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Effective Learning from Safety Events Reporting Takes Two: Getting to the Root & Just Culture

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ABSTRACT: SAFEMODE is an EU-funded project under the Horizon 2020 programme. The project brings together experience from the whole safety value chain including manufacturers, service providers, regulators, academia, and small-medium enterprises. This paper focuses on two core aspects the project is addressing: 1) the systematic collection, analysis, and categorization of Human Factors (HF) data from maritime and aviation safety events, and 2) the development of a Just Culture framework for maritime to encourage reporting of safety events and learning from them, and at which respondents feel they are treated in a fair and just manner when reporting. Learning from safety events is only possible if root causes of accidents and incidents are properly and systematically identified, analysed, and categorized, and reporters know that reporting is a "safe" and beneficial practice. The implementation of these two outcomes as part of the institutionalization strategy of the project includes recommendations to industry guidance and practice and proposals to the International Maritime Organization (IMO).

1 INTRODUCTION

Human operators play crucial roles in the safe, resilient, and efficient conduct of maritime and air transport operations. Maritime and aviation, like other safety-critical industries, expose their human operators to high risks because of the complexity of the industries and working environments. These high-risk environments, far from becoming safe, pose new risks to human operators. It has been evidenced that impacts of human factors (HF) on safety will probably evolve and become more prominent due to aspects such as increased automation, unmanned vessels and aircraft, and the trend to harmonise modes of transport' practices among others. Moreover, new technology and more automation change human work, which leads to new kinds of "human error" [15]. Consequently, new dimensions to the risk of accidents and system breakdowns appear, transforming human-machine interfaces and creating opportunities for more and "novel "risks, even risks we are not able to identify yet. The COVID-19 is a clear example of how the supply chain can be unexpectedly affected by new risks in which human operators play a central role as part of the whole system.

There is a need in the shipping and aviation industries to compile and analyse a large quantity of global real-world accident, incident, near-miss, and other safety event data with the aim of effectively managing human risk factors and producing cross-domain learning. Those data should derive in capturing systematically all contributing factors to accidents, beyond proximal or imminent causes referring to actions or omissions by operators. Those data should also bring learning to be used not just to improve training and changing procedures of operators who cope with usually poorly design systems, but also to develop methodologies and practices that integrate HF in the design and safety assessment stages.

"Human errors" are often reported as the main cause or contributor to maritime and airline accidents [1]. For maritime, in the literature, more than 80% of shipping accidents are attributed to "human error". About 75-96% of the marine accidents are caused, at least in part, by some form of "human error" [8]. Human and organizational factors are involved in most of maritime accidents, but the human element has not been evolving in the same way as technology [26]. For aviation, "human error" is also identified, at least in part, as a contributory or causal factor in 60-80% of aviation accidents [24]. However, for both domains, "human error" is not just about human operators and their individual characteristics, but about how other elements of people's jobs, working environments and organizations they work in influence systematically their performance [5].

The approach used for understanding and investigating why casualties occur determines the focus either on the individual or on the system and as a result, the information investigated. Behavioural-based safety management approaches are widespread in all kinds of organizations and their limitations have been described in shipping [3, 13]. These approaches stress people's behaviours and individual differences, which are usually indicated as the causes of accidents and the target of casualty investigations. A behaviour-based safety approach establishes a causal relationship between the unsafe act and its imminent cause, and this is clearly insufficient [5]. Casualty investigations collect imminent or proximal causes of accidents and incidents but do not systematically capture root-latent causes or contributors beyond unsafe behaviours. Alternatively, to a behavioural-based safety management, the system approach includes all those elements that affect people's work, including human, social, environmental, working and organizational factors. Under the system approach casualty investigations would explore all these factors as contributors to accidents beyond "human error", so it would not limit accidents to people's behaviour but include all those features connected to behaviour including tools, tasks, and operating and organizational environment.

However, there is still scarce human and organizational data derived from accident investigations and safety events reporting. Research-based evidence has highlighted the role of human and organizational factors in this respect as previously described. The U.S. National Transport Safety Board (NTSB) has concluded recently in a report on the most important lessons learned from marine accident investigations completed during 2019 that 1 in 3 accidents in shipping is caused by insufficient organizational oversight [17]. In a review of accident investigation reports, Schröder-Hinrichs et al. [23] concluded that organizational factors were not identified by maritime accident investigators to the extent expected had the IMO guidelines been observed. Instead, contributing factors at the lower end of organizations are over-represented. This scarcity of good HF data derived from safety events affects the effective loops from design back into end users. Hence, the SAFEMODE project is conducting a systematic identification, collection, and analysis of these human and organizational factors and apply them to the design and safety assessment stages.

2 SAFEMODE PROJECT: SUPPORTING THE HUMAN ELEMENT

The SAFEMODE project is a three-year Research and Innovation Action project funded under the Horizon 2020 programme (http://www.safemodeproject.eu/). The project is being conducted by a consortium of partners from maritime and aviation, from Europe and outside Europe, and includes service providers, builders, shipping companies and manufacturers, academia, European safety agencies, and small and medium enterprises.

The main aim of the project is to develop a novel Human Risk-Informed Design (HURID) framework in order to identify, collect and assess data for Human Factors in a systematic way. HURID will offer tools and data for designers and risk assessors, enabling them to take human factors risk-based considerations when designing transport systems and operations. SAFEMODE strengthens synergies between the aviation and maritime transport sectors in order to create shared methodologies for capturing Human Factors.

The objectives of the project include:

- Create a Safety Human Incident & Error Learning Database (SHIELD) for the maritime and aviation sector.
- Create tools and methodologies for assuring human performance.
- Create HURID, a Human Risk-Informed Design framework to support designers in Human Factors analysis in design and operations.
- Customize HURID to the specific characteristics of both domains.
- Create a Just Culture framework that will facilitate better reporting and learning from safety incidents and accident.
- Exploit project results by supporting Regulatory Framework developments in the industry.

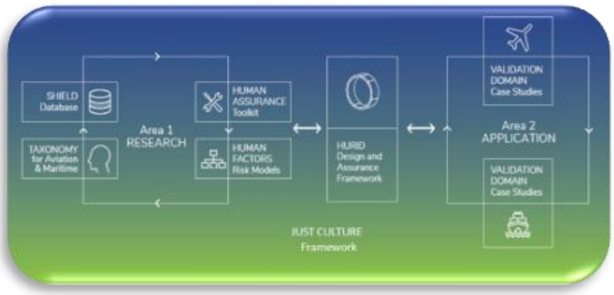

Figure 1. SAFEMODE diagram-main developments.

The two developments introduced in the paper are key for effective learning from safety events data; and include the development of a Just Culture and the systematic capture and analysis of human and organizational factors because of accidents, incidents, near-miss and other safety events reporting:

Human and organizational factors data. Casualty Investigation reports contain mostly "human error" and contributing factors at the sharp end, but not deeper and latent causes contributing to accidents. This information must be compiled and analysed systematically to capture root causes beyond operators' failure. So the question is how to get to the root of accidents and derive effective learning?

A Just Culture in maritime. If people feel that reporting leads to punishment, they are not being treated consistently and fairly or they do not trust the system they will be unlikely to report. If there is not reporting of near-misses or events, there is no data. If the reporting is not honest, the data obtained is not effective and meaningful. Hence, if reporting is compromised there will not be learning. Contrary to maritime, Just Culture is embedded in most aviation organisations, which allows facilitating honest reporting and learning from safety concerns, and criminalization is extremely rare. This contrasts with Maritime, so the question is whether Maritime could benefit from Just Culture?

2.1 *Human Factors Taxonomy and systematic analysis of safety events*

Identifying the root causes of incidents is essential for the prevention of accidents in the future. The Casualty investigation Code (MSC.255(84)) section 16.5 [9] provides valuable guidance:

"Proper identification of causal factors requires timely and methodical investigation, going far beyond the immediate evidence and looking for underlying conditions, which may be remote from the site of the marine casualty or marine incident, and which may cause other future marine casualties and marine incidents. Marine safety investigations should therefore be seen as a means of identifying not only immediate causal factors but also failures that may be present in the whole chain of responsibility."

However, root cause analysis in incident investigations must avoid the assumption that accidents will have one particular, identifiable, and single "root" cause, but multiple causes [5, 25]. Hence, root cause analysis should aim to bring together a large number of contributory factors as root causes, which are rarely active failures but latent conditions over which we have control [5]. Further that, the purpose of root cause analysis is not (primarily) to identify causes, but to identify solutions to system design flaws (and thereby prevent accidents).

SAFEMODE is using a systems approach to explore and capture systematically contributing factors of accidents. A unified HF taxonomy for maritime and aviation has been developed. The taxonomy de-codifies the HF iceberg (Figure 2) to make sure that all HF data are identified, analysed, and classified.

The taxonomy is the core of the Safety Human Incident & Error Learning Database (SHIELD) and describes the data elements and their relations. For the occurrences that will be gathered in SHIELD, at the highest level three classifications are used: 1) Occurrence facts, describing facts of the occurrence, such as location, date, injuries, type of vehicle, involved actors, and contextual conditions. 2) Occurrence assessment, describing the classification of the severity and the types of human factors that contributed to the occurrence. 3) Safety positive actions and learning, describing actions of human operators and/or technical systems that prevented occurrences getting worse (accident prevention) or that limited the consequences of an accident (consequences mitigation), and describing lessons learned following a safety occurrence, e.g. changes in system design, training or procedures.

Figure 2. Human Factors Iceberg-SAFEMODE project.

The methodology applied to develop the HF taxonomy initially includes a comprehensive review of Safety Occurrence Reporting and Analysis systems (SORAS) adopted in safety-critical industries. The taxonomy has been drawn on the review and analysis of 16 taxonomies from maritime, aviation, railway, nuclear, and space domains. The layers were defined after an extensive literature review and largely based on HERA, HFACS, TRACEr, HEIST, and NASAHFACS. The taxonomy is unified for maritime and aviation to facilitate cross-domain learning. This implies not that has been imported from marine to aviation or vice versa but it has been made sufficiently generic to be applicable to both domains, but considering domain specificities.

The SHIELD HF taxonomy includes four layers (see Figure 3), describing acts by human operators that contributed to an occurrence, preconditions affecting human performance, supervision issues, and organizational aspects. It is a layered HF taxonomy that enriches other existing taxonomies by capturing along with individual aspects, contextual and organizational factors.

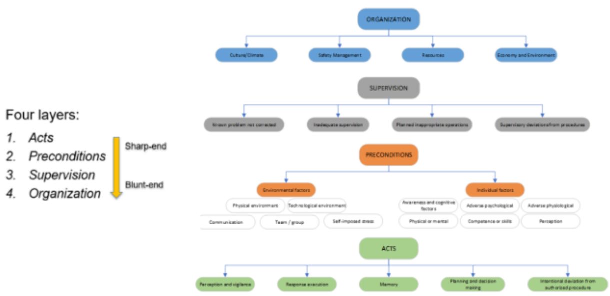

Figure 3. SAFEMODE Human Factors Taxonomy.

It is been designed to adapt to different users including frontline operators, designers and casualty investigators among others end-users.

2.2 *Implementing a Just Culture in Maritime*

The report on the investigation of the fatal crush accident on the general cargo vessel Karina C at Seville (Spain) on 24 May 2019 concluded that the lack of Just Culture was one of the safety issues (not directly) contributing to the accident that was addressed or resulted in recommendations:

"The vessel did not appear to have a Just Culture in that the crew did not report such a serious accident to the shore-based senior management." [16]

Underlying causes of accidents are not systematically captured in all accident investigations, and the above report is a good example of the value of understanding the causes of safety occurrences by focusing on why people did what they did, not judging them for what they did not do. In fact, there was a delay of 4½ months in reporting the accident as it was initially considered to have been due to a medical event. Consequently, the company was prompted to take action and update its SMS and company procedures to ensure all serious incidents are fully investigated until the underlying causes are established.

Investigations, usually, focus on operator error or technical failures, while ignoring other systemic causal factors which are also the most likely to be left out of accident reports [14]. Examples like the one described in which deep causes of accidents are captured (i.e., safety culture and other organizational and human factors) are scarce. A Just Culture is not probably identified in other accident reports because is not extensively implemented in the maritime organizations despite a key feature of a good SMS is an open and Just Culture of reporting accidents and incidents. Other reasons involve the HF training in event investigations and resources and commitment to thorough investigations.

In aviation, Just Culture is not new and has been embedded, both implicitly and explicitly, within aviation legislation for many years. It has been successfully implemented in the aviation industry to improve the level of safety aspects of organizations. A Just Culture is one aspect of a safety culture and the prerequisites to achieve a Just Culture include independence, feedback, acknowledgment, ease of reporting, motivation to report, and trust [7] (Figure 4).

Figure 4. Pre-requisites of a Just Culture. Adapted from Eurocontrol [7].

Aviation adopts the definition of Just Culture provided by the European Commission (Regulation 376/2014) [21] as 'A culture in which front-line operators or other persons are not punished for actions, omissions or decisions taken by them that are commensurate with their experience and training, but in which gross negligence, willful violations and destructive acts are not tolerated.' What is needed for a "Just Culture", is an atmosphere of trust in which people are encouraged, even rewarded, for providing essential safety-related information, but in which they are also clear about where the line must be drawn between acceptable and unacceptable behaviour [20]. Just Culture builds a trusting atmosphere where employees have the assurance to report safety events without fear of blame. Employees must believe that they will not be punished, the report will be confidential and that the information they submit will be acted upon, otherwise they will decide that there is no benefit in their reporting [19]. The challenge is to create a culture of accountability that encourages learning [5].

Contrary to what exists in the aviation industry, the quasi-absence of a Just Culture in shipping affects any form of reporting requirements [27]. One of the recommendations of the report "A Culture of Adjustment" produced by WMU [27] refers to companies' promotion of the concept of a Just Culture to strengthen their reporting systems. These reporting systems would include all kinds of reporting such as work and rest hours but also near-miss, incidents and accidents and others.

In maritime (MSC-MEPC.7/Circ.7 – Guidance on Near-miss reporting, paragraphs 1.3 and 1.4) a definition of "Just Culture" features an atmosphere of responsible behaviour and trust whereby people are encouraged to provide essential safety-related information without fear of retribution. However, a distinction is drawn between acceptable and unacceptable behaviour [10].

Just Culture is the essential component underpinning safety and business success [12] and its implementation and enforcement in maritime has become more necessary now than ever before. Effective Just Culture can lead to significant improvements in organizational performance and safety, which requires an effective safety information system and trust of the workforce. In turn, this depends on a culture that is, and is believed to be, open and fair, i.e. "Just" [11, 12]. Consequently, incentivizing seafarers' feedback and incorporating their views in safety are necessary to enhance safety in shipping and close the gap between shore and ships [2].

Building confidence between seafarers and management and mutual understanding and engagement is a necessary condition for implementing a Just Culture [27]. Lack of trustful relationships and blame culture in the industry are probably the main barriers to the adoption of a Just Culture as identified in previous studies. The amount of trust between workers and their management is an important element in the successful adoption of effective reporting concerning their purpose and use [4]. When companies fire employees who talk about what they think is "right," the consequences include not just losing a good worker but also generating a lack of trust in other employees [5]. Seafarers who think that having disagreements with their managers would result in future sanctions such as losing their jobs discourage them from sharing information [22].

Because of a poor Just Culture, the lack of reporting becomes a significant problem faced by the maritime industry. Factors related to incidents and accidents reporting frequency include a trusting relationship among the crew, safety-oriented ship management, and feedback on reported events, among others [18]. Bhattacharya's work [3] found that employees' fear of losing jobs was a primary aspect for not reporting incidents, which makes the incident reporting clearly ineffective. The biggest challenge to enhance trust is to change the culture of blame, where mistakes are seen as failures but not as learning opportunities to prevent future incidents. Moreover, learning from every accident as a result of safety information provided by reports and feedback established is not well developed in the maritime industry [6]. Indeed, to build trust, efforts are needed, such as involving and empowering employees and promoting their responsibility [20].

SAFEMODE project is analysing if the maritime industry needs a Just Culture and the benefit of it by conducting qualitative research through interviewing seafarers and casualty investigators (both at flag and organizational levels) mainly from Europe but also outside Europe. Focus groups are also being conducted to capture insights from trade unions, training colleges, shipping companies, regulatory bodies and policy makers.

Preliminary results indicate the existing disconnection and mistrust between shore management and ships, the fear of reprisals or unwarranted sanctions of seafarers, and the scarce use of reporting for learning purposes in most cases, aspects all previously mentioned as fundamental in Just Culture. The maritime industry for effective learning needs an effective reporting culture, which cannot exist without an effective Just Culture.

3 CONCLUSIONS

Maritime investigations teach us lessons by issuing and reiterating safety recommendations until safety improvements become realities onboard vessels. However, many accident lessons have unfortunately seen before [17]. SAFEMODE project developments aim to contribute to safety reporting and analysis at European and international levels. Two main outcomes of the project concern a unified HF taxonomy for maritime and aviation and a Just Culture analysis in maritime.

The advantages of a unified HF taxonomy that captures systematically individual, contextual, and organizational factors involved in casualties and near-misses for maritime and aviation include: 1) thorough consideration of underlying factors contributing to safety concerns beyond "human error", 2) cross-domain learning, and 3) harmonization of HF solutions through modes of transport.

On the other hand, a Just Culture is far from being a reality in maritime. Its implementation and enforcement becomes more necessary now than ever before, and then SAFEMODE is conducting work to revitalize this strategic discussion. In the same way as the aviation does, the maritime industry needs to adopt a culture of learning from incidents based on an effective Just Culture.

The implementation of these two outcomes as part of the institutionalization strategy of the project includes improved industry guidance and practice and proposals to the IMO.

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