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ASSESSMENT OF THE SEAMAN'S SOFT SKILLS CONDITION

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Abstract

This article presents approaches to the important task of assessing the management level of navigation bridge elements. The importance of this approach is confirmed by the documents of international organizations. The assessment is made on the basis of determining the level of so-called soft skills, in particular, this work is devoted to assessing the level of communication between the elements of the control system. To calculate the correctness of the actions performed, the data is presented in the form of a timeline with a target (intended) marker and a marker for the execution of actions. The Euclidean metric is chosen as the difference metric. For simple values of commands (for example, a steering wheel shift), a direct distance is used, taking into account the execution time with a weighting factor. For complex actions, the discrepancy with the expected effect is taken into account. In addition, based on the matrix of paired comparisons of Saati, a method for calculating the level of involvement and doubt was derived and experimentally confirmed. This is obtained due to the non-introduction of the normalizing coefficients of the eigenvector of the matrix. A system has been created that performs calculations, including an expert system based on the mathematical apparatus of fuzzy logic. An experiment was conducted to calculate the adequacy of the behavior of the control element of the bridge command. The applicability of this method for monitoring the status of a bridge team member by the communicativeness parameter is shown.

Keywords: Soft skills, sailors, IMO, fuzzy logic, measurement

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1. Introduction

Today, it is not good just to know a technical part of the job, for example, the profession of a navigator, i.e. simple algorithms for controlling a ship when performing a narrowly focused task in the age of technology, electronics, modern innovative and information technologies without paying attention to behavioural elements. It is necessary to radically revise the very principles of human performance for activities at sea and to study them (Koroleva et al., 2018).

Nowadays it is not enough to just know how to navigate a ship from point A to point B, because it might be dangerous if not impossible for one person to do this task. It is necessary to maintain good communication, be able to get good feedback, react as fast as you can and be stress-resistant in emergencies. It is essential to have behavioral competency to protect a vessel, a crew and other interested parties in this situation from the negative effect of the human factor.

In this paper we try to be concentrated on evaluation and measuring soft-skills. Moreover, we basically use the recommendations of the International Maritime Organization developed with the help of OCIMF and INTERTANKO (IMO Maritime safety committee, 2019).

2. Problem Statement

Nowadays in case of increased attention to soft skills not only in maritime professions, but also in different spheres of life, there are some problems with physical measurement of parameters defined by companies because it is difficult to formalize ones such as feedback, discipline and so on. And moreover it is important to know how to calculate such parameters with the help of mathematic methods and apply them in developing the automatic program, considering features of the studied area or company.

3. Research Questions

The research question of the article is to measure parameters defined by IMO, considered as soft skills in relation to the bridge team, and understand the main principles of automatization of the calculating process.

4. Purpose of the Study

As the base of the research, the NMEA protocol and «Implementation of the STCW convention. Behavioural competency assessment and verification for vessel operators» are submitted by OCIMF and INTERTANKO (IMO Maritime safety committee, 2019).

NMEA 0183 (from the «National Marine Electronics Association») is a standard that defines a textual protocol for communication among marine (usually navigation) pieces of equipment. Such protocol has become especially popular due to the proliferation of GPS receivers using this standard (NMEA 0183, 2020).

Due to data received using protocol's rules, we can understand how fulfilment of the navigation task was successfully done. It gives the understanding of the quality of crew's work on board. Attention to recommendations from «Implementation of the STCW convention» which contains the investigation in the

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part of soft skill's influence among sailor on their daily activity must be taken into account. There are several groups of parameters for estimating informal inputs which can be adequate to know how we are able to express soft skills: team working, situation awareness, decision making, communication and influencing, results focus, leadership and managerial skills.

The communication and influencing as one of more common for all part of sailor's crew is chosen for the purpose of the article. It contains such graduation as shared understanding, style of communication, feedback, persuasion (IMO Maritime safety committee, 2019). And these parameters were the main inputs in developed system.

5. Research Methods

The step-by-step approach of the research contained different steps (figure 01) in creation of the system.

The first step is information retrieval. This method included search, studying, questioning and conducting an experiment for consolidation of practical information.

The second step is cluster analysis. In this step, the fuzzy output algorythm of Mamdani with the centroid defuzzification method was chosen for creating analysis centers of each parameters from block «Communication and influence».

The third step is to create a system of current condition of a seaman evaluation.

The forth step is modeling, evaluation of data for final results, which give conclusion on how seaman can be good in communication and influence on board while performing as a part of bridge team.

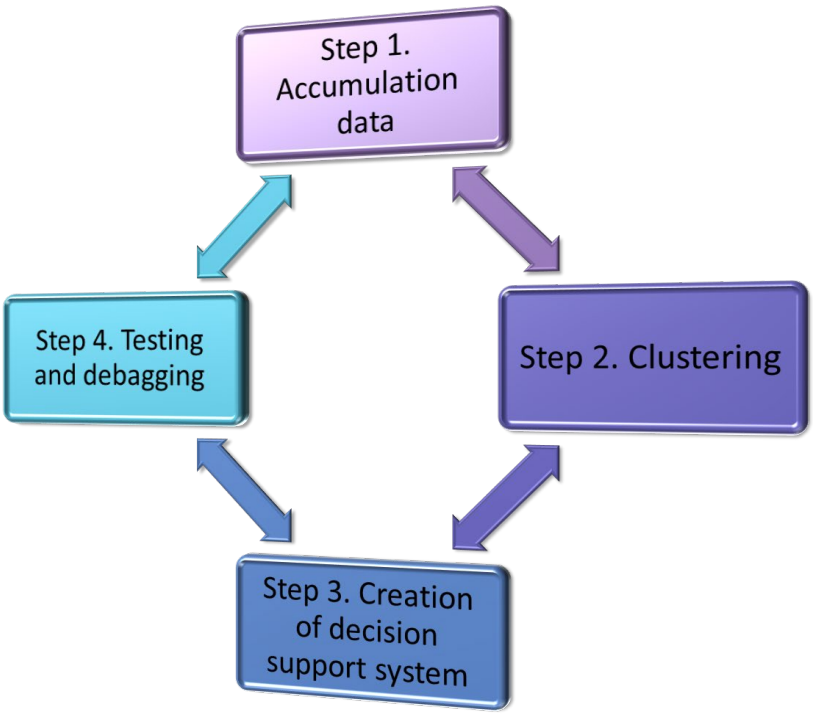

Figure 1. The main steps of creating the decision support system

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6. Findings

The concept of «educated person» becomes synonymous with the owner of cultural values. An educated person, first of all, should be educated in the Humanities, know the language of your people, read a lot, understand and adequately relate what you read to the phenomena of life.

The main task of maritime industry is preparation of educated seamen with developed soft-skills. And this fact must be considered even in the training program and in higher education (Koroleva et al., 2018).

We conducted 2-step experiment. If we have a supposed action, it is supposed time of action and it indicates what was actually done, we can create:

$$C_1 = \begin{cases} U = \{a_1t_1, a_2t_2, \dots, a_nt_n\} \\ U'_n = \{a'_1t'_1, a'_2t'_2, \dots, a'_nt'_n\} \end{cases}. \quad (1)$$

Going further, *a* is the performance of the action, that is, the maximum compliance with the given command. It can include 3 performance evaluation parameters (correct recording of results (recording) – x, achievement of the set goal – y, the least time difference t – h, that is, not the fact of quantifying the time (for how long), but the fact that the task was completed in the shortest possible time.

Then we can calculate x, y, h from the weighted Euclid distance:

$$d_{ij} = \sqrt{\Sigma_{j=1}^{k} \omega_k (z_{ik} - z_{jk})^2}. \quad (2)$$

Here z_{ik} or z_{jk} is a parameter (a or t or any additional), and ω_k is a weighted coefficient. There has been an analysis with the help of volunteers and simulator systems that was carried out in 2019, showed major correlation between the evaluation with this method and tasks given to participants.

However, it is now difficult to evaluate the action, which does not have a defined value. This was the main problem of the work.

All the actions are to be stated as the planned changes to the state vector of the vessel's condition.

Thus, we can put *a* as:

$$z_{ik} - z_{jk} = \frac{\sqrt{(x_{ic}t_c - x_{ig}t_g)^2}}{x_{ig}}, \quad (3)$$

where x_{ic} – state resulting from the current action, x_{ig} is the state resulting from goal action. The latter can be obtained from any good mathematical model of a ship, but, as we were using simulators that was of no problem.

Here, we used the fuzzy clustering method to obtain the normal figure of parameter changing, similar to the figure of vessel's safety.

For each cluster, we have some medium «a» and medium «t» (the first initially). Then we add another experiment, that is a1 and t1 and it happens N cycles.

The same happens to t and other functions. As we know, Gaussian process is a probability distribution over possible functions, allowing using an expert's knowledge, which is applied in the decision support system. At this moment, we can see correlation between expert's systems and Gaussian membership (Saaty & Kearns, 1991). This aspect gives the explanation why we use this type of function before feedback loops (You et al., 2017). There are works, where future actions of human are estimated. Some of them are trying to do so comparing behavioral data via situational data.

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Some of them do so with the outlook on human perception (Izumi et al., 2008).

It is however a common sense that a human mood greatly influences the decision taken.

To start, we can begin to obtain the info from the method, based on Saati's matrix (Saaty, 1993).

The membership degree of a parameter can be obtained this way:

$$\mu_j = \frac{\sum_n^{i=1} r_i}{\sum_n^{j=1} (\sum_n^{i=1} r_i)_j}. \quad (4)$$

Thus, a continuum vector of decisions taken is:

$$R = \{\mu_1, \mu_2, \dots, \mu_n\}, \quad (5)$$

noting that:

$$\sum_n^{j=1} (\sum_n^{i=1} r_i)_j = const. \quad (6)$$

However, if a normalization is skipped:

$$R = \left\{\sum_n^{i=1} r_{i_1}, \sum_n^{i=1} r_{i_2}, \dots, \sum_n^{i=1} r_{i_n}\right\} = \{s_1, s_2, \dots, s_n\}. \quad (7)$$

Thus, the overall decisiveness can be calculated as:

$$D = \sum_n^{i=1} s_i. \quad (8)$$

Basic decisiveness for each option (in comparison to others)

$$D_c = \left(\sum_n^{c=1} \frac{|s_i - s_j|}{\theta_0 + |s_i - s_c|}\right)^m, \quad (9)$$

$$\theta_0 = +0. \quad (10)$$

In this step we made some experimental measurement, which takes two iterations (tables 1-2), showing us how fast and effective the result can be on board if sailor works as a team with good developed soft skills such as communication and influencing.

The whole system, showing the value of current communication, is shown in figure 2 (Studenikin et al., 2018).

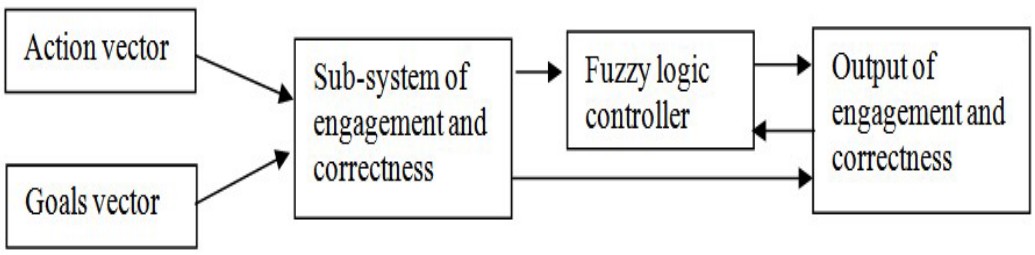

Figure 2. Scheme of the system

The experiment to check the system's performance has been carried out via Transas navigational simulators. The groups were given several tasks and their performance recorded. Then the data was fed to the system. There were two iterations of experiments. At the first stage, the lager groups were selected for making sure the tasks are adequate and familiar to seamen. At the second stage, there were some intentional inclusions of persons with the task to fail the communication process.

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Table 1. Samples description from the first set

Team's number	Amount of seamen	Total time	Task done
1	4	13 min 35 sec	Done
2	4	12 min 00 sec	Done

Table 2. Samples description from the second set

Team's number	Amount of sailors	Total time	Task done
4	2	7 min 30 sec	Not
10	1	12 min 00 sec	Done
14	1	12 min 35 sec	Done
8	3	12 min 00 sec	Done
5	4	12 min 03 sec	Done
6	2	12 min 00 sec	Done
2	1	11 min 50 sec	Done

The task was fulfilled successfully in the shortest period of time in the groups where team works together and they actively use their behavioral skills.

Some results calculation from the system are shown in figure 3 (excluding failed tasks).

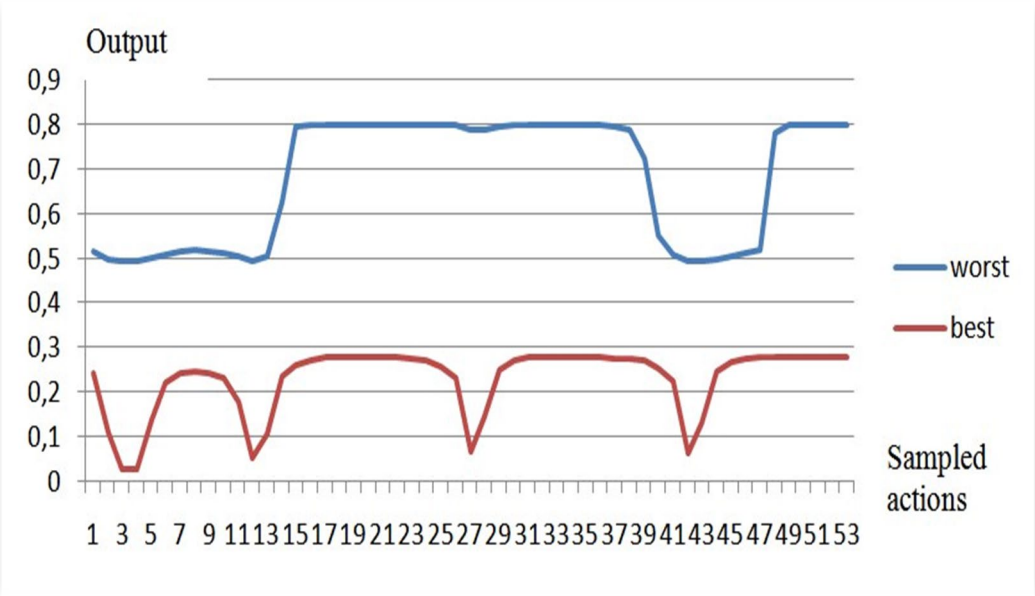

Figure 3. Final results

7. Conclusion

The system appeared to be a way to tackle the negative influence of the human factor. The smaller the difference for actions measured and the less the doubts in resulting actions from the team, the less is the output of the system. That correlates with the group's behaviours. However, there is a need to widen the scope of experiment to estimate bridge team's work on real seagoing vessels.

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