"Mircea cel Batran" Naval Academy Scientific Bulletin, Volume XX – 2017 – Issue 1
The journal is indexed in: PROQUEST / DOAJ / Crossref / EBSCOhost / INDEX COPERNICUS / DRJI / OAJI / JOURNAL INDEX / I2OR / SCIENCE LIBRARY INDEX / Google Scholar / Academic Keys/ ROAD Open Access / Academic Resources / Scientific Indexing Services / SCIPIO / JIFACTOR

RISK MANAGEMENT FOR COLISSION AT SEA

Andrei POCORA[1]
Alecu TOMA[2]
Sergiu LUPU[3]
Cosmin KATONA[4]
[1] Assistant Professor eng. PhD student, "Mircea cel Batran" Naval Academy, Constanta, Romania andrei.pocora@anmb.ro
[2] Adv. Instructor, PhD, "Mircea cel Batran" Naval Academy, Constanta, Romania alecu.toma@anmb.ro
[3] Lecturer eng. PhD, "Mircea cel Batran" Naval Academy, Constanta, Romania sergiu.lupu@anmb.ro
[4]PhD student, Politehnica University of Bucharest , Bucharest, Romania

Abstract: *Human error is widespread in the navy and merchant marine and literature confirms the need of research into maritime accidents. Investigation of a collision involves gathering evidence before the incident and after it. Some investigators agreed that the human factor is the main cause for putting ships aground, although few ships have recorded data from incidents, that can later be analyzed as a chain of errors. Respecting COLREG rules, officers of the watch need a simplified procedure to indicate how to act in various circumstances, stressing out the fact that time in an important parameter in COLREG rules.*
This paper aims to analyze collision risk factors using Human Factors Analysis Classification System improved by Reinach Viale by introducing external factors in the classification. Operations with high level of difficulty that have to be dealt in short time, with overload can lead to impaired performance of the crew create and collision risk situations. Inadequate planning operations my become a problem when risks are not exposed or wrongly addressed.
Key words: *risk management, HFACS, collision, COLREG*

Overview

Human Factors Analysis Classification System (HFACS) was initially developed for aviation by "Shappel" and "Wiegman" and it proved that can be applied in the maritime domain.
Human factors analysis model was improved Reinach and Viale (2006), which introduced a new classification level calling it "external factors" in order to be optimized in the railway industry. External factors include political influences both economic and social. This category is justified by the fact that certain decisions taken at high level may represent constraints for low level actors: company, management and team. Over time, other changes have appeared in order to adapt the research domain's characteristics to this system.

1. Applying HFACS system in shipping

2.1 Level I – Action

The action is represented by those factors directly linked to incidents represented by failures or actions committed by an operator resulting in a human error or coinciding to an unsafe situation.
This level of action can be generalized into two categories namely errors and abuses. In analysis-classification system for human errors these are described as mental or physical errors accounting activities of persons who fail to achieve their real goal. This means that actions are taken without a logical thinking of actions which lead to situations where operators might overlook certain procedures or technical operations.

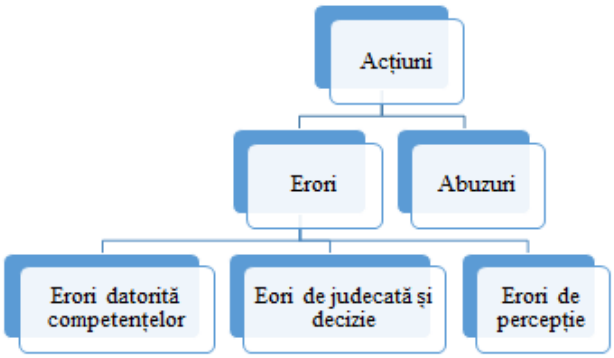

Fig. 1 Taxonomy of HFACS level I – action

Specific procedures used in simulation training should be identical to real ones in order to eliminate technical errors since, through routine, operators can lead to a much higher failure.

2.2 Level II – Preconditions

Preconditions are described as factors of an accident, elements affecting onboard practices, individual conditions and actions or results of human error due to insecurity. This concept has three categories, namely: environmental factors (technology environments or physical environments), status of individuals and personal factors.
The physical environment includes aspects such as weather within a framework or environmental factors (temperature, vibrations or lights). Regarding the individual conditions category, five distinct elements can be identified: cognitive factors, psycho-behavioral factors, physiological

DOI: 10.21279/1454-864X-17-I1-018

adverse conditions, physical or mental limitations and perceptual factors.

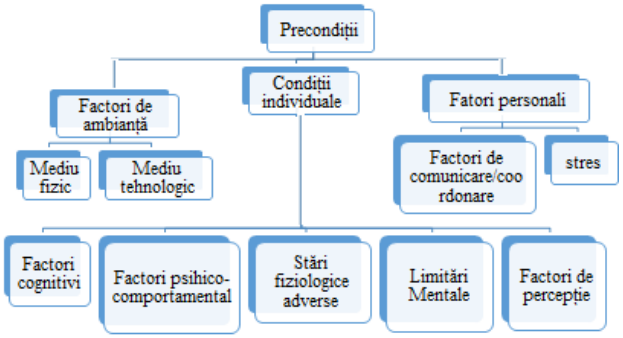

Fig. 2 Taxonomy of HFACS level I – action

Cognitive factors are affecting individual's perception of performances thus resulting in human errors. Lack of concentration, confusion and mental overload may be some examples of cognitive factors. When an individual presents individual personality traits, psychosocial problems, psychological disorders or has a wrong motivation, it can become a psycho-behavioral factor. In maritime domain, an example of adverse physiological condition can be fatigue, seasickness, operating under the influences of prescribed medical substances or even diseases or injuries. Physical/mental limitations are factors that relate to individuals who do not have the physical/mental ability to cope with high tensions during service.

The third category of preconditions comprises two sub-categories: planning factors, communication, coordination and stress.

Planning factors, communication and coordination study the interactions between individuals and their teams that are involved in the preparation and execution of operations as a result of a human error. The stress situation is generated when an operator is involved in an accident or insecure situation due to failure to comply with established procedures. Physical condition, alcohol, drugs and diet are key factors for this subcategory.

2.3 Level III – Supervising

In this category, improper supervising can lead to an unwanted situation or an incident.

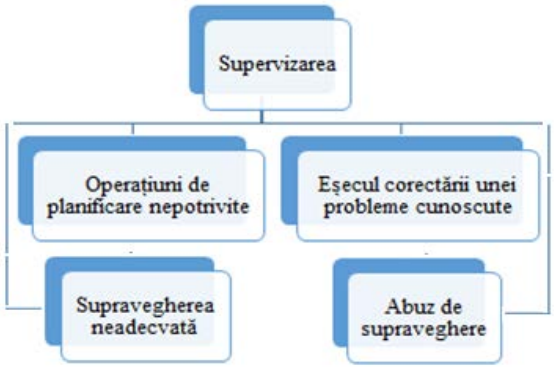

Fig. 3 Taxonomy of HFACS level III – supervising

Supervising has four subcategories: improper supervising, improper planning operations, failure in correcting a known problem and supervising abuse. The role of a supervisor should provide guidelines, training opportunities, as well as leadership and motivation.

Operations with high level of difficulty that have to be dealt in short time, with overload can lead to impaired performance of the crew create unwanted situations. Inadequate planning operations my become a problem when risks are not exposed or wrongly addressed.

Failure to correct a known problem, a problem recognized by supervisors due to relationships with subordinates, faulty equipment or poorly trained crew, all this leads to uncertainty on board and to a deficiency in the implemented management of the company.

Surveillance abuse is an intentional breach of the regulations and rules of the company. These violations are rare and hard to find, but can often start a chain of events that could lead to an incident.

2.4 Level IV – Organizational influences

This level is split into three subcategories: resource management, organizational climate and organizational process.

Organizational influences represent communication practices: actions, omissions or high level management politics that can affect surveillance and crew actions, resulting in an incident.

Resource management include high level decisions and their repercussions upon equipment and crew that can lead to human errors.

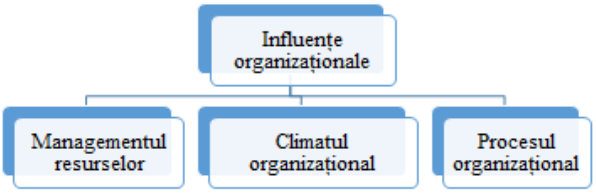

Fig. 4 Taxonomy of HFACS level IV – organizational influences

DOI: 10.21279/1454-864X-17-I1-018

Organizational climate refers to the link between working atmosphere onboard ship and the company. This refers to how a company is structured, such as policies on the promotion of officers and seamen and the cultural environment of the company. The organizational process looks upon the way the global operational mode (operational time, time pressure, schedule compliance, etc.,), procedures (standard or guidance on certain procedures) and the surveillance of company's implementations (operational risk management and safety programs) may affect the safety of the ship or crew. Due to high demands and time pressures, these organizational processes can lead to unknown risks resulting in human errors.

The literature confirms the need for continuous research in the field of maritime accidents. Human error is widespread in the navy and merchant marine. Some investigators agreed that the human factor is the main cause for putting ships aground, although few ships have recorded data from incidents, that can later be analyzed as a chain of errors through HFACS system.

		Eroare umană	TSS şi mare liberă (%)	Ape cu restricţii (%)	Total (%)
Acţiuni nesigure	Erori	Erori datorită lipsei de competenţe	-	-	-
		Erori în decizii	17	15	32
		Erori din percepţii greşite	1	5	6
	Încălcări	Încălcări regulate	-	1	1
		Încălcări excepţionale	-	-	-
Precondiţii pentru acţiuni nesigure	Factori de mediu	Fenomen hidrodinamic	5	5	0
		Vizibilitate sau iluminare	12	10	22
		Construcţia navei	2	2	4
		Neutilizarea instrumentelor	5	14	19
		Eroare radar	0	2	2
	Condiţii de operare	Pierdere de marfă	6	7	13
		Neatenţie	6	6	12
		Oboseală	-	5	5
		Anormalităţi medicale	-	1	1
		Capacităţi limitate	5	3	8
	Factori personali	Comunicaţii	14	5	19
		Bridge Resourse Management	12	3	15
		Alcool	1	-	1
Leadership nesigur		Leadership neadecvat	-	2	2
		Operaţiune de planificare neadecvată	6	14	20
		Eşec de a corecta problema	-	-	-
		Încălcare de leadership (SMS)	3	10	13
Influenţe organizaţionale		Managementul resurselor	3	3	6
		Climatul organizaţional	-	-	-
		Procesul organizaţional	-	-	-
		Safety Manag. Sys. Incomplet	7	7	14

Fig. 5 The number of overall percentages for each factor for collisions during 1998-2016 by Accident Investigators Maritime Organization

A study from 2015 showed that human error contributes to over 75% of tanker accidents, collisions and over 85% to over 75% of ships hit a bollard.

Accident research have shown that more research should be done in this field in order to find strategies to combat inconsistencies, as shipowners require.

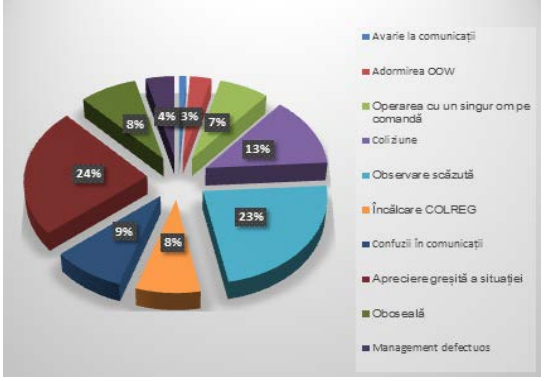

Fig. 6 Percentage for collision factors

2. Chain error in applying COLREG onboard ships

Human errors will be analyzed from the point of view of applying COLREG 72. Thus, starting from section II of the regulations, "Conduct of vessels in sight of one another", a chain of actions that can lead to the avoidance of a collision can be distinguished. In this section of COLREG, navigation and maneuvering rules are described when the vessels are in sight one another, one being the stand-on vessel and the other one the give-way vessel.

Respecting the rules imposed by COLREG, officers of the watch need a simplified procedure to indicate how to act in certain situations and what circumstances could be in those situations. For instance, if we have a situation where two ferries are approaching each other, each with a speed of 22 knots, this would mean a velocity (relative) of near 44 knots which would emphasize that time is an important parameter in applying COLREG rules.

In general terms, it is helpful to divide the approaching period of the two ships in four stages, as follows:

a) Identification, estimation and early approach. A target cannot be seen visually if it's over the horizon, so the designated distance cannot be bigger than 15 nautical miles. This distance will be divided into 3 so that between 15 to 10 miles, vessels can maneuver independently.

b) Verifying the type of the vessel, aspect and probability of approach. From 10 – 15 miles the risk of collision can be established and actions can be prepared or taken.

DOI: 10.21279/1454-864X-17-I1-018

c) Establishing compulsoriness and starting of the actions. From 5 – 3 miles, the give-way vessel must change course or reduce speed. The stand-on vessel should maintain the same course and speed.

d) Point of no return. From 3 – 2 miles, the stand-on vessel should immediately take action if the give-way vessel cannot give way.

Investigating a collision involves gathering evidences, before and after the collision.

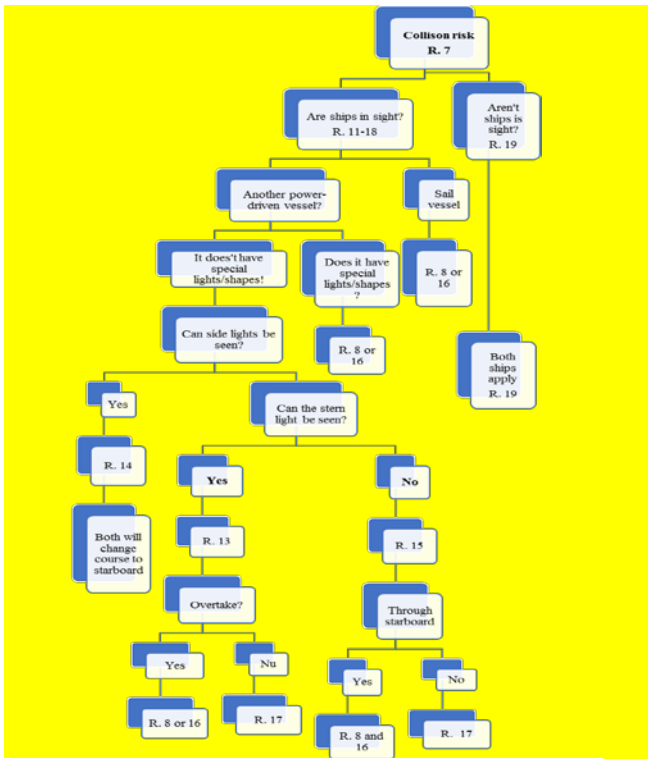

Fig. 7 Diagram of decision making to avoid collisions

Necessary evidences before the collision are paper charts, courses and logbooks. In order to investigate a collision as objectively as possible, a checklist was adopted with the following specifications:

- True courses with 4 hours before collision (hour, position, change of course);
- Hydrometeorological conditions at the time of the collision: wind force and direction, direction and height of the wave, direction and height of swell, visibility and the last forecast;
- Tide and current characteristics;
- Duty personnel before and during the collision and their duties;
- Number of radars in use and the used scale and GPS system used;
- First identifying of the collided target: classification as target, time, bearing and distance, identified lights/shapes, aspect, relative course;
- Own course, position and speed at the moment of target identification;
- Actions taken at the moment of target identification;
- Steps in plotting the target;
- Visual and sound signals given/heard, if it was case;
- VHF communications;
- Time of collision, collision position;
- Angle between ships at collision;
- Damage taken for each ship;
- Ships speed, draft and course at collision;
- Description of inertial movement after the collision;
- VHF communications after the collision;
- VHF communications with other ships;
- Other ships around the collision position;
- Giro course recorder log;
- Recording of the engine telegraph;
- Secure of data in VDR/S-VDR;
- Writing in the logbook with all known details such as: ships name, flag, port of registry, general data, type of communication equipment onboard, watchkeeping, powered equipment on main bridge, name and port of registry for the collided vessel, date and time of collision, type of cargo, local time, details about the voyage.

Conclusions

Risk analysis for collisions at sea is still an undergoing research field for both shipping companies and seafarers and should be given serious attention. Using HFACS a deeper understanding of risks is achieved. Thus, necessary actions to avoid collision or unwanted situations can be taken in time.

Bibliography

[1] European Maritime Data Management, "Sustainable Development, Global Change and Ecosystems", 2007
[2] IMO Resolution, MSC.214(81).
[3] Douglas A., Wiegmann and Scott A. Shappell, "A human Error Approach to Aviation Accident Analysis – The Human Factors Analysis and Classification System",
[4] Christine Chauvin, "Human and organisatinal factors in maritime accidents: analysis of collisions at sea using the HFACS", 2013

DOI: 10.21279/1454-864X-17-I1-018

[5] The Nautical Institute, "Managing collision avoidance at sea", 2007
[6] Interim Report, Hellenic Bureau for Marine Casualties Investigation, HBMCI
[7] The Mariner's Role in Collecting Evidence, The nautical institute, 2009
[8] Nicolae, F., Cotorcea, A., Ristea, M., & Roman, I., 2016. The human factor influence on the relationship risk - safety in the maritime industry. "Mircea cel Batran" Naval Academy Scientific Bulletin, Volume XIX – 2016 – Issue 1, pp. 67-72.

DOI: 10.21279/1454-864X-17-I1-018