The Application Of Nasa-Tlx Methods To Analysis Of Mtf Navy Personnel Allocation

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Abstract. Navy personnel warships as the Maritime Task Force (MTF) cannot be separated from the problems regarding the lack of conformity to the workload with the allocation of the number of available personnel. To anticipate this, an analysis of workload on mental and physical measurement is needed which can be used to determine the allocation of the right number of personnel in each Navy division. The Navy organization workload is related to the efficient and effective utilization of Navy human resources. It can realize the vision, mission, and objectives of the Navy organization. This study aims to get the right number of navy personnel on MTF allocation. This study uses the NASA-TLX mental workload and physical workload. The methods are compared between mental and physical burden that occurs. From the results of the comparison, it was found that physical workload is needed in the completion of tasks in each division. The results from this research study can be concluded that the number of MTF personnel is appropriate, but the allocation of personnel in each Navy division needs to adjust to the existing Navy workload. The final results in this study get the right and optimal number of navy personnel in the Navy assignment, to provide an effective value and efficiency to the organization.

Keywords: Workload, NASA-TLX, Allocation of Navy Personnel.

1. INTRODUCTION

For the Indonesian people, the participation of the Indonesia Military contained very important meanings, both in terms of political interests and aspects of military interests. For the Navy, this is an implementation of the law of Indonesia Military, namely carrying out the duties of Navy diplomacy to support foreign policy set by the government to MTF Maritime Task Force [12]. This goal is carried out together with other countries under the banner of the United Nations (UN) to create a world that is peaceful, safe and peaceful. Since 2019 the Indonesian Navy under the PMPP Indonesia Military has sent its sea power consisting of 2 (two) warships and 2 (two) Helicopters BO-105 (onboard) to join the Maritime Task Force (MTF) of the United Nations Interim Force in Lebanon (UNIFIL) operating in the operational area / Lebanese waters. MTF UNIFIL is a maritime task force under the United Nations (UN) which has been established since October 2006, due to landmark conflicts between Israel and Lebanon. The existence of the MTF is to assist the Lebanese navy in monitoring territorial waters, securing the coastline and preventing the entry of weapons and materials through Lebanese waters. MTF was formed at the request of the Lebanese government through the mandate of the United Nations Security Council Resolution 1701 (2006). Diplomatic activities carried out include cocktail parties, joint sports, and visits to government agencies in transit countries. Activities carried out after arriving in Lebanon are welcome, briefing and inspection from MTF staff [2]. After being declared in chop then the first assignment begins. Each day the task force will receive a Daily Intention Message (DIM) containing information and emphasis from staff personnel, intelligence, operations, planning, logistics, communication, and training staff. In the DIM mention the situation and conditions of Lebanon, the sector in the Area of Maritime Operation (AMO), which is a duty and responsibility that must be secured, the assignment of elements of the task becomes Maritime Interdiction Operation Commander (MIO), Helicopter Element Coordinator (HEC), Anti-Air Warfare Commander (AAWC) and activities operations and serial exercises that must be carried out with elements from other countries and the Lebanese Armed Force (LAF). The proportion of attendance at AMO and berth on the dock is 70/30. This means that once on task the average ship operating at sea is 5 to 6 days and only allowed to dock on the pier 1 to 2 days to carry out the provision [3]. Taskforce personnel has mental and physical burdens in carrying out the tasks mentioned above. Besides the very long operating time and having to leave the family for 10 (ten) months, each person must always maintain the good name of the nation and country. All personnel is always required to be professional in carrying out their duties. Task Force faced with the situation operational areas that are vulnerable, both at sea and on land when the weather conditions at the AMO are changing, but the task force must continue to carry out operations. These things were a mental burden for task force personnel. While the physical burden comes from various types of operations and exercises that have been determined and determined by the MTF commander staff. Following the monthly report of warship personnel, in January 2013 the number of real Personnel Checklist is 102 people. So that the number of Indonesia warship enlisted personnel must be reduced to 20 people to carry out their duties as UNIFIL MTF. 14 people outside warship personnel were 7 (seven) people from helicopters and pilots, 1 (one) intelligence officer, 1 (one) information officer, 1 (one) diver member, 1 (one) Special Forces, 1 (one) doctor, 1 (one) marine officer and 1 (one) Combat Information Center (CIC) officer. So that with a reduction in the number of personnel it results in an increase in workload for each division because some personnel has multiple tasks. Because of the duties and responsibilities that have been assigned to the task force personnel as mentioned above,

it is not easy, so in this case, the Indonesia warship as the decision-maker assisted by staff must make the right decision in determining the number of personnel in each division. The commander and staff must determine the allocation of the right number of personnel for each division so that tasks can be carried out properly. Based on the background above, in this study, a load analysis will be carried out to work for task force personnel under their divisions. The workload analysis is the basis for determining proportional personnel allocation [1]

2. MATERIAL AND METHODS

2.1 NASA-TLX

NASA-TLX method is a subjective method that is often used in measuring mental workload and physically in individuals in various industries [4]. In the NASA TLX method, there are 6 indicators to be measured from each individual, namely mental needs Demand, Physical needs Demands, Temporal time needs Demand, Performance, level of business / Effort and the last is the level of frustration. Each measure of workload, there is a scale that will have to be filled by respondents. This is the first step in measuring workload. On indicators of mental needs Demand for physical needs / Temporal Demands, level of effort / Effort and level of frustration, the scale used is low to high. Whereas for measurement of performance / Own Performance is used to scale well to bad. Explanation of indicators of mental burden in Table 1.

Table 1. Definition of Workload Indicator

Definition	Scale	Workload Indicator
Mental activities and perceptions to see, remember and search. Is the job easy or difficult, complex or simple, lose or tight to work on a task◎	Low, high	*Mental Demand* (MD)
Physical activity needed for doing a task	Low, high	*Physical Demand* (PD)
Pressure related to the time felt during the assignment take place, Is it slow, relaxed, or fast	Low, high	*Temporal Demand* (TD)
How much success someone in a task and how satisfied with the results of his work	Good, bad	*Performance* (OP)
How hard is the effort or mental and physical work needed to complete the task	Low, high	*Effort* (EF)
Overall stress or satisfaction, the complexity of the task	Low, high	*Frustration Level* (FR)

After the scale is known used to measure each indicator, the next step is data processing to load acquisition work. These steps are as follows [5]:

a. Calculate product value in a way multiplying the rating by the factor weight for each descriptor, so there are six product values for six descriptors (MD, PD, TD, OP, EF, and FR) [6] :

Product Value = Rating x Weight Factor

b. Calculating WWL (Weighted) Workload), which is the workload caused by each descriptor with the equation:

WWL = Σ Product

c. Calculate WWL values in a way that divides WWL by total weight that is 15.

Average of WWL = WWL / 15

In this research, NASA-TLX will be used as one method for knowing the mental workload, later on, indicates what a job is which is charged has a burden that high or low. Categorization what is meant as stated in Table 2.

Table 2. The Range of Mental of Workloads

Number	Category of Workload	Range of Mental Workload
1	Low	0 - 29
2	Medium	30 - 49
3	High	50 - 79
4	Very High	80 - 100

2.2. Job Position - Task Approach

On the task approach method job assignment was chosen because this method is a method for counting the needs of employees in the office the results of his work are abstract or diverse. On calculation with this method, sought first working time and working hour's effective personnel. Only time is calculated completion of each assignment for each position [7].

Basic Aspects

Basic aspects that must be noted there are 3 variables:

a. Workload

The workload is an aspect of the principal on which to base calculation. Workload needs to be set through work unit programs subsequently translated into targets job for each position.

b. Average Ability Standards

Average ability standard can be a standard of ability measured from the unit of time used or unit of results.

c. Working time

The working time referred to here is effective work time, meaning time work that is effectively used for work. Effective working time consists of Effective Business Days and Effective Working Hours, that is:

1) The effective working day is the number of days in calendar minus holidays and leave. The calculation is as follows:

Number of days according to calendar	…..day
Number of Sundays in 1 year	…..day
Number of days off in 1 year	…..day
Number of leaves in 1 year	…..day
Holidays and leave	…..day
Normative workday	…..day

2) Effective working hours are the number of hours formal work is reduced by working time lost because it doesn't work (allowance) such as defecating, removing tired, eating breaks and so on. According to the rules of the Indonesia Military Commander, that there is much unproductive work time for every member in carrying out allowance is influenced by each individual's activities are good routine or incidental. To achieve organizational goals it is necessary to note the balance between organizational interests on the one hand and individual interests on the other hand. The activities of each individual who routine and incidental can be classified into several examples [8]:

a) Personal matters (personnel related).

b) Medical examination (medical).

c) Organizational tasks outside the task organizational duties.

d) Education.

e) Training.

f) Social activity.

Each unit can calculate the working time which is not productive by using approach according to unit conditions local and unit characteristics. It has been determined that the amount of work time unproductive within the Indonesia Military 30% for staff and 20% for troops. In calculating working hours effective should be used for a week size. Here is an example of counting effective working hours:

Number of formal work hours 1 week	400 minutes
Allowance 30% x 400 minutes	120 minutes
Effective working hours of 1 week	280 minutes

Total formal working hours in 1 week are 8 hours per day for 5 days.

Steps of the Task Load Approach

a. Describe the duties of each position and calculate the completion time for each of these positions. This is due to the job description as a reference in describing the task not given for each position, but individuals, then the calculation is done for each employee [10].

b. Enter job description and task completion time (WPT).

c. If there are unit differences on task completion time (WPT), do it conversion to equalize time units completion of the task. In this research, the completion time is equated to be minutes / on task [8].

d. In determining the number of employees needed, used formula calculation.

$$\text{Number of employees} = \frac{\Sigma \text{ Time for completing assignments}}{\Sigma \text{ Effective Work Time}}$$

3. RESULTS AND DISCUSSION

The data analysis phase consists of 2 (two) activities, namely data collection and data processing. As the object of research, namely Indonesia Warships. The data that has been obtained will be used for processing the workload/task of each part/work unit. Personnel Checklist of Petty officer / Enlisted Rill and Indonesia Military Maritime Task Force Konga XXVIII/E UNIFIL Indonesia warships average can be seen in Table 3.

Table 3. Petty Officer of Personnel Checklist

No	Division	Real Personel Checklist	Task Force Personnel Checklist
1	Communication	7	7
2.	Navigation	4	3
3.	ASW	11	10
4.	AAW	11	7
5.	Weapon Detection	8	5
6.	Communication Det.	8	5

7.	Main Engine	7	6
8.	Auxiliary Engine	7	6
9.	Electric Control	7	6
10.	Logistic	13	11
	Total Number	83	65

3.1. NASA-TLX Mental Workload Process

The size of this method, carried out through three stages, namely calculating the value of the product multiplied by the rating by weight [11], calculating the Weighted Workload (WWL) value and calculating the WWVL average. The results of the recapitulation of the total WWL value and WWL average can be seen in Table 4.

Table 4. The Division and the WWL value

No	Division	Average of WWL	Value of WWL	Category of Workload
1	Communication	125,53	78,23	Very High
2.	Navigation	732,88	51,52	Medium
3.	ASW	1165,33	75,88	High
4.	AAW	15080	75	High
5.	Weapon Detection	697	42	Medium
6.	Communication Det.	685,44	43,54	Medium
7.	Main Engine	1140,23	77,82	High
8.	Auxiliary Engine	1145	77,84	High
9.	Electric Control	875,14	59,92	High
10.	Logistic	442,22	27,14	Low

3.2. Processing of Physical Workloads

The processing of this workload must first be determined regarding the active working day, the working hours of each personnel imposed on the Warships when carrying out activities. To obtain effective working time and working hours some secondary data is obtained from the object of research. Furthermore, the data is processed to obtain effective working time, effective working hours and time to complete tasks that are borne by each person [14]. The personnel requirements formula is as follows:

$$\text{Number of Personnel} = \frac{\Sigma \text{ Task Completion Time}}{\Sigma \text{ Effective Work Time}}$$

Table 5. Number of Personnel and Total Rounded Personnel

No	Division	Total Time of Task Completion	Number of Personnel Should Be Needed	Total Rounded Personnel
1	Communication	17.520	6.257	7
2.	Navigation	6.930	2.775	3
3.	ASW	18.945	7.567	8
4.	AAW	18.675	7.476	8
5.	Weapon Detection	14.060	5.027	5
6.	Communication Det.	9.960	3.878	4
7.	Main Engine	16.971	6.733	7
8.	Auxiliary Engine	17.215	6.458	7
9.	Electric Control	12.565	4.581	5
10.	Logistic	21.875	8.558	9

3.3. Comparison of the Value of Mental and Physical Workloads

In this comparison, the physical workload category is adjusted to the mental workload with NASA-TLX, which is made into 4 categories including low, medium, high and very high categories. In physical workload, categories are made into several ranges, namely by determining the quartile point of the minimum and maximum values for the total time of completion of each task [15].

Table 6. Value of Physical Workload

Range of Physical Workload	Category of Workload	Value of Physical Workload
≤ 11.154	Low	1
11.155 – 16.591	Medium	2
16.592 – 19.154	High	3
> 19.154	Very High	4

Table 7. Value of Mental Workload

Range of Mental Workload	Category of Workload	Value of Mental Workload
0 – 29	Low	1
30 – 49	Medium	2
50 – 79	High	3
80 – 100	Very High	4

Table 8. The Coefficient Value of workload & Category.

Coefficient value of Workload	Category of Workload	Remark
0 – 29	Low	No Need for Addition or Reduction of Personnel
30 – 49	Medium	Possible for Addition or Reduction of Personnel
50 – 79	High	Need Addition of Personnel
80 – 100	Very High	Need Addition of Personnel

Table 9. The Result of The Number Person Each Division

No	Division	Value Of Mental Workload (X)	Value Of Physical Workload (Y)	Average Of Workload Value (Z)	Category	Remark
1.	Communication	4	2	3	Very High	No Need For Addition or Reduction of Personnel
2.	Navigation	2	1	1.5	Low	Possible For Addition or Reduction of Personnel
3.	ASW	3	3	3	Very High	Need Addition of Personnel
4.	AAW	3	3	3	Very High	Need Addition of Personnel
5.	Weapon Detection	2	2	2	Medium	Possible For Addition or Reduction of Personnel
6.	Communication Detection	2	1	1.5	Medium	Possible For Addition or Reduction of Personnel
7.	Main Engine	3	3	3	Very High	Need Addition of Personnel
8.	Auxiliary Engine	3	3	3	Very High	Need Addition of Personnel
9.	Electric Control	3	2	2.5	Medium	Possible For Addition or Reduction of Personnel
10.	Logistic	1	4	2.5	Medium	Possible For Addition or Reduction of Personnel

3.4. The Optimal Number of Personnel

The basic calculation of the number of personnel is following the NASA-TLX method, then adjusted to the results of consideration according to Table 10 to determine the optimal number of personnel. Then next Table 10 will show a comparison of the number of optimal personnel with the number of personnel according to the task force personnel checklist [16].

Table 10. The Optimal Number of Personnel each Division

No	Division	Optimum Number Personnel	Number Personnel of Task Force	Remark
1.	Communication	7	5	2 Personnel Added
2.	Navigation	3	3	No Need Addition or Reduction of Personnel
3.	ASW	8	6	2 Personnel Added
4.	AAW	8	9	1 Personnel Reduced
5.	Weapon Detection	5	6	1 Personnel Reduced
6.	Communication Det.	4	4	No Need For Addition or Reduction of Personnel
7.	Main Engine	7	5	2 Personnel Added
8.	Auxiliary Engine	7	5	2 Personnel Added
9.	Electric Control	5	5	No Need For Addition or Reduction of Personnel
10.	Logistic	9	10	1 Personnel Reduced

4. CONCLUSION

The workload of Navy personnel when carrying out their duties as UNIFIL MTF indicates the existence of excess and lack of workload received by each person in their respective divisions. Following calculations with the mental workload approach, NASA-TLX, it is known that the largest mental workload is experienced by the Main Engine division with an average WWL and the lowest mental workload experienced by the division Communication Detection with a value of the average WWL. While the calculation according to the task load approach of each position Indonesia Military warplanes physically, the Logistics Administration division has the highest total task completion time. Indonesia Military (physical) approach. It was found that the value of mental workload in all divisions has a value of 3 with a high category. Except the Navigation, Weapon Technology and Communication Detection divisions which have load 2 or moderate categories. Whereas value Logistics Administration division's physical workload has the highest load value, 4 or very high category. Navigation, Main Engine, Auxiliary Engine and Electric Control divisions have the value of physical load 3 or high category. The Communication, Text, and Electric Control Division has the value of physical load 2 or in the medium category. The Navigation and Detection Division has the value of physical load 1 or low category. So that this can be concluded that the mental workload is more dominant than the physical workload on the assignment The optimal number of personnel per division is in accordance with the physical workload namely the Communication division required 7 personnel, Navigation division 3 personnel, ASW division 8 personnel, AAW division 8 personnel, Weapon Detection division 5 personnel, Communication Detection division 5 people personnel, Main Engine division 7 personnel, Auxiliary Engine division 7 personnel, Electric Control division 5 personnel and Logistics divisions 9 personnel. So for the overall optimal number of personnel needed for enlisted is 63 personnel.

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