TRANSNAV
http://www.transnav.eu
the International Journal
on Marine Navigation
and Safety of Sea Transportation
Volume 12
Number 4
December 2018
DOI: 10.12716/1001.12.04.09

# Problems that Occur in a Team: Learning From Maritime Accidents via Simulation Training

M. Barić, J. Čulin & T. Bielić
*University of Zadar, Zadar, Croatia*

ABSTRACT: Despite the efforts of all stakeholders maritime accidents still occur, most commonly caused by human failure. Efficient team work is a vital tool in preventing occurrence or rectifying the errors and violations. Therefore Bridge Resource Management course focuses on developing and sustaining work teams. Unfortunately, team work can be hampered by many factors, including poor organisation, cultural differences, improper attitudes and behaviours, as shown by analysis of many accidents and it is important to address these issues during trainings. As a starting point for a discussion simulation training can be used. In this paper we propose three scenarios based on real accidents, which address problems that are usually not familiar to students: authority gradient, desire for harmony in a group and antagonism between specialties.

## 1 INTRODUCTION

The safety performance of marine transportation is enormously significant since it affects humans, societies and natural environment globally (Anderson 2003). Despite safeguards, barriers and defences developed by modern technologies, the maritime accidents continue to occur, and their investigations are required in order to understand how they develop and to undertake measures which could prevent them (Cassama, 2015). Analyses of maritime accidents show that human failure, inadvertent or deliberate unsafe act, is the most common contributing factor (Baalisampang et al., 2018; Batalden and Sydnes, 2014). Therefore significant efforts by various stakeholders in maritime industry have been put to decrease human and organisational error (Valdez Banda and Goerlandt, 2018). However, the history of maritime safety is characterized by prescriptive standards and reactive approaches (Schröder-Hinrichs et al., 2016).

The complexity of human and organizational factors in shipping calls for proactive approach in maritime safety, such as adopting the 2010 Manila Amendments to the STCW Convention (Schröder-Hinrichs et al., 2013). Among numerous changes resulting from technological development of modern ships, human element-related changes were introduced (IMO 2011). To build important nontechnical skills new requirements related to training in leadership and team work were adopted.

Teams are considered to be more efficient in tackling tasks and offer greater adaptability, productivity and creativity than individuals (Xyrichis and Ream, 2008). Recognizing the special competencies and talents of each individual employee (Pantouvakis and Karakasnaki, 2018) and assigning appropriate tasks enables improving team work. Team performance depends on team characteristics such as familiarity (the level of knowledge team members hold about one another), virtuality (extent of coordination and communication via electronic

tools), and leadership structure (shared or hierarchical), which are intertwined and affect other important factors, such as communication (Marlow et al., 2018).

Simulations are effective educational tool used to acquire knowledge, skills and attitudes needed for performing jobs in different industries (Havold et al., 2015). Combined with the training on actual equipment and training on board ships, usage of simulators helps to increase training effectiveness (Mindykowski, 2017). Incorporation of simulation based modules in maritime training units and course schemes provides a way to attain experience and to gain the necessary skills (Felsenstein et al., 2013). For example, a study describing simulation training with scenario involving the fire on-board the Ro-Ro Ferry showed that the training and learning experience of trainees can be improved by simulation environment (Baldauf et al., 2016). The ship`s navigation simulators can be used to conduct Bridge Resource Management (BRM) courses. For example, the development of the most relevant nontechnical skills in bridge simulator and design of the appropriative behavioural marker system for their rating have been described by da Conceicao et al. (2017).

In order to be effective, BRM training should be carefully designed and implemented (Roettger et al., 2016). Nautical students at University of Zadar bridge resource management competencies in general, and leadership and team work in particular, acquire mainly through Shipboard Organization and Management course. The course is mainly classroom-based and to improve its effectiveness simulators can be used. The aim of this paper is to present three scenarios that can be used as a way to teach or reinforce the learning of topics such as communication, leadership, decision making and cooperation. Scenarios of real accidents are selected and adapted to the context of use, taking into account characteristics of student groups.

All scenarios, which are used as example in this paper, are developed and prepared using Transans NaviSailor Full mission bridge simulator v5.35. This type of simulator enables recreating most of conditions as in real situation. Conducted exercises are saved and can be replayed, along with the CCTV cameras, provide the whole picture of actions and behaviour during exercises.

## 2 AUTHORITY GRADIENT

Sometimes leaders are more concerned with their status and reputation than with making a good decision (Bang and Frith, 2017). Therefore team members do not voice valid concerns or question arrangements made by their superiors. Consequently, in complex sociotechnical systems such as medical care, aviation, railway, energy sector, accidents that could have been prevented occur (Kyriakidis et al., 2018). There are numerous maritime accidents where the authority gradient played a role (Schroder-Hinrichs et al., 2012). We use grounding of *Hamburg*, since it involves cadet, a rank on board that students first will achieve. According to report by MAIB "at 13:28:21 on 11th May 2015, the Bahamas registered passenger vessel *Hamburg* grounded on charted rocks near the New Rocks buoy in the Sound of Mull, Scotland. The accident caused considerable raking damage to the hull and rendered the port propeller, shaft and rudder unserviceable. There were no injuries and the vessel continued on its passage to Tobermory. The investigation found that, having been unable to enter Tobermory Bay on arrival, the passage plan was not re-evaluated or amended. Combined with poor bridge team management and navigational practices, this resulted in the vessel running into danger and grounding" (MAIB 2016). An investigation revealed that "Seven minutes before the grounding, both the officer of the watch (OOW) and the cadet plotted the vessel's position on the chart. Despite both plotted positions being incorrect, the cadet's fix did at least indicate that the vessel was running into danger. Unfortunately he did not feel empowered to challenge the OOW and chose to silently erase his own position, leaving the OOW's incorrect position on the chart."

In order to illustrate danger that can result from steep authority gradient we developed following scenario based on aforementioned accident.

The scenario is developed using full mission navigational simulator. Since the simulator has the ECDIS integrated with GPS/GLONASS position, the first step was to disengage satellite position on ECDIS. This enables recreating the situation that happened in real scenario, since the position can be determined plotting lat/long obtained using satellite position receiver or using RADAR/visual bearing either on paper chart or on ECDIS.

First step includes preparing the exercise, which means loading proper area, choosing appropriate vessel, matching prevailing weather conditions and plotting course as in scenario. All of this has to be explained to "simulator bridge team" during exercise briefing.

Second step is running exercise and recreating situation which involves authority gradient. This is obtained by employing exercise leader (usually instructor) as a team member. As the exercise is carried out, the bridge team and exercise leader separately plot ship position. However, the exercise leader, intentionally, is plotting the wrong position of the ship at the position with adequate depth. The goal is to see who will notice that ship is located in shallow water and say that exercise leader plotted wrong position of the ship.

Third step is exercise debriefing. Exercise stops when the wrong position, plotted by exercise leader, is noticed and corrected or when the ship grounds. During the debriefing, exercise is replayed and the authority gradient is explained using this example.

The exercise script is following:

- Preparing simulation
- Disengaging satellite position on ECDIS
- Bridge team:
  - Leader (Instructor)
  - Bridge team (students or seafarers)
- Plotting ship position
  - On paper chart
  - On ECDIS using LOP
  - Instructor intentionally plots wrong position

- End of scenario
  - Noticing wrong position
  - Grounding.

## 3 DESIRE FOR HARMONY IN A GROUP

Hostile work environment is readily identified by students as a cause for problems in developing and sustaining work team. Usually, they do not recognise good relationships with team members as a potential issue. However, group think, including direct pressure on dissenters (group members are under social pressure to not oppose the group consensus), self-censorship (doubts and deviations from the perceived group consensus are not accepted) and the illusion of unanimity may cause distortion of decision making, eventually triggering accidents (Murata et al., 2015). For example, poor decision-making based upon an emotional response to peers has been recognised as pilots´ behavioural trap (Velazquez, 2018). Similarly, the desire for harmony in a group manifested as reluctance to challenge the assessments and decisions made by their colleagues has been listed as a factor that do not receive sufficient attention during maritime accident investigations (Schroder-Hinrichs et al., 2012).

As an example of accident which involves desire to fit into the group, grounding of *Douwent* has been chosen. "At 02:54 on 26 February 2013, the United Kingdom (UK) registered general cargo ship *Douwent* grounded on Haisborough Sand in the North Sea. There were no injuries and no pollution.

The MAIB investigation established that the vessel had followed a navigation track displayed on the global positioning system (GPS) receiver and on the radar. The officer of the watch (OOW) did not notice that the vessel was heading into danger until it was too late for effective action to be taken. Contributory factors included: The OOW was alone on the bridge and probably fell asleep" (MAIB 2014). However, as investigation also found out: "An able seaman (AB) was also on watch but he was told by the chief officer that he was not required to remain on the bridge so he returned to the accommodation below." It is highly probable that the presence of the AB on the bridge would have prevented this accident. MAIB`s report does not addresses reasons for sending AB away from the bridge, but it is highly likely that OOW acted out of sympathy and/or that AB obeyed as a good mate in a team. Following description involves preparing exercise scenario and action script.

First step is preparing scenario on navigational simulator, which includes loading proper area, choosing appropriate vessel model, preparing weather conditions and establishing vessel route. In this scenario, vessel is on autopilot steering (heading control) through the exercise.

Second step is performing the exercise. In this scenario first officer can be played by one of the students or instructor. It is important to properly and separately brief the bridge team and "first officer". During the exercise, "first officer" sends the rest of bridge team away from the bridge. The key of this exercise is to see if the participants will go off the bridge and who and why will remain.

Last step is exercise debriefing. After the "chief officer" order and the reaction of bridge team the exercise is stopped. Using simulation replay, which means showing possible consequences and the importance of overcoming desire for harmony in the group during decision making is shown and explained.

The exercise script is following:
- Preparing simulation
- Determining the point when the rest of bridge team will be sent away
- Choosing "first officer"
  - Instructor or
  - One of the students
- Running the exercise
- Sending rest of the bridge team away
- End of scenario
  - Who remained on the bridge and why

## 4 ANTAGONISM BETWEEN SPECIALTIES

Effective communication and coordination between Master, Chief Engineer and deck and engine officers are preconditions for productive team work which can ensure safe and environmentally sound shipping. For example, knowledge sharing for a mutual understanding between bridge and engine department is critical to energy efficiency (Man et al., 2018).

However, relationship between the Master and Chief Officer can be characterized by strict subordination based on the principle of rank and the level of responsibility, especially within vertical, strictly centralized shipping companies (Bielić, 2009). A study investigating bridge-engine control room collaborative team communication (Kataria et al., 2015) showed that lack of understanding of the other group's job and context, not knowing what was going on in the other department and inter-departmental culture clashes can inhibit communication and collaboration. An antagonism between specialties, a rivalry or status conflict can be significantly present, as described by a participant in aforementioned study, who mentioned "huge Berlin wall".

An example of the accident where lack of communication between bridge and engine officers played a role is a heavy contact with berth of the ferry *Sirena Seaways* (MAIB 2014). "At 1254 on 22 June 2013, the ferry *Sirena Seaways* made heavy contact with berth 3 at Harwich International Port. The impact caused considerable damage to the fore-end of the vessel, including penetrations below the waterline. The linkspan at berth 3 collapsed into the water; the supporting structures were severely damaged and were no longer useable. No one was injured and there was no pollution. *Sirena Seaways* was subsequently moved to another berth to disembark the passengers and vehicles. *Sirena Seaways*'s propulsion control records showed that the starboard propulsion system remained set at about 63% ahead throughout the accident. No defects were found with the propulsion control systems and it was considered most likely that

the button to activate the back-up control system for the starboard propulsion system was inadvertently pressed during the early stages of the entry into the port. This bypassed normal control of the starboard propulsion system. The error was not noticed by the bridge team and the starboard propulsion system continued at 63% ahead for nearly 2 hours after the accident, hampering attempts to pull the vessel from the damaged berth." However, an investigation has revealed that unlike bridge team, the engineers in the engine control room noted the operation of the back-up control system 13 minutes before *Sirena Seaways* struck the berth but they did not communicate with the bridge team. Moreover, after collision discussion between senior deck and engineering officers centred around evaluating the effects of the damage and the most appropriate response, but information necessary to realise that back-up button was incorrectly operated was not delivered. Had they communicated effectively, this accident could have been prevented or at least emergency better managed.

In our scenario the exercise is performed two times. First time the error with propulsion is not reported and second time the error is reported to the bridge team.

First step is preparing the exercise, by choosing appropriate area and vessel model (with pitch propellers). Also, this scenario requires joint running of Nautical and Engine room simulator. This type of exercise if appropriate for Bridge team management and Engine room resource management courses. The key in this exercise is to time delay error which disables one of the pitch propellers.

Second step is to brief the bridge and engine room team separately for each scenario. In first scenario engine room team doesn't report the pitch problem and in second the problem is reported. In both scenarios bridge team is not familiar with the problem.

Third step is debriefing. Running the exercises replay to the both teams, bridge and engine room, the importance of cooperation and possible consequences of antagonisms are shown.

The exercise script is following:

- Preparing simulation
- Determining the point when the problem with one of pith propellers occurs
  - Time delay
- In 1st scenario
  - Engine room team doesn't report the problem
  - Bridge team continues with the exercise
  - The exercise is stopped
    - After the accident or
    - After the problem is noticed by bridge team
- In 2nd scenario
  - Engine room team reports the problem
  - Bridge team suspend following actions in scenario until problem is solved
  - Successfully completing the scenario after solving problem
- End of scenario

## 5 CONCLUSIONS

Analyses of the recent maritime accidents show that that, despite various preventive measures, problems in team, at bridge and engine room, still occur. Therefore it is important to address factors hampering teamwork during Bridge Resource Management courses.

In this paper examples of three accidents, which included authority gradient, harmony in the group and antagonism between specialities, were used to create simulator scenarios. Using simulator scenarios, with an exercise script based on real-life case, facilitates demonstration of these issues and situation that may result and lead to accident.

## REFERENCES


Anderson, P., 2003. Cracking the code: the relevance of the ISM code and its impact on shipping practices. Nautical Institute.

Baalisampang, T., Abbassi, R., Garaniya, V., Khan, F., Dadashzadeh, M., 2018. Review and analysis of fire and explosion accidents in maritime transportation. Ocean Eng. 158, 350–366. https://doi.org/10.1016/j.oceaneng.2018.04.022

Baldauf, M., Schröder-Hinrichs, J.-U., Kataria, A., Benedict, K., Tuschling, G., 2016. Multidimensional simulation in team training for safety and security in maritime transportation. Journal of Transportation Safety & Security 8, 197–213. https://doi.org/10.1080/19439962.2014.996932

Bang, D., Frith, C.D., 2017. Making better decisions in groups. R. Soc. Open Sci. 4, 170193. https://doi.org/10.1098/rsos.170193

Batalden, B.-M., Sydnes, A.K., 2014. Maritime safety and the ISM code: a study of investigated casualties and incidents. WMU J. Marit. Aff. 13, 3–25. https://doi.org/10.1007/s13437-013-0051-8

Bielić, T., 2009. INFLUENCE OF SHIPPING COMPANY ORGANIZATION ON SHIP'S TEAM WORK EFFECTIVENESS. Presented at the ICTS 2009.

Cassama, F., 2015. A study on marine accident causation models employed by marine casualty investigators / by Fatoumatta Cassama. World Maritime University Dissertations.

da Conceicao, V.P., Basso, J.C., Lopes, F.C., Dahlman, J., 2017. Development of a Behavioural Marker System for Rating Cadet's Non-Technical Skills. TransNav, the International Journal on Marine Navigation and Safety of Sea Transportation, 11, 255–262. https://doi.org/10.12716/1001.11.02.07

Felsenstein, C., Benedict, K., Baldauf, M., 2013. Maritime Safety and Security Challenges - 3D Simulation Based Training. TransNav, the International Journal on Marine Navigation and Safety of Sea Transportation 7, 327–336. https://doi.org/10.12716/1001.07.03.02

Havold, J.I., Nistad, S., Skiri, A., Odegard, A., 2015. The human factor and simulator training for offshore anchor handling operators. Saf. Sci. 75, 136–145. https://doi.org/10.1016/j.ssci.2015.02.001

Kataria, A., Holder, E., Praetorius, G., Baldauf, M., Schroder-Hinrichs, J.-U., 2015. Exploring Bridge-Engine Control Room Collaborative Team Communication. TransNav, the International Journal on Marine Navigation and Safety of Sea Transportation 9, 169–176. https://doi.org/10.12716/1001.09.02.02

Kyriakidis, M., Kant, V., Amir, S., Dang, V.N., 2018. Understanding human performance in sociotechnical

systems - Steps towards a generic framework. Saf. Sci. 107, 202–215. https://doi.org/10.1016/j.ssci.2017.07.008
Man, Y., Lundh, M., MacKinnon, S., 2018. Maritime Energy Efficiency in a Sociotechnical System: A Collaborative Learning Synergy via Mediating Technologies. TransNav 12, 239–250. https://doi.org/10.12716/1001.12.02.03
Marine Accident Investigation Branch 2014. *Report No 4/2014.* Marine Accident Investigation Branch, London
Marine Accident Investigation Branch 2016. *Report No 12/2016*. Marine Accident Investigation Branch, London.
Marlow, S.L., Lacerenza, C.N., Paoletti, J., Burke, C.S., Salas, E., 2018. Does team communication represent a one-size-fits-all approach?: A meta-analysis of team communication and performance. Organizational Behavior and Human Decision Processes 144, 145–170. https://doi.org/10.1016/j.obhdp.2017.08.001
Mindykowski, J., 2017. Towards safety improvement: implementation and assessment of new standards of competence for Electro-Technical Officers on ships. Maritime Policy & Management 44, 336–357. https://doi.org/10.1080/03088839.2016.1275861
Murata, A., Nakamura, T., Karwowski, W., 2015. Influence of Cognitive Biases in Distorting Decision Making and Leading to Critical Unfavorable Incidents. Safety 1, 44–58. https://doi.org/10.3390/safety1010044
Pantouvakis, A., Karakasnaki, M., 2018. The human talent and its role in ISM Code effectiveness and competitiveness in the shipping industry. Maritime Policy & Management 45, 649–664. https://doi.org/10.1080/03088839.2018.1454989
Roettger, S., Vetter, S., Kowalski, J.T., 2016. Effects of a classroom-based bridge resource management training on knowledge, attitudes, behaviour and performance of junior naval officers. WMU J. Marit. Aff. 15, 143–162. https://doi.org/10.1007/s13437-014-0073-x
Schroder-Hinrichs, J.-U., Hollnagel, E., Baldauf, M., 2012. From Titanic to Costa Concordia-a century of lessons not learned. WMU J. Marit. Aff. 11, 151–167. https://doi.org/10.1007/s13437-012-0032-3
Schröder-Hinrichs, J.-U., Hollnagel, E., Baldauf, M., Hofmann, S., Kataria, A., 2013. Maritime human factors and IMO policy. Maritime Policy & Management 40, 243–260. https://doi.org/10.1080/03088839.2013.782974
Schröder-Hinrichs, J.-U., Praetorius, G., Graziano, A., Kataria, A., Baldauf, M., 2016. Introducing the Concept of Resilience into Maritime Safety. Presented at the 6th Symposium on Resilience Engineering, Lisbon, Portugal, June 22-25, 2015, Resilience Engineering Association, pp. 176–182.
Schröder-Hinrichs, J.-U., Praetorius, G., Graziano, A., Kataria, A., Baldauf, M., 2015. Introducing the Concept of Resilience into Maritime Safety. Conference Papers.
STCW. 2011. International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, (STCW) 1978, as amended in 1995/2010. *International Maritime Organisation, London, UK.*
Valdez Banda, O.A., Goerlandt, F., 2018. A STAMP-based approach for designing maritime safety management systems. Safety Science 109, 109–129. https://doi.org/10.1016/j.ssci.2018.05.003
Velazquez, J., 2018. The Presence of Behavioral Traps in U.S. Airline Accidents: A Qualitative Analysis. Safety 4, 2. https://doi.org/10.3390/safety4010002
Xyrichis, A., Ream, E., 2008. Teamwork: A concept analysis. Journal of Advanced Nursing 61, 232–241. https://doi.org/10.1111/j.1365-2648.2007.04496.x