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Workload Environment Analysis And Optimization Of The Number Personnel Of Ships Using WLA Methods

I Made Jiwa Astika, Avando Bastari, Okol Sri Suharyo

Indonesia Naval Technology College, STTAL Surabaya Indonesia

Abstract – Navy Ships A is the newest ship in the ranks of the Barque type Koarmada Surabaya made in Spain which has the main task of specialization in Foreign Goods. Since being inaugurated as part of the Indonesian Navy, Navy Ships A has a definite schedule of shipping operations every year to support foreign goodwill, practice training for Khartika Jala Krida Navy cadets as well as protocol duties. While the real conditions that occur, the placement of personnel based on the existing Personnel Composition List (DSP) is very less compared to the number of personnel for the type of sailing ship, which is smaller in size. This makes the workload of Navy Ships A personnel high. This study aims to calculate the workload and work efficiency of Navy Ships A personnel and calculate the optimal number based on the Work Load Analysis (WLA) method. After collecting activity data and task completion time, calculations, and analysis of calculation results, it was found that all departments had met workload standards, namely efficiency levels above 80%, and two departments had high work efficiency levels above 120% so that additional personnel were needed. namely in the operations department and the arms and nautical department. And the optimal total personnel on Navy Ships A is 76 personnel. Thus it requires an additional 12 personnel from the previous DSP which amounted to 66.

Keywords – Workload analysis (WLA), The Number of Personnel.

I. INTRODUCTION

The Indonesian National Armed Forces The Navy is part of the Indonesian National Army which is responsible for the defense operations of the Republic of Indonesia in the sea area. Article 9 of the Armed Law no. 34 of 2004 states that the task of the Navy in the defense sector is to enforce the law and maintain security in the marine area of national jurisdiction following the provisions of national law and ratified international law, carry out the tasks of Navy diplomacy in the context of supporting foreign policy policies set by the government, and carry out the duties of the Armed in the development and strength of the marine dimension. In general, 5 things are the duties of the Indonesian Navy, namely:

a. Carry out the duties of the National Armed Forces in the field of defense.

b. Enforce the law and maintain security in the marine area of national jurisdiction under the provisions of ratified international law.

c. Carry out the duties of Navy diplomacy to support foreign policy policies set by the government.

d. Carrying out the duties of the National Armed Forces in the development and development of the strength of the marine dimension.

e. Implementing the empowerment of the marine defense area.

Seeing the tasks of the Navy above, one of the activities, namely the development and development of the strength of the marine dimension, is very important to be carried out to be able to control and secure the entire ocean area it owns. Therefore, having a strong, large, and professional posture is a must.

To procure new warships, the Indonesian Navy also brought in a new training sailing ship, the Barque type, which is twice as large as the previous training sailing ship, namely the Dewaruci Ships. This is intended to modernize the old ships so that they are more effective in supporting an operation, especially overseas shipping. In addition to requiring combat ships that function to carry out regional security and defense patrols, in its operations the Indonesian Navy also requires training sailing ships that function to carry out goodwill missions abroad in support of the Kartika Jala Krida practice training for Navy Academy cadets. Diplomatic missions and as a protocol ship. Currently, the Indonesian Navy requires the addition of this type of ship to replace ships that are no longer fit for operation.

Navy Ships A is the successor of the legendary Dewaruci Ship. This ship is based in Surabaya under the ranks of the Koarmada Auxiliary Ship Unit. The name of this ship is taken from the name of the god in the Javanese wayang story, namely Bima Suci. The ship measuring 111.20 meters and 13.56 meters wide of the Barque class was built at Freire Shipyard, Spain and was built in 2015 to 2017 and was inaugurated in 2017. On January 24, 2017, and was sailed to Indonesia by the first crew of Bimasuci and Naval Academy cadets force 64. This ship also has 3 main masts, namely Responding, Tanggon, and Trengginas masts, and has 26 sails. While the specifications of the Screen Type: Barque, 26 screens with a total area of 3,352 m2, and the number of decks 5. In addition to using sails, Navy Ships A also uses a propulsion system of 1 MAN 6L21/31 Diesel engine as a means of movement with one leaf propeller 4, full speed 12 knots with engines, 15 knots with engines and sails.

Based on the historical data of its operations, since joining the ranks of the Warships of the Republic of Indonesia since the beginning, it has carried out 3 operations. With details in 2017, there were 2 operations, in 2018 there was 1 operation. Almost every year Navy Ships A carries out goodwill voyages overseas to support navy cadets. Seeing the operational tasks carried out with various types of tasks, Navy Ships A crew personnel have to work hard in preparing the ship and manning the ship so that it is always ready for operation. One of the problems commonly faced by most agencies is the effectiveness of personnel at work.

Under normal conditions, the activities of Navy Ships A Soldiers are the same as those of other ships, namely carrying out marine guard services when the ship is carrying out shipping operations, in addition to carrying out daily administration and maintenance activities as well as land guarding services when the ship is docked. The heaviest workload conditions are felt by the personnel when the ship is carrying out a voyage because all personnel must carry out a guard service which is divided into three-guard divisions every four hours in one day (24 hours). In addition, they still have to carry out ship administration/maintenance activities during working hours from 08.00 to 16.00 time.

When participating in sea transportation shipping operations, Navy Ships A personnel have been under pressure in the form of the Bimasuci Ship mast which is high and has many sails, namely 26 sails. With a ship length of 111.20 meters, and a width of 13.56 meters with 5 decks, practically the crew of the Ships have to work extra in terms of maintenance, security, and equipment operators and ensure that all cargo, both personnel, and materials are safe. The workload of the personnel will increase if they carry out the screen role that involves all personnel from each department to manning the screen so that they get the maximum screen role. However, in the daily activities of soldiers as equipment operators and sailors, as well as maintenance and security of the work area, they must still be carried out properly.

Real conditions that occur at this time, the placement of personnel based on the List of Personnel Composition (DSP) on existing ships compared to the workload carried out shows a shortage of personnel. In the preparation of the DSP on duty on the ship, they consider the manning of certain equipment and do not yet have a standard. Unlike the manning of warships of other countries. The filling of personnel for Navy Ships A, which is the second ship of its kind, compared with the composition of personnel in other Dewaruci Ships, which also focuses more on manning the existing equipment. This causes the workload of personnel in certain divisions and departments to be different from personnel in other positions. In addition, it is still necessary to explain activities related to job descriptions, job classes, job values given by management to all personnel. So if you have to do tasks outside of their responsibilities, such as during protocol activities, it is certain that person will experience an excessive workload.

From the personnel data, it can be seen that currently Navy Ships A personnel have fulfilled all positions in the existing DSP, but compared to the workload of personnel on the ship, it is very less so that they have to change the existing DSP to meet the needs of Navy Ships A personnel. To overcome measurement problems the level of work efficiency of personnel and the determination

of activities related to the job description as well as determining the optimal number of personnel faced by Navy Ships A, it is necessary to carry out an analytical study of the workload received by the personnel in this study will use the Work Load Analysis (WLA) method.

Based on the description of the background above, there are conditions where the person in Navy Ships A gets an excessive physical and mental workload. From the many operational tasks and additional activities faced, a problem can be formulated, namely, how is the current workload condition of Navy Ships A personnel in carrying out operational tasks. To answer the formulation of the problem, the research questions can be derived as follows:

a. What are the workload and work efficiency of the personnel in Navy Ships A?

b. What is the optimal number of personnel on Navy Ships A with the Work Load Analysis approach?

II. Materials And Methods

Work Load Analysis (WLA)

WLA is one way that can be used to analyze the activities that arise along with the workload caused by these activities. From this WLA will be obtained several activities carried out by personnel along with the frequency of occurrence of these activities and the time required to complete these activities. The problem of calculating the workload that is solved using the WLA method has been carried out by several previous researchers, including by (State, 2015), where this study aims to calculate the workload and determine the optimal number of personnel on the object of research, namely the survey unit of the Hydro-oceanography Service. This Work Load Analysis method aims to determine the optimal number of personnel required by first measuring the workload (work measurement) and for the method by considering the total activity time and allowance.

This final project research aims to calculate the current workload of Navy Ships A personnel. In addition, it can also generate mathematical calculations that can be used to provide suggestions for the optimal number of personnel in Navy Ships A. With the implementation of the WLA method, it is hoped that there will be an increase in personnel work efficiency and find out the optimal number of personnel properly. The results of this study are expected to be input to the existing DSP of the Bimasuci type Ships because compared to similar ships which are smaller in size than Navy Ships A, the ship's personnel are more.

Research Design

This study describes the theoretical foundations or literature used to complete this research report. The theories used in this chapter will be used as a basis for researchers to carry out their research so that the truth of the existing methods can be accounted for. The theoretical basis used to support this research is previous research; work measurements; WLA; determination of slack (allowance); and job descriptions (job description, job class, job value).

General Characteristics of Navy Ships A

Navy Ships A is one of the newest elements of the Barquentine Training Sailing Ship built at the Freire Shipyard Vigo, Spain in 2016, and launched in 2017. Handed over to the Indonesian Navy on 12 September 2017, and is currently in the Auxiliary Ship Unit. 2nd Koarmada Surabaya. Navy Ships A is a type of training sailing ship that performs duties as a Naval Academy Cadets training ship, supports the Indonesian Navy's duties in diplomatic missions by carrying out goodwill abroad and the Tall ships race festival.

The tasks carried out by Navy Ships A consist of:

a. Main Duties: Facilitate Navy cadets to carry out marine and maritime practical training, cultivate instincts as officers who will serve at sea. and carry out diplomatic missions for the State of Indonesia in participating in international goodwill activities

b. Additional Tasks: In addition to basic functions on Navy Ships A as ambassadors for Indonesian culture and tourism, participating in the Thalship race festival and collecting limited maritime intelligence data.

c. Main Data

1) Ship Name: Navy Ships A

2) Type: Barque

3) Brand/Type: Navy Training Sailing Ship

4) Year of Manufacture: 2016

5) Factory / Shipyard: Freire Shipyard, Vigo, Spain

6) Fuel Material: Steel

7) Max Length (LOA): 111.20 m

8) Length Between Waterlines: 93.24 m

9) Max Width: 13.65 m

10) NetTonage : 2500 Ton

11) Draft Max / Fb : 4.5 m

12) Max Height: 52 m

13) Economical Speed 8 Knots (with engine)

14) Cruising Speed 10 Knots (with engine)

15) Maximum Speed 12 Knots (with engine)

16) Kindergarten capacity. BB HSD: 120 Ton

17) Kindergarten Capacity. ML: 5 Ton

18) Kindergarten Capacity. AT: 100 Ton

19) Main Drive: 1 Engine / MAN – Main Engine 6L2131

20) Number of Propellers: 1 Unit / 4 leaves

Figure 1. Navy Ships A

Navy Ships A Organizational Structure

As a new class ship, Navy Ships A has an organizational structure that is almost the same as the Dewaruci sailing vessel. The Commander of Navy Ships A has the standard position of a Navy Officer with the rank of Lieutenant Colonel. The Commander has a representative as an Implementing Officer, namely a Marine Officer with the rank of Major and oversees four Departments,

namely, the Operations Department, the Arms and Maritime Department, the Machinery Department, and the Logistics Department. Each Department has a different standard of job class according to the burden of responsibility it carries.

Effective Working Hours of Ship Personnel Annual

Based on the administrative manual for assessing and calculating workloads within the National Armed Forces, the calculation of the number of working hours per year in the work unit, in this case, the SHIP element, is as follows:

Formal working hours per week:

Monday to Thursday 07.00 – 15.00 8 hours X 4 = 32 hours

Friday 07.00 – 15.30 8.5 hours X 1 = 8.5 hours

Total = 40.5 hours

The amount of unproductive working time for each member in carrying out their activities (allowance) which is influenced by their respective activities both routine and incidental in an operating unit or troop within the Navy has been determined at 20% while for landowners it is 30%. So that the effective working hours of the Ships element members per week are:

80/100 X 40.5 hours = 32.04 hours

Effective working hours per day:

5 working days = 32.04 hours : 5 = 6.48 hours/day

The number of working days per year:

Number of days per year 365 days

104 days off Saturday-Sunday

14 days official holiday

12 days leave entitlement

130 days

235 days

So the effective working hours per year / person is = 235 X 6.48 hours = 1522.8 hours/person

III. Result And Discussion

Data on Research Results of Personnel Activities in Each Position

In this study, collecting data from personnel research in each position obtained through questionnaires is very necessary to find out how much time is needed to complete the activities carried out during working hours and to find out how much frequency of activities carried out during working hours. one year. So then you can calculate the total working time in one year. An example of a questionnaire that will be filled out by Navy Ships A personnel will be based on the job description of each position in Navy Ships A, the calculation of the total activity time is carried out by:

$$\text{Total activity time} = \sum \left[\left((\text{frequency} \times \text{fixed value}) \times \text{time}\right) \div 60 \text{ Minutes}\right]$$

Then the results of the calculation of the total time of activities carried out by a Pantry 1 interpreter for one year are:

Total Time = (((1x52)x180) + ((1x235)x180) + ((1x52)x180) + ((4x12)x240) + ((1x12)x240) + ((1x1)x240) + ((1x1) x300) + ((1x1)x240) + ((1x1)x500) + ((1x235)x20) + ((1x235)x15)) + ((2x235)x15)) + ((3x1)x30)) + ((2x1)x30)) + ((2x12)x60)) + ((1x52)x60)) + ((1x52)x300)) + ((1x4)x60)) + ((1x4)x240)) + ((1x235) x15)) + ((1x52)x480)) + ((1x4)x480)) 60 = 1642.17 hours per year.

The results of the calculation of the total activity time from the data obtained through questionnaires and interviews with all Navy Ships A personnel according to their positions with 64 respondents.

The workload for each position

The activities carried out by each position/position to carry out their duties as stated in the job description provide a workload for that position/position. After that, you will get the total activity time per position in 1 year and already know the calculation of effective working time so that the workload calculation can be formulated as follows:

$$\text{Workload Index} =$$

$$(\text{Total Workload})/(\text{Real Personnel X Effective Working Time}) \times 100\ \%$$

An example of calculating the workload index at the position of navigation interpreter 1 is as follows:

$$\text{Workload Index (IBK)} = 1{,}968.50/(1\ \times 1.522.80) \times 100\% = 129.27\%$$

From the results of the workload calculation above, we can determine the optimal number of personnel by rounding up the results of the workload calculation. However, if the result is <0.5 then in determining the optimal number of personnel it is still rounded up, which is 1 personnel, but on the condition that the person needs to be added to their workload or work activities that are appropriate and depend on the policies of the personnel management itself so that the personnel works effectively. Below are the results of the calculation of the workload index in the operations department.

Based on the data processing that has been carried out above, it can be concluded that all Navy Ships A personnel have exceeded the standard workload this is due to the large number of operations carried out in one year so that it requires more maintenance on all existing aircraft and equipment to be able to carry out operational tasks. and fulfill Job Descriptions effectively and optimally.

Calculation of the Average Workload of each Department

From the calculation of the workload of personnel, an assessment vessel is needed which is used as a benchmark for assessment to find out that the workload is low or high so that the number of personnel needed in a position/division can be determined. The vessels used based on the Armed War Number Perpang/93/XI/2011 are as follows:

a. Less than 60% of work units can be written off or

combined with other work units

b. 60% - 79% work units need personnel reduction

c. 80% - 119% work units meet workload standards

d. 120% - 140% of work units need additional personnel

e. More than 140% of work units need to be reviewed for organizational validation.

The following are the workload parameters according to the National Armed Forces how to identify low, medium, high, and very high workloads can be seen in Table 1 below:

Table 1. Parameters of Workload

Workload Average Nilai	Workload Category
0%-79%	Low
80%-119%	Medium
120%-140%	High
>140%	Very high

Table 2. Calculation of the Average Workload of each Department

No	Work Unit	Calculation	Work Load	Recommendations
1	Operations Department	$\frac{25799,33}{13 \times 1522,8} \times 100\%$	130,32%	need to add personnel
2	Arms and Maritime Department	$\frac{44441,01}{21 \times 1522,8} \times 100\%$	138,97%	need to add personnel
3	Machinery Department	$\frac{26215,17}{15 \times 1522,8} \times 100\%$	114,77%	meet the standard
4	Logistics Department	$\frac{26167,83}{15 \times 1522,8} \times 100\%$	114,56%	Meet the standard

From the calculations in Table 2, namely the number of workloads divided by the number of personnel and multiplied by 100%, it can be seen that the Department of Weapons and Maritime Affairs has the highest average workload of 138.97% while the logistics department has the lowest average workload. by 114.56%. Judging from the level of workload, we can conclude that all departments meet workload standards, and the weapons and maritime departments have very high workload levels so that additional personnel is needed in the Operations Department and the Arms and Maritime Department.

Determination of the optimal number of personnel for each position

Based on the workload that has been found, it can be found the number of personnel needed in a department, namely by rounding up from the calculation of the division's total workload divided by the effective working time.

$$\text{Personnel Formation} = (\text{Total Workload})/(\text{Effective Working Time})$$

Table 3. Number of Personnel Required

No	**Work Load**	**Calculation**	**Optimal Number of Personnel**
1	Operations Department	$\frac{25799,33}{1522,8} = 16,94$	17
2	Arms and Maritime Department	$\frac{44441,01}{1522,8} = 29,19$	29

From the calculation of the workload, as shown in Table 3, we can determine the optimal number of personnel in the operations department and the weapons and maritime department by rounding up the number of personnel workloads in the department. The Operations Department and the Arms and Maritime Affairs Department require additional personnel from the previous calculation of work efficiency, namely the operations department to 17 personnel, the weapons and maritime department to 29 personnel.

Determining the Level of Work Efficiency of Personnel

The following is a way to calculate the level of work efficiency of personnel in each Division/Department:

$$\text{Efficiency} = (\text{Total Actual Time})/(\text{Total Available Time}) \times 100\%$$

The calculation is carried out by dividing the total workload in each division by the product of the optimal number of personnel and the time available in one year and then multiplied by 100%.

Table 4. Calculation of Work Efficiency of Each Department

No	Work Load	Calculation	Work Load
1	Operations Department	$\frac{25799,33}{17 \times 1903,5} \times 100\%$	71,33%
2	Arms and Maritime Department	$\frac{44441,01}{29 \times 1903,5} \times 100\%$	80,51%

From the calculations in Table 4, it can be seen that the weapons and maritime departments have a moderate work efficiency level of 80.51% while the operations department has the lowest work efficiency level of 71.33%. Judging from all the results of the calculation of work efficiency, we can conclude that Dept Ops have a moderate level of work efficiency.

Comparison of the Number of Initial and Optimal Personnel

From the calculations that have been done previously, we can show the comparison of the number of personnel before the study with the optimal number of personnel after the research using the WLA method.

Table 5. Comparison of the Number of Initial and Optimal Personnel

No	Unit Kerja	Jumlah Personel Awal	Jumlah Personel Optimal Hasil Penelitian
1	Departemen Operasi	13	17
2	Departemen Senjata dan Bahari	21	29
3	Departemen Mesin	15	15
4	Departemen Logistik	15	15
Total		**64**	**76**

From Table 5, it can be seen that the comparison of the number of personnel before the workload calculation was carried out was 66 personnel and the optimal number of personnel after the workload calculation was 76 personnel. By adding 2 officers who must be on board, namely the Commander, Palaksa, the optimal number of personnel on Navy Ships A increases by 12 personnel to 78 personnel from the previous DSP which amounted to 66. In terms of accommodation, it is also very adequate if there are additional personnel in the two departments because Navy Ships A can accommodate 203 personnel.

IV. CONCLUSION

Based on the research that has been done by distributing questionnaires to 64 Navy Ships A personnel, it can be concluded about the workload and work efficiency as well as the optimal number of personnel in each department as follows:

a. The workload for each person for each position has been calculated based on data on the frequency and length of time working on tasks and activities. After being collected in the departmental group, the results are as follows:

1) The average workload index of all personnel in the Operations Department, amounting to 13 people, is 130.32% with a work efficiency level of 71.33%.

2) The average workload index of all personnel in the Department of Arms and Maritime Affairs, amounting to 21 people, is 138.97% with a work efficiency level of 80.51%.

3) The average workload index of all personnel in the Machinery Department, which amounted to 15 people, was 114.77% with a work efficiency level of 72.48%.

4) The average workload index of all personnel in the Logistics Department, amounting to 15 people, is 114.56% with a work efficiency level of 72.35%.

All departments have met the standard workload, namely the calculation of the workload index above 80% and several divisions have a high workload index above 120% so that additional personnel is needed in the operations department and the weapons and maritime department.

b. Optimal number of personnel.

Based on calculations from research data, the optimal number of personnel on Navy Ships A is 76 personnel. That is, consisting of 76 personnel obtained through calculating the workload of 64 respondents then adding 2 officials who must be on the ship, namely the Commander and Palaksa. Thus it requires an additional 12 personnel from the previous DSP so that the optimal number of personnel is 78 personnel.

Future Work

After research, suggestions and further work that can be submitted are as follows:

a. Based on research, Navy Ships A personnel get a high workload due to a large number of shipping operations during one year. This is a suggestion for the leadership of the Indonesian Navy as the decision-maker in the implementation of the voyage to take into account the workload that is proportional to the number of soldiers on the SHIP and adjust the sailing time to the capabilities possessed, by adjusting the SHIP operation schedule. However, the main task of the Koarmada II in supporting operations is still carried out. Therefore, the analysis of workload measurement in this study can be one of the references and considerations in scheduling Ships' operational activities in one year.

b. It is necessary to carry out a workload analysis by the Indonesian Navy on the Work Units, especially in Ships, especially the new type of ship so that it can be a reference for determining the appropriate DSP, considering that so far the DSP determination is only based on the equipment that must be manned and comparisons with the types of ships that already exist.

c. Further research is needed as a follow-up to the results of this study to get a real picture of the observed pattern of time use of activities or personnel and examine the factors causing the high workload and work efficiency of Navy Ships A personnel. Not only paying attention to task-based activity factors but also the mentality of personnel when carrying out shipping operations.

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Disclosure of conflict of interest

The authors declare no conflict of interest.

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