

## THE ENHANCEMENT OF SAFETY OF SHIPS NAVIGATION VIA DETERMINING OF DANGEROUS FACTORS IN CLOSE-QUARTER SITUATIONS UNDER EXTERNAL CONTROL

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Safe and efficient operation of the vessel is the common point of interest of all parties concerned in shipping. These are shipowners, crew, shippers, consignees, insurance and many others. Nowadays it is impossible to reduce the number of marine incidents and accidents to absolute zero, but keeping this figure as low as possible is a direct responsibility of all the above mentioned. Safety of navigation, safety of human life at sea, health and well-being of crew and passengers, safety of cargo and environment protection is a main and prior task for the government.

The criteria of safety of navigation is a low incident statistic [1]. Global coordination is the function of the International maritime organization (IMO) which is a part of United nations (UN) [2, 3]. One of the brightest examples is a Ministry of Land, Infrastructure statistics (MLIT), published for the last years. There are 92 incidents of collision and 90 of grounding for 7 months only. Summary these are most common reasons of incidents on sea (Fig. 1) [4].

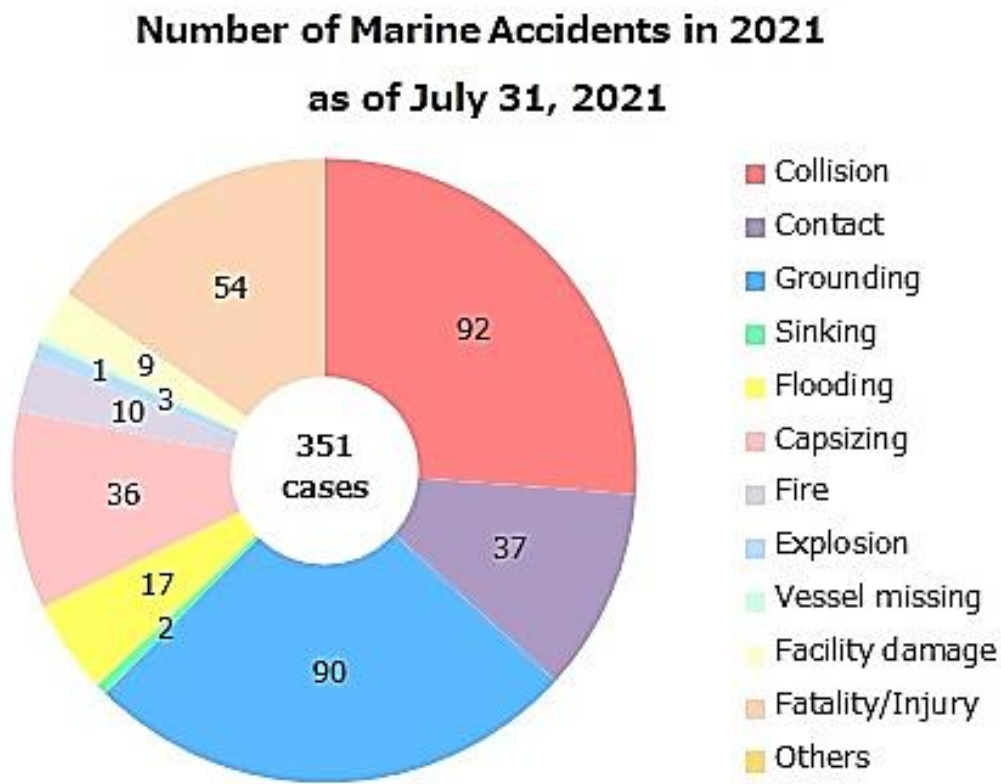


Fig. 1. MLIT statistics

Nowadays the most common practice is usage of AI-based system in different tasks even for road traffic control, incident analysis and prevention. There are some types of data exchange between vehicles and infrastructure, fitted with AI systems (Fig. 2).

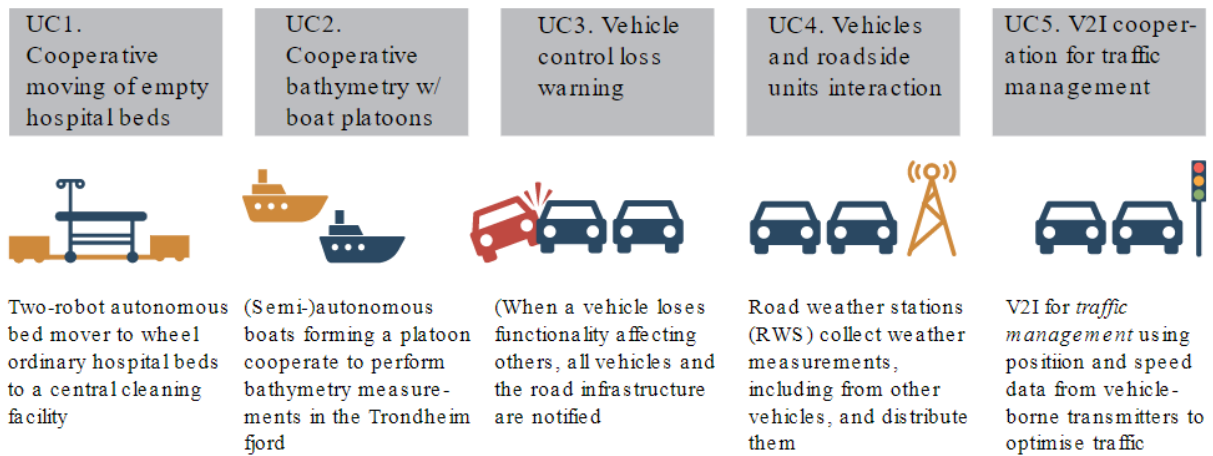


Fig. 2. Usage scenarios of data exchange

One of the most common scenarios is vehicle to vehicle (V2V). Data exchange is held between vehicles on safety related matters. This connection is helpful while maneuvering to avoid immediate danger.

Another one is group vehicle to vehicle (V2V) connection. This type of connection is established between vehicles which proceed in a line. The main intention for the use of the system is enabling vessels to pass narrow channels and straits, traffic separation schemes, which are the most dangerous parts of the route.

The newest scenario is vehicle to infrastructure (V2I). It is used during external con with feedback. This technology significantly reduces the risk of mistake because VTS operators have local knowledge and are aware of situation in complex. This type of connection is first of all required for passing through narrow channel and fairways, sea areas with high traffic, areas with special circumstances and condition. Another useful scenario is pilotage and mooring the vessel. Introducing +V2I reduces negative impact on environment, fuel consumption, seetime and wear and tear of the vessel and its machinery [5].

One more technology which is needed on the vessels all over the world in order to improve the safety and efficiency is night cams and thermal imagers systems. These appliances significantly enhance lookout options in night or fog conditions. The example of this equipment in complex with classic ship's systems is ORCA AI (Fig. 3) [6].



Fig. 3. ORCA AI system

This system provides constant monitoring and analysis on base of ready patterns of surrounding which includes ships course and speed, position of the vessel, reaction in critical and dangerous situation. It reduces a number of incidents, enhances safety, saves lives of people and preserves the environment.

There are some researches conducted into air traffic control via Artificial Intelligence- based systems. They are based on Machine Learning Patterns and are continuously developed and improved to reduce the decision-making time and to improve the quality of decisions taken. These systems are easy to learn on operating. The algorithm is drawn at the Fig. 4 [7].



Fig. 4. Ship – shore communication pattern

One of the most known companies introducing AI-based technologies for collision avoidance is a CMA CGM, which established a partnership with Fujitsu Laboratories Ltd. As a part of Digital Transformation Program wide testing of Fujitsu Human Centric AI Zinrai was held in cooperation with Japan Coast Guard and Tokyo VTS. The main objective is to reduce a close-quarter alarm latency for about 2 minutes and achieve a twofold increase of the number of alarms. There is a clear evidence that this system works in advance as a matter of safety of navigation [8].

The same partnership is established with the Shone start-up located in San-Francisco. Some prototypes are used as auxiliary aids to navigation and collision avoidance tools during passing heavy traffic areas, narrow channels and straits.

AI based system conducts a thorough analysis of accidents including collisions, groundings, strandings with gathering all data including, but not limited to heading, speed, position of the vessels involved. AI tries to predict the accident possibility based on the known patterns. Usage of this technology can significantly reduce number of accidents, keep people alive, protect the environment from negative impact, improves safety of navigation on a basic new level. Cooperation of seamen and IT sector is vital for the development of this branch onboard ships.

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