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APPLIED FUZZY AND NASA TLX METHOD TO MEASURE OF THE MENTAL WORKLOAD

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ABSTRACT

In carrying out its main duty as a guardian of the sovereignty State of republic Indonesia, especially at sea, the strength of the Navy is directed as a strategic force developed under the SSAT. The strength of the Navy can be measured by the arsenal and the quality of the personnel who are responsible for it. The performance, quality of personnel is strongly influenced by the work load it receives. Measurement of personnel workload in KRI to determine the class of his current position using the Factor Evaluation System (FES) method that is more oriented on the volume of work and work time. While the mental workload has not been accommodated in the measurement of workload using this method. In this research will carry out the measurement of mental workload of Indonesian Warship personnel for each type of work when the Indonesian Warship operates, using the NASA TLX method integrated with the Fuzzy method. The questionnaire data collection was obtained from 82 respondents Indonesian Warship personnel. From the research results obtained data that of 11 (eleven) types of work in Indonesian Warship at the time of operation, the Main Engine Operator is the work that has the highest mental workload with a value of 74.33. While the type of work that most low-level mental work is to electronics operators with a value of 58.83. with the known mental workload of each personnel, it can be used to determine a policy so that personnel do not get excessive workload.

Keywords: *NASA TLX, Workload*

1. INTRODUCTION

In carrying out its main duty as a guardian of the sovereignty State of republic Indonesia, the strength of the Navy is directed as a strategic force developed under the SSAT. The strength of the navy can be measured by the arsenal and the quality of the personnel that it carries. The performance, quality of personnel is strongly influenced by the work load it receives. The current condition, the measurement of personnel workload using the Factor Evaluation System (FES) method is more concerned with the physical workload. While the mental workload has not been accommodated in the measurement of workload using this method. From this measurement is used to determine the job class of each job.

The mental workload of personnel serving in the KRI needs to be considered, since an assessment of the mental workload is an important aspect in the design and evaluation of tasks at work (Didomenico & A. Nussbaum, 2011). The work load has an influence on job stress, which will further cause the decrease of performance of the employee (Ali, et al., 2014). The mental workload of KRI personnel at the time of sailing must be observed, so as not to cause the excessive mental work load because work at the time KRI sail has a high accident risk.

The purpose of this study is to determine the mental workload of KRI soldiers for each type of work at the time of KRI carry out the operation. The method used in this research is by a NASA TLX method that integrated with Fuzzy.

This research refers to the literature of journals and books, among others are Impact of Stress on Job Performance: An Empirical Study of the Employees of Private Sector Universities of Karachi (Ali, et al., 2014), Fuzzy TLX: using fuzzy integrals for evaluating human mental workload with NASA-Task Load index in

laboratory and field studies (Amady, et al., 2013), A Survey on Analysis and Classification of Workload in Cloud (Chethan, et al., 2016), Effects of different physical workload parameters on mental workload and performance (Didomenico & A. Nussbaum, 2011), The effect of performance failure and task demand on the perception of mental workload (Hancock, 1989), Development of NASA-TLX (Task Load Index): Results of Empirical and Theoretical Research (Hart & Staveland, 1988), Comparison of Four Subjective Workload Rating Scales (Hill, et al., 1992), Evaluation of Subjective Mental Workload: A Comparison of SWAT, NASA-TLX, and Workload Profile Methods (Rubio, et al., 2004), The Impact of Job Satisfaction, Job Attitude and Ability on Employee Performance (Inuwa, 2015), Influence of Mental Workload on Performance (Omolayo & Omole, 2013), Human Factors in Engineering and Design Seventh Edition (Sanders & McCormick, 1993), Impact of Workload and Job Complexity on Employee Job Performance with the Moderating Role of Social Support and Mediating Role of Job Stress (Shabbir & Naqvi, 2017), Workload and Performance of Employees (Shah, et al., 2011), Using NASA-TLX to evaluate the flight deck design in Design Phase of Aircraft (Yiyuan, et al., 2011), Fuzzy Logic and Approximate Reasoning (Zadeh, 1975), Operations in a Fuzzy-Valued Logic (Dubois, 1979), Fuzzy Logic with Engineering Applications Third Edition (Ross, 2010).

From the results of this study can be used to determine policies in the guidance of personnel, that is by arranging the shif time of the duty on the sea based on the mental workload on each job, so as to improve the performance and reduce the job risk of each soldier. This research is assumed at the time of KRI perform operation (sail).

2. MATERIAL AND METHODOLOGY

2.1 Workload

The workload is one of the main factors to achi high performance (Chethan, et al., 2016). The workload can be divided into two categories: physical workload and mental workload. And based on the condition, the workload is divided into 3 conditions, namely workload according to the standard, over capacity and under workload. Assessment of the mental workload is an important aspect in the design and evaluation of work tasks (Didomenico & A. Nussbaum, 2011). Mental workload can be the extent to which level of expertise and work performance possessed by person (Sanders & McCormick, 1993). The measurement of the mental workload can be subjectively performed using the Modified Cooper urper Scale (MCH) method, Bedford Scale, NASA-Task Load Index (NASA-TLX), Workload Assessment Technique (SWAT), Workload Assessment instrument (Workload Profile) (Rubio, et al., 2004).

2.2 NASA-TLX (*NASA - Task Load Index*)

The NASA-TLX method was developed by Sandra G. Hart of NASA - Ames Research Center and Lowell E. Staveland fro an Jose State University in 1981. NASA TLX uses 6 (six) dimensions to assess the workload of mental needs, physical needs, time requirements, frustration level, performance and business level ((Hart & Staveland, 1988). From each size of the workload, there is a scale that will be filled by the respondent. Scale measurements on each indicator are described in Table 1 Scale and Dimension **of** NASA-TLX.

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Table 1 Scale and Dimension of NASA-TLX

No	Indicator / Dimension	scale	Description
1	*Mental Demand* (MD)	*Low / high*	How much mental and perceptual activity is required to see, remember and seek. Whether the job is easy or difficult, simple or complex, loose or tight.
2	*Physical Demand* (PD)	*Low / high*	The amount of physical activity required (examples of running, drawing, etc.)
3	*Temporal Demand* (TD)	*Low / high*	The amount of pressure associated with the time that is felt during the work element takes place. Do the work slowly, relax or fast and tiring.
4	*Performance* (P)	*Poor / Good*	How much success a person in his job and how satisfied with the results of his work
5	*Frustation* (FR)	*Low / high*	How insecure, hopeless, offended, distracted compared to feelings of security, satisfaction, comfort and perceived self-satisfaction
6	*Effort* (EF)	*Low / high*	How hard mental and physical work is required to get things done

The steps of the NASA-TLX method are as follows:

a. Calculate product value

Product=Rating x Weight Factor …. (1)

b. Calculates the value of Weighted Workload (WWL)

WWL = $\sum Produk$…….. (2)

c. Calculate the average of WWL

Average WWL = WWL / 15 ……. (3)

From the average value of the WWL will be known the value of a worker's workload and in which category the workload. The category of workload is classified into 5 (five) categories, as shown in Table 2 Mental Workload Category.

Table 2 Mental Workload Categories

No	Average WWL Value Range	Category of Workload
1	0 - 20	Very low
2	21 - 40	Low
3	41 - 59	Medium
4	60 - 79	high
5	80 - 100	very High

2.3 Fuzzy Logic

Fuzzy logic is a method that has the ability to process variables that are blurred or biased and can't be described with certainty (Zadeh, 1975). In fuzzy logic, variables that are blurring are represented as a set whose members are a value of crops and its membership degrees on the set. On the Fuzzyfication stage is done to change the inputs of the true value of truth (input Crips) in the form of fuzzy input (Ross, 2010). A Triangular Fuzzy Number is denoted as M = (a, b, c) where a<b<c, is a special fuzzy number and has a triangular membership function as follows (Zadeh, 1975).

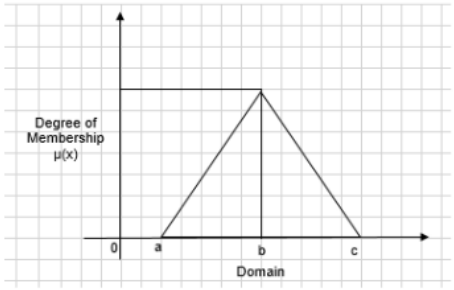

Fig. 1 Function of the Triangle Curve
(Source: Zadeh, 1975)

$$\mu(x) \begin{cases} 0, & \text{if } x < a \\ (x-a) / (b-a), & \text{if } a < x \leq b \\ & \ldots\ldots \\ (c-x) / (c-b), & \text{if } b < x \leq c \\ 0, & \text{if } x > c \end{cases} \quad (4)$$

(Source: Zadeh, 1975)

The next step is defuzzyfication. This stage is a calculation to obtain output crips. (Ross,

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2010). There are several methods of defuzzyfication such as Maximum Membership Principle, Centroid Method or Center of Gravity (COG) method, Average Weighted Method and Method of Membership Mean.

2.4 Methodology of Research

The research designs are outlined in the research flow diagrams shown in Figure 2 Flow Chart of Research.

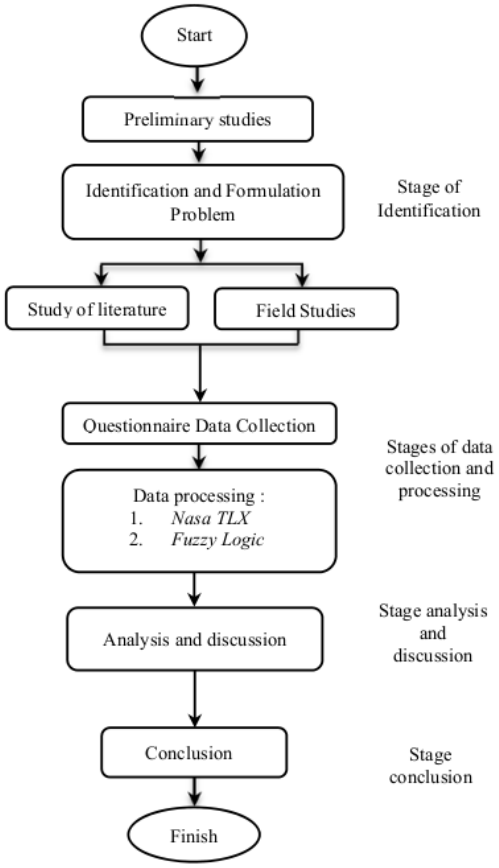

Fig. 2 Flow Chart Of Research

In this stage, starting from a preliminary study, problem identification, literature and field study, designing the NASA TLX questionnaire, distributing questionnaires to respondents, data processing, data analysis, conclusion and suggestion. The NASA TLX questionnaire consisted of 2 types: Questionnaires for weighting (Table 3 Weighted Questionnaire) and ranking questionnaires (Fig. 3 Rating Questionnaire).

Table 3 Weighted Questionnaire

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No	Mental Load Indicator		
1	MD *(Mental Demand)*	vs	PD (Physical Demand)
2	MD *(Mental Demand)*	vs	TD (Temporal Demand)
3	MD *(Mental Demand)*	vs	P (Performance)
4	MD *(Mental Demand)*	vs	EF (Effort)
5	MD *(Mental Demand)*	vs	FR (Frustration)
6	PD (Physical Demand)	vs	TD (Temporal Demand)
7	PD (Physical Demand)	vs	P (Performance)
8	PD (Physical Demand)	vs	EF (Effort)
9	PD (Physical Demand)	vs	FR (Frustration)
10	TD (Temporal Demand)	vs	P (Performance)
11	TD (Temporal Demand)	vs	EF (Effort)
12	TD (Temporal Demand)	vs	FR (Frustration)
13	P (Performance)	vs	EF (Effort)
14	P (Performance)	vs	FR (Frustration)
15	EF (Effort)	vs	FR (Frustration)

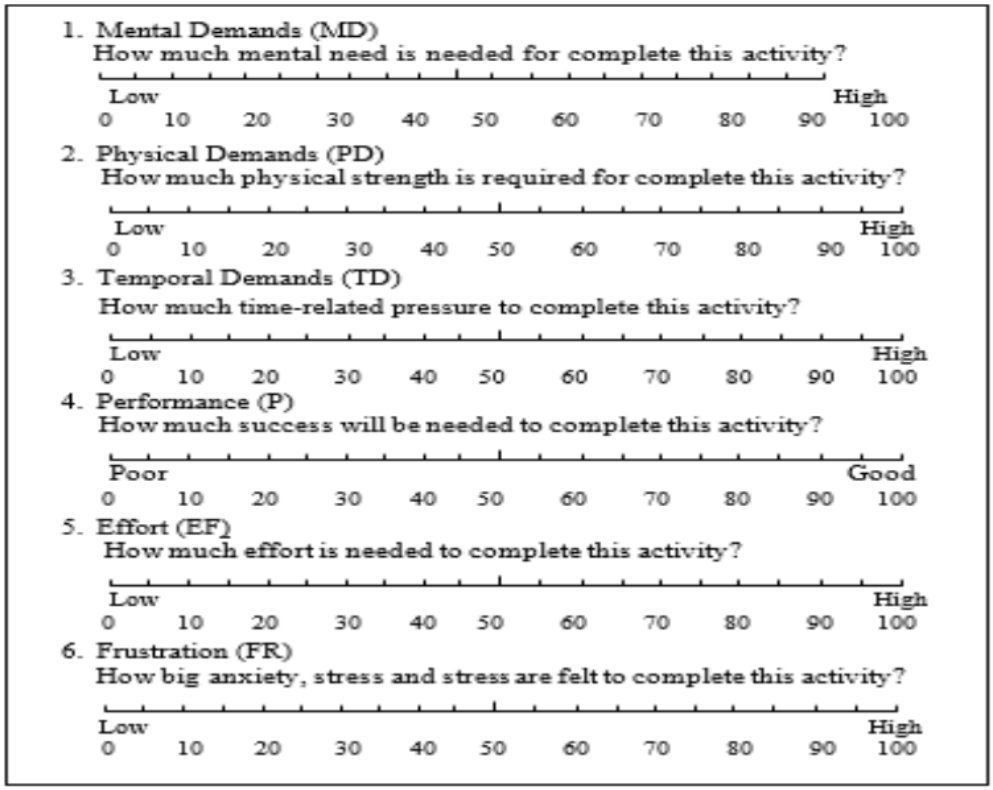

Fig. 3 Rating Questionnaire

3 RESULT AND DISCUSSION

3.1 Result

The data were collected at KRI with 82 respondents. The type of nautical journey works each Department in KRI as shown in Table 4. Job Types of Crew

After obtaining the questionnaire from all respondents, the next step is to calculate the result of the rating and the result of weight ratio. Where the number of ratings per point multiplied by the amount of weight generated by weighting NASA

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TLX at each point called Weighted Workload (WWL), then from the multiplication of the rating and weight of each indicator summed and divided by Divided Constant of 15 (number of comparison, it will get Average Weighted Workload (AVG WWL) or average Workload.

The results of the questionnaire for the Weighted Value of each department are shown in Table 5 NASA TLX Weighting. While the results of the mental workload rating questionnaire and the results of Average Weighted Workload (AVG WWL) scores are shown in Table 6. NASA TLX Questionnaire Recapitulation.

Table 4. Job Types of Crew

Department	Job type	Respondents
Operations Department	Quartermaster	8
	Communication specialist	8
	Throttle Operators	8
	Radar operators	8
	Navigator	8
Engine Department	Main Engine Operators	6
	Generator Engine Operators	6
	Electrician Operators	6
Electronics Department	Electronic Operators	8
Logistics Department	Ship Chef	8
	Pantryman	8

Table 5 NASA TLX Weighting

	Operations Department	Engine Department	Electronic Department	Logistics Department
Mental Demand (MD)	5	4	4	2
Physical Demand (PD)	1	2	1	3
Temporal Demand (TD)	2	1	2	2
Performance (P)	3	4	2	5
Effort (EF)	1	1	4	1
Frustration (FR)	3	3	2	2
Total	15	15	15	15

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Table 6. Nasa Tlx Questionnaire Recapitulation

Operation Department	Resp	weight / Rating						Product Value						WWL	DC	Average WWL
		MD 5	PD 1	TD 2	P 3	EF 1	FR 3	MD	PD	TD	P	EF	FR			
Quartermaster	1	80	60	70	60	70	70	400	60	140	180	70	210	1060	15	70.67
	2	70	70	70	70	70	80	350	70	140	210	70	240	1080	15	72.00
	3	80	70	60	70	60	70	400	70	120	210	60	210	1070	15	71.33
	4	80	80	60	70	70	60	400	80	120	210	70	180	1060	15	70.67
	5	70	70	80	70	80	70	350	70	160	210	80	210	1080	15	72.00
	6	80	70	80	80	80	60	400	70	160	240	80	180	1130	15	75.33
	7	80	70	80	70	80	60	400	70	160	210	80	180	1100	15	73.33
	8	70	80	70	70	70	80	350	80	140	210	70	240	1090	15	72.67
Communication Specialist	1	60	70	50	70	80	40	300	70	100	210	80	120	880	15	58.67
	2	60	60	50	40	40	70	300	60	100	120	40	210	830	15	55.33
	3	40	50	50	40	50	70	200	50	100	120	50	210	730	15	48.67
	4	60	80	60	70	80	50	300	80	120	210	80	150	940	15	62.67
	5	80	90	70	80	80	10	400	90	140	240	80	30	980	15	65.33
	6	50	50	60	50	40	40	250	50	120	150	40	120	730	15	48.67
	7	50	50	60	60	60	50	250	50	120	180	60	150	810	15	54.00
	8	60	80	70	90	50	70	300	80	140	270	50	210	1050	15	70.00
Throttle Operators	1	60	80	60	70	70	60	300	80	120	210	70	180	960	15	64.00
	2	70	60	80	60	70	60	350	60	160	180	70	180	1000	15	66.67
	3	50	50	50	70	50	50	250	50	100	210	50	150	810	15	54.00
	4	50	50	50	70	70	60	250	50	100	210	70	180	860	15	57.33
	5	70	60	60	50	70	60	350	60	120	150	70	180	930	15	62.00
	6	60	60	60	50	70	70	300	60	120	150	70	210	910	15	60.67
	7	70	60	50	40	40	60	350	60	100	120	40	180	850	15	56.67
	8	50	50	40	60	70	70	250	50	80	180	70	210	840	15	56.00
Radar operators	1	80	50	60	80	60	80	400	50	120	240	60	240	1110	15	74.00
	2	70	50	60	80	50	70	350	50	120	240	50	210	1020	15	68.00
	3	80	60	60	70	60	70	400	60	120	210	60	210	1060	15	70.67
	4	60	70	50	60	50	80	300	70	100	180	50	240	940	15	62.67
	5	60	60	80	60	70	70	300	60	160	180	70	210	980	15	65.33
	6	70	60	50	80	70	70	350	60	100	240	70	210	1030	15	68.67
	7	70	60	60	70	70	60	350	60	120	210	70	180	990	15	66.00
	8	80	70	60	80	70	70	400	70	120	240	70	210	1110	15	74.00
Navigator	1	80	60	60	70	70	80	400	60	120	210	70	240	1100	15	73.33
	2	80	70	80	80	90	60	400	70	160	240	90	180	1140	15	76.00
	3	70	60	80	50	70	80	350	60	160	150	70	240	1030	15	68.67
	4	80	90	80	70	80	80	400	90	160	210	80	240	1180	15	78.67
	5	80	90	70	80	80	60	400	90	140	240	80	180	1130	15	75.33
	6	80	60	50	70	60	80	400	60	100	210	60	240	1070	15	71.33
	7	70	60	70	70	70	70	350	60	140	210	70	210	1040	15	69.33
	8	90	60	80	50	70	60	450	60	160	150	70	180	1070	15	71.33

Table 7. Nasa Tlx Questionnaire Recapitulation (Continue)

Engine Department	Resp	weight / Rating						Product Value								Average WWL
		MD 4	PD 2	TD 1	P 4	EF 1	FR 3	MD	PD	TD	P	EF	FR	WWL	DC	
Main Engine Operators	1	80	60	60	70	70	80	320	120	60	280	70	240	1090	15	72.67
	2	80	70	80	80	90	60	320	140	80	320	90	180	1130	15	75.33
	3	70	60	80	70	70	80	280	120	80	280	70	240	1070	15	71.33
	4	80	90	80	70	80	80	320	180	80	280	80	240	1180	15	78.67
	5	80	90	70	80	80	60	320	180	70	320	80	180	1150	15	76.67
	6	80	60	50	70	60	80	320	120	50	280	60	240	1070	15	71.33
Generator Engine Operators	1	70	70	80	70	80	60	280	140	80	280	80	180	1040	15	69.33
	2	60	70	70	70	70	60	240	140	70	280	70	180	980	15	65.33
	3	70	70	70	60	80	60	280	140	70	240	80	180	990	15	66.00
	4	70	70	50	60	70	70	280	140	50	240	70	210	990	15	66.00
	5	80	60	50	60	60	80	320	120	50	240	60	240	1030	15	68.67
	6	70	70	70	70	70	50	280	140	70	280	70	150	990	15	66.00
Electrician Operators	1	60	70	50	70	80	40	240	140	50	280	80	120	910	15	60.67
	2	60	60	50	40	60	70	240	120	50	160	60	210	840	15	56.00
	3	70	50	50	40	50	70	280	100	50	160	50	210	850	15	56.67
	4	60	80	60	70	80	50	240	160	60	280	80	150	970	15	64.67
	5	70	70	70	50	60	60	280	140	70	200	60	180	930	15	62.00
	6	60	50	60	50	40	60	240	100	60	200	40	180	820	15	54.67
Electronic Department	Resp	MD 4	PD 1	TD 2	P 2	EF 4	FR 2	MD	PD	TD	P	EF	FR	WWL	DC	Average WWL
Electronic Operators	1	60	50	50	60	50	60	240	50	100	120	200	120	830	15	55.33
	2	50	60	60	50	50	60	200	60	120	100	200	120	800	15	53.33
	3	50	50	60	60	60	60	200	50	120	120	240	120	850	15	56.67
	4	50	60	60	70	50	70	200	60	120	140	200	140	860	15	57.33
	5	60	70	70	80	60	70	240	70	140	160	240	140	990	15	66.00
	6	60	70	50	60	70	70	240	70	100	120	280	140	950	15	63.33
	7	50	50	50	60	60	70	200	50	100	120	240	140	850	15	56.67
	8	60	70	70	70	60	50	240	70	140	140	240	100	930	15	62.00
Logistic Department	Resp	MD 4	PD 1	TD 2	P 2	EF 4	FR 2	MD	PD	TD	P	EF	FR	WWL	DC	Average WWL
Pantryman	1	60	50	50	60	50	60	240	50	100	120	200	120	830	15	55.33
	2	50	60	60	50	50	60	200	60	120	100	200	120	800	15	53.33
	3	50	50	60	60	60	60	200	50	120	120	240	120	850	15	56.67
	4	50	60	60	70	50	70	200	60	120	140	200	140	860	15	57.33
	5	60	70	70	80	60	70	240	70	140	160	240	140	990	15	66.00
	6	60	70	50	60	70	70	240	70	100	120	280	140	950	15	63.33
	7	50	50	50	60	60	70	200	50	100	120	240	140	850	15	56.67
	8	60	70	70	70	60	50	240	70	140	140	240	100	930	15	62.00
Ship Chef	1	40	70	70	60	80	60	160	70	140	120	320	120	930	15	62.00
	2	70	70	60	50	70	60	280	70	120	100	280	120	970	15	64.67
	3	60	50	50	50	80	50	240	50	100	100	320	100	910	15	60.67
	4	50	90	60	80	90	50	200	90	120	160	360	100	1030	15	68.67
	5	60	70	40	80	70	50	240	70	80	160	280	100	930	15	62.00
	6	50	80	60	50	70	70	200	80	120	100	280	140	920	15	61.33
	7	60	80	70	50	80	80	240	80	140	100	320	160	1040	15	69.33
	8	50	70	70	80	80	50	200	70	140	160	320	100	990	15	66.00

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After the results obtained from the processing of mental workload data, then processed by Fuzzy method. This is done because of the uncertainty of the workload value of personnel performing the same task. In this method there are two stages, namely fuzzyfication and defuzzyfication.

a. Fuzzyfication

At this stage the input crips are first determined. The requirement to convert input ciphers into fuzzy inputs is to determine the membership function for each input. The average WWL value of the questionnaire data processing is used as the Input Crips Value. To determine the membership function, use triangle curve function. As shown in Fig 4. Triangle curve.

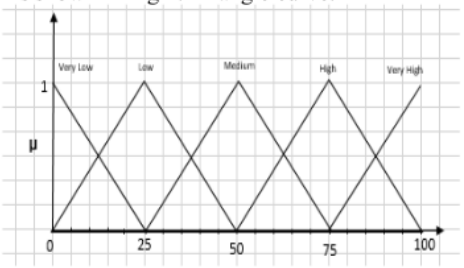

Fig 4. Triangle curve

For example, the Quartermaster of respondent 1 has the value of mental workload (average WWL) of 70.67. This value as input crips from the mental workload of the respondent's Quartermaster 1. This value is in the linguistic value of "medium" and "high". As shown in Fig.5 Crips Input of Quartermaster 1.

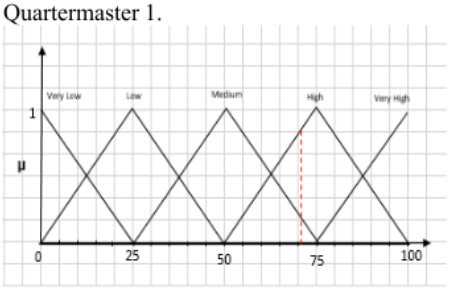

Fig. 5 Crips Input of Quartermaster 1

For the Quartermaster job (1), on a high linguistic scale, the location of 70.67 is at a≤x≤b, where "x" is a value of 70.67, "b" is a value of 75, and "a" is the mean of the medium linguistic scale of 50. So the degree of membership of the Quartermaster (1) for high linguistic scale is as follows:

$$\mu A = \frac{(x-a)}{(b-a)}$$

$$\mu A = \frac{(70{,}67-50)}{(75-50)}$$

$$\mu A = 0{,}83$$

While for medium linguistic scale, the location of 70,67 is at b≤x≤c, where "x" is 70,67, "c" is 75, and "b" is the mean value of medium linguistic scale 50. So the degree of membership of the Quartermaster (1) for high linguistic scale is as follows:

$$\mu A = \frac{(c-x)}{(c-b)}$$

$$\mu A = \frac{(75-70{,}67)}{(75-50)}$$

$$\mu A = 0{,}21$$

The full results of the fuzzyfication calculations for each job are shown in Table 8 Fuzzyfication.

b. Defuzzyfication

After implementing fuzzyfikasi, the next step is Defuzzyfikasi the stages change the value of fuzzy into output crips. The method used is the method of Center Of Gravity (COG). The defuzzyfication calculations in the Quartermaster's work are as follows:

$$COG = \frac{\sum x.\mu\,()}{\sum \mu\,(A)}$$

$$= \frac{(70{,}67 \times 0{,}17) + (70{,}67 \times 0{,}83) + \cdots + (72{,}67 \times 0.91)}{(0{,}17 + 0{,}83 + 0{,}12 + \cdots + 0{,}91)}$$

$$= \frac{578}{8} = 72{,}25$$

In the same way for each job, a defuzzyfication result is obtained as shown in Table 9 Defuzzyfication.

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Table 9 Defuzzyfication

Department	Job Types	Result of Defuzzyfikasi
Operations Department	Quartermaster	72,25
	Communication specialist	59,67
	Throttle Operators	59,67
	Radar operators	68,67
	Navigator	73,00
Engine Department	Main Engine Operators	74,33
	Generator Engine Operators	66,89
	Electrician Operators	59,11
Electronics Department	Electronic Operators	58,83
Logistics Department	Ship Chef	64,33
	Pantryman	58,92

Table 8 Fuzzyfication

No	Job Types	Linguistic Scale	X	µA	No	Job Types	Linguistic Scale	X	µA
1	Quartermaster 1	Medium	70.67	0.17	17	Throttle Operators 1	Medium	64.00	0.44
		High	70.67	0.83			High	64.00	0.56
2	Quartermaster 2	Medium	72.00	0.12	18	Throttle Operators 2	Medium	66.67	0.33
		High	72.00	0.88			High	66.67	0.67
3	Quartermaster 3	Medium	71.33	0.15	19	Throttle Operators 3	Medium	54.00	0.84
		High	71.33	0.85			High	54.00	0.16
4	Quartermaster 4	Medium	70.67	0.17	20	Throttle Operators 4	Medium	57.33	0.71
		High	70.67	0.83			High	57.33	0.29
5	Quartermaster 5	Medium	72.00	0.12	21	Throttle Operators 5	Medium	62.00	0.52
		High	72.00	0.88			High	62.00	0.48
6	Quartermaster 6	High	75.33	0.99	22	Throttle Operators 6	Medium	60.67	0.57
		Very High	75.33	0.01			High	60.67	0.43
7	Quartermaster 7	Medium	73.33	0.07	23	Throttle Operators 7	Medium	56.67	0.73
		High	73.33	0.93			High	56.67	0.27
8	Quartermaster 8	Medium	72.67	0.09	24	Throttle Operators 8	Medium	56.00	0.76
		High	72.67	0.91			High	56.00	0.24

9	Communication Specialist 1	Medium	58.67	0.65	25	Radar Operators 1	Medium	74.00	0.04
		High	58.67	0.35			High	74.00	0.96
10	Communication Specialist 2	Medium	56.67	0.73	26	Radar Operators 2	Medium	68.00	0.28
		High	56.67	0.27			High	68.00	0.72
11	Communication Specialist 3	Medium	58.67	0.65	27	Radar Operators 3	Medium	70.67	0.17
		High	58.67	0.35			High	70.67	0.83
12	Communication Specialist 4	Medium	62.67	0.49	28	Radar Operators 4	Medium	62.67	0.49
		High	62.67	0.51			High	62.67	0.51
13	Communication Specialist 5	Medium	63.33	0.47	29	Radar Operators 5	Medium	65.33	0.39
		High	63.33	0.53			High	65.33	0.61
14	Communication Specialist 6	Medium	56.00	0.76	30	Radar Operators 6	Medium	68.67	0.25
		High	56.00	0.24			High	68.67	0.75
15	Communication Specialist 7	Medium	57.33	0.71	31	Radar Operators 7	Medium	66.00	0.36
		High	57.33	0.29			High	66.00	0.64
16	Communication Specialist 8	Medium	64.00	0.44	32	Radar Operators 8	Medium	74.00	0.04
		High	64.00	0.56			High	74.00	0.96

Table 8 Fuzzyfication (Continue)

No	Job Types	Linguistic Scale	X	μA	No	Job Types	Linguistic Scale	X	μA
33	Navigator 1	Medium	73.33	0.07	58	Electrician Operator 6	Medium	54.67	0.81
		High	73.33	0.93			High	54.67	0.19
34	Navigator 2	High	76.00	0.96	59	Electronic Operator 1	Medium	55.33	0.79
		Very High	76.00	0.04			High	55.33	0.21
35	Navigator 3	Medium	68.67	0.25	60	Electronic Operator 2	Medium	53.33	0.87
		High	68.67	0.75			High	53.33	0.13
36	Navigator 4	High	78.67	0.85	61	Electronic Operator 3	Medium	56.67	0.73
		Very High	78.67	0.15			High	56.67	0.27
37	Navigator 5	High	75.33	0.99	62	Electronic Operator 4	Medium	57.33	0.71
		Very High	75.33	0.01			High	57.33	0.29
38	Navigator 6	Medium	71.33	0.15	63	Electronic Operator 5	Medium	66.00	0.36
		High	71.33	0.85			High	66.00	0.64
39	Navigator 7	Medium	69.33	0.23	64	Electronic Operator 6	Medium	63.33	0.47
		High	69.33	0.77			High	63.33	0.53
40	Navigator 8	Medium	71.33	0.15	65	Electronic Operator 7	Medium	56.67	0.73
		High	71.33	0.85			High	56.67	0.27

41	Main Engine Operators 1	Medium	72.67	0.09	66	Electronic Operator 8	Medium	62.00	0.52
		High	72.67	0.91			High	62.00	0.48
42	Main Engine Operators 2	High	75.33	0.99	67	Ship Chef 1	Medium	62.00	0.52
		Very High	75.33	0.01			High	62.00	0.48
43	Main Engine Operators 3	Medium	71.33	0.15	68	Ship Chef 2	Medium	64.67	0.41
		High	71.33	0.85			High	64.67	0.59
44	Main Engine Operators 4	High	78.67	0.85	69	Ship Chef 3	Medium	60.67	0.57
		Very High	78.67	0.15			High	60.67	0.43
45	Main Engine Operators 5	High	76.67	0.93	70	Ship Chef 4	Medium	68.67	0.25
		Very High	76.67	0.07			High	68.67	0.75
46	Main Engine Operators 6	Medium	71.33	0.15	71	Ship Chef 5	Medium	62.00	0.52
		High	71.33	0.85			High	62.00	0.48
47	Gen Engine Operators 1	Medium	69.33	0.23	72	Ship Chef 6	Medium	61.33	0.55
		High	69.33	0.77			High	61.33	0.45
48	Gen Engine Operators 2	Medium	65.33	0.39	73	Ship Chef 7	Medium	69.33	0.23
		High	65.33	0.61			High	69.33	0.77
49	Gen Engine Operators 3	Medium	66.00	0.36	74	Ship Chef 8	Medium	66.00	0.36
		High	66.00	0.64			High	66.00	0.64
50	Gen Engine Operators 4	Medium	66.00	0.36	75	Pantryman 1	Medium	56.67	0.73
		High	66.00	0.64			High	56.67	0.27
51	Gen Engine Operators 5	Medium	68.67	0.25	76	Pantryman 2	Medium	57.33	0.71
		High	68.67	0.75			High	57.33	0.29
52	Gen Engine Operators 6	Medium	66.00	0.36	77	Pantryman 3	Medium	64.67	0.41
		High	66.00	0.64			High	64.67	0.59
53	Electrician Operator 1	Medium	60.67	0.57	78	Pantryman 4	Medium	57.33	0.71
		High	60.67	0.43			High	57.33	0.29
54	Electrician Operator 2	Medium	56.00	0.76	79	Pantryman 5	Medium	56.67	0.73
		High	56.00	0.24			High	56.67	0.27
55	Electrician Operator 3	Medium	56.67	0.73	80	Pantryman 6	Medium	63.33	0.47
		High	56.67	0.27			High	63.33	0.53
56	Electrician Operator 4	Medium	64.67	0.41	81	Pantryman 7	Medium	54.00	0.84
		High	64.67	0.59			High	54.00	0.16
57	Electrician Operator 5	Medium	62.00	0.52	82	Pantryman 8	Medium	61.33	0.55
		High	62.00	0.48			High	61.33	0.45

3.2 Discussion

The mental workload perceived by each person varies even in the same type of work, because the assessors are based on their respective perceptions. But the difference is in a relatively small range. Mental workload on the job of the Quartermaster with the respondent as many as 8 people have a workload with the range between 70.67 up to 75,33. At the Communication specialist with 8 respondents, the workload received by personnel in the range between 56 to 64. The Throttle Operators with 8 respondents, workload received by personnel in the range of 54 to 66,66. In the work of Radar operators with 8 respondents, the workload received by personnel in the range of 54 to 66.66. In Navigator work with 8 respondents, the workload received by personnel is in the range of 68,66 to 78,66. In the Main Engine Operators work with 6 respondents, the workload received by personnel in the range between 71,33 to 78,66. Of Generator Engine Operators work with 6 respondents, the workload received by personnel is in the range of 65,33 to 69,33. In Electrician operator work with 6 respondents, the workload received by the personnel is in the range between 54,66 and 64,66, In electronic operators work with 8 respondents, the workload received by the personnel is in the range of 53,33 up to 66, On the Ship chef with 8 respondents, the workload

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received by the personnel is in the range between 60,66 to 69,33, On the Pantryman work with 8 respondents, the workload received by personnel is in the range of 54 to 64,66.

Of the 11 (eleven) types of work in the KRI at the time of the sail, have a mental workload in the medium and high category. Jobs that fall into the moderate category are the Throttle Operators, Electrician Operators, Electronic Operators and Pantryman. For work that has the lowest mental workload value is an Electronic Operator with a value of 58,83. While the type of work included in the category of high workload is the Quartermaster, Radar operators, Navigator, Main Engine Operators, Generator Engine Operators and Ship Chef. Main Engine Operators is the work that has the highest mental workload with a value of 74,33, while the Electronic Operators is the job that has the lowest workload with a value of 58,83.

4 CONCLUSION

From the results of this study it is known that the type of work in the KRI at the time of operation (sail) which has the highest mental workload is the Main Engine Operators with a work load value of 74,43, while the type of work is the lowest mental workload is to keep Electronic Operators with work load value of 58,83. So to keep the performance of the organization remains good, then this mental workload needs to be considered in order not to happen excessive workload for personnel. The other than that with the known mental workload of each personnel, it can be used to determine a policy so that personnel do not get excessive workload

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