

Manpower Optimisation Needs with Workload Approach Using NASA-TLX Method on Ship Reparation

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Abstract— One of many things that could help the company to achieve their goals is a good human resource planning. The right calculation to optimize the manpower needs can make a company be more effective, efficient, and productive in finishing their works. In contrast, to increase productivity, the workload would be increasing too. KM. Asia Putra reparation in PT. Adiluhung Saranasegara Indonesia will be used as the object of this research because the project is considered to experience a long delay. The main purpose of this study is to provide recommendations for recruiting more manpower with a workload approach. The method that chosen is NASA-TLX which is a method that calculate workload subjectively. The result from NASA-TLX method recommends the company to add 35 more manpower to reach the optimal number for ship reparation process. With the recommendation, the schedule of ships reparation that was first planned for 25 days could be reduced 18 days. This study has a limitation in the field of cost that could be used as an object for further research.

Keywords—workload, standard time, NASA-TLX, full time equivalent

I. INTRODUCTION

One of many things that could help a company to achieve their goals is a good human resource planning. The right calculation to optimise the manpower needs can make a company more effective and efficient. Therefore, with the increase of effectiveness and efficiency, the workload of the manpower will be increased too [1]. The workload that should be given to the manpower must be calculated so the manpower will get the perfect amount of workload. Workload can affect productivity and the speed of works done in a job, including in a shipbuilding sector [2]. Many previous studies have analysed the delay in ship production through work schedules, project costs, material arrivals, and others. These past research have the same goals, namely to evaluate the delayed schedule of ship production to be applied in the future. This research will only focus on the manpower. This paper will use KM. Asia Putra as the object in PT. Adiluhung Saranasegara Indonesia. This ship experienced an extension of annual repair schedule for 11 days from the main timetable which resulted in the process being delayed to 25 days for no apparent reasons. This paper will use NASA-TLX method to help determining the amount of workload subjectively. The purposes of this paper are determining the workload of the manpower and

determining the optimal manpower using NASA-TLX method.

II. LITERATURE REVIEW

A. Human Capital Management

Management is an activity of planning, organizing, implementing, and controlling the available resources in order to achieve the goals that have been made.

Human capital management is a process of recruitment, development, and motivation to all members in an organisation. This process includes choosing the right mand on the right place [3].

B. NASA-TLX

NASA-TLX is a multi dimensional rating procedure to determine workload of the manpower subjectively that provides an overall workload score based on a weighted average ratings on six subscales : Mental Demand (MD), Physical Demand (PD), Temporal Demand (TD), Performance (P), Effort (E), and Frustration (F) [4]. The form of this method is a questionnaire based on measurement needs that are easier but sensitive to measure the mental workload of the manpower.

The six subscales of NASA-TLX could be described as : Mental Demand, is the ability of a person to process an information that could affect a person's performance. Physical Demand, is how much physical activity is needed when the person is working. Temporal Demand, is a person's time needs to complete a task from provided time and the person's ability to complete the job. Performance, is the level of success that the person's carry out with an indicator whether the job they're doing is successful or not. Effort, is how much effort does the person makes to complete a task. Frustration, is a condition that can cause a person confusion, stress, and fear during the completion of the job [5].

III. METHODS

In this research, there will be 51 manpower that directly involved in KM. Asia Putra reparation process from Project Leader, PPC, and Welder. They will be asked about what they feel during the reparation process.

A. NASA-TLX Measurement Stages

There are 4 stages to measure the workload of the manpower using NASA-TLX Method;

- **Weighting:** At this stage, manpower involved will be provided with 15 pair-wise comparisons of indicator that must be filled in by giving a check based on which indicator they feel most when during work.
- **Rating:** At this stage, manpower will be asked to give a reting of the six indicators with a range of 0-100 on the rating sheet. The rating will be multiplied by the tally for each indicators to present the final result.
- **Averaging:** After multiplying the rating and the tally, the sum of weighted ratings for each task will be devided by 15.
- **Determining:** The final number after deviding the weighted ratings is the workload of the manpower that categorised into three. For the final number between 0-50, the workload is light. 51-80 is categorised as average and the heavy workload is for the final number above 81.

IV. DISCUSSION

For 51 respondents that directly involved with the reparation process of KM. Asia Putra, the results for the workloads are as follows.

A. Weighting

In this pair-wise comparisons of factor stage, respondents will be asked to choose between two comparisons according to what they feel most during work. For example, the Project Leader and PPC gave this responses in Table I.

TABLE I. WEIGHTING

Respondent	MD	PD	TD	P	E	F	Total
1	2	1	4	3	3	2	15
2	2	2	3	3	4	1	15

B. Rating

In this stage, the respondents will give rating scale for each factors. As mention before, the respondents will have to give rating from scale 0 to 100. This rating stage will be followed by relevant questions for each indicator as shown in Table II.

TABLE II. INDICATOR QUESTIONS

Indicators	Questions
Mental Demand	How much mental effort is needed in your work ?
Physical Demand	How much physical effort is needed in your work ?
Temporal Demand	How much pressure that related to time to finish your work ?
Performance	How big is your level of success in doing your work ?
Effort	How much mental and physical work is needed to complete your work ?
Frustration	How much level of anxiety, feeling stressed do you feel when doing your work ?

The rating example is shown in Table II.

TABLE III. RATINGS

	MD	PD	TD	P	E	F
Project Leader	40	60	50	40	60	40
PPC	50	50	75	40	80	60

C. Averaging

Table III shows the result of weighted rating for each indicators that then will be divided by 15.

TABLE IV. AVERAGING

	MD	PD	TD	P	E	F	Total	WWL
Project Leader	80	60	200	120	180	80	720	48
PPC	100	100	225	120	320	60	925	61.7

D. Determining

Table IV shows the complete WWL of 51 respondents.

TABLE V. WEIGHTED WORKLOAD

Respondent	WWL
1	48.0
2	61.7
3	78.7
4	69.0
5	67.0
6	68.0
7	63.3
8	67.3
9	69.3
10	66.7
11	61.3
12	78.3
13	60.3
14	48.3
15	53.7
16	46.0
17	53.3
18	48.3
19	50.0
20	50.3
21	72.0
22	69.0
23	69.0
24	78.7
25	76.3
26	68.7
27	71.0
28	56.7
29	56.0
30	64.0
31	77.0
32	50.7
33	60.0
34	52.3
35	69.7
36	50.0
37	50.7
38	48.0
39	50.0
40	54.7
41	54.0
42	54.7
43	53.3
44	45.3

Respondent	WWL
45	49.3
46	48.7
47	68.0
48	72.3
49	74.0
50	69.0
51	70.7

For analysis example, respondent 1 has 48 weighted workload that categorised into the light workload. The factor that affect respondent’s workload can be different from each manpower. As for respondent 1 or the project leader, he valued his Mental Demand 80, the Physical Demand 60, 200 for Temporal Demand, 120 for Performance, 180 for Effort, and 80 for Frustration. From this number, it can be concluded that the factor that influence respondent 1 workload the most was Temporal Demand. In the previous explanation, Temporal Demand, is a person’s time needs to complete a task from provided time and the person’s ability to complete the job. It can be seen that respondent 1 or project leader needs more time or more ability to finish the task given.

From the whole weighted workload, the average weighted workload for 51 respondents is 61.03 which is categorised as Average workload.

To make the workload light, an amount of manpower will be recommended. The suggestion number of manpower will be shown in Table 5.

TABLE VI. MANPOWER RECOMMENDATION

Respondent	WWL	Recomm.	WWL Recom.
1	48.0	1	48.0
2	61.7	2	30.8
3	78.7	2	39.3
4	69.0	2	34.5
5	67.0	2	33.5
6	68.0	2	34.0
7	63.3	2	31.7
8	67.3	2	33.7
9	69.3	2	34.7
10	66.7	2	33.3
11	61.3	2	30.7
12	78.3	2	39.2
13	60.3	2	30.2
14	48.3	1	48.3
15	53.7	2	26.8
16	46.0	1	46.0
17	53.3	2	26.7
18	48.3	1	48.3
19	50.0	1	50.0
20	50.3	1	50.3
21	72.0	2	36.0
22	69.0	2	34.5
23	69.0	2	34.5
24	78.7	2	39.3
25	76.3	2	38.2
26	68.7	2	34.3
27	71.0	2	35.5
28	56.7	2	28.3
29	56.0	2	28.0
30	64.0	2	32.0
31	77.0	2	38.5
32	50.7	1	50.7
33	60.0	2	30.0
34	52.3	2	26.2
35	69.7	2	34.8

Respondent	WWL	Recomm.	WWL Recom.
36	50.0	1	50.0
37	50.7	1	50.7
38	48.0	1	48.0
39	50.0	1	50.0
40	54.7	2	27.3
41	54.0	2	27.0
42	54.7	2	27.3
43	53.3	2	26.7
44	45.3	1	45.3
45	49.3	1	49.3
46	48.7	1	48.7
47	68.0	2	34.0
48	72.3	2	36.7
49	74.0	2	37.0
50	69.0	2	34.5
51	70.7	2	35.3

With the new number of manpower, the schedule for ship reparation could be fastened as shown in Table VI with Eq. (1).

$$\begin{aligned}
 & \text{No. of new worker} \\
 &= \frac{\text{no. of old days}}{\text{no. of new days}} \\
 & \times \text{no. of old worker} \quad (1)
 \end{aligned}$$

TABLE VII. SCHEDULE RECOMMENDATION

No	Process	Old Day	New Day
1	Docking/Undocking	2	2
2	Scrapping	2	1
3	Water-jetting	1	1
4	Sandblasting	2	1
5	Ultrasonic Test	1	1
6	Replating	13	9
7	QA-QC	2	1
8	Painting	3	1
9	Zinc Anode Replacement	2	2
10	Sea Chest Treatment	5	1
11	Anchor Treatment	6	3
12	Propulsion Treatment	2	1

In conclusion, the average manpower workload using NASA-TLX is 61.03 and after adding more 35 manpower, the workload can be reduced to light categorised. For further research, the suggestion is to compare NASA-TLX method with another and also the later paper could include cost.

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