivity for each criteria

Year	productivity criteria 1 (%)	productivity criteria 2 (%)	productivity criteria 3 (%)
2017	98.84	82.24	21.04
2018	95.16	83.35	19.97
2019	96.17	90.45	10.56
2020	94.76	86.24	15.95

Table 3 Criteria value

No	Productivity Criteria	Unit (%)	Perfomance			
			Worst	Expected	Based	Measured
1	Work Effectiveness Ratio	%	85.09	100	98.3	95
2	Effective working hours ratio	%	75.71	100	93.21	95
3	Machine Downtime Ratio	%	32.08	10	7.28	8

B. Productivity Measurement

In measuring productivity with the Objective Matrix (OMAX) model, there is a matrix body which is divided into ten levels that have value levels. Meanwhile, the performance indicators consist of: current (number of values at the time of measurement), previous (number of measurements of the previous period), and productivity index (IP).

The performance scale is divided into three levels which serve as reference points. Level 0 is determined based on the lowest ratio value from the calculation of the productivity ratio. Level 3 is determined from the calculation of the average value of the ratio on each productivity criterion which is then called standard performance. Level 10 is determined based on the targets to be achieved in the coming year. The results of determining the weights are placed in the weight (%) row for each productivity criterion. The determination of the performance scale of each level can be seen in Table 4 below.

Table 4 Objective Matrix (OMAX) at 2020

Work Effectiveness Ratio	Effective working hours ratio	Machine Downtime Ratio	Productivity Criteria
95	95	8	Performance
100	100	7.28	10
99.75	99.03	7.66	9
99.51	98.09	8.06	8
99.27	97.09	8.44	7
99.02	96.12	8.83	6
98.78	95.15	9.22	5
98.54	94.18	9.61	4
98.30	93.21	10	3
94.62	83.35	19.97	2
89.19	82.61	21.04	1
85.09	75.71	32.08	0
2	5	8	Score
33.33	16.67	16.67	Weight
66.66	83.35	133.36	Value
383.36			Total Productivity (Current)
300			Total Productivity (Based)
27.79%			Index of Productivity

In measuring productivity with the Objective Matrix (OMAX) model, there is a matrix body which is divided into ten levels that have value levels. Meanwhile, the performance indicators consist of: current (number of values at the time of measurement), previous (number of measurements of the previous period), and productivity index (IP). There was an increase in productivity, it can be seen because the IP value (productivity index) which was positive (+) was 12.49 and there was an increase in the calculation at the time of measurement (current) from 300 to be 383.36 This increase was due to an increase in the value of all criteria.

Analysis of productivity measurement based on criteria is carried out to determine the influential criteria and must be improved. From the results of the scores for each of the productivity criteria, it shows that the scores for the first and second criteria really need to be improved because the scores produced are dominated by quite a lot of poor productivity. The third criterion also needs to be improved even though it is good enough so that the company's productivity will increase. As for the

fourth criterion, although it is good enough for the company's productivity to increase.

Overall the performance produced by PT. Mariana Bahagia shipyard is quite productive. This is because in each measurement period many performance indicators reach a score of 3, some are even stable at a score of 10. A score of 3 is the average value of the entire measurement period. There are still indicators whose achievement score is below a score of 3, even reaching a score of 2 as in 2017, but none of the indicators achieved a score of 0. The total performance achievement achieved by PT. Mariana Bahagia shipyard did not show a significant change. every period, or can even be said to be stable. This can be seen from the index value based on the previous period, only an increase in the index by 43.47% in 2008 and a decrease in the index in 2020 by 18.72%.

All performance indicators that have been measured are, of course, expected to reach and even exceed the average value of the measurement, it indicates an increase in better work. In fact what happens is that most of the values of performance indicators that have been measured each period fluctuate, meaning that the indicators from one period to the next may increase or decrease. This shows that a company's efforts to improve performance are still not optimal, and have not shown good results. Based on the measurement results, indicators that have low scores (not exceeding a score of 3) are machine usage and actual working hours of production.

C. Potential for scaling up and down OMAX applications

The application of OMAX has been concentrated on an intermediate level in the organization for a specific key resource, specifically man hour, because it has a significant impact on work efficiency. OMAX is a flexible strategy that may be expanded to incorporate greater areas of, or perhaps the entire business. It can also be reduced in size to focus on more intricate processes or fewer organizational units.

Every effort should be made for each kind of application to arrange the matrix to include those performance criteria that are critical in completing the work unit's goal. Consider an organization to have a shadow tree-like set of elements influencing its performance. At each level and for each process, there is a collection of CSFs that impact the degree to which the strategy's goals are met.

IV. Conclusion

The connection between levels and their interactions is critical, as enterprise-level productivity increases are necessary for macro-level productivity improvements. Thus, enterprise-level productivity measurement is required for the aim of realizing how to maximize corporate efforts on findings in order.

Productivity PT. Mariana Bahagia Shipyard is already quite productive. This is because in each measurement period, many performance indicators reach a score of 3, some are even stable at a score of 10. In general, the achievement of total performance achieved by PT. Mariana Bahagia Shipyard does not show significant changes every period, or can even be said to be stable. This can be seen from the index value based on the previous period, which experienced an increase in the index by 35.47% in 2017 and a decrease in the index in 2020 by 11.72% due to the pandemic.

The factors that influence the increase in productivity are employee absenteeism, use of machines, effective working hours, actual working hours of production, and use of labor. Thus, steps must be taken to increase productivity is to pay attention to the number of employee absenteeism. Given, the performance indicator for employee absence has the highest importance weight value, which is 27.5%.

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