

## **ASSESSMENT OF THE INFLUENCE OF MULTIFACTORITY OF EVENTS ON THE PERFORMANCE OF COMPLEX NAVIGATION MANEUVERS BY NAVIGATORS**

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**Introduction.** One of the priority areas of Ukraine's transport strategy is to increase the level of navigation safety on waterways. It remains up-to-date, as the negative tendency in the number of maritime accidents remains almost unchanged. To ensure the steadfast safety of navigation, a set of measures is currently being developed, one of the current areas of which is to correct the weaknesses of ship management due to the human factor of the navigator [1-4]. Much attention is paid to modeling situations of interaction between navigators and the conditions of their readiness to make management decisions during complex maneuvers.

After numerous investigations, the European Maritime Safety Agency (EMSA) reported that most navigation accidents (hereinafter referred to as NAs) occurred in waterways with limited navigational conditions - port waters, inner anchorages, and approaching canals, mainly at night and in the morning. At the same time, according to EMSA, the main cause of 75% of NAs that occurred at sea were results of improper human actions, which led to violations of the rules of COLREG-72 and the rules of technical operation of ships. Their analysis showed that they occurred as a result of unsatisfactory observation and inaction, which contributed to incorrect decisions. In addition to the human factor, other causes of incidents on water transport invariably remain dangerous or unknown circumstances, the impact on the actions from the navigator of another vessel and the failure of systems or equipment. In addition, the difficulty of determining the causes of influence on management decision-making processes depends on the psychological factors of the operator-navigator [5]. Thus, the agency has formed the main factors of NA, which require the development of an effective mechanism to assist ship-owners in making decisions in difficult navigational conditions.

**Main part.** Assessment of the effect of multifactority on the development of situations makes it clear that the contribution of the "human factor" to the NA is very significant. Therefore, it is necessary to focus on correcting the wrong decisions of navigators, which can be the initiating factors for accidents or contribute to the development of the existing emergency in the sea. To reduce the risk of its occurrence, it is proposed to create an algorithm for such a computer program - an organizer, with which it will be easier to choose and perform the correct maneuver for drivers. Whereas there could be countless number of situations of ship's passing the procedure under different circumstances: locations, weather conditions, technical capabilities of ships, at the beginning of programming the algorithm only situations that are most common in practice and fall under some rules COLREG-72 can be considered. Such as rule 13 - "Overtaking", rule 14 - "head-on situations", rule 15 - "crossing situations", rule 16 - "actions to be taken by the give-way vessel", rule 18 - "responsibilities between vessels", And only after that the necessary additions will be made to the program. It is proposed to develop three possible scenarios. The first is the so-called "green scenario", which is safe when two ships are passing. It requires conditions when they won't have to change the trajectory of their movement. It will be enough for drivers to coordinate their actions on VHF radio communication or follow the recommendations of the traffic coordinator. The second is the "yellow scenario", with an average level of decision-making difficulty. A similar situation of crossing the courses of two vessels is considered, in which the correct solution is the maneuver to avoid the danger by one of them. In this case, the organizer will help them to disperse safely, according to the initial data of the movement. The third is the "red scenario", which forms a rather complex situation, close to

critical when the distinction must be made simultaneously by three or more vessels (Fig. 1, 2). The correct solution for the program algorithm will be the passing of ships according to the rules above. In this scenario, the program's purpose will be to reduce the risk of NA from "red to yellow". Several experiments using simulators in the form of navigation bridges were provided to study the proposed approach [6-11].

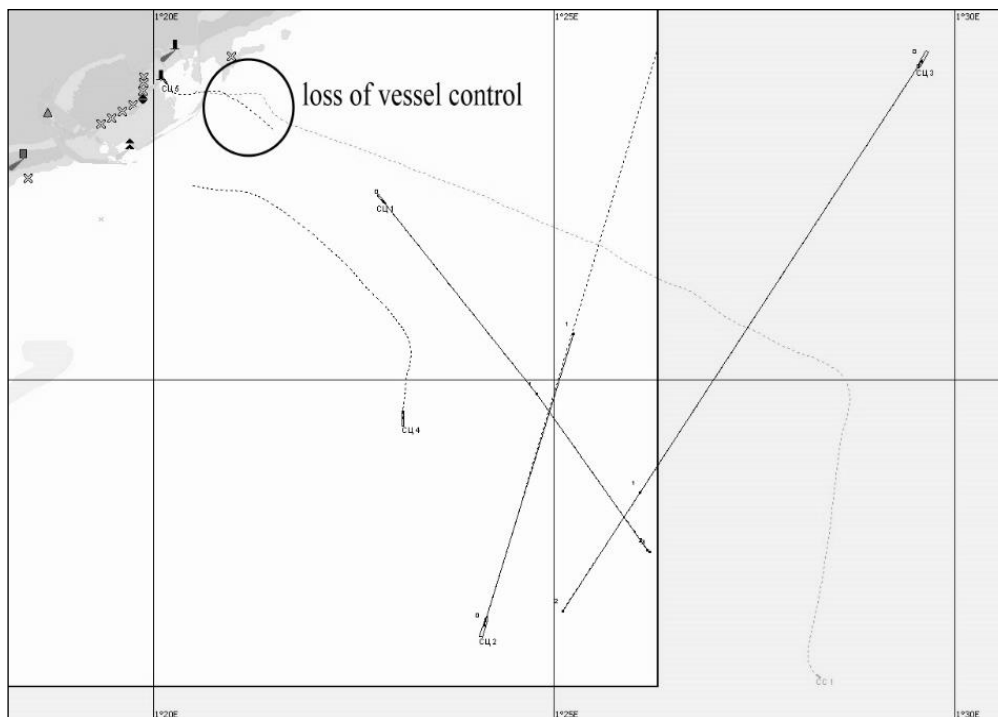


Figure 1 – The situation of "red" color with four target vessels

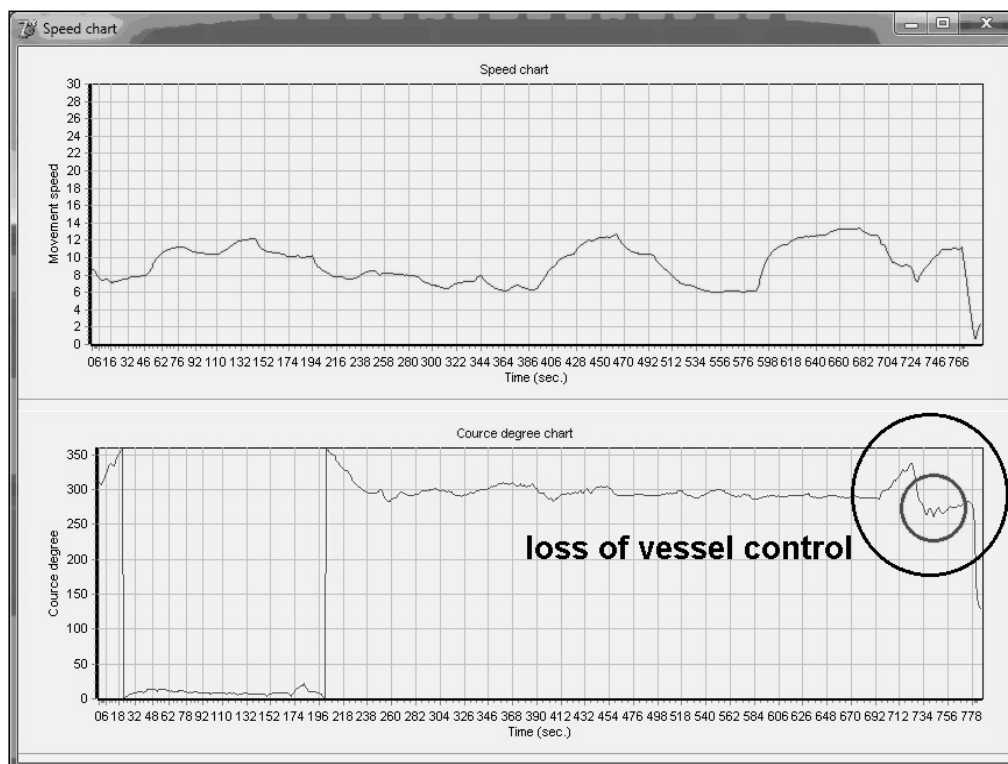


Figure 2 – Determining the moment of loss of control over the vessel

The experiment conducted in the framework of the research laboratory "Development of decision support systems, ergatic and automated traffic control systems", indicated the need to

use the above organizer. This statement is marked by the fact that the captain, who performed a maneuver of passing with the three target vessels, did not expect that the fourth vessel would leave the port and the simultaneous deterioration of weather conditions (Fig. 1, 2). As a result, the ship and crew were rescued, but the critical situation showed us the possibility of a catastrophe. The qualification of the captain and his experience in this location became a decisive factor. In case of insufficient experience in this navigation area, incorrect maneuvering of the vessel would inevitably lead to catastrophic consequences.

Thus, based on ECDIS and navigation simulator Navi Trainer 5000 data, it can be stated that the use of the organizer as an assistant during the watch significantly reduces the impact of the human factor on the appearance of an emergency and critical situations. This approach can be applied for educational purposes in terms of individualization of learning [12]. Further research will be aimed at developing the algorithm for coding situations and their recognition in offline and online modes.

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