

FaR 2021**International Forum “Freedom and responsibility in pivotal times”****METHODOLOGY FOR STUDYING PROFESSIONAL
RESPONSIBILITY OF THE FUTURE SEA TRANSPORT
SPECIALISTS**

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mail@nsma.ru**Abstract**

The accident rate on sea vessels is largely due to the mistakes of ship personnel, fatigue of seamen, and negative manifestations of the "human factor". The subject of study is the methodology for the formation of professional responsibility among future specialists of sea transport. The term "professional responsibility of a future sea transport specialist" means his ability to conscientiously fulfill his direct and additional professional duties as defined by guiding documents and instructions, as well as to understand and realize how the actions taken (commands, instructions, orders, personal actions) will affect him, his colleagues and subordinates, what will be their consequences. This article reflects the results of an empirical study devoted to the investigation of the level of awareness of the seamen of the transport fleet and cadets of the maritime university of the essence of the term "human factor", the ways of its formation and negative impact on the safety of modern navigation, their personal responsibility for the quality and effectiveness of their professional duties, compliance with the requirements of safety precautions. Specific recommendations are given to improve their professional training in the field of the "human factor"; recommendations were prepared to enhance the quality of conventional training and improve control over the formation of professional competencies, knowledge, skills and abilities in the process of final certification in special and conventional disciplines.

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1. Introduction

The navigational accident that occurred on March 23, 2021 – grounding of the container ship Ever Given (vessel length – 400 m, width – 59 m) led to the blockage of the Suez Canal, which in turn entailed a multi-day collapse of world cargo transportation, costing world trade \$ 400 million per hour. It took several weeks to unblock the Suez Canal from the stuck giant container ship Ever Given. Every day of downtime cost the global economy more than \$ 100 million (Samozhnev, 2021).

Why in the 21st century, with such a powerful technical equipment of sea transport vessels with modern navigation facilities, accidents occur that cause not only significant economic losses, but also colossal damage to the marine environment, marine flora and fauna? Why do ships continue to wreck now?

These issues concern not only professional seafarers and the leadership of the International Maritime Organization, the maritime community, but also all progressive humanity.

According to leading marine specialists and scientists, such as Katsman and Ershov (2006), and Dmitriev (2009) maritime transport accidents occur for four main and dominant reasons, which include: irresistible and unfavourable hydrometeorological impact of the marine environment (including hurricanes, storms, tsunamis, killer waves, etc.), which account for an average of 5 % of accidents; mistakes made in the design of ships, their laying and construction, subsequent major and medium repairs (5 %); incorrect loading of ships, storage and transportation of cargo, which contributes to the occurrence of another 5 % of accidents. And the rest – 85 % of the accidents fall on the notorious "human factor", which is based on low professionalism, formalism at work, simplification, irresponsibility, sloppiness, sleep on watch, carelessness, etc.

The analysis of accidents carried out by Katsman and Ershov (2006) shows that the predominant number of accidents are made by navigators. Grounding of ships, collisions and berthing impacts is their fault.

This circumstance prompted the authors to study the level of awareness of the current personnel of ships performing the duties of navigators and future graduates of the maritime university, fifth-year cadets of the essence of the phenomenon of the "human factor", unconditional guidance by the requirements to prevent its negative impact on safety.

2. Problem Statement

What should be understood by the term "human factor"?

IMO guidelines (Amendments to the Code for ..., 1999; Code of Investigation of ..., 1997) relating to the role of the human factor in the context of ensuring the safety of navigation interpret this phenomenon as:

- "the abilities and capacities of a person to receive, process information and make decisions in various conditions of its functioning" (Pechnikov et al., 2019, p. 107);
- "actions or omissions, willful or otherwise committed, which adversely affect the proper functioning of the relevant system or the performance of a specific task" (Pechnikov et al., 2019, p. 107).

As follows from these definitions, the characteristic features of the "human factor" are:

- errors and misinterpretation of the information received;
- simplified interpretation of the received information, distorting its essence;
- ill-considered and hasty making of the required decision;
- improper organization of the implementation of the assigned tasks;
- incompetent actions that do not correspond to the current situation;
- lack of logic and consistency in the actions performed;
- omissions and oversimplifications in professional activities;
- ignoring and deliberate violation of the requirements of guiding documents and operating instructions;
- delayed and belated actions and others.

In addition, according to Kuzmenko and Tomilin (2016), the carelessness and low level of professionalism of some seamen is manifested in the absence of personal responsibility for improving their level of knowledge, mastering the methods and techniques of using individual and collective life-saving appliances, which negatively affects the preservation of human life at sea.

As we can see from the above reasons, the existence of the “human factor” is based on low professionalism and lack of due responsibility of a specialist for the quality performance of his official powers. Due to carelessness and unfair practices, all kinds of errors, shortcomings and shortcomings appear. Accidents and shipwrecks are the result of such mistakes and irresponsibility of the personnel of transport ships.

3. Research Questions

This article is devoted to solution to the following issues: a) clarification, on the basis of diagnostics, of the real level of awareness by professional seafarers and cadets of the maritime university of the essence of the "human factor" and its negative impact on the safety of navigation; b) analysis of the quality of the diagnostic material (test questionnaire), which is necessary for adequate assessment of the investigated results; c) development of methodological recommendations for teachers of maritime educational institutions in order to improve educational work with cadets and seamen of transport ships, their understanding of the essence of the "human factor", the ability to prevent accidents. Knowledge and understanding by cadets and seamen of the transport fleet of the essence of the "human factor", the reasons for its occurrence and the negative impact on the safety of navigation are the basis for trouble-free navigation and the preservation of human life at sea. Awareness by future maritime specialists of the essence of the "human factor" is the basis for the formation of personal responsibility for the conscientious fulfillment of the requirements of guiding documents, compliance with safety requirements, and functional duties.

4. Purpose of the Study

The purpose of the study is to establish the actual level of awareness of the essence of the “human factor” and its negative impact on the safety of navigation by professional seamen and cadets of the maritime university. Knowledge and understanding of the meaning of the “human factor” by the personnel

of ships is the basis for accident-free navigation, the preservation of the vessel, cargo and people. The provisions of the methodology can be used not only in educational institutions, but also in ship-owning and crewing companies, when recruiting personnel for ships, as well as on ships to understand the level of reliability and responsibility of crew members.

5. Research Methods

When writing this article, the following methods were used: theoretical analysis of the following guidelines of the International Maritime Organization: IMO Resolutions (Amendments to the Code for ..., 1999; Code of Investigation of ..., 1997); theoretical analysis of publications by domestic authors in the field of professional training and application of the testing method. The following methods were also used: testing (allowed under the same conditions to examine cadets who studied the discipline "Initial training in safety" and to check and objectively measure the level of their professional competence; comparisons (made it possible to compare the data on two groups of respondents (cadets of the second and fifth years); analysis (ensured identification of the strengths and weaknesses of the study groups, the gaps in learning of the academic program, as well as identification of shortcomings in professional training); method of parallel forms, retest method and method of splitting the test (provided verification of the reliability and validity of the test).

6. Findings

A survey of seamen of transport ships for their knowledge of guiding documents showed that 58 % of them could not list the main IMO resolutions related to the topic of "human factor" in maritime transport; 22 % were able to name only one document and only 20 % listed the entire complex of regulatory legal acts. The survey and individual conversations with the cadets of the fifth, graduating course of the maritime university showed that 92 % of them know quite thoroughly the main governing documents of the IMO, including those that relate to the "human factor"; 8 % of respondents know badly the requirements to reduce the negative impact of the "human factor" on the safety of navigation. To clarify the level of professional seamen and cadets of the maritime university awareness of the essence of the "human factor" and its negative impact on the safety of navigation, a targeted diagnostics was carried out using the methodology for determining the level of understanding of the essence of the human factor by seamen (graduates of the maritime university and members of the crew of ships), their predisposition to create emergency, developed by a group of scientists of the Ushakov State Maritime University under the leadership of Vice-Rector A.L. Boran-Keshishian. 107 seamen of the transport fleet were involved in the experimental work, 44 of them are representatives of the command staff of ships, and 63 hold various positions in the ship's crew. The cadets are represented by 112 graduate students studying at the Faculty of Sea Transport Exploitation and Navigation. Taking into account the recommendations of Artishcheva (2011), Kondratev et al. (2019), Rastopchina (2015) we tested the participants in the experiment.

The test results are shown in Table 01.

Table 1. Results of determining the level of understanding of the essence of the "human factor" by seamen of the transport fleet and cadets of the maritime university, their possible predisposition to create an accident situation

No.	Test-survey questions	Scores									
		SMU graduate students					Seamen				
Block 1: «Competence of sea specialists»											
1	Did you choose your seaman profession yourself?	-	-	19	24	69	-	-	13	26	68
2	Do you consider seaman profession prestigious?	-	-	-	29	83	-	-	16	35	56
3	Are you a true professional?	-	-	9	91	12	-	-	18	49	40
4	Do you know your future professional duties completely?	-	-	24	68	20	-	-	11	39	57
5	How do you evaluate professionalism of command of the vessel?	-	-	-	64	48	-	-	27	21	59
6	How do you evaluate yourself as a professional?	-	4	43	27	38	-	-	14	35	58
7	How do you evaluate professionalism of the crew?	-	-	16	53	43	-	-	28	37	42
8	Are you willing to improve your professional development?	-	-	11	78	23	-	12	19	57	19
Block 2: «Navigational safety rules»											
9	Do you think the profession of a seaman implies a risk to the life?	-	7	26	44	35	-	-	-	29	78
10	Do you know what is human factor?	-	-	19	47	46	-	14	31	32	30
11	Do you think that the accidents are caused by the crew members ?	-	-	6	58	48	-	-	13	57	37
12	Do you allow deviation from watchkeeping instructions?	68	37	7	-	-	89	14	4	-	-
13	Do you implement all check-lists requirements?	96	14	2	-	-	92	8	7	-	-
14	Are you ready to act precisely and courageously in an emergency?	-	-	15	91	6	-	-	-	52	55
15	You do not allow yourself to leave the workplace on your own?	-	-	-	-	112	-	-	-	26	81
16	Are you using your leisure time rationally?	-	-	67	23	22	-	9	53	21	24
17	Do you always comply with safety requirements?	-	17	24	39	42	-	13	22	43	29
18	Is mutual assistance possible among the crew members?	-	-	16	48	48	-	2	19	34	52
19	Are you engaged in extraneous matters during watch?	50	53	9	-	-	61	23	23	-	-
20	Will you report to the command staff if you find out that any of the seamen consumes alcohol or drugs on the ship?	-	17	33	41	21	6	14	19	33	35
Block 3: "Physical and psychological states and properties of a person"											
21	Do you feel confident in your workplace?	-	-	29	55	28	-	-	19	57	31
22	Are you a sociable person?	-	5	27	58	22	-	7	22	43	35
23	Does the quality of food affect the mood of seamen?	-	22	18	21	73	-	-	39	44	24
24	Is sleep on watch the result of fatigue?	-	12	33	34	33	-	-	18	35	54
25	During working hours, do you think about your family, wife, children?	-	-	27	42	43	-	8	67	21	11

26	Do you consider it unacceptable to smoke in the cabin?	-	-	29	35	48	-	11	23	24	49
27	Is fatigue caused by the ship's command staff?	-	-	34	51	27	-	29	34	22	22
28	Are you averse to scandals and showdowns with colleagues?	-	12	28	43	29	5	14	22	43	23
29	Are there elements of formalism in your work?	11	30	53	18	-	28	29	19	31	-
30	During working hours, do you allow yourself to drink alcoholic beverages on the ship?	108	4	-	-	-	89	12	6	-	-

Analysis of Table 01 allows us to judge the strengths and weaknesses of the personnel of ships and cadets of the maritime university, in relation to the human factor.

The strengths are:

- independent choice of the profession of a seaman in the transport fleet: cadets – 83 %; sea-going personnel – 87.8 %;
- attitude to the maritime profession as prestigious one: cadets – 100 %; sea-going personnel – 85 %;
- self-awareness as a professional: cadets – 92 %; sea-going personnel – 93 %;
- knowledge of official duties: cadets – 78.6 %; sea-going personnel – 89.7 %;
- high assessment of the professionalism of the vessels command staff: cadets – 100 %; sea-going personnel – 74.7 %;
- a balanced and critical assessment of their level of professionalism: cadets – 58 %; sea-going personnel – 86.9 %;
- assessment of the professionalism of the crew as meeting all the requirements: cadets – 85.7 %; sea-going personnel – 73.8 %;
- desire to improve their professional development: cadets – 90 %; sea-going personnel – 71 %;
- understanding of the dangers and risks associated with the profession of a seafarer: cadets – 70.5 %; sea-going personnel – 100 %;
- an individual's understanding that, in general, accidents in maritime transport occur through the fault of the crew members: cadets – 94.6 %; sea-going personnel – 87.8 %;
- categorical exclusion of deviations from instructions during watchkeeping: cadets – 94.6 %; sea-going personnel – 96.2 %;
- exemplary adherence to the requirements of checklists in their professional activities: cadets – 98.2 %; sea-going personnel – 93.4 %;
- readiness to act precisely and courageously in an emergency: cadets – 86.6 %; sea-going personnel – 100 %;
- responsible performance of official duties, excluding independent departure from the workplace according to their needs: cadets – 100 %; sea-going personnel – 100 %;
- the presence of mutual assistance among the crew members: cadets – 85.7 %; sea-going personnel – 80.3 %;

- feeling of complete confidence onboard and in the workplace: cadets – 74.1 %; sea-going personnel – 82.2 %;
- cheerfulness, optimism and sociability: cadets – 71.4 %; sea-going personnel – 63.5 %;
- understanding that sleep on watch is a direct result of accumulated fatigue: cadets – 59.8 %; sea-going personnel – 83.2 %;
- discipline and strict attitude to smoking on board: cadets – 74.1 %; sea-going personnel – 68.2 %;
- maintaining a healthy lifestyle onboard, excluding the use of alcoholic beverages during working hours: cadets – 100 %; sea-going personnel – 100 %.

Weaknesses are:

- lack of understanding of the high proportion of risk in maritime professional activity among 30 % of cadets;
- insufficient understanding by some of the respondents of the essence of the human factor and its role in ensuring the safety of navigation: cadets – 16.9 %; sea-going personnel – 42 %;
- irrational use of time allotted for rest: cadets – 59.8 %; sea-going personnel – 57.9 %;
- simplified attitude towards compliance with safety requirements: cadets – 36.6 %; sea-going personnel – 32.7 %;
- engaging in extraneous matters during watch: sea-going personnel – 21.5 %;
- false understanding of decency, which contributes to concealment from the ship's command staff of the facts of alcohol or drugs use by the crew members on the voyage: cadets – 44.6 %; sea-going personnel – 36.4 %;
- lack of concern for the quality and variety of food, which is noted by: cadets – 83.9 %; sea-going personnel – 32.7 %;
- lack of full concentration on professional activity, distraction by extraneous thoughts (about their family, wife, children): cadets – 75.9 %; sea-going personnel – 29.9 %;
- formation of fatigue of sailors due to the fault of the ship's command staff (lack of proper control over people's rest): cadets – 69.6 %; sea-going personnel – 41.1 %;
- nervousness and tendency of the ship's personnel to scandals and showdowns with colleagues: cadets – 35.7 %; sea-going personnel – 38.3 %;
- the presence of elements of formalism in personal work: cadets – 16 %; sea-going personnel – 28.9 %.

One of the key aspects of diagnostics for determining the level of understanding of the essence of the "human factor" among the cadets of the maritime university is the need not only to assess the knowledge of the respondents on key issues, but also to analyze the quality of the diagnostic material (questionnaire test), which is necessary for an adequate assessment of the studied results. By the quality of diagnostic materials, we mean an assessment of its reliability and validity, which are the main parameters of the measurements obtained. The reliability of the questionnaire test characterizes the accuracy of measurements and the stability of the results to the influence of random factors.

Among the methods for determining the reliability of the proposed questionnaire test were chosen: the method of parallel forms, the retest method and the method of splitting the test.

Since all tasks were assessed on a dichotomous scale (1 point if the answer to the question posed is correct, or 0 if the answer is incorrect), the most common Kuder-Richardson formula was used to assess reliability: $K = \frac{m}{m-1} \left(1 - \frac{1}{S_x^2} \cdot \sum_{j=1}^m p_j \cdot q_j \right)$, where m is the number of tasks in the test; p_j – the proportion of correct answers to the question with number j ; q_j – percentage of incorrect answers to question with number j ; S_x^2 – variance of individual scores of all respondents, calculated from the ratio $S_x^2 = \frac{n \sum_{i=1}^n x_i^2 - (\sum_{i=1}^n x_i)^2}{n \cdot (n-1)}$; n – the number of respondents; x_i – i -th respondent. The value of the calculated coefficient the test equal to 0.89 was obtained when diagnosing, which made it possible to draw a conclusion about the reliability of this questionnaire test. The reliability of the content area test was also confirmed by the consistency of the respondents' test results using parallel forms and the retest method.

By the validity of the test questionnaire test we mean its ability to measure exactly those characteristics for which this test was created, that is, to determine the level of understanding of the essence of the "human factor" among the cadets of the maritime university. The presented diagnostic material in the form of a questionnaire test has substantial validity, since it adequately reflects all the main components of the studied content area. Practical validity characterizes this test from the point of view of its importance in relation to achieving a certain goal – the awareness by professional seamen and cadets of the maritime university of the essence of the "human factor" and its negative impact on the safety of navigation.

One of the methods for assessing the validity of individual test questions was based on calculating the values of the biserial correlation coefficients according to the formula: $r_j = \frac{\bar{X}_{1j} - \bar{X}_{0j}}{S_x} \sqrt{\frac{n_{1j} \cdot n_{0j}}{n \cdot (n-1)}}$, where \bar{X}_{1j} – the average individual score of the respondent who answered correctly to the j -th task; \bar{X}_{0j} – the average individual score of the respondent who answered incorrectly (incompletely) to the task j ; n_{1j} – the number of respondents who answered correctly to the j -th task; n_{0j} – the number of respondents who answered to the j -th task incorrectly (incomplete); n – the total number of respondents; S_x – the standard deviation of the individual scores of all respondents $\left(S_x = \sqrt{\frac{n \sum_{i=1}^n x_i^2 - (\sum_{i=1}^n x_i)^2}{n \cdot (n-1)}} \right)$. As a result, the obtained correlation coefficients by value, exceeding 0.5 made it possible to confirm the validity of the test questions.

Thus, for each test question, an analysis was carried out for the correspondence of its form and content to the foundations of the test theory, the effectiveness of the method was confirmed by the stages of validation and the methods used to confirm the reliability.

7. Conclusion

The following results were obtained in this study:

1. The results of the diagnostics allow us to state that 70 % of the seamen of the transport fleet and cadets of the maritime university are fully ready for high-quality professional activities on modern ships of the maritime industry. For the most part, cadets and active seamen of transport ships are sufficiently thoroughly trained in the problem of the "human factor" and its possible negative impact on the safety of navigation. There is a good knowledge of the IMO guidelines and their content by the cadets of the maritime

university. At the same time, the theoretical training of vessels personnel is weaker, especially among the rank and file.

2. Some of the participants in the experiment admitted that during the voyage they incorrectly use the time allotted to them for rest, which subsequently becomes the main cause of the accumulated fatigue. They are externals, as they attribute their responsibility for their actions and the irrational use of the time allotted to them for rest to the command staff of the ships.

3. More than 30 % of the respondents admitted that they ignore and violate safety requirements, which can cause an accident on the ship, including the death of personnel.

4. It is alarming that about 20 % of seamen say that while on watch, fleeing boredom, they can engage in extraneous activities (playing on the phone, texting with relatives and friends on the phone, reading various information on the Internet, etc.). During watch, especially at night, the crew members can be distracted from work by thoughts and memories of their family, wife, children and loved ones.

5. To avoid accusations of dishonesty, a significant part of the sailors and cadets will not inform the ship's command staff about the fact that other crew members are using alcohol or drugs.

6. Control over the quality of food preparation and the variety of menus should be strengthened on vessels. Tasteless and unvaried food negatively affects the mood and performance of seamen.

7. According to more than 30 % of respondents, during the voyage, people's nervousness and irritability increase, which can lead to unwanted incidents.

8. Seafarers and cadets said that they sometimes practice formalism and simplification in the process of performing their official duties, which can also negatively affect the trouble-free sailing.

It follows from the above:

- testing has shown that, on average, up to 30 % of the participants in the experiment are aware of the harmfulness of the "human factor" in a quite trivial and superficial way;
- fatigue, psychological state, as well as personal indiscipline and lack of diligence of seafarers are main causes of accidents on sea transport.

It should be explained to cadets and personnel of maritime transport ships that by conscientious attitude to their personal professional training (knowledge component), high desire, persistent aspiration (motivational component), attitude, discipline, responsibility, behavior, diligence (behavioral component), they can provide a high level of navigation safety and exclude accidents on their vessels.

At the final stage of the experimental work, cadets and seamen were given specific recommendations to improve their professional training in the field of the "human factor", which will increase the professional responsibility of each specialist for knowledge of the theory of accidents and conscientious fulfillment of their duties; recommendations were prepared to enhance the quality of conventional training and improve control over the formation of professional competencies, knowledge, skills and abilities in the process of final certification in special and conventional disciplines.

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