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A Feasibility Study on the Application of Safety Assessment to the Fishing Vessels

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Abstract

The current paper deals with the safety of fishing vessels, which needs more speculations than other ship types. The characteristics of accidents of fishing vessels are rather different compared with other commercial vessels. In the context, the methodology of the formal safety assessment, one of the important issues in the maritime world to enhance the safety of marine vehicles, are reviewed and consulted along with other methodologies to see its applicability for fishing vessels. It is anticipated that further effective measures for better safety of fishing vessels can be identified including due considerations of the aspect of human elements, i.e. cultural environment.
Keywords: safety culture, human factor, fishing vessel safety, FSA

1 Introduction

Fishing is amongst the most dangerous professions in the world. In many countries, it has the highest fatality rate of any occupation. It is reasonable to believe that the fatality rate in countries(especially developing and undeveloped countries), for which information is not available, will be higher than it is in those that do keep records. Thus, the International Labor Organization's(ILO 1999) estimate of 24,000 fatalities worldwide, per year, may be considerably lower than the true figure. Even though in some countries the numbers of fishing vessels being lost and fishermen being killed have reduced during recent years, as the size of the fishing fleet reduces, the number of deaths remains high.

In this study, an attempt has been made to find a safety assessment method that could suit the fishing vessels. Having reviewed briefly the assessment methodologies/approaches available, main attention was paid to the hazard identification in order to stress the important factor of human element, especially the cultural aspect. As Vassalos et al(2000) speculated, emphasis now be shifted towards the human element and the organization and management before a market improvement of safety can be achieved.

2 Safety status of fishing vessels

Safety has been a problem in fishing industry, and continues to be so. According to the studies conducted by various international and national bodies, fishing has the greatest fatal accident rate(FAR) than any other occupation. Often it exceeds the national average by a long way - it often seems to be a case of 'an accident waiting to happen'(Wiseman 2002). In all of these studies, it is difficult to point out a single cause of fishing vessel accidents. Even though fishing vessel accidents are a result of combination of events, in many occasions, human factor triggers the accident(Kwon 1995, Choi 1996). Generally, small-scale and skilled fishermen are the worst affected.

In most of the cases, accidents could have been prevented by a little care, but there appears to be a definite lack of safety culture in fishing industry(MAIB 2002). On many occasions, accidents occur because those onboard ignore basic principles of seamanship. People fail to identify potential risks and act accordingly. They are reluctant to change because they have always been done that way(Spitzer 1999). Some fishermen are not good at understanding the likely consequences of a particular action. Furthermore, often problems develop so fast that there is little time to respond.

3 Safety assessment options.

In general, there are several basic methods developed for ensuring safety of a system or ship.

(a) The prescriptive method
(b) The safety case approach
(c) Risk Based Decision Making(RBDM) approach
(d) Design for Safety, and
(e) Formal safety assessment(FSA).

The prescriptive method is based on the principle of enforcing certain safety features or rules and regulations by the government of a country or its representatives, or an international organization, on those who wish to provide products or services to the public or their own use. Safety case approach is based on the system principles and setting a safety goal to be achieved(Kuo 1998). It has got four steps, namely, hazard identification, risk assessment, risk reduction and emergency preparedness. RBDM is again a system-oriented approach used by the United States Coast Guard(USCG 2000). The elements in RBDM are decision structure, risk assessment, risk management, impact assessment and risk communication, the last of which is quite unique and could be of great help for feedback. Design for Safety is a formalized methodology to allow safety assessment to become an integral part of the design process(Vassalos et al 2000). To achieve the goal, it accommodates, so called, blackboard systems as the platform in the development of the integrated design environment.

Even though methods (b) to (e) are somewhat similar, FSA seems to be one of the most viable options for addressing safety of ships including fishing vessels(Yeo 1997, Kim 1999). Because it enables the cost-effective acquisition of as much practical safety as possible by choosing risk control options that give an overall reduction of risk and good value for money. FSA is a proactive method, which can address new problems, arising due to new technology, equipment or management practices. FSA can evaluate how much and at what cost a particular safety measure will improve safety, and if that safety measure is equitable to all stakeholders involved or not.

4 Brief overview of FSA

By definition "Formal Safety Assessment(FSA) is a structured and systematic methodology, aimed at enhancing maritime safety, including protection of life, health, the marine environment and property, by using risk and cost benefit assessment". FSA can be used as a tool to help in the evaluation of new regulations for maritime safety and protection of marine environment or making a comparison between existing and possibly improved regulations, with a view to achieving a balance between the various technical and operational issues, including the human element, and between maritime safety or protection of marine environment and costs.

FSA should comprise the following steps(Figure 1);

(1) Identification of hazards;
(2) Risk analysis;
(3) Risk control options;
(4) Cost benefit assessment; and
(5) Recommendations for decision-making.

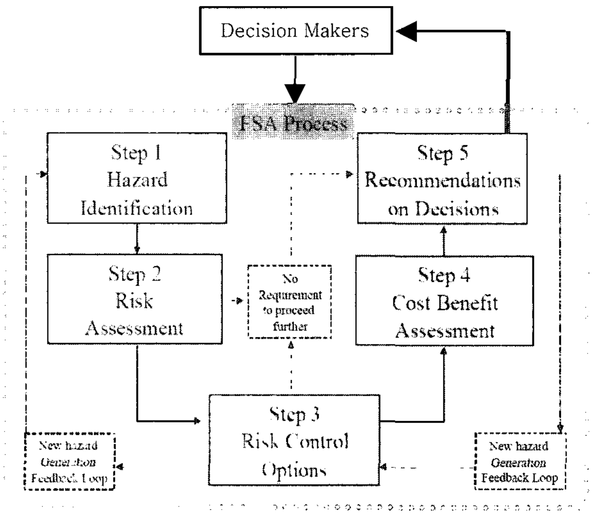

Figure 1: FSA Methodology (IMO 1995)

If applied properly FSA can considerably improve the safety status of the marine industry by providing valuable information to decision makers. Especially, fishing industry has long been lacking systematic approach to deal with safety problems. Therefore, FSA could well provide the desired safety results for, the most hazardous industry in the world.

In the following sections, the so-called pre-requisites for the application of FSA will be briefly reviewed before entering main steps of the process.

4.1 Information and data

Availability of reliable data is important for the successful completion of the FSA process. Results of each stage will be carried over to the subsequent stages and any error involved will be magnified leading to a faulty output. As far as fishing vessels are concerned, there is an abundance of historical data available, but reliability of those data cannot be guaranteed. So apart from historical data, we may have to use analytical models and simulation methods. Nevertheless, the most important aspect remains to be expert judgment.

4.2 Problem definition

First phase of step 1 of FSA process is problem definition and preparation of generic model to be assessed. However, fishing vessels, in particular, differ in length, type of fishing, deck equipment and fishing gear, propulsion and steering systems, material of construction etc. Obviously, it will not be possible to include all the systems of all vessels. Therefore, it would be advisable to include systems, which might be common to most of the fishing vessels or group of vessels, which need special attention/consideration. For example, a generic model should not be viewed as an individual ship in isolation, but rather as a collection of systems, including organizational, management, operational, human, and electronic and hardware aspects(IMO 1995). We also have to consider generic ship life cycle including design, construction and commissioning, entering port, berthing, leaving, loading and unloading, passage, dry-docking, decommissioning and disposal. We should also consider different functions of the generic ship including bunkering and storage, navigation, emergency response and control, communications, habitable environment, manoeuvrability, power and propulsion, stability, pollution prevention, anchoring, structure, mooring, towing and payload. The last part is generic accident categories such as contact or collision, grounding or stranding, fire, explosion, loss of hull integrity, flooding, machinery failure, hazardous substances, payload related and external hazard.

5 Hazard identification

The purpose of this step is to identify a prioritized list of hazards and associated scenarios specific to the problem under review. Despite of the efforts gone into the safety of fishing vessels, accidents and loss of lives continues to occur regardless of time, place, weather and region. It indicates that we are looking only at the tip of the iceberg and need to understand the underlying causes and influences, which may differ according to regional factors. So we must consider the overall picture to get to know about extend of the problem.

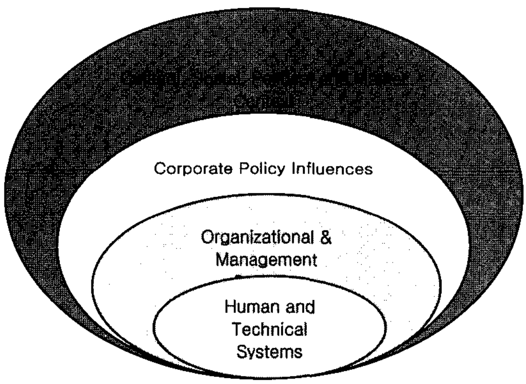

Figure 2: Nested system of Influences(RID), (IMO 2002)

In the context, a Regulatory Influence Diagram(RID) shown in Figure 2, is a model representing the various factors that influence the occurrence of a particular accident. Especially for fishing vessels market and social contexts are unique and need special attention, which is different at different regions even with in a particular country. Many previous studies suggested that human factor is the most important direct factor or contributory factor in fishing vessel accidents. It must be, therefore, recognized that social and cultural aspects should be given due importance along with management regimes and other aspects to find out the root of the problem. In other words, although culture has been a safety issue in fishing industry for many years, it has been seldom determined as a causal factor of an accident. The reason is that the hidden defects of humans are not easy to be clearly observed and the accident investigation needs to raise the fact with evidence.

According to Helmreich and Merritt(1998), three types of cultures are prominent, which affect the overall safety (Figure 3) (Yong 2003). They are national culture, organizational culture and professional culture. Of these three, national culture is the most important element of the model and the one least amenable to change. The organizational culture has a powerful influence on training practices and safety culture. The organizational climate(morale) reflects the positive or negative feeling that employees have about their organization. It can influence the behavior of crew or master onboard the vessel. Poor morale can affect on-time performance, compliance with procedures and willingness to perform to their maximum capacity. Professional culture may influence the safety culture, through feeling of responsibility, for crew or vessel safety and dedication to execute ones job as effectively as possible. On the other hand, it has a negative influence on vessel safety culture by making the skipper or crew less aware of their personal limitations and less accepting of training that focused on safe behaviors.

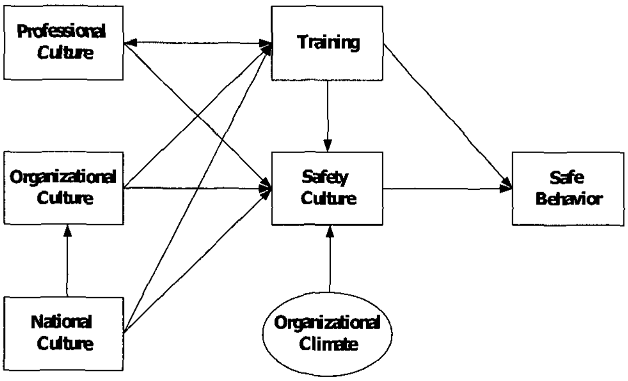

Figure 3: A model of the interaction of cultures and their outcomes(Helmreich and Merritt 1998)

5.1 Applicability of reason's model for finding out hazards

Reason's (Figure 4) the so-called Swiss cheese model, allows looking beyond the immediate circumstances of the accident and at the preconditions at the time of the occurrence(Ayeko 2002). That is, it would be a useful tool in identifying that who should take what actions to prevent and mitigate the effect of future accidents(ILO 1999). The model is based on the theory that there are a number of 'barriers' or layers between the potential accident and the actual accident: the first layer (defenses) represents physical defenses that should mitigate the results of the unsafe act. The second layer (unsafe acts) and third layer (preconditions) include such conditions as fatigue, stress, operating practices, etc. The fourth layer (line management) includes aspects such as training, maintenance, etc. The fifth layer depicts all high-level decision-makers such as regulators, owners, designers, manufacturers, trade unions, etc. The model shows the importance of reducing or eliminating safety deficiencies, representing a reduction in the number or size of the holes, thus reducing the probability of an accident. Reason's model is particularly useful in illustrating how an accident can have a number of causes.

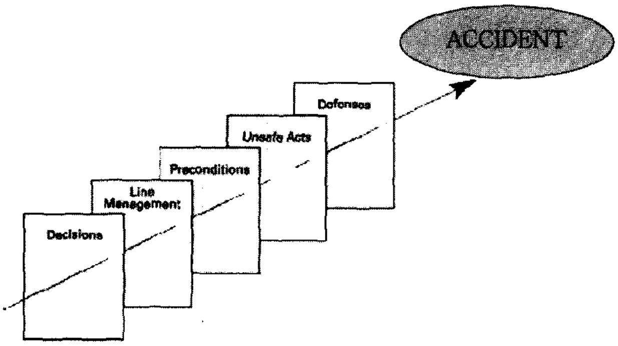

Figure 4: Reason's Model (Ayeko 2002, ILO 1999)

That is, even though this is not a quantitative method, it can greatly facilitate initial risk assessment and ranking. It can relate inadequacies in rules and regulations with accidents. Many nations have already used this method in their studies related to fishing vessels, which can serve as a valuable data source.

Apart from human factor, failures in vessel related aspects are systematically considered by applying well-known methodologies such as FMEA and HAZOP, which usually starts from identifying failure modes of each system. Detailed work sheets regarding the various methods used are prepared for further evaluation. At the end of step 1, the identified hazards are arranged in the order of importance to facilitate further steps of FSA process. So all the identified hazards are ranked by qualitative risk evaluation methods, and a prioritized list of hazards is obtained.

6 Step 2-5 of FSA

In the rest of the process of FSA, risk assessment and quantification are to be done with extreme care to ensure the maximum accuracy of the process. It should also be noted that selection of a proper risk assessment technique is required to facilitate the risk quantification and further documentation. In certain cases, especially in the event of scarce or uncertain data, theoretical simulations, such as fussy set theory (FST) (Pillay 2001) can be used with care. It is anticipated that, even though the practical application of this method is not yet well established, methods such as this could improve quality of the results.

It is also necessary to find out meaningful and practical risk control options, which should be cost effective and easy to implement. The recommendations would be based upon the comparison and ranking of all hazards and their underlying causes; the comparison and ranking of risk control options as a function of associated costs and benefits; and the identification of those risk control options which keep risks at least in ALARP region. Recommendations should be presented in a form that can be understood by all parties irrespective of their experience in the application of risk and cost benefit assessment(CBA) and related techniques. Those submitting the results of an FSA process should provide timely and open access to relevant supporting documents, and a reasonable opportunity for, and a mechanism to incorporate, comments.

Each step deserves fully understanding and speculation, which is beyond the scope of the present study, and waiting for future works.

7 Concluding remarks

It is becoming clear that human element should be treated with due importance in order to get any meaningful results in reducing the fishing vessel accidents. Cultural aspect is an integral part of human element, and proper understanding of this issue can greatly contribute towards the fishing vessel safety by improving current practices.

The application of FSA to fishing vessels can suggest valuable recommendations to IMO or other regulatory bodies for helping in its rule making process. However, the quality of the result depends on the reliability of the input data to the process. The present condition of the fishing vessel database is not satisfactory. Nevertheless, currently there is a large effort going on in this direction, and hopefully a more reliable data bank will be created in the near future. Still the matter of fishing vessel safety largely depends on individual governments and organizations, so a greater effort with in the regional level is required to improve the safety aspect of the fishing industry. In addition, greater coordination between the governments, who have experience in fishing vessel safety, could be of great help.

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