Assessment of VTS Operators’ Mental Workload by Using NASA Task Load Index

Serdar KUM*, Masao FURUSHO** and Masaki FUCHI **

Abstract

The objective of this paper is to determine the level of Vessel Traffic Services Operators’ (VTS-Os’) Mental Workload (MWL) by using NASA Task Load Index (NASA-TLX). For this purpose the questionnaire is prepared and submitted to the Turkish VTS Operators (in the Istanbul and Canakkale VTS Centres) who has a long term sea experience as a Ship Master and submitted to the Japanese VTS-Os in the different locations (Akashi Strait, Bissan Seto, Kurushima and Kannon Straits). The VTS-Os’ MWL is subjectively determined by using NASA-TLX because of its origin that includes the operators judgements. In the analysing part, MWL of the Turkish and Japanese Operators are compared and also the relationship among the different safety culture of VTS-Os and their characteristics are investigated. The results show that there is not any significantly difference between Turkish and Japanese Operators’ MWL, and the MWL is independent from operators’ profile variables such as; age, marital situation, sea experience, experience at VTS Centre and educational level.

Keywords: Vessel Traffic Services, Human factors, VTS Operators, mental workload, NASA-TLX

1. Introduction

In the literature survey, there are a few paper related to behaviours of Vessel Traffic Services Operators (VTS-Os), especially for the cognitive approaches. Also, very few studies related to mental workload are attained in the maritime field, but they are not focus on VTS-Os. The statistics of maritime accidents obviously indicates that the affect of high workload to cause human error. And as a common sense, majority of the maritime accidents occur in narrow waterways such as channels and fairways. Therefore, VTS effect can not be omitted in the maritime accidents. Authors consider VTS-Os for aiming to maximise human reliability in the VTS systems, so they can provide the maximum service by minimising operators’ error.

The main aim of studies related to human factors is also to minimise human error for the safety management. Understanding the VTS-Os’ mental workload (MWL) could help to get this aim; the optimizing of MWL could minimize human errors; improve safety of system, increase productivity and operators’ satisfaction[1]

On the other hand, the dimension of work has changed from physical to cognitive because of technology and widespread using of computers[2]. The physical demand of work has been reduced by automation.

Mental workload is an important issue since the operating systems are designed in the central of human operator. According to the international standards, the evaluation of MWL is a key point for the usability enhancement of the components of a technical system and for the quality improvement of a design[3].

2. Mental Workload (MWL)

Workload is the amount of work that expected to be done by an operator in a specified time. In another words, it is the interaction between the operator and assigned task[4]. The operator needs physical and/or mental requirements to perform a task or combination of tasks. Workload is classified as Physical Workload (PWL) and Mental Workload (MWL). PWL means how much effort expended for the physical resources while performing task(s). On the other hand, MWL is defined as the level of processing capacity while performing the task[5]. MWL is also considered as the demand on the brain and sensory system (eyes, ears, and skin) due to the tasks[6]. The common idea, MWL is directly proportional with the difference between existing sources and required sources by the task.

The problem is how we can understand/feel the mental workload. MWL can not be obtained directly, but the impact of MWL can be achieved. So, it can be measured indirectly assessing the variables to cause MWL by using some common methodologies such as subjective rating scales, performance measures and physiological measures.

The common subjective methods are; Modified Cooper Harper-MCH[6], NASA Task Load Index[7] and Subjective Workload Assessment Technique-SWAT[8]. They are originally developed for air navigation and military applications. The purpose of subjective workload assessment techniques is to assess the operator cognitive load. The methods including subjective ratings measure the overall workload[9]. The advantages of using subjective measures are; ease of using, low cost, high face, validity, and known sensitivity to workload variations. NASA-TLX is the

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most appropriate subjective measurement technique to achieve overall mental workload (6).

3. NASA Task Load Index (NASA-TLX)

The NASA-TLX is a common subjective measurement technique to assess operators’ workload for determining MWL level by the multidimensional rating scale in six dimensions; Mental Demand (MD), Physical Demand (PD), Temporal Demand (TD), Effort (E), Performance (P) and Frustration Level (FL). Task Load Index was originally set up by NASA for the evaluation of pilots’ workload.

The NASA-TLX includes two parts; weighting and rating. Firstly, operator makes a pairwise comparison by choosing which dimension is more related to workload for the task in all pairs of six dimensions (15 cases). Different weights are assigned to six dimensions based on the operator’s preference. These comparisons are made for determining the higher source of workload factor for each pair. Then, operator provides ratings (gives a score between 0 and 100) for each dimension. Finally, operator’s subjective workload is obtained by weighted average of ratings. One of the disadvantages of NASA-TLX is misinterpreted by operators because of the translations in their mother tongues. Especially, misinterpretation increases for assessing Physical Demand as a measure of physical workload, but the NASA-TLX recognizes PD as the potential influence of physical activity on the perception of mental workload, and it is one of the dimensions used to determine the NASA-TLX. Consequently, the results are investigated for two cases; with PD and without PD.

In the pair-wise comparison in Table 1, the subjects were asked to select one of the two dimensions of workload that they felt, was more critical to them.

Table 1 Pairwise comparison

<table>
<thead>
<tr>
<th>Case</th>
<th>Dimension – 1</th>
<th>Dimension – 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mental Demand</td>
<td>Temporal Demand</td>
</tr>
<tr>
<td>2</td>
<td>Temporal Demand</td>
<td>Performance</td>
</tr>
<tr>
<td>3</td>
<td>Mental Demand</td>
<td>Frustration Level</td>
</tr>
<tr>
<td>4</td>
<td>Effort</td>
<td>Performance</td>
</tr>
<tr>
<td>5</td>
<td>Mental Demand</td>
<td>Physical Demand</td>
</tr>
<tr>
<td>6</td>
<td>Physical Demand</td>
<td>Frustration Level</td>
</tr>
<tr>
<td>7</td>
<td>Temporal Demand</td>
<td>Effort</td>
</tr>
<tr>
<td>8</td>
<td>Mental Demand</td>
<td>Performance</td>
</tr>
<tr>
<td>9</td>
<td>Temporal Demand</td>
<td>Frustration Level</td>
</tr>
<tr>
<td>10</td>
<td>Physical Demand</td>
<td>Temporal Demand</td>
</tr>
<tr>
<td>11</td>
<td>Performance</td>
<td>Frustration Level</td>
</tr>
<tr>
<td>12</td>
<td>Physical Demand</td>
<td>Effort</td>
</tr>
<tr>
<td>13</td>
<td>Effort</td>
<td>Frustration Level</td>
</tr>
<tr>
<td>14</td>
<td>Mental Demand</td>
<td>Effort</td>
</tr>
<tr>
<td>15</td>
<td>Physical Demand</td>
<td>Performance</td>
</tr>
</tbody>
</table>

SPSS 13.0 (Statistical Package for Social Science) program is used for determining and analysing of MWL. VTS-O’s MWL was calculated by the Equation (1) and one example is given in Table 3.

\[
WL(O_i) = \left( \frac{(W_{MD}, R_{MD}) + (W_{PD}, R_{PD})}{\sum W_i} \right)
\]

[Equation (1)]

In the Equation (1), the workload estimate for the \(i\)th operator is represented by \(O_i\), weights showed by \(W\) and \(R\) represents to rating. Weights are obtained from the pair-wise comparisons, when a dimension is selected as the most significant workload source; the weighting of that dimension is increased by one. Then operators’ workload is determined by summing the rating for each dimension, multiplied by its weighting and divided by the sum of all weights. For the MWL of all operators, the average value of operators’ MWL is calculated by summing their overall workload and divided to the number of operators as shown in Equation (2).

\[
WL(VTS - O) = \frac{\sum WL(O_i)}{n}
\]

Table 2 shows the sample of rated scores in the scale of low loading to high loading (from 0 to 20). Then, the rating scores should be multiplied by 5 for obtaining 100.

Table 2 Operator’s rating

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Rating</th>
<th>Low Loading</th>
<th>High Loading</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mental Demand</td>
<td>18</td>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td>Physical Demand</td>
<td>5</td>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td>Temporal Demand</td>
<td>15</td>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td>Effort</td>
<td>10</td>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td>Performance</td>
<td>8</td>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td>Frustration Level</td>
<td>20</td>
<td>0</td>
<td>20</td>
</tr>
</tbody>
</table>

Table 3 shows the example how to compute overall MWL. The weights are based on the number of times that particular dimension was selected during the pairwise comparison (circles in Table 1). When the weights are determined for each dimension, it is multiplied by its rate.

Table 3 Determining of overall mental workload

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Weight</th>
<th>Rating</th>
<th>Weight Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mental D.</td>
<td>3</td>
<td>18</td>
<td>(3 \times (18 \times 5)/15)</td>
</tr>
<tr>
<td>Physical D.</td>
<td>1</td>
<td>5</td>
<td>(1 \times (5 \times 5)/15)</td>
</tr>
<tr>
<td>Temporal D.</td>
<td>4</td>
<td>15</td>
<td>(4 \times (15 \times 5)/15)</td>
</tr>
<tr>
<td>Effort</td>
<td>0</td>
<td>10</td>
<td>(0 \times (10 \times 5)/15)</td>
</tr>
<tr>
<td>Performance</td>
<td>3</td>
<td>8</td>
<td>(3 \times (8 \times 5)/15)</td>
</tr>
<tr>
<td>Frustration L.</td>
<td>4</td>
<td>20</td>
<td>(4 \times (20 \times 5)/15)</td>
</tr>
<tr>
<td>(W)</td>
<td>15</td>
<td>Overall MWL</td>
<td>(74.33)</td>
</tr>
</tbody>
</table>
4. VTS-Os' Profile

VTS-Os' role in the maritime traffic is to provide necessary information to the ships and advising them, that is different from controlling traffic. Because ships have freedom to accept or reject information given by VTS. VTS-Os provide the information by using different sources (e.g. radar screen, AIS Information, communication with vessels, etc.), and VTS-Os have to control dynamic traffic situations in a limited time. They have perceived risky relationships among the ships and to solve these potential threats beforehand to let Ship Master deciding the own ship situation with the others. Moreover, this loop continues with new incoming ships which to create new traffic relations for the assessment.

The NASA-TLX form is submitted to the Turkish (TR) and Japanese (JP) VTS Centres. A questionnaire is prepared to study on operators’ workload. Questionnaire consists of three parts;

(1) Assessment of the variables that cause to workload,
(2) Role of the VTS-Os for preventing of maritime accidents (Effectiveness of VTS), and
(3) NASA-TLX.

The first section of questionnaire includes the profile information of operators. The total number of operators; VTS Supervisors (VTS-S) and VTS-Os, is shown in Table 4.

Table 4 Operators number at VTS Centres

<table>
<thead>
<tr>
<th>Country</th>
<th>VTS Centre</th>
<th>Number</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>TURKEY</td>
<td>Istanbul</td>
<td>48</td>
<td>82</td>
</tr>
<tr>
<td></td>
<td>Canakkale</td>
<td>34</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Akashi</td>
<td>19</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bissan Seto</td>
<td>32</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Kannon</td>
<td>33</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Kurushima</td>
<td>29</td>
<td></td>
</tr>
<tr>
<td>JAPAN</td>
<td></td>
<td></td>
<td>113</td>
</tr>
</tbody>
</table>

The NASA-TLX is send separately from the questionnaire to VTS Centres and authors especially consider the Istanbul Strait for analysing of MWL by using NASA-TLX in Turkish Operators, due to their systematic studies. In this case, the successful response number of NASA-TLX is 74 for JP Operators and 24 for Turkish (the form is just send to the Istanbul VTS). Moreover, the whole profile information of VTS-Os and data of questionnaire Part (1) & (2) are not indicated in this paper; just the part related to NASA-TLX is explained, because the relationships between MWL and profile variables are investigated. So, the successful replied form of NASA-TLX is analysed with the profile variables (the sample population is; n (JP) = 74 and n (TR) = 24). In addition, no specific task is required to perform by the operators before filling the NASA-TLX form. They filled the form by considering the whole tasks during executing their regular job as VTS-O, so the total workload is obtained by NASA-TLX.

4.1 Turkish VTS-Os

All Turkish Operators have Ocean Going Ship Master Certificate and they have minimum Bachelor Science degree from maritime faculty. Moreover, they have on board experience in average 12.7 years (5 years as a Ship Master). All of them are male ranging in age from 30 to 47 years with the average of 38.2 years as shown in Fig.1.

![Age graphic of TR VTS-Os](image1)

Fig.1 Age graphic of TR VTS-Os

Turkish VTS-Os did not hesitate to fill their age data; all of them replied it. 70.8% of TR VTS-Os is between 30 and 40 years old.

![Graphic for the sea experience of TR VTS-Os](image2)

Fig.2 Graphic for the sea experience of TR VTS-Os

The Turkish VTS has been in service since 2003. So, operators have less than 5 years experience as VTS-O. Fig.3 shows the distribution of their experience at VTS Centre. 83.3% of Turkish VTS-Os are married and 16.7% of them is engaged as VTS-S.
4.2 Japanese VTS-Os

Japanese VTS-Os hesitate to fill their age data (32.4% of them did not reply). Majority of JP VTS-Os are older than 40 years (61%) and 36.5% of them older than 50 years as shown in Fig.4.

![Age graphic of JP VTS-Os](image)

Japanese VTS-Os mainly do not have on board experience as a Ship Master, but some of them have sea experience as an officer and a navigator, and a few of them have international voyage. Their average sea experience is 6.2 years. On the other hand, their VTS experience is higher than Turkish VTS-Os’. Fig.5 shows the Japanese VTS-Os’ experience with the average of 4.6 years (their VTS experience has uniform distribution as TR Operators have normal).

85.1% of JP Operators is married and the percentage of married VTS-S is higher than VTS-Os, comparing to TR Operators this situation is converse. Moreover, 45.9% of JP Operators is engaged as VTS Supervisor.

Japanese VTS-Os are mainly graduated from the Japan Coast Guard (JCG) School and JCG Moji School. If the maritime education system is compared between Turkey and Japan to becoming a VTS-O, it is obviously clarified that JP VTS-Os are mainly trained based on vocational education. At this point, it should be identified that the administrative procedure and regulation are different among the maritime authorities. E.g. graduating a maritime faculty, having a Ship Master licence with minimum 5 years on board experience are the compulsory requirements to be a VTS-O in Turkey. On the other hand, all these requirements are strongly related to the sea trading, and there is not any specific educational organization for VTS-Os or in the existing maritime education system. That means when they graduate a maritime faculty, and satisfy other requirements, they have to get proper VTS-O’s training desired by administration.

5. Results

Mental workload of VTS-Os is determined based on the NASA-TLX as explained in chapter 3. Firstly, the result is obtained by including all dimensions, and then the “Physical Demand - PD” dimension is neglected from NASA-TLX. Because, it is considerable to be aware of VTS-Os have properly understood the meaning of Physical Demand. The results show that workload level of NASA-TLX included PD dimension has similar behaviour excluded PD; not only for Turkish VTS-Os (r = 0.97, p < 0.01, two tailed) and but also for Japanese VTS-Os (r = 0.85, p < 0.01, two tailed). So, these two data sets of MWL (with PD or without PD) are related to each other, both of them can be applied as MWL. These two cases are showed in Fig.6 and Fig.7. The Fig.6 shows the Turkish VTS-Os’ MWL and the NASA-TLX score is determined as 63.4 (in the scale of 100), so that means their workload level is 63.4%.
The NASA-TLX score of Japanese VTS-Os is showed in Fig.7. Their overall mental workload score is 58.0 (MWL level is 58.0%).

![Graph showing NASA-TLX Dimensions](image)

**Fig.7** MWL of Japanese VTS-Os by NASA-TLX

SPSS 13.0 software is used for analysing VTS-Os’ MWL scores. In the analyzing part:

1. The data is split into two cases; Turkish and Japanese Operators, then
2. To investigate the relation among the profile variables (nationality, age, marital situation as the operator is married or single, position as VTS-S or VTS-O, on board experience and experience at VTS Centres)
3. To compare the result of NASA-TLX if there is any difference between Turkish and Japanese Operators,
4. Then, the relationship between MWL and profile variables is investigated to look for any profile effects on MWL. Therefore, the statistical tests are carried out one by one for each profile variables and also for their interactions (within all combination) for the whole data.

When VTS-Os’ MWL scores are determined, according to Student’s *t* independent test [*t* (96) = -1.46, *p*: 0.14>0.05] and F-test [F (23; 73) = 1.18 is less than F Critical (1.84), *p*: 0.33 >0.05]; the MWL is found no significantly different for Turkish and Japanese VTS-Os. Their mean and variance are equal, and there is no correlation between Turkish and Japanese VTS Operators.

On the other hand, when comparing operators’ judgement for six dimensions, the weighted ratings are similar for Japanese and Turkish, except Temporal Demand. Japanese VTS-Os feel that time pressure is the second factor to affect their workload after Mental Demand; and Temporal Demand is the last order for the Turkish Operators. But, statistically there is no difference between Turkish and Japanese VTS-Os.

The two sample data (TR and JP) based on the profile variables are determined as significantly different from each others, except the marital variable. They have similar marital condition (*t* (96) = -0.21, *p*:0.83). The correlation between nationality and age is significantly high. And, there are medium correlations between; nationality-experience on sea-experience at VTS; age and experience at VTS. On the other hand, the correlations between position and sea experience, position and age are weak; that means when to employ operators as VTS-S or VTS-O, their age and sea experience have not any effect.

Two-way ANOVA for independent samples and for mixed measures are carried out to determine the total effect of profile variables on MWL. In addition, the interaction effects of profile variables are also tested by Student’s *t* test. Totally, 59 cases are tested including pair and multiple interactions. According to the results, some differences are obtained between Japanese and Turkish VTS-Os (for the local cases) when the confidence interval is simulated at 90% (*z* =0.10) based on profile variables that TR VTS-Os’ MWL is higher than Japanese Operators (*t* (96) = -1.46, *p*:0.07, one-tailed).

There is no significant difference between Japanese and Turkish Operators on the MWL depends on operators’ profile variables individually. And, all of these variables are independent from each others; they have not any effect on MWL. Furthermore, some differences are determined within interactions of the profile variables as follows;

1. TR VTS Supervisors have significantly higher MWL than JP VTS Supervisors as shown in Fig.8 (*t* (36) = -2.09, *p*:0.04).

![Graph showing MWL Scores](image)

**Fig.8** The average values of MWL based on nationality and position

2. The Operators (Turkish and Japanese) are married and 40 to 50 years old, have higher MWL than single operators in the age of 40 to 50 (*t* (22) = 2.22, *p*:0.03).
3. Turkish Operators who have over than 10 years on board experience have higher MWL than Japanese as shown in Fig.9 (*t* (39) = -1.95, *p*:0.05).
Fig. 9 The average values of MWL based on nationality and sea experience

(4) VTS Supervisors (30 to 40 years old) have higher MWL than VTS Operators as shown in Fig.10 (t (18) = 2.03, p<0.05).

Fig.10 The average values of MWL based on position and VTS experience

(5) When the operators have less than 5 years sea experience and their VTS experience less than 5 years, they have higher MWL than over 5 years experience at VTS (t (40) = 3.3, p<0.00). It can be said that the experience has partial effect on MWL. This is assumed that when the experience is increased, MWL is decreased. The operators who have more experience to feel their MWL is not as high as who have less experience. Fig.11 shows the average value of MWL for the profiles; sea experience and VTS experience.

(6) VTS Supervisors who has less than 5 years experience at VTS Centre have higher MWL than Japanese (t (24) = -2.33, p<0.04).

Fig. 11 The average values of MWL based on VTS experience and sea experience

(7) Turkish VTS Supervisors’ MWL is higher than VTS-Os depend on their age, between 30 and 40 years old (t (15) = 1.88, p<0.08).

(8) Japanese Operators who are married have higher MWL than single in between the operators’ age is 40 to 50 years old.

6. Consideration

In this paper, the mental workload level of VTS-Os is obtained from different nationality and employees in the different locations. Furthermore, some factors related to their characteristics are investigated to understand whether they affect to operators’ workload or not. But, there is some existing knowledge should be clarified on VTS-Os’ MWL such as; the factors related to operator tasks (especially while performing their service to the ships) that to cause mental workload, the relation and assessment of MWL level that obtained by different measurement techniques.

The NASA-TLX scores are determined as 63.4 for Turkish VTS-Os and 58.0 for Japanese VTS-Os, and it is significantly same (. =0.05). At this point, the question is that this level is high or low for VTS-Os, or it is an acceptable workload level or excessive. Because, the same amount of workload means different things for each person. The remarkable workload level is mentioned as “workload redline” and the critical values on the SWAT rating-scale have been proposed as 40 ± 10 referring to the point at which performance begins to be affected. And, high overall SWAT ratings are obtained near 80. On the other hand, NASA-TLX score consistently demonstrates higher loading than scores of SWAT and MCH.

The hypothesis says that when workload level is high, human tends to make error. According to another hypothesis, when workload decreases that also tends
human to make error; because of carelessness, and loosing the attention.

The reason for considering operators’ mental workload is; the operator may be overloaded to the point of task(s) where he can make error or otherwise if the workload is low, he can not keep his attention to understand circumstances. In both cases, the workload level should in an optimum level for protecting any tiredness (due to high loading) and boredom (due to low loading). Finally, the main aim is to minimize any kind of human error to get “safety”; especially when the automation covers all life circles.

In case of VTS-Os, when he makes any error, it is inevitable for facing a potential maritime accident. Human is the central of the system for protecting any undesirable situation and keeping safety of the system. That’s why; the important point is to keep proper attention based on MWL required by operators’ tasks. This situation is completely related to the operators’ performance. Their performance should be appropriate level that means not to have higher workload that makes operator to be overload, and not to have lower workload tends the operator to loose attention. In this paper, the level of VTS-Os’ MWL is assumed as acceptable level for keeping proper attention according to NASA-TLX scores.

One way to understand the attention is to analyse the eye movements. So, it can be obtained the operator’s attention to where and how. Human never pay attention to something without looking. When operators have higher fixation duration to one area, it starts the procedure (e.g. communication with ship) and as a result of that to increase operator’s workload. Basic characteristics of VTS-Os’ eye movements are defined by authors (12) as a physiological index.

The factors to cause MWL are investigated out of the maritime field. In a common sense, nature of work, work equipments, physical and social conditions of working environment effect to workload. Also, the structure of task such as task aims and operator’s task perception (7); task size, time pressure, and individual knowledge have the important effects on MWL (9). Moreover, MWL is different for the employees in the Information Technology sector depend upon their training and age (13).

There is not found any direct relation between the profile factors and MWL based on NASA-TLX. NASA-TLX is useful for determining the level of mental workload, but it is not suitable for defining workload factors. Authors claim the Questionnaire-Part I will help to clarify these factors for VTS-Os. VTS-Os should evaluate the all variables related to their tasks based on affecting to increase their mental workload in 5-grade Likert scale or not.

At the end, it is better to associate NASA-TLX with the other measurements; such as physiological, physical and other subjective methods or combination of them. Heart rate (11) and eye movements (12) are suitable index to assess mental workload (13). Authors suppose to find some relation among the different view points of evaluating mental workload. And, the result of NASA-TLX will be tried to explained by heart rate and eye movements, the hypothesis will be constructed as; NASA-TLX (subjective measure) = Function {Heart rate (physiological and/or physical measure) + Eye movements (physiological measure)}.

7. Conclusions

There are some differences among the maritime authorities on the criteria to being a VTS-O. International Association of Marine Aids Lighthouse Authority-IALA has circulated some guidelines and recommendation on training and certification of operators. On the other hand, there is not any consensus for the operators’ background qualification.

The results of mental workload analyse for VTS-Os, who employed in the different area (and they have different profiles such as different culture, education and experiences etc.) can be summarized as follows;

1. The NASA-TLX scores are determined as 63.4 for Turkish VTS Operators and 58.0 for Japanese VTS Operators.
2. Japanese and Turkish VTS Operators statistically have similar tendency depend on mental workload.
3. MWL is independent from profile factors (nationality, age, marital situation, engaged as VTS Supervisor or Operator, experience on board and at VTS and educational level). MWL completely depends on individual items and related to nature of performing task.
4. There is no significant difference between the operators who have a maritime background and who have not. It is not so related to be a Ship Master or not.
5. MWL is the similar for VTS Supervisors and Operators. There is no relation among the Operators’ position, sea experience and VTS experience. (It may be assumed that the position of operators for being VTS Supervisor or Operator is not depending on to have any sea experience).
6. It is necessary to use advanced method for defining the factors to cause MWL while operator is performing the task.

References


Questions and Answers

Mitsuko NISHIGUCHI (Tokyo University of Marine Science and Technology):

Japanese and Turkish Operators have the same patterns, except the high Temporal Demand. Would you explain why this difference exists between two nationalities in terms of mental workload?

Serdar KUM:

Firstly, I have to mention that there is not any significant difference between Japanese and Turkish Operators based on overall mental workload. When Japanese VTS-Os judge the dimensions that which of them is high and to affect their MWL, they feel Temporal Demand is strong effect comparing with the other dimensions and Turkish Operators ranking order. Moreover, when the weighted rankings of Temporal Demand is tested, there is no significant (t(96) = 0.24, p:0.81 and F(1;96) = 0.05, p:0.81). In here, we can just say that Japanese Operators may feel some time restriction while performing their task. And, if the question changes to “why they feel like that and/or Turkish Operators don’t have such feeling?”. The main reason may be explained due to “age”. Because, almost all VTS system is computerised and it is difficult to use/operate such kind of system for the old persons (especially considering he should communicate with ship at that time, checking and controlling ship’s information simultaneously and so on).

Janji FUKUTO (National Maritime Research Institute):

Do you find any correlation among the VTS Centres?

Serdar KUM:

In this study, we mainly focus the cultural and national differences between two VTS Systems. The correlation among the VTS Centres is not investigated at this time.