Original Article

Print ISSN: 2321-6379
Online ISSN: 2321-595X
DOI: 10.17354/ijssSept/2017/48

Marine accidents investigation methods based on the role of human factors in accidents

Majid Mousavi[1,*], Mehdi Jafari[2]

[1]PhD. of Crisis Management, Khark Island Maritime Science University, Khark. Iran, [2]M.SC. of Economic system, Amirkabir University of Technology, Mahshahr Campus, Iran

Abstract

Objective: The maritime shipping industry is considered as one of the huge and high-risk industries, which, according to strict rules and regulations to improve the level of safety, we unfortunately continue to witness various events around the world.

Methodology: Meanwhile, human factors have the largest share in marine events. Despite the advances in technology, more than 80% of marine accidents have been caused by human error, according to studies.

Results: In this article, we study different techniques of marine accidents and the role of human errors in accidents. The purpose of this article is to introduce methods for investigating marine accidents based on human factors. Theoretical and methodological principles of this research, psychology and the common narration of human factors and techniques are present. By examining two cases of marine accidents, we concluded that using inferential accident analysis techniques can help in identifying human error and navigational problems.

Conclusion: The performance of the text analysis before the incident and the role of human error as a descriptive analysis of the report is very effective in reducing the similar incidents.

Keywords: human factors, human error, marine accidents, accident investigation techniques

INTRODUCTION

Over the past 40 years, the shipping industry has focused on improving ship structures and reliability of ship systems to reduce losses and increase productivity. We can observe improvements in designing the body, stability system, drift system, and the navigation equipment. Ship systems today are advanced and highly reliable technologies.

However, the amount of marine damage is still high. Why? And why with all this progress, the accidents do not significantly decrease? Because the structure of the ship and system reliability are a relatively small part of the safety equation. The marine system is a human-based system, and human errors play an important role in accidents and casualties. This paper focuses on definitions, classifications, techniques and the central methodological issues in studies and relying on the role of human factors in marine accidents. According to the definition, the direct study of human error is impossible, but it can be studied indirectly by studying and evaluating behavior on the basis of specific performance standards in this field. This assessment requires a high level of information in the field of navigation. The study of behavior in the field of marine activities, both at sea and in the simulation laboratory, is a difficult, costly, and time-consuming task. There are two advantages in using marine incident reports as empirical data. First, there is the possibility of exploiting the cause and effect relationship between human error and the accident, a relationship that is generally considered to be very strong. The second advantage is that, in comparison to field and laboratory studies, quick and easy access to experimental data (which is previously prepared, collected, interpreted and analyzed) is provided. The disadvantage of this method is that we have to choose the attitude, relationship and conclusions of the author of the inspection report. [1].

Access this article online

IJSS
www.ijss-sn.com

Month of Submission	: 00-0000
Month of Peer Review	: 00-0000
Month of Acceptance	: 00-0000
Month of Publishing	: 00-0000

Corresponding Author: Majid Mousavi, PhD. of Crisis Management, Khark Island Maritime Science University, Khark. Iran

DEFINITION OF HUMAN ERROR

According to Hollnagel (1998), it is impossible to directly observe human error. Observing human error is only observable indirectly and by observing human behavior. Therefore, the definition of human error consists of three parts [2]:

- Assessing human behavior according to the criteria and performance standards.
- An event that results in a measurable decrease in performance so that the level expected by the agent is not met.
- The amount of will and desire of the individual in a way that the operator has the opportunity to act in a way that does not seem false.

Accordingly, the behavior must occur due to an accident and be the response to that accident or situation. Otherwise, the interpretation of a behavior as an error would be nonsense [2].

INVESTIGATING THE METHODOLOGY

In this research, we will explore a variety of methods and techniques for investigating accidents, relying on the role of human factors. In this way, regardless of the type of information we seek to collect, we need two very important things:

- Practical data
- A way to deal with data

Reporting the accidents is the first data of this work, and we will present a three-step approach to investigate this accident report. This method, as we will explain below, is a quick and easy way, but the disadvantage is that the inferential quality of the extracted information, regarding the hypothesis, is not as good as the other methods, such as laboratory experiments or field studies.

It is clear from the analysis of incidents that human error is the cause of a large number of accidents in the field of navigational activities. There are many indications that major accidents rarely occur by a single direct action (or failure in one action). Many factors can contribute to an accident that may not be geographically or manageably close to the accident. Environmental factors can also be added to work-related pressures. The problem, of course, is that not all errors necessarily lead to an accident, and all accidents are not necessarily caused by human error.

CLASSIFICATION OF HUMAN ERRORS

Classification is an important tool in researching human errors. Scientists of the psychology and humanities have proposed several general classifications. These classifications have been used in the reporting system for accidents and incidents, accident analysis, and official studies of safety in the field of maritime work. These general classifications and theories are used in marine event reporting and inspection and safety studies at sea. Here, some examples are mentioned:

The International Maritime Organization (IMO) has recommended the use of a standardized predesign for analyzing marine accidents. In this section, a branch called "Violations and Type of Error" has been introduced. The International Maritime Organization has classified the sub-categories of "violations and type of error" as follows [3]:

- Violations and type of error
- Violation (arbitrary decision to commit a violation contrary to a law or map)
- Slip (abnormal behavior that affects the problem of negligence)
- Temporary deviation (an unintended behavior that affects the memory problem)
- Mistake (intentional act in which there is no intention to commit a violation contrary to law or process)

Operational errors in marine accidents are defined as follows [4]:

- Navigation errors
- Lack of effective presence at work shifts
- Lack of order and non-observance of hierarchy in command
- Inappropriate use of equipment
- Ship maneuver errors
- Violation of the rules of accident prevention at sea
- Falling asleep
- Alcohol and drugs
- Overloading of ships
- Lack of tightening the load on the ship
- Lack of training
- Lots of workload
- Other operational errors

As can be easily observed, there is, in fact, no systematic order in these classifications, so that these categories are not really different levels of each other, and in addition, the cause and effect of the accident are mixed up. "Lack of effective presence at work shifts" due to "falling asleep", as well as "inappropriate use of equipment" can occur as a result of "lack of training". In fact, almost all modes (except for "alcohol and drugs") can occur as a result of "falling asleep" [4].

METHODS OF INVESTIGATION AND ANALYSIS OF ACCIDENTS

Step-by-step approach

A step-by-step approach is a way to describe events before an accident or incident. This method is graphical and involves preparation of a diagram [5]. The first step is to plot the horizontal line representing the time and continues from t start to t end. The level of the diagram below this line is divided into several lines. Each line represents an actor or an object in which has been involved in that event which can be a particular person or any object such as radar, lever, push switch, screen, crane hook, container, etc. The second step is the definition of the event's final status at the point of trend. For example, it's time to recognize the ship's strand. The status, performance, and current position of any object and player in the list must be specified in tend. The mechanism of this method is to go back from the point tend to the tstart point. And ask about the status, performance and position of each actor. See Fig. 1, which illustrates a simplified example [5].

Determining where to start the tstart point can be difficult. In fact, accidents can occur as a result of events that occur hours, days, and sometimes months ago. In the step diagram, we can plot arrows as the mean value for analyses between the fields, which are related regarding cause and effect. If an event is the reason for the occurrence of another event, the arrow should be directed to the effect. We can use the step method to provide an overview of the circumstances in which an incident or event has occurred. This can help to understand exactly what has happened, it can also help us understand and coordinate evidences from multiple sources or witnesses [6].

CAUSE AND EFFECT MODEL OF DNV DAMAGE

(Dot Norsk Virits: Norwegian Classification Institute 2001) This model is made up of five levels that represent the cause and effect flow from the identified causes to the consequences. This model is used in the opposite direction of the cause and effect flow. As a guide the inspector will ask questions to help him and identify all aspects of the accident. These five steps are [6]:

1. Lack of control (systems, standards, and compliance)
2. Real causes (weaknesses associated with the staff or work environment)
3. Direct causes (actions and conditions below the standard level)
4. Unwanted event (physical, chemical or excessive psychological pressure)
5. Loss of resources (damage to people, property, environment or production)

Considering lesion as the starting point, we can move along the path of this model and identify the causes of this lesion. The model's name is taken from this principle: "Cause and effect model of lesion". This model can be easily combined with the step diagram model provided that the timing of the cause and effect presented in the step diagram is not necessarily aligned with the cause and effect order defined by the cause and effect method of the lesion. If we want to describe it in a simple way, we can say that the step method gives us answers to the question "What happened? When did it happen?" Whereas the cause and effect model of the lesion gives us the answer to the question: "Why did that accident happen?" [7].

BARRIER ANALYSIS METHOD

Each system has been designed to protect people and equipment; shields, fences or fortifications. In fact, they are deployed in such a way to provide barriers to the occurrence of accidents, unintentional events, or any system failure. The absence of barriers or discrepancies in them causes abnormalities in the system and causes the occurrence of an accident. Obstacles are generally divided into three categories: physical barriers, management barriers, and organizational barriers. [2, 8].

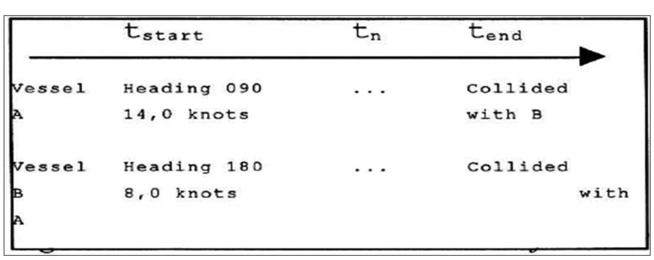

Figure 1. Step Method

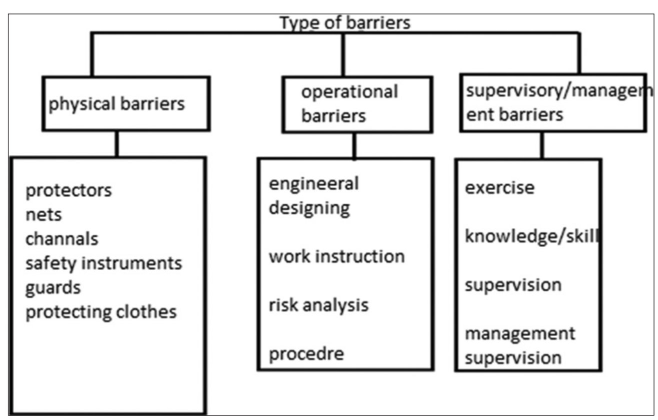

Figure 2. Three common classes of barriers

THE BASICS OF BARRIERS ANALYSIS PROCESS

Defining final damage of incident- an incident that leads to losses and failures (such as injury and damage to tools)

Identifying barriers- both the barriers that were in the incident and the barriers that must have existed in the incident; be careful that more than one related barrier with the incident can be unwanted.

Assessing barrier purpose- explaining the barrier purpose and its responsibilities in eliminating risky conditions.

Assessing barrier performance- explaining how and why of barrier stop and its results.

Assessing the analysis- making sure of lack of inconsistency between the results and the results of other analyses and that they complement each other.

When the effectiveness of the barriers and controllers were assessed, the researchers must find the responsibilities, conditions, and characteristics of each barrier. The required sources to analyze the barriers are as following (8):

1) Preliminary map of equipment
2) The system and facilities
3) The results of risk analysis
4) The maintenance stages
5) Operational methods
6) Site map

The least amount of data needed for barrier and control analysis are as following:

1) The existing documents and facts in reconstructed images of the incident
2) Identifying all the related dangers
3) Identifying all the related barriers and controls
4) The facts about all the controls and barriers

The main responsibility of a barrier and condition must be considered after determining how energy sources and objectives can get together and what is essential to keep them apart. The obvious barriers are the ones that are directly put on danger (like shielding of the cutting stone) or the ones that between the danger and objective (such as fence in the second floor) or the ones that are put on the goal (like welding mask). Such sources define the extent that are exposed to risk to reduce the risks that are implicit to the person (8). Therefore, researchers have to cross-check the results of the barrier analysis with other analytical kernel techniques to make sure of determining the unused, failed and uninstalled barriers. Then complete and exact factors in the incident can be identified (figure3).

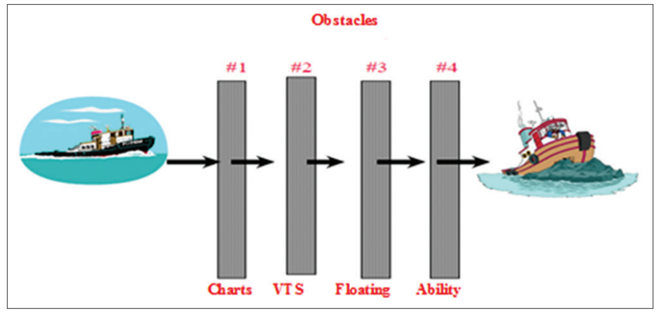

Figure 3. Barrier analysis

Barrier analysis can assist identifying other failures, whereas such failures do not always contribute to the accident. However the analysis results directly has a role in accelerating the main reason. In most incidents, a set of barriers must fail, for the incident to happen (8).

SHELL ANALYSIS METHOD

SHELL analysis method categorizes the initial components related to human errors into software, hardware, environment and liveware. Therefore human errors can be divided into following groups:

S- software: software is the non-material part of the system that includes cases such as organizational policies, procedures, guidance, counselling, computer programs and etc,.

H- hardware: hardware refers to facilities and installations, which includes screen, control, switch operation and etc,.

E- environment: environment includes local and foreign climate, temperature and other factors. And sometimes it includes broad political and economic limitations on system performance.

L- Liveware (User) (middle component): the most valuable and flexible component of the system is the human factor which is placed at the center of this model. The intended person interacts directly with each of the four other factors.

L- liveware (external or side): external Liveware refers to interpersonal interactions of the system.

The SHELL model is shown in figure (4), you can see not only the five components, but also the relationship between the user (the middle component) and the other components. The figure indicates that matching and lack of matching between the components and characteristics are very important. One inconsistency can be human error source and the identifier of an inconsistency can identify lack of security (8).

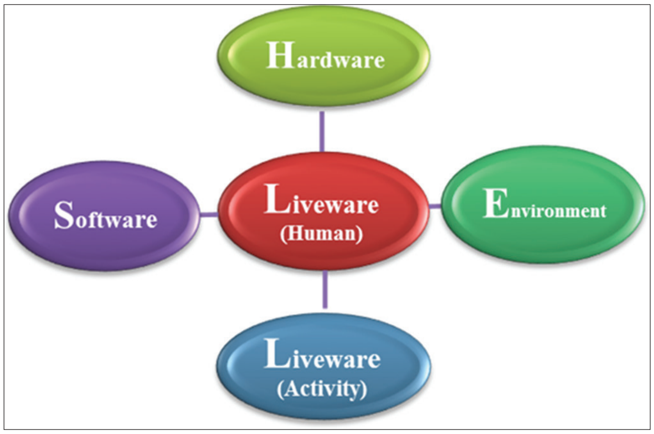

Figure 4. SHELL analysis method

USER- HARDWARE FACTORS

This area includes any physical or mental interactions between human and machine, designing characteristics and limitations in configuring the workstation. The hardware-user factors can be investigated by examining device layout in management section , workstation and utilized equipment by the coast and ship staff, tank breakdown, tanks with similar configurations, maps and images, maintenance and service facilities, equipment and facilities for maritime services, electronic components, and simulation training systems (8).

USER-LIVEWARE FACTORS

The communication between people in work environment include all the people in function such as ship crew, engineering crew, repair crew, food providing crew, coastal personnel and etc,.

Factors such as stuttering, ambiguity, word association, expression, spelling, parasitic interference, rate and speed of word delivery, tiredness, operation pressure, quality of communication facilities, hearing impairs of the personnel, age are called user to user factors (8).

SOFTWARE-USER FACTORS

This area determines the nature of data transfer between backup systems and humans in work environment in performing data rules, instructions, lists, publications, standard methods and designing computer software. By a weak design, the documents can lead to increase in reply time, increase in risk, and confusion and maybe subject to distraction or any other factor (8).

ENVIRONMENT-USER FACTORS

The internal environment is called field of work. Physical factors can influence the common point of hardware- user of a system by putting operator security and health at risk. Physical environment has impact on human component or its role in destroying operator functioning and can finally lead to a risky situation.

The external environment include the physical environment outside of work field. This area includes economic and political limitations which operate under the influence of maritime system and can lead to decision makings (8).

EVENT & CAUSAL FACTOR CHARTING

Charting, analysis of events and identify the various factors responsible for the incident beneficial and graphically show sufficient requirements of the event. Manually events, drawing factors of the accident, analysis of events and factors are considered as a technic for this purpose. These factors are shown separately because they are created in different stages of the research process. Charting and analysis of events and factors responsible for an accident is the graphical representation of the incident image and primarily are used for editing and compiling documents to draw the scene. This process is continuous and runs during the investigation. Analysis of events and factors responsible for an accident means the use of analysis to identify the factors responsible for the incident; This takes place due to the identification of important events and conditions which led to the accident [8].

Charting the events and factors responsible for the accident is probably the most widely used analytical technique as drawing the graph is simple and reveals clear picture of the information. By exact tracking of the events and circumstances that led to the accident, group members can identify important events and special conditions with specific details and recurrence will be prevented in case of corrective measures.

ECF CHARTING

Charting events and factors responsible for the incident should be started immediately. Although the basic chart is just the skeleton of the final product, a lot of facts and circumstances will be discovered in a short time. Hence, the diagram should be daily updated during survey information collection phase. Continuous updating helps the graph to be ensured, the process to be passed smoothly, information gaps to be identified and researchers to have a clear picture of the incident in order to gather evidence and witnesses [8].

Researchers and analysts can use the manual or computer calculations to draw the event graph and the causative factors of the accident. Incident investigation team often use both techniques during the review. They manually draw the initial part of the charts and then transfer the data to a computer program. Manual method includes the paper stickers for notes to show the image of the accident and affected circumstance. Paper or different colored inks can be used to identify events, handy draw a basic diagram of events and conditions and the accident-causing factors [8]. If the volume of data to be manually calculate is very high, the data can be entered into the computer analysis. Using the software for the analysis, researchers can, like other analytical tree and event models, can draw graph of an accident and causative agents.

This method both presents the information visually and specifies events occurred as well as non-standard conditions related to any of the events. This diagram helps the viewer recognize at a simple glance that what events and non-standard happenings have been occurred and in what circumstances. Accordingly, it is necessary to consider the structure of the graph to understand how to use it (Figure 5).

ROOT CAUSE ANALYSIS (RCA)

RCA is a process to identify the causes of failure in a system. This method takes advantage of its special structure and is designed to identify and solve the problem in the scene or hidden. This analysis method is the step by step and led to identify the root cause of failure or accident at the end. This method uses the other techniques which have caused workgroups or researchers analyze collected data from all dimensions. After identifying multiple causal factors through the use of techniques listed and allocating them in layers of responsibility, this method can be used to identify the fundamental factors in the research. As mentioned, root factors are the root cause of many non-standard conditions of a failure or event. By identifying root causes and taking corrective measures in this regard, the system will be able to prevent deficiencies, abnormalities, accidents and prevent another similar crisis. Through previous steps of the transfer of the substrate upward, the same factors will be identified and the root of some of the factors will also be identified in the substrate. The causative agent identified in step later in case of having similar roots in the pre-operating stage, will not be repeated in its column layer such that its mark is not allocated to identify factors of previous column. This compliance prevents the insertion and duplicate of unnecessary information (Figure6). [8].

The aim of this approach is the identification and classification of the root causes. Points should be observed in the root selection to prioritize corrective actions based on them. Following tips are as follows:

A) the factors allocating maximum tags and marks are in priority of the root cause selection.

B) the factors in the upper layers are more important with more priority for selection as the root cause.

C) some factors may not have root in the top management factors. The transfer of their label will be stopped in the lower layers. In the next priority, these factors are considered as root causes at that point.

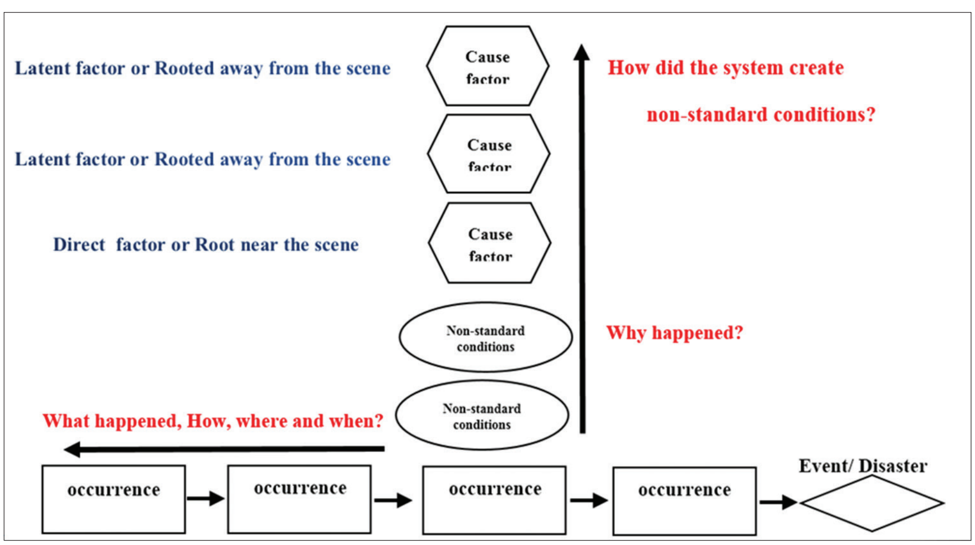

Figure 5. ECF direct accident and direct causative agents derived from (MAIIF, 2011)

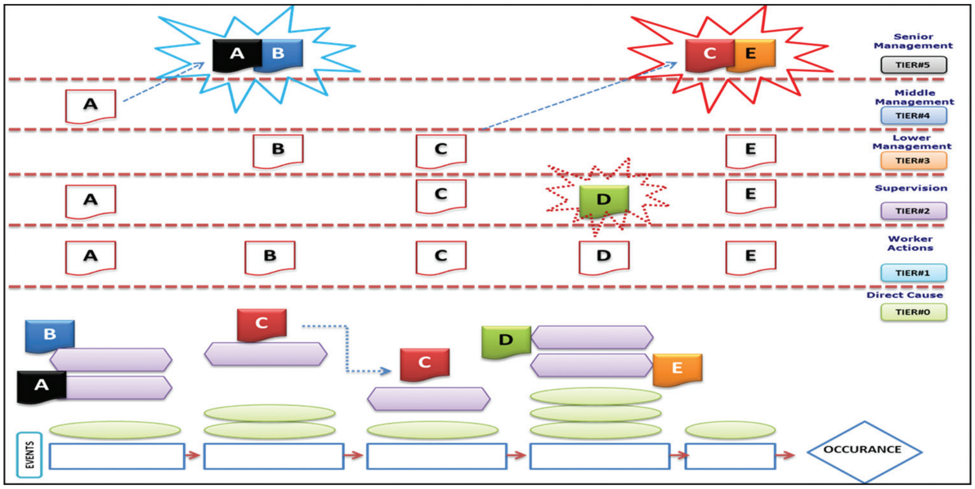

Figure 6. Allocation of factors toward the upper management layers and grouping together similar root causes (MAIIF, 2011)

THREE-STAGE PROCEDURE

I've mentioned examples of human error classification which can be used to describe, classify and in human error analysis in the field of maritime affairs and also have mentioned examples of tools and methods to analyze the events. In addition, I proposed, I proposed a method for analyzing incident reports using Basic text analysis concepts [9].

It is suggested to use the methods, tools and techniques mentioned here inversely to be informed about human error in terms of navigation.

TEXT ANALYSIS

1) Analyzes and identify the report test at first.
2) Descriptive
3) Description of events, not necessarily continuous texts
4) Discursive: human error analysis

ANALYSIS OF THE INCIDENT

Second, the analysis of a description of the facts, for example, for the step method or the cause and effect model of the lesion and the recognition of the behavior, which can be compared according to the definition with the performance standards. In these analyzes, I use the cause and effect model of the lesion, it is necessary to enter descriptive information, for example, describing the personality involved in the incident. Avoid argumentative arguments. These parts of the text represent understanding and analysis from the author's perspective. These analyzes and perceptions may, if combined with our own analyzes, result in a negative effect on the work. The risk is that the user's end result is based on the conclusions made by the user. In addition, the use of the step method and the method of the cause of the lesion and its application to any type of text, apart from descriptive and describing the work of meaningless work [9].

HUMAN ERROR ANALYSIS

Finally, we can describe and analyze the errors identified by Step 1 and Step 2 using the classification of human errors. These analyses can focus on the cause-and-effect relationship between well-known human factors such as lack of attention and human error. Or it can focus on investigating the causal relationships between human error and accidents. Analyzes can be done quantitatively and quantitatively [9].

This method is considered as a tool for analyzing existing reports. It can also be used as a policy to prepare new reports. If we look at this as a strategy, we must remember that the classification methods mentioned here have already been applied in some reports. And it is important that some projects and articles can use solutions to use the official accident analysis tool, such as the step-by-step approach. Indeed, it is open to discuss how incident reports can be improved by using formal analysis methods and new display techniques [9].

CASE STUDY

Cradling of Royal Majesty ship

In June 1995, the Royal Majesty cruise ship cradled on a journey from Bermuda to Boston with 1509 passengers near the Nantucket Island. The ship was equipped with new systems, including an auto-guidance system that could navigate the ship during a pre-programmed route by using the GPS system as the initial location information. The GPS was designed to take the Phase Assumption Mode (DR) in the event of inaccurate satellite information. In this way, the autopilot or auto-guidance system could not detect any change in GPS status, so GPS in DR mode could only continue to route and navigate without modifying the effects of wind or currents. The auto-guidance system was set up on the Bermuda route, but after about an hour, GPS went into DR mode (probably due to the disconnection of the receiver cables), and in the next 34 hours, the ship was driven by an automatic DR system. During this time, this situation was not detected by any person, and so when the ship suddenly landed at a distance of 17 miles from the coast [10].

The National Transportation Safety Agency issued a report on the probable cause of the ship's cradle:

Due to the trust of the maintenance officer on the automatic characteristics of the ship's navigation system, the Majesty shipping lines could not be sure that his officer had an automatic feature of the navigation and navigation system of the ship, the reason for applying this system to the ship's management, the defect in designing and launching the complete system of conducting the ship and its implementation methods are well trained. The second officer was associated with carelessness and fault in detecting several signs of the boarding of the ship [10].

ANALYSIS AND REVIEW

This case illustrates one of the issues of overwhelming trust in the technology available to the ship's employees. All the officers had a false sense of security because of the benefit of this modern system that seemed to care for the ship but was in fact traumatic. Their understanding of the system and its weaknesses were incomplete and their trust in technology led to the use of only a limited number of limited information resources to detect the position of the ship. Another is to ignore and not use tracking tools. Caring for non-diversion of the main route is one of the tasks assigned to all ship employees.

There were many opportunities for deportation and a second officer in their investigations that could prevent the use of guides and the use of radars to keep them on board. However, due to their excessive reliance on GPS, as a result, people mistakenly missed the use of just one source of information and neglected the actual situation.

COLLISION OF THE TWO SHIPS OF DIAMENT AND NORTHERN MERCHANT

On the morning of January 6, 2002, two ships were crossing the Dover strait, while the vision radius was decreased to 200 meters. Diament had started its journey from Oostende to Dover. Northern Merchant was moving from Dover to Dunkerque. Both ships were moving at a normal speed. Diament which was a fast-moving ship, was moving at a speed of 29 marine knots, and the Northern Merchant which was a car carrying ship, was moving at the speed of 21 marine knots. If both ships were continuing their route and speed, they would have collided in less than half a mile. However, at just a mile away, the shipping team noticed the position and began to change the route, but did not change the speed because they thought they were going to get away more. They eventually collided [11].

The International Organization for the Study of Marine Casualties lists 18 reasons and factors affecting the accidents, including the uncertainty of speed of both ships, the inability of the ship guidance team to assess the risk, neglect to follow the accident and rely on the "Unwritten Law" that by increasing the speed you can get away from the other ship [11].

ANALYSIS OF THE ACCIDENT

This accident is similar to previous crashes due to reduced visibility, in which both sides are confused with tuning error and practical tasks. Both sides had hypotheses about the others intention and function, and considering their high speed, they had little time to correct the critical situation when they realized what was happening in reality.

This incident raises questions about the proper solution to such problems, in particular the ability to train operator to create a solution to such problems is questioned. All the people involved in this incident were experienced professionals and professional officers who knew well how to manage such an accident, but there were one or two errors that could possibly be a routine issue. The root cause of this error may not be easily addressed by sending individuals guilty of a retraining course related to radar interpretation or accident management.

Organizational culture plays an important role in strengthening the desirable behaviors on the ship. If the Coastal Management Team implicitly renders implicit service and enforcement policies and procedures that fail on board, and at the same time implicitly encourages deviant behavior, individuals and crew will learn that a similar cultural perspective is consistent with it.

After analyzing the case studies and taking into account the analyses carried out on the two cases, the following results are obtained:

1) In this figure, the boundary between negligent errors and landslides that occur in very automated tasks, and mistakes and violations associated with intellectual activity are well defined.
2) Law-based mistakes can also be caused by a bad law or a good law (due to improper actions) (change analysis).
3) Mistakes that originate from knowledge occur when we are in a new position for which we do not have specific rules and regulations, and we have to think to find the procedure. The lack of awareness and knowledge of a situation is an example of knowledge-based mistakes (loose analysis).
   Mistakes themselves do not always lead to catastrophes. It is the consequence of a
4) Mistake that determines a disaster to happen or not (the chart of the events and factors behind the ECF incident).
5) At a completely paradoxical situation, people can break all the rules and at the same time become heroes.
6) There are ways in which intentional violations can occur. One of the specific cases is the normal or routine deviations from ordinary actions. Individuals have learned to create shortcuts for different situations, where their violation becomes a usual and normal act.
7) The nature of the violations can be explained and the practical or organizational culture is usually the root of the violations (rooting method (RCA).

SCIENTIFIC APPROACHES

Scientific approaches to reduce human error have led to various paradigms. Each paradigm accommodates several models within itself, and to some extent it is effective in describing and reducing human error, but as it has not been able to prevent human error at a desired level, the next paradigm has arisen [11].These paradigms are:

1) Engineering Approach
2) Individual approach
3) Organizational Approach

ENGINEERING APPROACH

The basis of this approach is the idea that human is an unreliable component in a system. This approach suggests that it is better for humans to be removed from the workplace to reduce human error, and use automated systems instead. Also, to enhance the staff's trustworthiness, it is necessary to design appropriate work environment and interactions. Such suggestions can be beneficial, but one must note that the rapid decision-making power of human in unpredictable situations, as well as some technical problems in automated systems, makes the applicability domain of these systems suspected [12].

INDIVIDUALAPPROACH

The construction of this approach is assumed such that human error results from the mismatch between individual abilities and the needs of the problem. As a result, selecting people with proper abilities and proper design of the job are defined as a method of preventing errors [12].

ORGANIZATIONAL APPROACH

This approach tends to point out that inaccurate management decisions create conditions that create the basis for human error. The organizational approach from the 1980s was considered. The Swiss cheese model described in this research as a barrier analysis method illustrates the organization's impact on human error. This model has been proposed by Reason and some know it as the modern Domino model. Reason has indicated in this model that human error is an immediate cause of the incident. But this is the reason caused by other reasons. In this model, each of the parts that can prevent the incident become a cut of Swiss cheese. Each section has cavities that indicate the defects in that section. Whenever these layers are placed in such a way that some of these cavities can be aligned, the way for the occurrence of an incident can be provided [12].

Reason calls the errors associated with the operator as "active error". At the time of an incident, the first issue that inspires the attention of the inspector is this error, but it should be noted that there are other errors in the system that may be hidden for years and only occurs in combination with one of the active errors. These errors are called latent errors above which is the organizational error.

CONCLUSION

Disaster and accident investigation methods should be comprehensive in order to ensure that their underlying causes are well-defined and that the activities necessary to modify the problems are effectively implemented. In spite of perceptual problems, we can look at models, trends, and root causes and get valuable lessons from single events and basic information about the accident. The direct study of human error is impossible, and can only be studied indirectly through the study of human behavior. As explained, there is a cause and effect relationship between human error and accidents, and there is a quick and easy access to information about human error from the incident report, because this information has already been collected, described and analyzed. Tips must be taken while analyzing. First, no single method can provide all the necessary analyses to complete the calculation of the causes of the accident. Several methods can complement each other and their rotational estimates should be used to obtain the desired results. Second, analytical methods cannot be implemented mechanically and without thought. If tools and analytical tools are not cumbersome and ineffective if not used in special circumstances and not compatible with those conditions. In addition, a three-step approach was proposed for analyzing incident reports. This method is based on the general method of analyzing texts, the methods used to analyze incidents and to classify human error. This inventive method can help in identifying the central human error in navigational problems. The effect of text analysis before an accident and the analysis of human error is important as a descriptive analysis of the report.

REFERENCES

1. Barsan E., Surugiu, F., Dragomir, C. Factors of human resources competitiveness in maritime transport. 2012.
2. Hollnagel E. Cognitive Reliability and Error Analysis Method (CREAM), Oxford, Elsevier. 1998.
3. IMO, International Maritime Organisation. Port State Control [online]. Available: www.imo.org/ ourwork /safety/ implementation/pages/ portstatecontrol.aspx. 2015.
4. Berg H.B. Human Factors and Safety Culture in Maritime Safety, the International Journal on Marine Navigation and Safety of Sea Transportation, 2013:7:.343-352.
5. CASMET. Casualty Analysis Methodology for Maritime Operations, National Technica University of Athens. 1999.
6. Det Norske Veritas. Undersøkelse av uønskede hendelser, kurskompendium, DNV,Oslo.2001.
7. Busse D.K, Wright D.J. Classification and Analysis of Incidents in Complex, Medical Environments, Topics in Health Information Management (THIM), 2000:4:115-135.
8. MAIIF. (2011) Investigator Manual. Marine Accident Investigators' International Forum. Available from www.bahamasmaritime.com/ downloads/Others/MAIIF.
9. Johnson, C.W. Improving the Presentation of Accident Reports over the World Wide Web, Proceedings of the 17th International Systems Safety Conference, Unionville, Virginia, USA, 1999b:6: 396-405.
10. National Transportation Safety Board (NTSB). Grounding of the Panamanian Passenger Ship Royal Majesty on Rose and Crown Shoal near Nantucket, Massachusetts, June 10, 1995. In: Marine Accident Report. Washington, DC. 1997.
11. Marine Accident Investigation Branch (MAIB). Report on the Investigation of the collision between Diamant/Northern Merchant. In: Marine Accident Report. 2003:10:29-43.
12. Karwowski, w. Accident Analysis and human error, International Encyclopedia of ergonomics and Human Factors, by Taylor & Francis Inc.2001.

How to cite this article: Mousavi M, Jafari M. Marine accidents investigation methods based on the role of human factors in accidents. Int J Sci Stud 2017;5(6):256-265.

Source of Support: Nil, **Conflict of Interest:** None declared.