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Analysis of violations of safety requirements established by the international maritime regulations

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Abstract

Historically, marine accident has been an inseparable part of shipping. Majority of all recorded marine accidents are generally attributed to human error or associated with human error. Many individuals and organizations in the maritime field use risk management techniques to minimize the effect of human error. The main focus is to enhance safety and reduce human error through motivation, education and training, system design, rules and regulations. It has always been recognized that the best way of improving safety at sea is by developing international regulations that are followed by all shipping nations. Adopting proper regulations will definitely decrease human error and thus, maritime accidents.

The main objective of this research was to analyze the violations of safety requirements adopted by international regulations, using the evidences from Iranian inspections. As such, the maritime safety issues are addressed and an outline of the safety regulations in the international seaborne trade is given. Also, the effects of international regulations on improving maritime safety in Iran, owner of one of the largest fleets, are evaluated through reviewing records of all maritime disasters, ships' deficiencies and their causes in Iranian territories since 2007 till 2009.

Keywords: *Maritime Accident, Maritime Safety, Conventions, Human Error, Shipping*

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 (2009), marine accidents were identified to be the cause of death of more than 5000 people in this decade. Studies have shown that for each serious accident in the maritime domain, or in any other domain, there were 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 were actually the result of errors (i.e. latent failures) that had been designed and constructed into highly complex systems especially system integration and interfacing. Their result were reconfirmed by the findings of a study published by Sampson and Zhao (2003), pointing to the human element in 90 percent of serious incidents at sea.

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).

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Human errors are caused by the internal factors related to the characteristics and differences of the operators, such as skill, experience, task familiarity, etc. and the external factors 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). The most common human errors occuring in transportation has been summarized in Figure 1 (Dillihon, 2007).

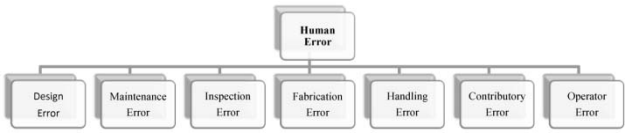

Fig 1. Human error categorization in transportation

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 reduced or had potential for reducing system effectiveness, safety or performance.

The term safety usually encompasses 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

Safety is regulated on the basis of different legal sources, the key ones of which are the following:

- International laws and regulations
- National laws and regulations
- Case law
- National territorial zones
- International Maritime Organization (IMO) conventions and regulations
- Classification construction rules
- Port state control guidelines

In addition, there are number of other organizations and agents that affect safety. The main ones are listed below:

- Flag and Port State Control
- Classification Societies
- Insurance companies
- Charterer, cargo owner

Lack of an effective response to lessons learned from marine accidents annually reported all around the world, in particular those accidents caused by regulations defects, strongly motivated this study.

Followings are the main objectives of this study:

- Classifying different human errors under the conventions of IMO dealing with maritime safety,
- Evaluating the effectiveness of flag state control on maritime safety by studying the violations of maritime safety regulations,
- Evaluating the effectiveness of port state control on improving maritime safety,
- Evaluating the effectiveness of classification societies on maritime safety by studying the violations of maritime safety regulations, and
- Finding the main category of deficiencies reported in Iranian territories.

Evaluating the effect of international regulations on maritime safety, all ships' deficiencies in Iranian

territories, i.e. Caspian Sea, Persian Gulf, and the Gulf of Oman, on both the Iranian and foreign vessels, during the last three years were studied. Based on the annual reports of Search and Rescue (SAR) committee of the PMO, which provided the most accurate and reliable information on marine disasters in Iran, the causes of each accident are specified.

After a discussion about the IMO and its relevant conventions on maritime safety, the effects of Flag State Control, Port State Control, and Classification Societies on maritime safety are studied, respectively.

2. International Maritime Organization

Shipping industry is one of the key branches of international business cycle. If each nation publishes its own safety legislation, serious conflicts with the international laws will occur. Maritime safety is an integral part of IMO's responsibilities. IMO is acting on setting internationally approved baseline standards for its members in order to prevent diversity in terms of practicing the codes, rules, and regulations (Celik, 2009). Followings are some of the international conventions and treaties engaged with maritime safety h adopted by IIMO:

Safety of Life at Sea (SOLAS) Convention, 1974

- International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW), 1978
- International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto (MARPOL 73/78)
- Convention on the International Regulations for Preventing Collisions at Sea (CORLEG), 1972
- The Maritime Code (MC)
- United Nations Convention on the Law of the Sea (UNCLOS)

3. Effectiveness of IMO in Improving the Safety at Sea

One of the main objectives of adopting a new convention, in the field of maritime safety, is decreasing some sort of human error. Generally speaking, all mentioned conventions cover one or more type of human error. Table 1 represents the relationship between the conventions adopted by the IMO and human errors. Decreasing the human error definitely causes an increase in the level of maritime safety.

Table 1- Relationship between IMO conventions and human error

Design Error	Maintenance Error	Operator Error	Inspection Error	Fabrication Error	Handling Error	Contributory Error
SOLAS	MARPOL	SOLAS LLC STCW	MC	MC	STCW ISM	CORLEG ILLC
MARPOLCORLEG	SOLAS	MARPOL ISM CORLEG	UNCLOS		CORLEG	

4. Flag State Control

As mentioned above, the set of internationally accepted safety rules and regulations are not enforced by the IMO but by the Flag States. The national maritime administration, e.g. PMO, is acting as Flag State on behalf of the country in question. When a government accepts an IMO convention it agrees to make it part of its own national law and to enforce it similar any other law.

5. The Seaworthiness Act

Each country has to give a legal basis for exercising this role as Flag State. The law regulates shipping activity in relation to the public sphere and also

defines the role of the national maritime administration (Kristiansen, 2005). This law should cover the following items:

- Safety control activity in general
- The competence of the Maritime Directorate
- Investigation of accidents
- Inspection and detention
- Certificates
- Safety and occupational health-related activities onboard
- Equipment standard
- Cargo condition and safety
- Manning and working hours
- Control of passenger vessels
- Responsibility of master and ship owner

Basically, the law applies to vessels with greater than 50 tones gross register tonnage, but the administration may decide that other vessels also have to be built in accordance with the rules under the law.

6. Effectiveness of Flag State Control on Improving the Safety

In accordance with the requirements of conventions adopted by the IMO, Flag States are responsible for ensuring that ships under their flag comply with their requirements, and a number of certificates are prescribed in the conventions as proof that those requirements have been fulfilled (IMO, 2000; Vassalos, 2006). Thus, Flag State Control has been a key principle in the safety control of shipping. Based on the internationally accepted rules, the safety is to be ensured by the maritime authority of registration of the vessel. Vassalos (2006) stated that it had become evident that different Flag States had varying competence and motivation to undertake their role.

Percent of deficient ship per inspections by flag is a good measure for evaluating the effect of Flag State Controls on improving the safety of respective ships as depicted in figure 2 using data collected during random inspections on ships in Iranian territories in the last three years (based on the data of SAR committee of PMO).

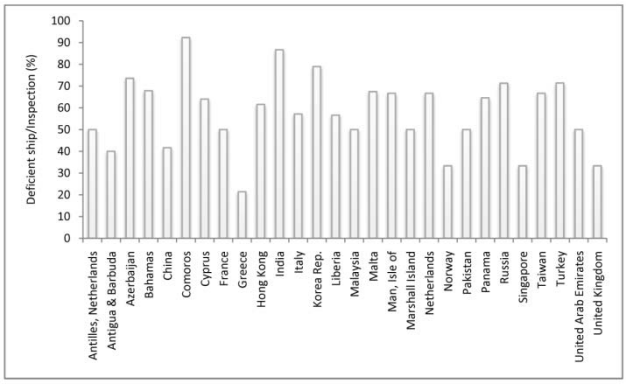

Fig 2. Percent of deficient ship per inspections by flag

According to the reports of SAR committee of PMO, many ships with different flags and under different classification societies are berthed in Iran, annually. A comparison between the deficiencies of these ships is achieved only after normalizing data on the number of deficient ships or deficiencies on the total number of inspections or deficient ships, respectively (figures 2-5).

Another suitable measuring tool for evaluating the effect of Flag State Controls on maritime safety is the number of deficiencies reported per deficient ship by its flag, as shown in figure 3.

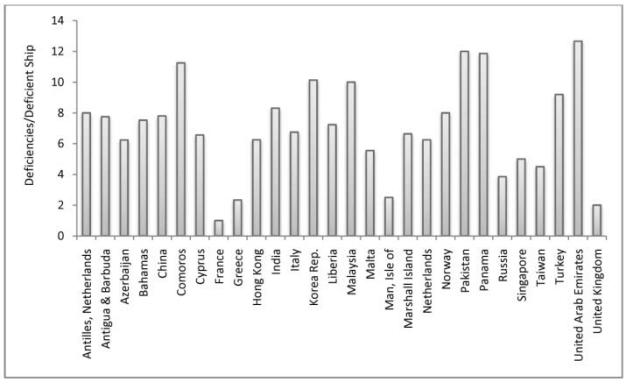

Fig 3. Number of dciencies per deficient ship by flag

7. Port State Control

The present regime of port state control (PSC)

traces its origins from a memorandum of understanding signed in the Hague between eight North Sea states in 1978. This laid down a general surveillance procedure aimed at verifying a number of requirements derived from various international agreements and conditions not hazardous to safety or health in ships (Kasoulides, 1993). PSC is the inspection of foreign ships in national ports to verify that the condition of the ship and her equipment comply with the requirements of international regulations and that she is manned and operated in compliance with these rules (MOU, 2004).

8. Effectiveness of Port State Control on Improving the Safety of Ships

Odeke (1997) stated that PSC enhanced maritime safety and pollution prevention and slowly eliminated the unfair advantage associated with operating cheaper, substandard ships. As stated by Cariou et al, (2008), seven of the most important conventions in the international regulatory framework for maritime safety served as the bases upon which the regime of Port State Control was institutionalized. These were SOLAS, MARPOL, ILLC, STCW, COLREG, International Convention on Tonnage Measurement of Ships (TONNAGE), and Merchant Shipping (Minimum Standards) Convention. This highlights the role that Port State Control can play on increasing the level of maritime safety based on the regulations adopted by both of the IMO and the International Labor Organization (ILO).

Providing an accurate control on PSCs and IMO has encouraged the establishment of regional Port State Control organizations and agreements on PSC, Memoranda of Understanding or MOUs, which have been signed internationally and cover all of the world's oceans, including Europe and the north Atlantic (Paris MOU), Asia and the Pacific (Tokyo MOU), Latin America (Acuerdo de Viña del Mar), Caribbean (Caribbean MOU), West and Central Africa (Abuja MOU), the Black Sea region (Black Sea MOU), the Mediterranean (Mediterranean MOU), the Indian Ocean (Indian Ocean MOU), and the Arab States of the Gulf (GCC MOU). Port State Control of Iran enforces regular and random focoused inspection campaigns on foreign ships, aiming to increase the maritime safety. This activity caused I. R. Iran's grade be elevated from Gray to White level in Tokyo MOU on Port State Control List.

9. Classification Societies

Classification Societies are independent bodies which set standards for design, maintenance and repair of ships (Kristiansen, 2005). The Classification building rules cover:

- Hull strength and design
- Materials
- Main and auxiliary machinery
- Electrical installations
- Control systems
- Safety equipments

A classed vessel will be surveyed on a regular basis and given recommendations for necessary maintenance and repair in order to keep its class. Thus, classification societies eliminate/decrease design error, fabrication error, inspection error, and contributory error directly and other human errors indirectly.

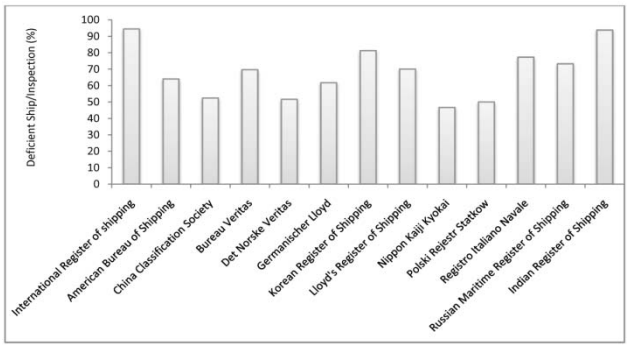

Fig 4. Percent of deficient ship per inspections by classification society

Percent of deficient ship per inspections, and number of deficiencies per deficient ship regarding her classification society is used as inspecting tools for evaluating the effect of classification societies on improving the safety of their ships as depicted in figures 4 and 5, respectively using data collected from random inspections in Iranian territories in the last three years.

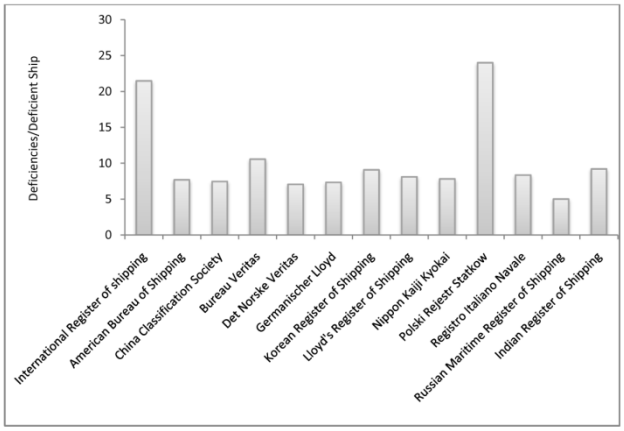

Fig 5. Number of deficiencies per deficient ship by classification society

10. Discussion and Conclusions

The success of the future international maritime cooperation among the nations strictly depends on the extent to which regulations affect the maritime safety. Since, majority of maritime accidents are reported to be related to human error, considering the factors affecting human error, both ashore and aboard, is of great importance. In terms of shipping, based on the data of SAR committee of PMO, as shown in figure 6, the main deficiency reported, is the problem of navigation communications, fatigue, poor automation design, poor general technical knowledge, poor maintenance, decisions based on inadequate information, faulty policies, practices, or standards, poor knowledge of own ship systems, and hazardous natural environment are other factors in the category of human errors.

This study which was carried out by random inspections of the ships in Iranian territories from 2007 up to the first quarter of 2009, focused on conventions and regulations, marine administrations and societies dealing with human errors in maritime fields and studies their effectiveness on decreasing mariners' errors and increasing maritime safety.

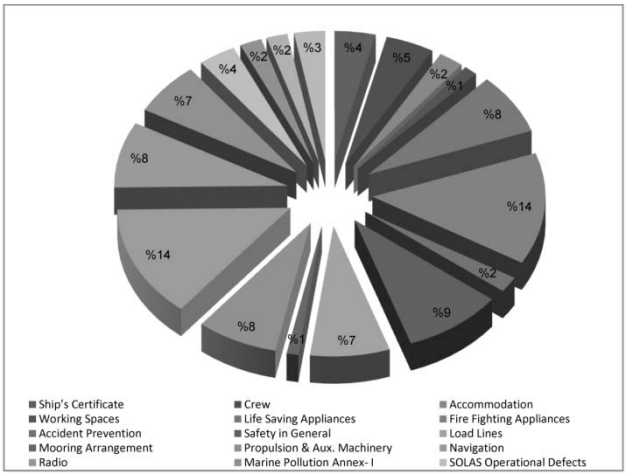

Fig 6. Nature of deficiencies reported in Iranian territories

However, there are still some shortcomings in safety control on vessels, i.e. fisheries and small cargo carrier. Based on the reports of SAR committee of PMO, these vessels are usually engaged with problems such as machinery failure, fire, flooding and hull rupture due to poor enforcement and or consequent of inadequate regulations. In addition, large body of data on medical assistance, crew injuries, and man over board disasters reported annually all around the world, crew must be better capable of acting under adequate regulations as categorized in the mentioned operator error level. Having said that, in order to improve the level of safety in maritime trade and to decrease maritime disasters, following principals should be considered:

- Since there are usually many reports on marine disasters on small vessels, Port State Controls and Classification Societies should insert a more restricted control over them than ocean-going vessels.
- There should be annual training programs for seafarers to satisfy requirements of safety

conventions, in particular the new amendments to the STCW, SOLAS and MARPOL.

- Oil and fuel leakage in engine rooms is the main root of fire, especially in small vessels. Thus, fire fighting equipments should be inspected more rigorously and regularly by both the port state control and classification society.

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