

An Empirical Survey on the Role of Human Error in Marine Incidents

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ABSTRACT: Error is a part of human. Despite that organizations are trying to reduce error to the zero level, this goal is unachievable. As far as human operation is taking place in a complicated environment, error will occur, and its possibility would be increased under the conditions of stress, extra loading work, and fatigue. One of the most important transportation modes is marine transportations. The sea is an unsafe place that kills many by a simple event. Every year there are thousands of marine accidents that result in injuries, casualties, marine pollutions and also massive financial loss. To reduce the accidents, there should be more attention to the factors such as suitable training of human resource, proper implementation of national and international laws and regulations, vessels and the equipment on board them, port facilities, and also the utilities for marine search and rescue.

In this research 1816 marine accidents have been studied in five Iranian shipping companies. 17 factors are known to be effective in occurrence of human error in these accidents. Four factors of the most influence are negligence, poor training, inadequate tools, and lack of skill and experience.

1 INTRODUCTION

A large number of maritime accidents and incidents involve some form of human error (Harati et al., 2006). As reported by Port and Maritime Organization (PMO) of Iran, marine accidents were identified to be the cause of death of more than 5000 people in this decade. Studies show that for each serious accident in the maritime domain, or in any other domain, there are a larger number of incidents, a larger number of near misses, and many more safety-critical events and unsafe acts (Kristiansen, 2005). Pomeroy and Tomlinson (2000) stated that many of the failures are actually the result of errors (i.e. latent failures) that have been designed and constructed into highly complex systems especially system integration and interfacing.

The full text of 44 marine incidents was analyzed by Phillips (2000), including collisions and groundings reports. Indeed his study focused on evaluating the effects of sleep in marine incidents. Tzannatos and Kokotos (2009) examined human reliability with reference to all accidents involving Greek-flagged ships during 1993-2006, a time-scale spanned over the pre- and post-ISM period. Celik et al. (2010) developed a risk-based modeling approach to enhance the execution process of shipping accident investigation (SAI). Their paper addressed a fuzzy extended fault tree analysis which combined the effects of organizational faults and shipboard technical system failures under a risk assessment analysis. Mullai and Paulsson (2011) designed a conceptual model for analysis of marine accidents.

As in the aviation and other transportation modes, human error is at the root of most preventable casualties in the maritime field and around 70 to 90 percent of transportation crashes are, directly or indirectly, the result of human error (Dhillon, 2007). Human errors depend upon the internal factors related to the operators' characteristics and differences such as skill, experience, task familiarity, etc. and the external factors to the operators such as equipment design and installation, task complexity, work environment, organizational factors and operating procedures. A proper balance between the capability of the human operator and the difficulty of the task would decrease the likelihood of human error (Whittingham, 2004). Figure 1 represents the most common human errors occur in transportation.



Figure 1. Human error categorization in transportation (Dillihon, 2007)

Celik and Cebi (2009) proposed an analytical human factors analysis in order to identify the role of human errors in shipping accidents based on the fuzzy analytical hierarchy process. Sanders and McCormick (1993) defined human error as an inappropriate or undesirable human decision or behavior that reduces or has potential for reducing system effectiveness, safety or performance.

When we use the term safety, it will encompass:

- Safety and health of persons,
- Safety of vessel, and
- Environmental aspects

Hetherington et al. (2006) reviewed the literature on safety in three key areas; common themes of accidents, the influence of human error, and interventions to make shipping safer.

The control of safety in shipping is complex for a number of reasons (Kristiansen, 2005):

- International, regional and national laws and regulations
- Control is exercised by a number of agencies
- Control affects the various life-cycles of the vessel

Lack of enough information on the role of human in marine disaster coupled with the importance of maritime safety motivate this study. The aims of this research can be summarised as seeking to answer the following questions in context of the Iranian shipping lines:

Q1. What are the main root causes of human error in Iranian shipping lines?

Q2. How these errors can be reduced in Iranian shipping lines?

Firstly, this paper starts with research method. After that, the main root causes of marine incidents in Iranian shipping lines are studied. The paper follows with a questioner based analysis on the ways of reducing human error in marine incidents.

2 METHOD

Questionnaires are one of the most frequently used methods for gathering data from individuals in research studies (Bourque & Fielder, 1995). In other words, the questionnaire is a technique of data collection in which each person is asked to respond to the same set of questions in a predetermined order (Saunders et al., 2003). When the survey is confined to one organization, and the organization is willing and able to assemble groups of employees to respond to the questionnaires at the work place, personally administering questionnaires in groups is a good way to collect data (Sekaran, 2000). Therefore, group administration was found to be very appropriate for this research study.

In this study, different items associated with human error in maritime transport were self-assessed by respondents using a 5-point Likert scale from 'Strongly Disagree' to 'Strongly Agree'. All results, analyses and tables using these variables were constructed from answers to questions in the survey instrument.

Items in the survey instrument related to question and hypothesis were statistically examined in three ways. Firstly, Cronbach's alpha and principal component factor analysis were discussed to test the reliability and validity of collected data. Secondly, descriptive statistics were used to get a feel for the data. Thirdly, appropriate statistical techniques were conducted to test the hypotheses.

With respect to statistical analysis, first each item/variable was individually tested using statistical techniques suitable for single samples, such as one-sample Chi-square and Kolmogorov-Smirnov one-sample tests, to ensure the existence or lack of significant differences between the frequencies of response categories of each item. Second, each variable was assessed by organization location, managerial position titles, and managerial education levels variables using a series of nonparametric statistical tests, such as Chi-square test of relatedness/independence, Kruskal-Wallis several independent samples test, and Mann-Whitney and Kolmogorov-Smirnov two-independent-samples tests. These tests were carried out to reveal whether the significant differences, which were found in frequencies of responses to each item (first sets of statistical tests), were related to any particular branch, position title, or education level (hypothesis of independence tests). Third, finally the first variable (human error) was used as a pivot variable and checked with the other variables for possible correlation using Spearman's rho bivariate correlation (Spearman's rank order correlation—a nonparametric alternative to Pearson's r) (Healey, 1999).

3 HUMAN ERROR IN MARINE INCIDENTS

Human is the main root of marine incidents which is studied in two categories, including human error and human element. Personal, group, and organizational factors are the main categories of human element, while human error consists of operational, legal, and knowledge-based errors.

3.1 The Role of Human in Marine Incidents

Human error is an inseparable part of marine incident all around the world. Indeed, majority of marine incidents are directly related to human error. Like its global scale, human error is one of the main causes of marine incident in Iranian territories.

Collecting the necessary data for analysis, face to face interview coupled with the published reports (2008 to date) of Search and Rescue (SAR) committee of Port and Maritime Organization of Iran (PMO) are used as data collection method. Figures 2 to 6 represent the main causes of marine incident in the main Iranian shipping line.

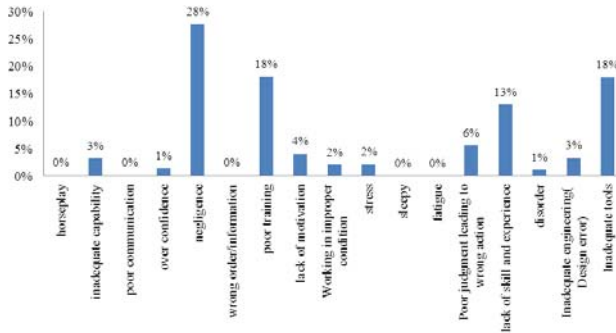


Figure 2. Causes of defects in NITC

As shown in figure 2, crew negligence is the main root of incident in National Iranian Tanker Company (NITC). Poor training and inadequate tools are at the second level of importance.

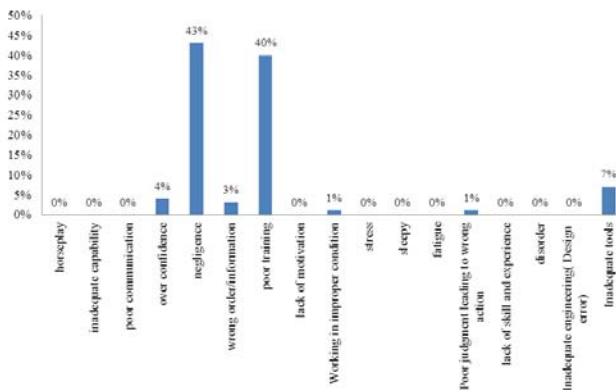


Figure 3. Causes of defects in IRISL

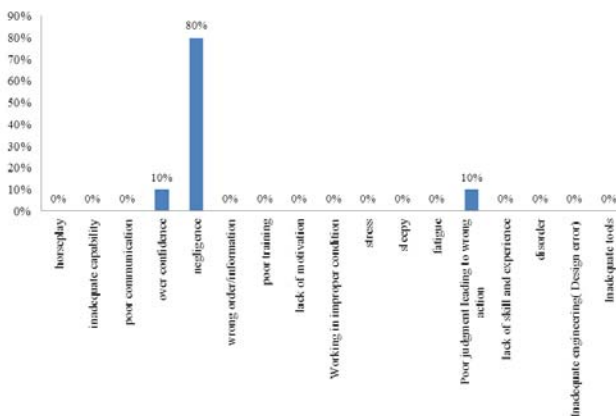


Figure 4. Causes of defects in Iran-o-Hend

As same as the NITC, crew negligence and poor training are the main causes of accident in Islamic Republic of Iran Shipping Line (IRISL).

As illustrated in figure 4, crew negligence is the main cause of defects in Iran-o-Hend shipping line. The second main root causes are belong to over confidence and poor judgment leading to wrong action.

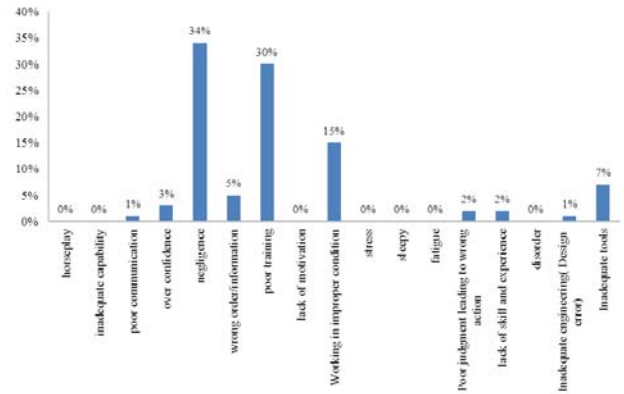


Figure 5. Causes of defects in Valfajr

For Valfajr shipping line, crew negligence, poor training, and working improper condition are the main causes of marine incident, respectively, as shown in figure 5.

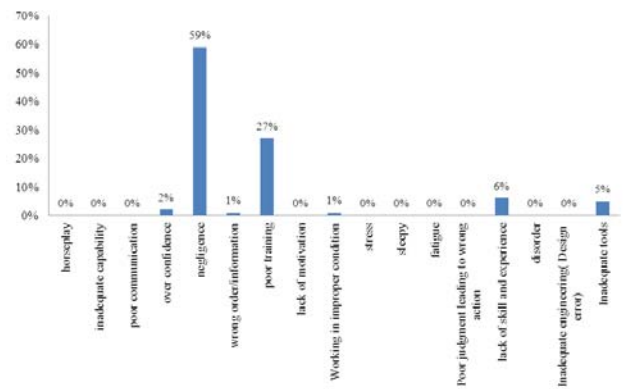


Figure 6. Causes of defects in BOSCO

As illustrated from figure 6, crew negligence and poor training are the main causes of incident in Bonyad Shipping Line (BOSCO), respectively.

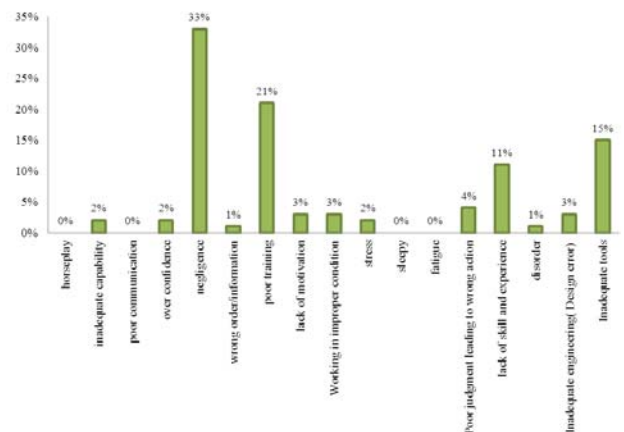


Figure 7 Nature of deficiencies reported by Iranian shipping lines

In terms of shipping, as shown in figure 7, the main deficiency reported is the problem of negligence. Poor training, fatigue, inadequate tools, and lack of skill and experience are other factors in the category of human errors.

3.2 Methods of Human Error Reduction

As mentioned in section 2, more than 1800 Iranian deck- and engine officers (figure 8) are asked to answer the questioner, which was prepared to find the ways for reducing human error.

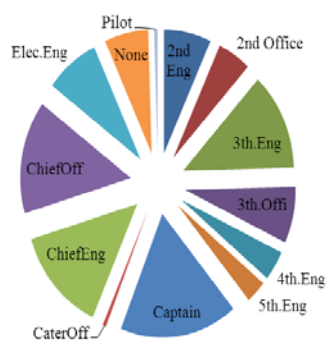


Figure 8. Respondents ranking

Based on the obtained results, followings are selected as the solutions for negligence:

- Increasing the automation level,
- More control and survey,
- More usage of alert signs,
- More accurate working standards, and
- More accurate Programming Maintenance Services (PMS)

Achieving the problem of poor training, followings are proposed by respondents:

- Improving the STCW-based trainings for seafarers,
- Implementing ISM Code on non-conventional vessels,
- Increasing the safety culture by the use of on-board trainings, and
- Improving the knowledge of officers on marine perils

Regarding the seafarers ideas, followings are the ways to overcome inadequate tools:

- More installation of alert tools, and
- On-board hierarchical risk assessment system

Increasing the skill and experience of seafarers, following are proposed:

- Increasing the simulator-based training

4 RESULTS AND CONCLUSIONS

This research studied the role of human error in marine incidents in the main Iranian shipping companies by the use of self-data collection, coupled with questioner among more than 1800 Iranian seafarers. Based on the obtained results, poor training, fatigue, inadequate tools, and lack of skill and

experience are the main root causes of human error in marine incidents.

Unfortunately, there is no accurate data base for reports of many incidents. Indeed, there is no accurate and update data on marine accidents of unclassified, nonconventional, and fishery vessels. Based on the reports of SAR committee of PMO, these vessels are usually engaged with problems such as machinery failure, fire, flooding, hull rupture which can be the result of poor control and inadequate regulations on them. In addition, according to lots of medical helps, crew injuries, and man over board disasters reported annually all around the world on these vessels, their crew should act under adequate regulations categorized in the mentioned operator error level.

Improving the level of safety in maritime trade and decreasing maritime disasters, followings should be considered:

- Since there are usually many reports on marine disasters on nonconventional vessels, Port State Controls and Classification Societies should control them more careful than ocean-going vessels.
- There should be annual training programs for seafarers under safety conventions, in particular the new amendments of the STCW, SOLAS, and CORLEG.
- Oil and fuel leakage in engine rooms is the main root of fire, especially in small vessels. Thus firefighting appliances should control regularly by both of the port state control and classification societies.

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