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Marine Accident Investigation: Is There a Common Approach to Communication as a Contributing Factor to Maritime Casualties?

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ABSTRACT

Learning from casualty investigations is a requisite to effect maritime safety and marine environment protection. Moreover, it helps improve training. Communication at sea is a broad concept, as it includes exchanges within the ship's bridge, among crew members, as well as between crew members and pilots, together with ship-to-ship and ship-to-shore conversations. Communication takes place in various contexts, from routine ship operations, such as pilotage, to emergency situations, such as Search and Rescue (SAR). Communication is a human capability that entails both technical and non-technical skills. Technical skills can be evaluated, but non-technical skills are more challenging for appraisal. In addition, ships operate in a highly dynamic environment which makes information retrieval far more difficult than for an operator seated in an office ashore. How do casualty investigators break down miscommunication as a contributor to maritime accidents? What do they look for? Do they evaluate deviations? Is there consistency among investigation bodies in this regard? This study aims to better understand how casualty investigation agencies identify, label and frame failures in communication, and whether there is a common approach to communication across casualty investigation agencies.

Keywords: Maritime, Communication, Accident, Investigation

INTRODUCTION

Maritime transport is by nature a global industry, with stakeholders located across the world, multicultural crews, English spoken at varying levels of command, and the coexistence of native languages. Maritime communication includes oral, written, sound, visual, and data transmission. Given the very nature of ships, operating in isolation or remoteness from the shore, exposed to unsafe environments, the ability to communicate efficiently plays an important role, particularly in safety-critical situations. Effective communication is characterized by a 'mirroring' between the message encoded by the sender and the message decoded by the receiver. There is communication failure when the message encoded by the sender is misunderstood or not caught by the receiver (Shakirova, Safina & Akhunzianova, 2018). Communication failures can take various forms: insufficient verbal reporting when a watch is finished and handed over to a new team, notably in the bridge/engine room

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coordination (The Swedish Club, 2018 & 2022); inaudible instructions because of surrounding noise or deteriorated navigational conditions (Idnani, 2025); misunderstandings caused by ambiguous terms, lack of clear directives, specifically when third parties are onboard a ship; confusion in intentions or responsibilities (Swedish Accident Investigation Authority, 2016; Britannia P&I Club, 2024; Transport Safety Investigation Bureau of Singapore, 2024); wrong assumptions by absence of open communication (Gimmestad, 2015; Dutch Safety Board, 2021); cultural barriers or perceived hierarchy resulting in individuals not daring to speak up and draw the attention to themselves (United States Coast Guard, 2005; Gimmestad, 2015; The Swedish Club, 2020; Grøneng, 2023); deliberate non-cooperation, such as not accepting followership in the master/pilot interaction. It is estimated that 80% of maritime accidents are caused by incorrect human behavior, and that half of them involve communication as a contributing factor (Gabedava & Hu, 2025).

To remedy miscommunication and codify maritime English, the International Maritime Organization (IMO), the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA), and the International Telecommunications Union (ITU) adopted maritime communication standards for implementation on board ships, by search and rescue (SAR) organisations, Vessel Traffic Service (VTS) operators, pilots and port authorities. These are the Standard Marine Communication Phrases (SMCP) (IMO, 2002), the Guideline 1132 on VTS Voice Communications and Phraseology (IALA, 2022), and the Manual for Use by the Maritime Mobile and Maritime Mobile-Satellite Services (ITU, 2024).

The Code of the International Standards and Recommended Practices for a Safety Investigation into a Marine Casualty or Marine Incident, also called the Casualty Investigation (CI) Code, was adopted by the IMO in 2008 and became mandatory in 2010 under the International Convention for the Safety of Life at Sea (SOLAS), 1974. The CI Code is accompanied by guidelines for investigators, with an appendix on 'Areas of human and organizational factors inquiry', including verbal and written communication, language barriers, interpersonal communication, and exchanges with shore support (IMO, 2014). Learning from casualty investigations is a requisite to effect maritime safety and marine environment protection, not only under SOLAS but also under other maritime conventions. Moreover, it helps improve training by building simulation scenarios based on past events. Chapter 1 of the CI Code states that it provides casualty investigation agencies with a 'common approach' to carry on a marine safety investigation.

This study aims to better understand how casualty investigation agencies identify, label and frame failures in communication, and whether there is a common approach to communication across casualty investigation agencies.

HOW DO MARINE ACCIDENT INVESTIGATORS WORK?

A preliminary review of marine accident investigation reports from various countries suggested that communication is not subject to a systematic approach and that communication failures, when they occur, appear in a scattered way in the timeline of events and/or in the analysis of contributing factors.

To shed light upon the work of investigators, a call for interviewees was disseminated via the Marine Accident Investigators' International Forum (MAIIF), the European Maritime Safety Agency (EMSA)'s Permanent Cooperation Framework, as well as through direct correspondence with accident investigation bodies.

Ten marine accident investigators (referred to hereafter as Investigators A, B, C, D, E, F, G, H, I, J) from eight countries (Denmark, France, Japan, the Netherlands, Portugal, Singapore, Sweden, the United States) volunteered for an interview.

The respondents were asked the following three questions:

- During the facts gathering phase, how do you detect failures in communication?
- How do you handle them?
- How do you measure deviations in communication?

A marine accident investigation comprises three phases, the data collection phase, the data analysis phase, and the formulation of safety recommendations.

Data Collection Phase

After an accident, the investigators need to collect both soft data and hard data. The collection of soft data is executed as quickly as possible, to avoid distortion of facts through time, by means of interviews with the parties involved in the accident: not only crew members, but also marine pilots and personnel ashore. Conducting interviews with a wide array of individuals and gathering statements in an unbiased manner after an accident has happened is a sensitive task (Investigator F). These interviews are distinct from the testimonies given at the accident's hearings (Investigator D). The responses provided by the stakeholders help the investigators understand the rationale behind their actions and may enable communication failures to be identified at this stage (Investigators A & H). A simplified Fault Tree Analysis (FTA) is sometimes used to visualize their interplay with other factors (Investigator H). To better understand or verify the information provided by the parties, hard data are extracted from both shore and ship sources. These sources include maritime coastal surveillance authorities', Search and Rescue (SAR) centers' and VTS centers' recordings and logbooks, delivering Very High Frequency (VHF) conversations, radar tracks and Automatic Identification System (AIS) tracks (Investigators F & J), any nearby security video camera recordings (Swedish Accident Investigation Authority, 2022), which may also include speech (Investigator C), the shipping company's management documentation, as well as the vessel's voyage data recorder (VDR) and other onboard records.

It is noteworthy that VDR is not mandatory on all ships. Regulation V/20 of SOLAS requires that all passenger ships, regardless of tonnage, and ships other than passenger ships of 3,000 gross tonnage and upwards constructed after 1 July 2014, and engaged in international voyages, be equipped with a

VDR to assist in casualty investigations. The VDR includes three recording components: the long-term data collecting unit (located in a secure area inside the ship), the outdoor fixed capsule (to be picked up from the deck of a ship that has sunk), and the outdoor capsule which operates by hydrostatic release (it is supposed to float to the surface after a ship has sunk). Among the data available are the recordings from the microphones positioned both on the bridge and on the outside bridge wings, as well as VHF communications and AIS data (IMO, 2012). A parallel with aviation is the carriage onboard planes of a combination of two recorders, the cockpit voice recorder (CVR) and the flight data recorder (FDR). They provide accident investigators with precise information on the flight conditions, cockpit voices and alarms. FDR and CVR proved to be essential tools in the investigation of airplane accidents (International Civil Aviation Organization, 2025).

Since not all ships carry a VDR, it might be necessary, during an investigation, to retrieve the VDR of nearby vessels (Investigator B).

The availability of sufficient data makes possible the simulation of the conditions of the accident (ship's movements, weather, visibility, etc.) in a bridge simulator (Swedish Accident Investigation Authority, 2016).

Finally, when there is discrepancy between the soft and hard data collected, it might be necessary to conduct a second round of interviews with the crew members (Investigator I).

Data Analysis Phase

The traditional data analysis method for all investigators is the reconstruction of the sequence of events. One investigation team also implements a systemic approach based on the SHELL model, focused on people, operational contexts and safety, as well as the Reason model of accident causation. The SHELL analysis will lead the investigators towards the hardware (H) (e.g. are the monitored VHF channels appropriate?), the software (S) (e.g. are the procedures clear?), the environment (E), characterized by the operational circumstances in which the L-H-S system is functioning (what weather conditions prevailed at the time of the accident?) and the interactions with the liveware (L), i.e. the other humans in the workplace (Investigators D & E).

Audio recordings provide written transcripts of conversations, but they can also allow the partition of other sounds, such as the displacements of crew members within the navigational bridge and those related to the operation of bridge equipment (Investigators D & E). Deviations from the international maritime communication standards are usually not evaluated (Investigators B, C, D, E, F, G, H, I & J), because they are difficult to quantify (Investigators A & F). What is scrutinized is the rationality of the conversations and whether there is mismatch (Investigator C). It is therefore a qualitative analysis (Investigator J). When a discrepancy is found, investigators search likely cascading failures. "This can be examined by looking at outcome and actions executed by individuals: for example, a pilot gave the helmsman a 'starboard 20' helm order prior to a collision, but the VDR indicated that the rudder went to port 20, which was in an opposite direction. Before determining this communication was to be a deviation, the investigator would examine whether this helmsman understood the helm order given by the pilot. If the helmsman mistakenly heard this helm order and assumed to be 'port 20', then the human element plays a part, and the investigator would have to find out the reasons for the helmsman to hear it as 'port 20'. There are also other areas to look into, whether the other bridge team members noticed the deviation of the pilot's helm order and why there was no intervention to correct it, etc. The investigation objectively states the deviation in communication observed in the report and explains how it could have occurred and proposes recommendations to prevent it from recurring" (Investigator A).

How communication aspects are addressed depends on the context of the accident (Investigators B, C & F). To set out this context, the investigation will trace the decisional chain, for instance, through a meticulous review of the documentation to ensure it does not leave room for misinterpretation (Investigator A); it may also assess the shipboard culture to detect potential lack of trust, cultural divide and/or poor crew cohesiveness (United States Coast Guard, 2005); working hours, sleep deprivation, fatigue accumulation, and their impacts on human performance will inevitably be scrutinized.

Investigators may capture gaps in regulatory requirements or procedural noncompliance. For instance, in training. Investigator B cited as an example of deficiency that not all crew members on board cruise ships receive adequate VHF radiocommunication training. Leisure activities are managed by entertainment staff. In high-risk areas, such as polar waters, they are entrusted with the task of guiding cruise passengers onboard inflatable boats (Zodiacs) for sightseeing excursions. When an emergency occurs, such as boat capsizing, these crew members are unable to handle VHF conversations correctly (United States Coast Guard, 2024). Poor performance in VHF radio communication is also observed onboard fishing vessels, and these training deficiencies remain unaddressed (Investigators D&E).

Formulation of Safety Recommendations

The findings of the investigation and the recommendations to all the parties involved in the accident, including public authorities, are compiled in an investigation report, which terminates the investigation work.

DISCUSSION

Maritime competences are often associated with technical skills. And yet, communication is the element supporting all the technical aspects (Idnani, 2025). Communication can be compared to "the glue that keeps the other parts together" (Mickelson, 2025). The results of a communication failure are either a response from the receiver that was unanticipated by the message sender, or an absence of reaction on the part of the receiver. Either way, the original instruction communicated by the sender remains unexecuted (Shakirova et al., 2018). The most important condition for crew coordination is that crew members can communicate effectively (The Swedish Club, 2020). The concepts of Bridge Resource Management (BRM) and

Engine Resource Management (ERM), inspired by the concept of Cockpit (and later Crew) Resource Management (CRM) in aviation, highlight that interpersonal relations are as valued as technical competences. In BRM/ERM seminars, trainees learn that "safety is built on leadership, coordination, communication and utilization of the resources in a crew" (Gimmestad, 2015). It is also taught, for example, how a less experienced crew member should formulate reservations and point out a possible error from an experienced officer. Changing human behavior takes time, and recurrent training is necessary to put and maintain appropriate reactions into practice, particularly in emergencies. As CRM, BRM should be considered more than simply a training course to make crew members work better together. It is rather a valuable set of human error management skills, as it establishes lines of defenses to prevent errors, detect nascent errors before they develop further, or mitigate the consequences of errors that have not been detected in time (Helmreich, Merrit & Wilhelm, 2017).

One difference between maritime transport and aviation is that it is possible onboard ships that the officer of the watch (OOW) is alone on the bridge with the responsibility to conduct the ship. In aviation, there is pair work between the Pilot Flying (PF) and the Pilot Monitoring (PM) also called the Pilot Not Flying (PNF). Radiocommunications management is the task of the PM. When air traffic controllers give instructions, the PF executes and the PM checks adequate execution (Lelaie, 2014). In addition, they have an obligation to verbalize their actions. On the bridge, when the OOW is alone, he/she would most probably not verbalize his/her actions. In case of an accident, the investigators have difficulties retracing the sequence of actions. This point was the subject of a recommendation made to a shipping company by a marine accident investigation team to encourage officers, when they are on duty alone on the bridge, to say aloud what they observe or are doing in critical situations (e.g. collision avoidance), to be recorded by the VDR (investigator B).

Each situation is unique, and the categorization of communication failures should not oversimplify the complexity of the accident. Even feeding an accident database is perceived as holding an inherent risk of simplification: the description of the failure should fit a particular item, although it does not correspond exactly to the definition given (investigator C). There is no taxonomy of communication failures considering what the BRM courses include (Investigator J). Investigators attach great importance to a holistic/integrated approach to accidents and bear in mind that they should avoid reductionism. None of the interviewees reported having a specialist to investigate communication issues and explained that all investigators in the team have competence in this subject. The fact that they are few in numbers makes them necessarily polyvalent. Two investigators mentioned they can refer to an in-house human factors expert, although this person is not specialized in the maritime sector. However, one interviewee described an investigative work backed with the support of a human factors' expert dedicated specifically to maritime (Investigator J). Investigation teams hold regular cross-cooperation meetings with the other divisions of their institution, e.g. aviation and railway (Investigators F & G). It is notable that some investigators introduced, on their own initiative, structured approaches and methods in their teams, in the wake of training courses and working groups organized by the European Maritime Safety Agency (EMSA), as well as by enrolling themselves in university programs (Investigators D, E & F).

None of the interviewees reported to have any contact with marine insurers, although they also participate in drawing the attention of the maritime community on critical/risk prone situations in which communication plays a vital role (UK P&I, 2020; West, 2021; Britannia P&I Club, 2024).

CONCLUSION

This study provides insight into the way marine accident investigators handle communication failures. Their task consists of determining what happened, why it happened and how it could be prevented from happening again. Based on the collection of soft and hard data, their analysis traditionally aims at the reconstruction of the sequence of events which led to the accident. Their findings are shared publicly in a report, At the core of this framework is the provision of recommendations to improve maritime safety.

Investigators are involved at every stage of the investigation process with an inclusive approach, and communication failures are never considered independently from the other contributing factors. There does not exist a standard taxonomy of communication anomalies, most importantly by comparison with the professional communication principles that are taught in BRM courses, which have been purposely developed to reduce the frequency and severity of human errors. This absence of defined criteria hinders a common approach of miscommunication by accident investigators.

All investigators interviewed placed strong emphasis on their polyvalence in their mission. Hence, the analysis of communication failures is a standard competence among investigators. Yet that did not prevent some of them from forging an individual approach to their work with the help of the human factors toolkit they were given in academic or professional training.

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