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WORLD MARITIME UNIVERSITY

Malmö, Sweden

SAVE LIVES, PROPERTY AND THE ENVIRONMENT

A practical application of the concept of Risk Management to enhance the effectiveness of the SAR service provision in developing countries

By

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Uganda

A dissertation submitted to the World Maritime University in partial fulfilment of the requirements for the award of the degree of

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In

MARITIME AFFAIRS

(MARITIME SAFETY AND ENVIRONMENTAL PROTECTION)

2006

Declaration

I certify that all the material in this dissertation that is not my own work has been identified, and that no material is included for which the degree has previously been conferred on me.

The contents of this dissertation reflect my own personal views, and are not necessarily endorsed by the university.

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Abstract

Risk is the chance of an un-wanted event happening that will have a negative impact on the organisation, the society, and the environment; it is an integral part of all our day-to-day activities and therefore a potential hazard to all mankind and their surroundings. Virtually, almost every activity on this planet is associated with a risk of some sort or other.

How best to live with risk is every one's concern in today's competitive and ever changing environment; a reason why risk management is one of the contemporary issues of today.

Interestingly, however, although mankind has lived with risk since time immemorial, the concept of risk management only came to light not so long ago. In the stone age era, there was a great deal of uncertainty surrounding man's existence; man was aware of those uncertainties and the possibility of each of the major hazards but did not know when and where they could strike and therefore had no clue of what to do to prevent or minimise their occurrence.

Today, managing risk can be put into a systematic framework so that all possible losses/failures that can result from the occurrence of untoward events (risks) are prevented or minimised.

Despite the fact that risk management is a widely applied technique in many organisations today, there are some maritime institutions that have not adopted the concept to-date.

In this thesis, the author will demonstrate practically how the concept of risk management can be applied to SAR activities at operational level to enhance the effectiveness of the SAR service provision.

The thesis is aimed at assisting developing countries that might have difficulties in applying the risk management concept to maritime activities, and in particular, SAR operations.

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List of Abbreviations

1. COMSAR	Sub-Committee on Radio communications and Search and Rescue
2. COSPAS-SARSAT	Space System for the Search of Vessels in Distress; Search and Rescue Satellite-Aided Tracking
3. EPIRP	Emergency Position Indicating Radio Beacon
4. Fig.	Figure
5. GMDSS	Global Maritime Distress and Safety System
6. IAMSAR- Manual	International Aeronautical and Maritime Search and Rescue Manual
7. ICAO	International Civil Aviation Organisation
8. IMO	International Maritime Organisation
9. MAYDAY	An internationally recognized distress signal via radiotelephone
10. MEDVAC	Medical Evacuation in situations of emergency
11. MRCC	Maritime Rescue Coordination Centre
12. MRO	Mass Rescue Operations
13. OSC	On-Scene Coordinator/Commander
14. p.	Page
15. PAN-PAN	A French abbreviation for “Panne”, meaning “Break Down”. It is used by a vessel urgently needing help but not in imminent danger
16. PLB	Personal Locator (Emergency Indicating Radio) Beacon
17. RCC	Rescue Coordination Centre
18. RSC	Rescue Sub-Centre
19. SAR	Search and Rescue
20. SC	Search and Rescue Coordinator
21. SITREP	Situation Reports

22. SMC	Search and Rescue Mission Coordinator
23. SOLAS	International Convention for the Safety of Life at Sea, 1974.
24. SRR	Search and Rescue Region
25. SRU	Search and Rescue Unit
26. UNCLOS	United Nations Convention on the Law of the Sea, 1981
27. USCG	United States Coast Guard

1 Overview

1.1 Introduction

To most people, “Search and Rescue” is an ordinary expression with no hidden meaning. In order to fully understand the meaning of the statement, it is imperative to first break it down into two separate words:

1. Search; and
2. Rescue

The Oxford Dictionary of Current English language (Soanes, 2001), defines the two words as follows:

Search: Try to find something by looking carefully and thoroughly.

Rescue: Save from a dangerous or distressing situation.

In the maritime and aeronautical industries, the terminology “Search and Rescue (acronym SAR) is not new and is very often used. In the context of these two industries, search and rescue is much more than just locating and rescuing those in danger.

According to the IAMSAR manual (vol. II, 2001-2003 amendments), “search and rescue means a rapid and coordinated response (or operation) often¹ mounted by

¹ Sometimes non-trained volunteers or good Samaritans commit themselves to carry out the operations

trained personnel who are provided with dedicated equipment and facilities, to **locate** and **retrieve** those in distress situations, cater for their **initial medical** needs, and finally **deliver** them to a **place of safety** ashore”.

Ordinarily, SAR operations are usually mounted to rescue those who might find themselves in un-favourable conditions under any of the following circumstances:

- When either a vessel or an aircraft is missing (or overdue) along with the occupants;
- When a vessel (with occupants onboard) is disabled, capsizing, disoriented, aground or sinking;
- When people believed to be at sea or on any water body are missing or are overdue;
- When a vessel unexpectedly runs out of fuel;
- When a vessel or aircraft catches fire, or develops any mechanical, electrical or structural failures that might jeopardise the safety of life of those on board and might also eventually present a serious danger to the environment.

Search and rescue is a humanitarian² service offered by States primarily to minimize the loss of life, injuries, damage to the property³ and environment by rendering assistance to those in distress.

Usually, in most jurisdictions, maritime and aeronautical SAR activities are harmonised presumably to minimise on the expense while at the same time increasing the effectiveness of the entire SAR system, mainly through resource optimisation and better management. This study, however, will mainly concentrate on the activities related to maritime search and rescue operations.

² Usually no fees are levied for the service.

³ However, this could be of secondary importance, depending on the situation

While the quality of maritime SAR service provision is somewhat un-questionable in most parts of the developed world⁴, the provision of SAR services in some⁵ developing countries still leaves a lot to be desired; a reason why this research is being conducted to assist in bridging this gap.

Principally, SAR activities can be divided into two major categories, namely:

- SAR at management level; and
- SAR at operational level

In order to give an in-depth analysis of how to apply the concept of risk management to enhance the effectiveness of SAR service provision, this research will mainly focus on analysing the activities of SAR at the operational level (operations).

However, although SAR operations usually address a full spectrum of activities ranging from incident monitoring, prevention, preparedness, response, and recovery actions, the analysis will be centred on those operational aspects that are directly related to an evolving or potential incident rather than the steady-state monitoring activities that are conducted in the absence of a specific incident.

In light of the above, therefore, SAR at the operational level can be chronologically divided into four main⁶ phases, namely:

⁴ Presumably due to the technological and managerial advancements exhibited by most developed States.

⁵ Not all

⁶ These are considered the primary phases, although there could be other intermediate phases in-between.

- i. Emergency phase
- ii. Initial response (from the SAR System)
- iii. Actual mission or activation of the rescue operation
- iv. Mission conclusion

1.2 Primary Objective of the Thesis

To be of practical value, managing risk needs to be an integral part of the management planning and review processes to support priority setting and decision-making by clearly informing managers about key risks, the likelihood of their occurrence, the possible degree of severity (in case of risk occurrence) and what options are available to prevent/minimise the risk occurrences.

With respect to SAR service provision, failure to manage risks can hugely reduce the effectiveness of a given SAR system. This in turn jeopardises the organisation's ability to achieve the desired goals.

In this regard therefore, this thesis is aimed at practically demonstrating how the risk management concept can be applied to SAR activities at the operational level to enhance the effectiveness of SAR service provision.

1.3 Anticipated Benefits of the Research

It is anticipated that this research can be used as a guide by the interested SAR organizations in developing countries to develop their own SAR operational procedures and principles that are based on risk.

Having knowledge of the potential risks that can jeopardize the effectiveness of the SAR system helps in enhancing the quality of SAR services by preventing or

minimizing the occurrence of the untoward events through devising appropriate risk control measures.

The SAR decision makers can then use the devised risk control measures as a basis for:

- ◆ Developing appropriate action plans for the rescue operations that are based on anticipated risks;
- ◆ Minimizing operating costs through prioritization of tasks that are in line with the identified potential risks;
- ◆ Making well informed and rational decisions with respect to the following:
 - i. Recruitment of operational SAR personnel who possess the right skills that are necessary to handle the identified risks;
 - ii. Determining the appropriate type and adequate quantity of equipments that are required for the efficient execution of SAR activities with due regard to the identified risks and the devised corresponding risk control measures;
 - iii. Determining the sufficient number of facilities that are needed for the efficient execution of the anticipated SAR activities;
 - iv. Identification of training needs based on the identified risks and the corresponding remedial measures;

1.4 Methodology and Limitations

i. Methodology

This research was conducted using both primary and secondary material sources.

The primary data was obtained through distributing the questionnaires to SAR operational personnel in various countries. A total of fifteen questionnaires were

distributed to various SAR organizations in fifteen different countries, and out of those fifteen, only five countries⁷ responded to the questionnaires.

Basically, the questionnaires⁸ were used to gather information about the events that can go wrong (risks) at each of the four phases of SAR operations, the frequency of occurrence of those un-wanted events and the measures employed to deal with them. The data that was obtained was then carefully analysed, and through application of the principles of risk management to the identified risks, appropriate risk control options⁹ corresponding to each of the identified risks were devised. Additional information about the risks associated with SAR activities at operational level was obtained by referring to secondary material sources¹⁰.

ii. Limitations

The main limitation was the difficulty in obtaining information from the developing countries. However, despite the fact that none of countries¹¹ from the developing world responded to the questionnaires that were distributed to them, the information gathered from those countries that responded to the questionnaires was sufficient for conducting the research.

Another limitation was the time constraint; the time allocated for carrying out the analysis was very limited and as such, a very detailed and deep analysis was not easy to achieve within the allocated time framework.

⁷ These countries are: Sweden, German, Denmark, Australia and the United Kingdom

⁸ See appendix 1

⁹ Risk control options are the strategies that can be taken to effectively manage the identified risks.

¹⁰ Literature available both from the Internet and libraries about SAR risks

¹¹ For purposes of respecting sovereignty, no particular country will be mentioned here. .

1.5 Scope of the Thesis

The entire thesis will be structured to cover the following chapters:

- ◆ **Chapter 2:** Brief Introduction to the Principles of Risk Management.

In this chapter, a brief overview of the basic principles governing the risk management process shall be covered.

- ◆ **Chapter 3:** Functional Requirements of SAR.

This is where a general review of the obligatory requirements for provision of the SAR services shall be briefly highlighted.

- ◆ **Chapter 4:** Analysis: Application of Risk Based Approach to SAR at the Operational Level. Analytical

This is where the risk management concept shall be applied separately to each of the four phases¹² of SAR at the operational level. The aim is to devise appropriate risk control measures for the identified risks. These risk control measures can then be used by the SAR decision makers as a basis for making informed and rational decisions for conducting SAR activities at the operational level.

- ◆ **Chapter 5:** Conclusions and Recommendations.

¹² Emergency phase, Initial response, Actual mission or activation of the rescue operation and Mission conclusion phase

2 Brief Introduction to the Principles of Risk Management

2.1 Risk: *What is Risk?*

To different people, risk has so many meanings. If you happen to randomly ask people about the meaning of the term “risk”, it is most likely that each will give their own version although most of them will say “it is the prospect of getting hurt”. This is not to mean that some people will be wrong, but the thing is risk can be defined depending on someone’s perception of it.

According to the Oxford English dictionary, risk is defined as a hazard; a situation that could be dangerous; or the possibility that something undesirable could happen. Technically speaking, and from the risk management perspective, risk is much more than just a hazard or a dangerous situation. Defining risk is rather complicated because risk manifests itself in two dimensions: Likelihood and the degree of severity.

Experts define risk is as a combination of the severity and the likelihood of occurrence of an undesirable event. Put simply, risks are those things that, if go wrong unexpectedly, can impair your ability to achieve the desired goal(s).

Applied to maritime SAR, risk is the chance of an undesirable event happening that will jeopardise the objectives of a given SAR system and hence pose a negative impact on the marine community as well as the marine environment.

2.2 Risk Management

Risk Management is the process of measuring or assessing risks and then developing strategies to mitigate minimize or control the assessed risks. The process is the combination of risk assessment and the actions to deal with the risks (Frame, 2003, P.14-15). The principal focus of risk management is on the identification and treatment of risks with the objective of adding maximum sustainable value to all the activities of the organisation.

Generally, the strategies employed to manage risk may include transferring the risk to another party, avoiding the risk, completely eliminating the risk, reducing the negative effects of the risk, and accepting the risk.

Risk management is a step-by-step process *per se* and as such, certain principles have to be observed when carrying out that process; these principles include, *inter alia*:

- ◆ Risk identification
- ◆ Risk assessment, and
- ◆ Risk control

2.2.1 Risk Identification

This is the initial step carried out during the risk management process (Dickson, 1991, P. V).

Although some authors generally categorise risk identification as one of the steps in the risk assessment process, in this author's opinion, risk identification should be a stand-alone step. After risks have been identified, they can then be assessed. In the context of this discussion, however, we will not enter any debate regarding the subject matter because it will be of little importance to the main task at hand.

In some cases¹³, the phrase "hazard identification" is used instead of "risk identification". This is so because the two terms "risk" and "hazard" are often used interchangeably to mean the same thing.

Risk or hazard identification consists of determining which unwanted events might occur and bring about negative impacts on the organisational resources and society, as well as the environment.

There are several ways in which risks can be identified. For this research, however, risks were identified by using questionnaires that were distributed to the personnel¹⁴ who are in charge of conducting/managing SAR operations. The questionnaires were seeking the experience and knowledge of those personnel to identify what can go wrong at each phase of SAR operations. For better results, the risk identification process should be a continuous process because new risks keep emerging as time passes by (Dickson, 2003, P. 41).

Risks can be classified as internal or external. Internal risks are those risks that organisational members can influence or control. On the contrary, external risks are those risks that are outside the organisational control and therefore staff members

¹³ Depending on the author

¹⁴ From the selected countries

may have little or no control over such risks. Examples of external risks are technological changes, political changes and risks due to *force majeure*¹⁵.

2.2.2 Risk Assessment

This is the most critical step in the risk the management process. After risks have been identified in the first step, they are then assessed on a systematic basis. Risk assessment generally refers to the process of analysing and prioritising the identified risks with respect to their potential degree of severity of the consequences and to their probability of occurrence.

Neatly expressed, risk assessment consists of two main steps, namely:

- ◆ Risk analysis; and
- ◆ Risk prioritisation

1) Risk analysis: This is primarily concerned with a broader and clear understanding of the identified risks with respect to:

- i. The probable root causes or source of the risk;
- ii. The likelihood of occurrence of the risk, and
- iii. The possible magnitude of the consequences or degree of severity in case of risk occurrence

The trickiest thing, however, is to estimate or measure the two quantities of risk, that is, the probability of occurrence of the undesirable event and the magnitude of the possible consequences.

2) Risk prioritisation: This refers to the process of categorising the risks on the basis of their likelihood of occurrence and the corresponding degree of severity

¹⁵ *Force majeure* is a Latin word meaning failures brought about due to an act of God or natural disasters; for instance abrupt changes in weather that could bring about unfavourable conditions leading to failure of an operation or otherwise.

of the consequences in case of risk occurrence. By using this information, it can then be decided which risks should be given particular attention and the appropriate actions to take.

From the SAR perspective, risk Prioritization is very important because focus is concentrated at only those areas that are most likely to have the greatest impact to overall objective of the SAR system.

Figure 2.1 shows an illustration of how risks are categorised on the basis of their likelihood of occurrence and the degree of severity of the consequences.

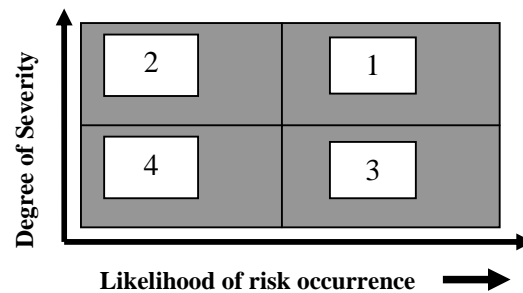


Fig.2.1- Risk categorisation

Source: Adapted from unpublished lecture handouts; World Maritime University, Malmö, Sweden

Table 1 is the summary of the description of the risk categories shown in fig. 1.

Table 1- Description of risk categories

Risk Category	Description
1	A combination of high likelihood and high degree of severity
2	High degree of severity of consequences but with low possibility of occurrence
3	High likelihood of occurrence but with minor consequences
4	Low possibility of occurrence and low degree of severity

2.2.3 Risk Control Measures

This is one of the last steps in the process of risk management. After careful and thorough analysis of the risks, the principal issue that arises at this juncture is “what should be done with the identified and analysed risks?” The process of addressing this question is referred to as risk response planning (Frame, 2003, P. 134). It involves devising suitable and cost effective remedial measures to deal with the prioritised potential risks.

Risks are mitigated on the basis of their likelihood of occurrence and the possible degree of severity of the consequences. It should also be noted that there are some risks that cannot be mitigated completely; in which case, measures that can reduce the risk to an acceptable level¹⁶ are devised.

However, for those risks which the organisation does not have any control over (external risks), the only option available is to **accept** them and just pray that they do not occur; for instance adverse weather conditions which may not permit the SAR units to conduct a search and rescue mission in time. However, adequate contingency planning may, to some extent, help in reducing the eventual consequences in case of occurrence of such risks (Frame, 2003, P. 135).

In a nutshell, risks associated with SAR operations can either be mitigated or accepted depending on their nature¹⁷, likelihood of occurrence and degree of severity of consequences.¹⁸

¹⁶ A level where the consequences are very minor

¹⁷ Internal risks (mitigate); external risks (accept but develop contingency plans to minimise eventual consequences)

¹⁸ There are other means of dealing with risks, and these include **risk transfer** and **risk avoidance**. However, these do not seem to apply well to SAR operations.

2.2.4 Cost benefit analysis

Generally, this is not considered to be part of the risk management process. However, its inclusion in this analysis is to bring to the attention of those devising risk control measures to put into consideration the costs that might be involved in implementing the risk control measures.

Broadly speaking, cost benefit analysis is the process that involves the weighing of costs required for implementing the proposed risk control measures against the anticipated over-all benefits expected from enforcing those measures. On ascertaining that the proposed remedial measures are cost effective¹⁹, then the next step is to effect the implementation of the devised control measures.

2.3 Why Risk Management

The principal reason why it is important to employ the concept of risk management is to prepare for those future unwanted events that, if occurring without our knowledge, would cause significant losses, injuries, deaths and other forms of suffering. The idea is to be well prepared for emergencies and reduce the number of undue surprises that might be encountered in the day-to-day operational activities (Frame, 2003, P.20).

Broadly speaking, there are so many benefits associated with establishing and maintaining a risk management culture in any organisational setting, and the following are some of them:

- i. Systematic, well informed and thorough method of decision making;
- ii. Better utilisation of resources;
- iii. Improved cost control;

¹⁹ In other words, if the benefits outweigh the costs involved in implementing the control measures

- iv. Strengthening of the culture for continued improvement;
- v. Increased knowledge and understanding of exposure to risk;
- vi. Creation of best practices to improve the quality of the organisation;
- vii. More effective strategic planning.

3 Functional Requirements of SAR

3.1 SAR System Requirements

The principal focus for setting up SAR systems is to increase the mariners' chances of survival at sea. In most jurisdictions, SAR services are provided on a humanitarian²⁰ basis primarily to save the lives of the citizens and to protect the environment in case of a disaster.

For maritime activities, SAR systems help in rendering such a service to mariners that might find themselves in un-favourable conditions at sea.

Maritime activities being international in nature, SAR services are also normally conducted on an international (global) or regional basis, though not necessarily a primary requirement. On the basis of this, the International Maritime Organisation (IMO) member States are encouraged²¹ to form regional co-operations with the view of having a uniform method of conducting SAR operations.

3.1.1 Typical SAR system set-up

In a very simplified format, a typical search and rescue system set-up can look as shown in figure 3.1.

²⁰ No charges are levied from the victims

²¹ It is not a must though

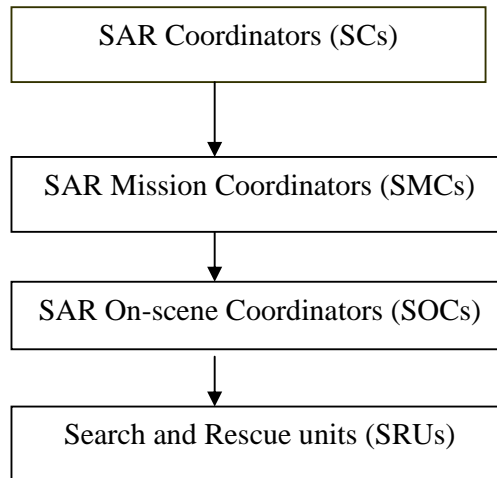


Fig. 3.1: Simplified SAR system set-up

1) SAR Coordinator (SCs))

Generally, search and rescue coordinators (SCs) are the top level SAR managers and their main responsibilities include, *inter alia*:

- i. Establishing, staffing, equipping, and managing the SAR system;
- ii. Establishing rescue coordination centres (RCCs);
- iii. Providing or arranging for SAR facilities;
- iv. Coordinating SAR training;
- v. Developing SAR policies.

SCs are not directly²² involved in the actual rescue operations but they only deal with management roles

2) SAR Mission Coordinator (SMCs)

Usually, SMCs are the personnel responsible for coordinating all the SAR missions. In most cases, SAR operations are carried out under the guidance of an SMC. The

²² However, they can indirectly be involved in the rescue operations in one way or another

SMC(s) usually carry out their duties from designated Rescue Coordination Centres (RCCs). The main duties and responsibilities of an SMC include, *inter alia*:

- i. Obtaining, compiling and evaluating all data on the emergency;
- ii. Dispatching search and rescue units (SRUs) on the basis of this information;
- iii. Developing search plans that include determining limits for the search area, selecting the search pattern, and designating the OSC;
- iv. Controlling the SAR communication network for the assigned mission,
- v. Monitoring the progress of the SAR mission and request additional SAR resources as necessary;

3) On-Scene Coordinator (OSC)

Normally, the first unit or person to arrive at the scene of distress assumes the duty of the OSC until the SMC directs otherwise.

In most cases, however, the OSC is designated by the SMC to coordinate the activities of all SAR units at the scene of distress. The OSC should be the most capable unit or person putting into consideration the following factors:

- ◆ SAR training, integrity, resilience/endurance and experience;
- ◆ Communications capabilities; and
- ◆ The length of time that the unit or person can stay at the distress scene.²³

As a subordinate to the SMC, the OSC has several responsibilities and these include, but not limited to:

- i. Updating the SMC through periodic situation reports (SITREPs)²⁴;
- ii. Controlling all the on-scene communications between SRUs;
- iii. Monitoring the endurance of all SRUs and call for replacement units if the situation warrants so;

²³ This explains why aircrafts are not good for acting as on scene coordinators because of their inability to stay in a particular for long periods.

²⁴ These are reports used to convey information to a higher authority about the status of the incident

- iv. Coordinating the efforts of all SRUs at the distress scene;
- v. Implementing the search action plan from the SMC;
- vi. Providing initial briefings and search instructions to the arriving SRUs.

4) Search and Rescue Units (SRUs)

An SRU is a facility with specially trained personnel, and provided with specialized equipment for conducting SAR operations.

The primary responsibilities of an SRU include, but are not limited to:

- i. Efficiently and effectively executing all the assigned rescue operations;
- ii. Establishing and maintaining communications with the OSC or SMC, as appropriate, prior to arriving at the distress scene, and until released from the case by the SMC.

3.2 SAR International Obligations

The International Maritime Organisation, being the body in charge of regulating maritime activities, is responsible for developing international standards that govern SAR activities. In light of this therefore, there are various international regulations developed by IMO (and other international organizations)²⁵ which oblige Member States²⁶ as well as the masters of sea-going vessels to offer a duty of care to those who might find themselves in distress situations at sea.

According to the Geneva Convention for the Amelioration of the Condition of the Wounded, Sick and Shipwrecked Members of the Armed Forces at sea, there is an obligation for States to still offer SAR services to those in distress at sea even if they are your enemies (12 August, 1949).

²⁵For instance, the International Civil Aviation Organisation (ICAO), International Lifeboat Federation (ILF), etc

²⁶ And to some extent, non-member States

In the following sections, a review of the SAR obligations for both member States and the shipmasters to render assistance to the affected parties at sea, as per the international law, shall be briefly examined.

3.2.1 Member States' Obligations

Member States are obliged to ensure that necessary and adequate arrangements for the provision of SAR services to the affected parties are put in place.

The following are some of the international obligations for Member States as far as SAR service provision is concerned:

- 1) Convention on Maritime SAR, 1979.

Section 2.1.1

Parties²⁷ shall ensure that necessary arrangements are made for the provision of adequate search and rescue services for persons in distress at sea around their coasts.

Section 2.1.8

Parties should ensure that their search and rescue services are able to give prompt response to distress calls.

Section 2.1.9

On receiving information that a person is in distress at sea in an area within which a Party provides for the overall co-ordination of search and rescue operations, the responsible authorities of that Party shall take urgent steps to provide the most appropriate assistance available.

Section 2.1.10

²⁷ Member States

Parties shall ensure that assistance be provided to any person in distress at sea, and they shall do so regardless of the nationality or status of such a person or the circumstances in which that person is found.

Section 3.1.5

States should enter into agreements with neighbouring States setting forth the conditions for entry of each other's rescue units into or over their respective territorial sea or territory. These agreements should also provide for the expeditious entry of another State's SAR units with the least possible formalities.

2) International convention for the Safety of Life At Sea (SOLAS, 1974):

Reg. V/7: SAR services

Contracting governments are obliged to ensure that necessary arrangements are made for distress communication and coordination in their areas of jurisdictions for purposes of SAR service provision.

Reg. V/8

Contracting governments are obliged to ensure that life saving-signals are used by search and rescue facilities engaged in SAR operations when communicating with vessels or persons in distress.

3) The United Nations Convention on Law Of the Sea (UNCLOS), 1982:

Article 98: Duty to render assistance

- ◆ Every state shall require the master of a ship flying its flag, in so far as he can do so without serious danger to the safety of the ship, the crew or the passengers to:
 - a) Render assistance to any person at sea in imminent danger of being lost;
 - b) Proceed with all possible speed to the rescue of persons in distress;

c) Render assistance (after a collision) to the other ship, her crew and passengers and, where possible, to inform the other ship of the name of his/her own ship, her port of registry and the nearest port at which she will call.

- ◆ Every coastal State shall promote the establishment, operation and maintenance of adequate and effective SAR services.

4) Salvage Convention 1989

Article 10 (2): Duty to render assistance

The States Parties shall adopt measures to ensure that, every master is bound, so far as he can do so without serious danger to their vessel and persons thereon, to render assistance to any person in danger of being lost at sea.

3.2.2 Ship-masters' Obligations

Various provisions of international law coupled with a long standing customary practice at sea, require masters of ships to render assistance to distressed vessels or persons at sea whenever it is feasible to do so (IAMSAR manual, Vol.2, P.2-20).

Below are some of the obligations placed on masters of ships by various international conventions.

i. International convention for the Safety of Life At Sea (SOLAS)

Regulation 33, Chapter V

This regulation places an obligation on masters of ships at sea to respond to distress calls from any source at sea if their ship is within the vicinity of those in distress.

On receiving a signal from any source that persons are in distress at sea, this regulation requires the master of any ship that is in a position to provide assistance to proceed with all speed to assist the affected people, and if possible, should

inform them or the search and rescue service that the ship is doing so. However, the master should ensure such assistance does not present any danger to the ship, her cargo, passengers and crew.

ii. Salvage Convention 1989

Article 10(1): duty to render assistance

Every master is bound, so far as he can do so without serious danger to his vessel and persons thereon, to render assistance to any person in danger of being lost at sea.

iii. Brussels Convention on Assistance and Salvage of 1910

Article 11

Every master of the ship within the vicinity of the incident is bound, so far as he can do so without serious danger to his vessel, the crew and passengers, to render assistance to everybody (even though an enemy) found at sea in danger of being lost.

3.3 Non-conventional Measures

Besides the conventions which act as mandatory instruments obliging States to provide SAR rescue services in their areas of jurisdiction, there are also other various guidelines and recommendations adopted mainly by IMO and ICAO²⁸ intended to assist States in the fulfilment of their humanitarian obligations to establish and maintain SAR services. Most notably amongst those guidelines is the IAMSAR manual, volumes I-III. The manual was published jointly by ICAO and IMO primarily to assist States in establishing, managing, conducting and coordinating their SAR activities. Briefly, the contents of the three volumes of the manual are:

²⁸ International Civil Aviation Organisation, an internationally recognized body in charge of regulating aeronautical activities

- ◆ **Volume I:** this gives guidelines for establishing the SAR organisation and how to manage it effectively;
- ◆ **volume II:** this offers valuable guidelines on how to coordinate rescue operations;
- ◆ **volume III:** this provides background information on mobile facilities that are supposed to be carried onboard rescue units, aircrafts and all SOLAS ships;

Generally, the guidelines developed jointly by the IMO and ICAO are intended to meet the following objectives:

- ii. Co-ordination between maritime and aeronautical services to ensure efficient and effective SAR services;
- iii. The possibility of combining aeronautical and maritime RCCs or to carry out a close coordination among aeronautical and maritime RCCs when they are independent; and
- iv. The uniformity among the aeronautical and maritime SAR service provision

4 Analysis: Application of Risk Based Approach to SAR at the Operational Level

4.1 Introduction

The previous chapters have served to set the scene for the practical demonstration of how to apply the concept of risk management to SAR operations to enhance the quality of SAR service provision.

Operations, which encompass a number of coordinated responses, form the heart of the maritime SAR activities.

As mentioned in chapter 1, SAR operations can be²⁹ categorically divided into four distinct phases. Arranged in a chronological sequence, the four phases are:

- i. Emergency phase;
- ii. Initial response (from the SAR system);
- iii. Actual mission/mission execution; and
- iv. Mission conclusion phase.

The first thing to do in any risk management process is to identify all the un-wanted events (risks)³⁰ that are associated with a particular activity.

²⁹ There might be some other forms of categorisation depending on the author, but this categorisation was preferred for this study.

³⁰ Things that can go wrong

In this regard, therefore, a survey³¹ was conducted in five countries³² primarily to identify the potential risks associated with each of the above-mentioned phases of SAR at operational level.

In order to demonstrate practically how the concept of risk management can be used to enhance the effectiveness of SAR service provision, the rest of this chapter will be dedicated to analyzing the identified risks at each phase, establishing their possible root causes, and then devising appropriate remedial measures corresponding to each of the identified risks. Collectively, the entire process is referred to as risk management or risk based approach.

For purposes of simplicity³³, the following criteria shall be followed for each of the above-mentioned SAR phases to devise appropriate risk control measures corresponding to the identified risks:

1. STEP 1: *Risk identification and analysis*

This is where all the risks that were identified through the questionnaire from the five countries will be stated, along with their possible likelihood of occurrence, corresponding possible consequences and the possible degree of severity of the consequences (in case of risk occurrence).

The following key words shall be used throughout this step for all the phases:

- ◆ **Identified risk:** to mean all those risks or un-wanted events that were identified by the SAR operational personnel from the countries that responded to the questionnaires;

³¹ See sample questionnaire in appendix 1

³² United Kingdom, Sweden, German, Australia, and Denmark

³³ Without necessarily following the systematic sequence of the risk management process described in chapter 2

- ♦ **Consequences:** to mean all the possible consequences that might take place in case of risk occurrence;
- ♦ **Likelihood of occurrence rating:** to mean the possibility of occurrence of the identified risk. The higher the rating, the more likely the risk is to occur. A scale rating of **1-4** shall be used to estimate the likelihood of risk occurrences (table 2a).
- ♦ **Degree of severity or severity rating:** to mean the possible magnitude of the consequences in case of risk occurrence; the higher the rating, the more severe the consequences. In this regard, a scale rating of **1-4** shall be used to estimate the degree of severity of the consequences (see table 2b);

On the basis of the information gathered through the questionnaires, the following tables 2(a) and 2(b) shall be used throughout the analysis for rating the likelihood of risk occurrence and the degree of severity of the consequences.

Table 2(a) - Scale for rating the likelihood of risk occurrence

Assign a rating of:	If the identified risk is:	Indicators
1	Very un-likely to occur	Once in 7 many years
2	Less likely to occur	A few times in a year
3	Likely to occur	Can occur any time
4	Very likely to occur	Very frequent (occurs regularly)

Source: Adapted from the International Maritime Organization (IMO), MSC/Circ.1023 (P.43)

Table 2(b) - Scale for rating the degree of severity

Assign a rating of:	If the degree of severity of the consequences is:	Indicators
1	Minor	Minor injuries, minor equipment damage, minor impact on the environment, minor impact on the SAR organisation, negligible impact on the SAR system.
2	Significant	Significant injuries, significant equipment damage, significant impact on the environment, significant impact on the SAR organisation, significant wastage of resources, significant reduction in the SAR system's effectiveness
3	Severe	Death of people and multiple injuries, severe equipment damage/loss, severe impact on the environment, severe impact on the SAR organisation (loss of reputation), massive economic losses, huge negative impact on the country's reputation, huge impact on the SAR system's effectiveness
4	Catastrophic	Multiple deaths of people, total equipment loss, appalling environmental damage, total loss of reputation of the SAR organisation, huge economic losses, extreme loss of country's reputation (at the international arena), extreme impact on the SAR system.

Source: Adapted from the International Maritime Organization (IMO), MSC/Circ.1023 (P.43)

2. STEP 2: Risk categorization and prioritisation

For purposes of determining appropriate risk control measures, the identified risks will be categorized on the basis of their corresponding risk priority number; where:

$$\text{Risk priority number} = (\text{degree of severity}) \times (\text{likelihood})$$

(Source: Dickson, 2003, P.122)

Remedial measures shall be sought for only those risks with the priority number greater or equal to 3. Risks with higher priority numbers should be given priority over other risks, and as such, they must be dealt with first; this is what is referred to as risk prioritization³⁴.

This procedure is closely related to the illustration that was given in figure 2.1, (p. 12), where risks with higher combinations of likelihood of occurrence and degree of severity are given higher priority for mitigation purposes.

3. STEP 3: Risk control measures

This is where risk control options for the prioritized risks shall be devised. However, in order to effectively deal with the risks, it is normally recommended to first identify their sources/causes before devising the possible risk control measures to cater for the risks (Frame, 2003, P. 3). In this regard, therefore, attempts shall be made to first establish the possible root causes of the prioritized risks before devising corresponding remedial measures.

³⁴ What to tackle first?

4.2 Emergency phase

Applied to SAR, the emergency phase is a generic term used to refer, depending on the circumstances, either to un-certainty, alert, or distress phase (IAMSAR manual, 2001-2003 amendments, P. xvi)).

i. Uncertainty phase

This situation can be triggered by any of the following circumstances:

- When a vessel is reportedly overdue at its destination; or
- When a vessel has failed to make an expected position or a safety report.

ii. Alert phase

An alert situation is said to exist when, following the uncertainty situation, attempts to establish contact with the vessel have failed and inquiries addressed to other appropriate sources have been unsuccessful; or, when information has been received indicating that the operating efficiency of a vessel is impaired but not to the extent that a distress situation is likely.

iii. Distress phase:

This situation might prevail in any of the following circumstances:

- When positive information is received indicating that a vessel or a person is in imminent danger and urgently needs assistance; or
- When it is beyond reasonable doubt that the reportedly overdue vessel or person(s) is in distress and requires urgent assistance; or
- When information is received indicating that the operating efficiency of a particular vessel has been impaired to the extent that a distress situation is likely.
- When there is an attempt by the distressed vessel or person(s) to contact the SAR authorities for assistance.

For purposes of simplicity, only the generic term “emergency phase” shall be used in the analysis.

4.2.1 Risk identification and analysis (step 1)

With reference to the criteria described in section 4.1, table 3 shows a list of events that can go wrong (risks) during the emergency phase, the possible likelihood of risk occurrence, the corresponding possible consequences, and the degree of severity of the consequences (based on scale rating in tables 2a and 2b, section 4.1).

Table 3- Risk identification and analysis (Emergency phase)

Identified risk	Likelihood of risk occurrence[§]	Possible Consequences	severity rating[®]
1. Un-necessary activation of the SAR system by a false alert/distress signal	4	<ul style="list-style-type: none"> ▪ Unnecessary deployment of resources that could otherwise be used for a genuine emergency; this leads to wastage of resources as well as the tax payers money; ▪ Creates unnecessary workloads for SAR personnel and this might also put their lives at risk; ▪ Responding to false alerts can cause large and unnecessary delays in responding to real emergencies; ▪ Reduces the over-all efficiency of the SAR system because at times the SAR 	2

[§] Based on the rating scale in table 2(a), section 4.1

[®] Based on the rating scale in table 2(b), section 4.1

		personnel may not take some alerts seriously, thinking that they are false when in actual sense they are not false	
2. Inability of the distressed vessel or person(s) to effectively alert the SAR authorities	3	<ul style="list-style-type: none"> Leads to scanty information regarding the nature and location of the incident; this undermines the rescue personnel's capabilities to locate those in distress within the shortest possible time. This might eventually lead to loss of lives or extended injuries. 	3
3. Delays by the distressed vessel or person(s) to activate the SAR system when in distress situation	2	<ul style="list-style-type: none"> Late response from the SAR system; this leads to unnecessary delays in locating and rescuing those in distress; eventually, this might lead to loss of lives that would otherwise have been saved had the RCC personnel been alerted early enough; This practice also causes panic among the SAR personnel because it allows them very limited time to adequately prepare for the response. 	3
4. Incoming distress alert, but no personnel at the designated rescue centres to acknowledge the call.	3	<ul style="list-style-type: none"> No response from the SAR system; this will lead to eventual loss of lives of those in distress 	3
5. Misinterpretation		<ul style="list-style-type: none"> This will have an impact on the 	

of a distress message/signal by the RCC personnel	2	successfulness of the rescue operations because all the subsequent rescue actions will be based on the wrong information. In the end this might lead to a failure in locating the distress scene or to deploy inappropriate resources	3
6. Failure of the distressed vessel or person(s) to activate the SAR system to request for assistance	2	<ul style="list-style-type: none"> No response from the SAR system; this might lead to total loss of lives of those in distress or extended injuries. 	3

4.2.2 Risk Categorisation and Prioritisation (Step 2)

At this stage, all the risks that were identified in the previous sub-section 4.2.1, shall be categorised and prioritised for purposes of mitigation. However, that will be done on the basis of their likelihood of occurrence rating as well as the degree of severity of the consequences. A factor called the risk priority number³⁵ will be used to rate and rank the magnitude of each of the identified risks. The greater this factor, the higher the risk rating and hence the more urgency for the need to devise remedial measures to address the risk. All risks with the risk priority number greater than or equal to 2 will be subject to mitigation.

In line with this, table 4 shows a list of categorised and prioritised risks arranged in accordance with the magnitude of the risk priority number, and as mentioned earlier, risks with higher priority numbers must be addressed first.

³⁵ Risk priority number = (likelihood of occurrence factor) X (degree of severity factor); see section 4.1

Table 4- Risk categorisation and prioritisation (emergency phase)

Identified Risk	Priority number**	Risk Category[⊕]
1. Inability of the distressed vessel or person(s) to effectively alert the SAR authorities.	9	Very urgent
2. Incoming distress alert, but no personnel at the designated rescue centres to acknowledge it	9	Very urgent
3. Un-necessary activation of the SAR system by a false alert/distress signal	8	Very urgent
4. Delays by the distressed vessel or persons to activate the SAR system when in distress situation.	6	Urgent
5. Misinterpretation of a distress message/signal by the RCC personnel	6	Urgent
6. Failure of the distressed vessel or person(s) to activate the SAR system to request for assistance	6	Urgent

4.2.3 Risk Control Measures (step 3)

This is the last step, and it involves devising appropriate remedial measures for the prioritized risks. However, efforts shall be made to first establish the possible root causes of the (prioritized) risks in step 2, and thereafter, appropriate risk control measures corresponding to each risk shall be devised.

** Refer to section 4.1 (step 2) for the description of the priority number

[⊕] This column indicates the degree of urgency required to mitigate a particular risk.

1- Inability of the distressed vessel or person(s) to effectively alert the SAR authorities.

Failure of those in distress to effectively alert the SAR authorities can hugely affect the effectiveness of the subsequent SAR operations to rescue the survivors.

a) Possible root causes:

- ◆ Ignorance of the crew of the distressed vessel on usage of onboard communication equipment;
- ◆ Lack of proper means of onboard communication equipment;
- ◆ Communication equipment onboard is faulty: either due to poor maintenance or bad handling;
- ◆ The distress signal is very weak;
- ◆ Alerting devices/equipment onboard expired: there are certain types of alerting devices that expire after a specified period. There is therefore a possibility that they can expire without the knowledge of the shipboard management, and when time for use comes, i.e. where there is an emergency, they cannot be effectively activated.

b) Appropriate risk control measures.

The following measures can assist to reduce magnitude of the risk:

- ◆ Training of equipment users on how to send out distress alerts or how to activate the SAR system in case of an emergency;
- ◆ Improving the SAR communications capabilities to ensure that distress information is clearly transmitted and in a timely manner;
- ◆ Only approved type of onboard communications equipment should be authorised for usage;
- ◆ Regular inspections and maintenance should be carried out on all the communications equipment onboard to avoid technical failures at the time of usage of the equipment.

Regulation III/20 of the International Convention for the Safety of Life at Sea (SOLAS, 2004 amendments) requires all ships to ensure operational readiness, maintenance and inspection of all lifesaving appliances onboard. The same regulation also requires that, spares and repair equipment shall be provided on board for all lifesaving appliances (reg. III/20.5).

2- Incoming distress alert, but no personnel at the designated RCCs to receive/acknowledge the call.

Although this might appear peculiar, it could be possible (in some jurisdictions) that there is no one at the designated RCC or alerting posts, to receive/acknowledge a distress call sent out by those in distress.

a) Possible root causes:

- ◆ No properly established 24-hour service;
- ◆ Insufficient staff at the rescue centres;
- ◆ Poor management of staff at the rescue centres, lack of staff supervision;
- ◆ RCC personnel poorly motivated;
- ◆ Lack of professionalism/commitment amongst the RCC personnel.

b) Appropriate risk control measures:

- ◆ Ensure the continuous availability of a sufficient³⁶ number of properly trained personnel at the RCC to attend to any SAR emergency that might arise;
- ◆ The RCC or alerting posts should be operated on a 24-hour basis in as much as it is practically possible;

³⁶ Just enough personnel to operate the station continuously; however, prior arrangements should be put in place to quickly mobilise other additional personnel if the situation warrants so.

- ◆ Instil a high level of professionalism³⁷ amongst the RCC personnel through continuous training, exercises and performance appraisals;
- ◆ Motivate the RCC personnel to execute their duties diligently;
- ◆ Continually monitor the performance of the RCC staff.

3- Un-necessary activation of the SAR system by a false alert/distress signal

False alerts are any alerts received by the SAR system indicating that there is an emergency situation but when in reality no such situation exists (vol. II IAMSAR manual, P. 2-11).

False alerts are a great threat to any SAR system as they tremendously reduce the effectiveness of the SAR system in one way or another.

a) Possible root causes:

- ◆ Un-authorised users playing around with the alerting devices/equipment. For instance, curious passengers on board trying to figure out how the equipment works might end up activating the equipment without their knowledge;
- ◆ Accidental activation of the alerting devices/equipment by the ship-board crew;
- ◆ Mishandling of alerting equipment/devices due to lack of knowledge of equipment usage. In line with this, statistics collected by the IMO from various RCCs worldwide show that a big percentage of false alerts (approximately 95% of the total false alerts received), are mainly caused by lack of knowledge of the shipboard crew, and more so ignorance of the relevant conventions, codes and regulations.
- ◆ Frequent technical failures of alerting devices;
- ◆ Human errors cannot be overlooked also.

³⁷ Integrity, honesty and commitment

b) Appropriate Risk control measures:

- ◆ Training of the ship-board crew on how to use the alerting devices/equipment onboard;
- ◆ The shipboard management should put warning notices on all the alerting devices that can be accidentally activated by passengers on onboard to prevent un-authorised handling; simple warning notices like “DO NOT TOUCH”, fully visible on the equipment can be very useful in dealing with this risk;
- ◆ Only approved type of alerting devices should be authorised by the responsible authorities for usage onboard;
- ◆ All the alerting devices/equipment used onboard every vessel should be registered by the responsible authorities. This registration should ensure that there is an easy way to identify the distress alerts with a particular alerting device/equipment installed onboard a particular ship. This can provide the SAR authorities with an easy way of tracking the origin of the false alerts, and to take timely actions to establish a communication link with the responsible vessel to confirm the validity of the alert;
- ◆ The shipboard crew personnel should be sensitized about the implications of sending out false alerts and be taught how to immediately cancel them in case of accidental activation. Experience has shown that most false alerts are caused by emergency position indicating radio beacons (EPIRBs)³⁸, and of late, from the GMDSS system. If by accident (for example) an EPIRB is activated, the shipboard crew should immediately make attempts to contact any nearest coast station or an appropriate coast earth station or RCC and cancel the distress alert. The International Maritime Organization

³⁸ These are electronic units with built-in transmitters and a battery and they transmit radio signals when activated

(IMO), through the sub-committee on Radio Communications and Search and Rescue (COMSAR) developed some useful guidelines to administrations on the reporting of false alerts.³⁹ In addition, the US coast guard also developed some operating instructions on how to cancel the false alerts in case of accidental activation.⁴⁰

- ◆ All alerting devices should always be secured onboard vessels in such a manner that prevents accidental activation. EPIRBs, for instance, can be secured in brackets and only be removed from the bracket when there is an emergency;
- ◆ Imposing heavy fines on those who irresponsibly activate the SAR system by false alerts.

4- Delays by the distressed vessel or person(s) to activate the SAR system when in distress situation.

With all the communication gadgets at their disposal, it is not uncommon for some masters of the distressed vessels to take a lot of time before finally deciding to activate the SAR system for assistance.

a) Possible root causes:

- ◆ Overconfidence of the shipboard crew and in particular the master;
- ◆ Negligence, by the shipboard crew;
- ◆ Failure of the ship-board management to recognise that an emergency situation exists;

b) Appropriate risk control measures:

- ◆ The shipboard management, and in particular the master who has the over-riding responsibility over the safety of the ship and her

³⁹ See MSC/Circ.1078; COMSAR seventh session (13 to 17 January 2003).

⁴⁰ For details, follow this link: <http://206.65.196.29/marcomms/gmdss/false.htm>

occupants, should be sensitised on the implications of taking too much time to activate the SAR system when faced with uncertainties. Although this could be a sensible idea not to un-necessarily activate the system when actually the problem can be fixed, it is better to notify the responsible authorities about the existence of an emergency situation and assure them that efforts are being made to rectify the situation. Technically, this is done by sending out PAN-PAN alerts (instead of the usual MAYDAY calls) to the responsible SAR authorities. Sending out PAN-PAN alerts does not necessarily mean requesting for assistance but it is primarily meant to inform the SAR authorities that a particular vessel has developed some problems and the shipboard crew (in the meantime) is trying to rectify the problem. This gives ample time to the SAR authorities to be on a standby should the situation deteriorate.

5- Misinterpretation of a distress message/signal by the RCC personnel.

- a) possible root causes
 - ◆ Lack of proper training in use of communication equipment;
 - ◆ Panicking of the RCC personnel brought about by lack of exposure experience in handling distress alerts;
 - ◆ Misunderstandings in the exchange of information between those in distress and the RCC/alerting posts; this is especially possible if there are no direct communication links between the RCC and those in distress.
- b) Appropriate risk control measures
 - ◆ Proper training should be given to the RCC personnel on how to use the communications equipment, and in particular how to respond to emergencies when alerted. There should be properly laid down

guidelines on what steps to take on receipt of an emergency call/message.

The IAMSAR manual volume II, gives important guidelines on the type training the RCC and the rescue sub-centre (RSC) personnel are supposed to undergo (2001-2003 amendments, P.1-11).

- ◆ Efforts should be made to ensure that there is at least one experienced person available at the RCC/alerting post at any given time;
- ◆ The validity of all the distress information received about a particular incident should be carefully evaluated in order to avoid undue misunderstandings. This done, it can then be easy to decide on the immediate course of action that is based on factual information.

6- Failure of the distressed vessel or person(s) to activate the SAR system to request for assistance.

Failure by those in distress to activate the SAR system for assistance is a very dangerous situation because no one will come to their rescue.

a) Possible root causes:

- ◆ No time to send out distress alert due to abruptness of the emergency situation; for instance, vessel capsizes or sinks suddenly due to an abrupt technical failure, force *majeure*, or otherwise;
- ◆ Those in distress do not know who to contact for assistance;
- ◆ Technical failure or faulty alerting devices/equipment;
- ◆ Those in distress have no means of sending out distress alerts to activate the SAR system.

b) Appropriate risk control measures:

- ◆ All vessels should be required to carry onboard alerting devices/equipment that can be automatically activated in case the

vessel sinks abruptly without prior warning signs. Such equipment should include, but not limited to:

- i. Hydrostatically controlled EPIRPs (supported in a COSPAS-SARSAT environment)⁴¹;
- ii. The Global Maritime Distress Safety System;
- iii. Hydrostatically controlled SAR radar transponders.

- ◆ Individual mariners should be encouraged to carry with them devices known as Personal Locator Radio Beacons (PLRB). These operate under the same principle as EPIRBs, the only difference being that, they are designed for individuals. For better performance, EPIRBs should be regularly inspected and well maintained to ensure that they are ready to work anytime and anywhere. The United States Coast Guard department of SAR in conjunction with the US National Environmental, Satellite, Data and Information Service (NESDIS), provide useful guidelines on how to carry out monthly inspections on EPIRBs to ensure their operational readiness.⁴²
- ◆ Publishing all the information that could be needed by distressed mariners to activate the SAR system for assistance; such information might include, but not limited to:
 - Emergency Telephone numbers;
 - Dedicated frequency channels;
 - Who⁴³ to contact in case of emergency.

⁴¹ More information about how the COSPAS-SARSAT system works can be obtained directly from the web site: <http://www.cospas-sarsat.org/Description/concept.htm>

⁴² Details about the procedures can be obtained from the web site: http://www.sarsat.noaa.gov/EPIRB_inspecting.pdf

⁴³ Which authorities/personnel/units

- ◆ **Float Plan enforcement:** In order to cater for cases of overdue vessels or individuals that, for some reasons, are unable to contact the SAR authorities to request for assistance in case of an emergency, all mariners⁴⁴ should be required and encouraged to fill in a float plan of their intended voyages and leave it with their next of keens or they can file it with the SAR authorities or any other responsible authority like the marine police. A float plan is a list of basic information about a particular vessel, her crew, the number of passengers (if any), her intended final destination and the expected time of arrival to the destination, expected time of return to the home port and lots of other relevant information. The float plan can assist the SAR authorities in tracking the missing vessels or persons suspected to be in distress but which, for some reasons, cannot alert the SAR authorities to request for assistance.

However, mariners who filed a float plan should be advised to cancel it on return from their trip/voyage. This is to ensure that the SAR authorities do not conduct not unnecessary searches to trace them.

So when a vessel happens to be overdue either at its intended destination or at the homeport, then the SAR authorities can be notified to immediately mount a search for the overdue vessel.

This float plan arrangement, if well enforced, can go a long way in assisting the SAR authorities to mitigate the risk of overdue vessels or persons that, for some reasons, cannot activate the SAR system to request for assistance when in grave danger. This system is in use in

⁴⁴ Especially fisher-men

several countries and the outcomes have proved to be very effective in terms of saving the lives of mariners.

An example of a float plan layout can be viewed from the USCG web site.⁴⁵

- ◆ All vessels should be required to carry appropriate and sufficient life saving appliances that are in compliance with chapter III of the International Convention for the Safety of Life at Sea (SOLAS), 1974. The standards of such life saving appliances should be as specified in the Life Saving Appliances code. For non-convention vessels, the maritime administration should specify the appropriate type of life saving appliances to be carried onboard such vessels.

4.3 Initial response (from the SAR system)

On receiving information about the possible existence of an emergency situation, the preliminary action taken by the designated rescue coordination centre (RCC)⁴⁶ personnel is referred to as the initial response. However, this should not be confused with the initial action taken by the distressed vessel or person(s) to activate the SAR system in case of an emergency; instead this refers to the response from the responsible SAR authorities after being alerted by the distressed vessel or person(s). This SAR stage period is critical because all the subsequent SAR actions will principally depend on the accuracy of the decisions and the appropriateness of the actions taken by the RCC designated personnel in response to the distress alert.

⁴⁵ See link: <http://floatplan.uscgaux.info/download/USCGFloatPlan.pdf>

⁴⁶ It could be a Joint Rescue Coordination Centre (JRCC), i.e. when the centre is being jointly used for both maritime and aeronautical responses; Or maritime rescue coordination centre (MRCC), i.e. centre only used for maritime SAR activities or any other suitable arrangement.

4.3.1 Risk identification and analysis (step 1)

Table 5 shows a list of the possible unwanted events (risks) that were identified to be associated with the initial response phase. Also, stated along are the corresponding likelihood of risk occurrence, the possible consequences (in case of risk occurrence) and the corresponding degree of severity of consequences

Table 5- Risk identification and analysis (initial response phase)

Identified risk	Likelihood of risk occurrence [§]	Possible Consequences	Severity rating [⊕]
1. Delay in response or longer response time	3	◆ This leads to late deployment of resources to assist those in distress; could eventually lead to loss of lives that would otherwise have been saved if the response was quick	3
2. Inappropriate response to the incident	3	◆ Failure to save the lives of those in distress ◆ Wastage of resources	3
3. Improper, inaccurate or incorrect search planning	2	◆ Failure of the subsequent rescue operations leading to massive loss of lives and wastage of resources	3

[§] Based on the scale rating in table 2a, section 4.1

[⊕] Based on the scale rating in table 2b, section 4.1

4.3.2 Risk Categorisation and Prioritisation (Step 2)

The identified and analysed risks in section 4.3.1 are categorised and prioritised for mitigation purposes as shown in table 6. This section is related to section 4.2.2 (for the emergency phase), and therefore, more clarification may be sought from there.

Table 6- Risk categorisation and prioritisation (Initial response phase)

Identified Risk	Priority number**	Category [⊕]
1. Improper search planning	9	Very urgent
2. Delay in response or longer response time	9	Urgent
3. Improper, inaccurate or incorrect search planning.	6	Urgent

4.3.3 Risk Control Measures (step 3)

In order to devise appropriate remedial measures for the prioritised risks it is imperative to first establish the possible root causes for each of the prioritised risks. Like in the previous sections, risks with higher priority numbers should be dealt with first; in other words they have priority over other risks.

The following discussion is aimed at devising appropriate control measures for the prioritised risks.

1- Improper search planning;

One of the initial principal requirements for conducting a successful SAR mission is to draw up SAR action plans for executing the mission. To this end therefore, a wrongly planned SAR mission can be very costly, both from the

** Refer to section 4.1 (step 2) for the description of the priority number

⊕ This column indicates the degree of urgency required to mitigate a particular risk.

economic perspective (wastage of resources and time) and from the casualty point of view (massive loss of lives of those in distress).

a) Possible root causes

- ◆ The principal root cause for this risky situation is lack of training and experience amongst the RCC personnel who are tasked with the responsibility of drawing up plans for the mission;
- ◆ Human error might also be a primary contributor to this risk.

b) Appropriate control measures

- ◆ Appropriate training should be offered to the personnel in charge of rescue planning and in particular, practical training in form of exercises should be emphasized. Volume II of the IAMSAR manual (2001-2003 amendments, Chap. 4), offers valuable guidelines on how to carry out search planning;
- ◆ All the responsible RCC personnel should be given basic training in human element-related courses to minimise the risk of errors that might be committed during the search planning process.

2- Delay in response or longer response time;

Any successful SAR operation depends on the speed with which the mission is planned and executed (ICAO SAR manual, 1994). However, more often than not, the responses to the emergencies are unnecessarily delayed.

a) Possible root causes

- ◆ Over-documentation of the incident by the RCC staff leading to too much time wastage;
- ◆ Technical or man power problems with first choice resource;
- ◆ Lack of professionalism amongst the designated RCC personnel;
- ◆ Over planning of the incident leading to too much time consumption;

- ◆ Wrongly believing that those in distress are safer than they actually are;
- ◆ The RCC is doubtful about the existence of an emergency situation.

b) Appropriate control measures

- ◆ On confirming that a distress situation exists after receipt of an alert call, the RCC personnel should immediately notify all relevant SAR authorities and facilities that are likely to be involved in the mission about the incident so that necessary arrangements can be put in place to rescue the survivors within the shortest possible time;
- ◆ All the resources⁴⁷ that might be needed for conducting SAR missions should be kept in a continuous state of readiness so that they can be swiftly deployed any time in case of an emergency;
- ◆ Although documenting the details of the incident and the subsequent evaluation of the reports about the prevailing incident is a good working practice, care must be taken to avoid consuming too much valuable time in doing so. Decisions must be made swiftly and precise actions taken to rescue the survivors within the shortest possible time. In SAR language, there is what we call “the first golden hour”; within that hour, one should try as much as possible to ensure that there is minimal time wasting. Experience has shown that the chances of survival of the victims decrease on average by about 80% during the first 24 hours (ICAO SAR manual, 1994, P. II-1-1)
- ◆ Although devising plans for the subsequent rescue operations is one of the recommended steps in conducting a successful the SAR mission (IAMSAR manual, Vol. II), efforts should be made to deploy at least one search and rescue unit (SRU) to the scene of distress as soon as possible (after being alerted) while attempts are underway to

⁴⁷ Not only the equipment but also the SAR personnel

develop comprehensive rescue action plans for executing the entire mission.

It should, however, be noted that the deployed SRU may not have the capabilities to rescue the victims but they can help in comforting the survivors as they wait for the main rescue units to arrive at the distress scene. Besides, this SRU can also act as a communication link between the SAR shore-based authorities and those in distress, thereby making it possible to take appropriate decisions and in particular, the deployment of adequate resources to the rescue the survivors;

- ◆ Whenever there is an incident, it must always be assumed that there are survivors who need immediate assistance and that any delay in providing such assistance can lead to their loss of lives or extended injuries;
- ◆ If confirmation of the existence of an emergency cannot be obtained without undue delay, the RCC should act on the basis of the doubtful information until the real situation about the incident is verified;
- ◆ Training and instilling professionalism⁴⁸ amongst the RCC staff can be an effective measure to combat this risk.

3- Inappropriate or wrong response from the RCC;

a) Possible root causes

- ◆ RCC acting on the basis of wrong information supplied to them either by those in distress or from third parties;
- ◆ The type of incident being reacted to is either under-estimated (leading to under-deployment of resources) or over-estimated (leading to over-deployment of resources).

b) Appropriate risk control measures:

⁴⁸ Integrity, responsibility and honesty

- ◆ The RCC should always ensure that they verify all the relevant information relating to the distressed vessel before alerting other relevant SAR authorities for subsequent actions.
- ◆ In order to have a rough idea on the right amount of resources to deploy to the scene of distress, the RCC personnel or any other responsible SAR authorities should undertake efforts to obtain, at least⁴⁹, the following basic information from the distressed vessel before taking any action to deploy resources:
 - i. Nature of the incident or emergency;
 - ii. Number of persons at risk;
 - iii. Location of the incident;
 - iv. Types of detection aids and survival equipment available onboard;⁵⁰
 - v. Present Weather conditions at the scene of distress.

4.4 Mission Execution Phase

This is the stage at which the SAR units proceed to the distress scene to execute the SAR mission (IAMSAR manual, vol. II, p. xix). It involves such activities as searching for the distressed vessel or person(s), rescuing the survivors, providing them with initial medical care (if necessary), and then finally delivering them to a designated place of safety ashore where further assistance can be rendered to them. This stage period is critical and as such, so many things can go wrong in the process.

⁴⁹ It is recommended to gather sufficient information from those in distress. But for some reasons, this may (at times) not be possible, and for that reason therefore, **at least** the most critical information should always be obtained.

⁵⁰ This information can be obtained from other sources like the IMO publications, government databases or from the owners of the vessel ashore.

4.4.1 Risk identification and analysis (step 1)

Table 7 shows a list of events that can go wrong during this stage period, the corresponding consequences (in case of risk occurrence), the likelihood of risk occurrence and the estimated degree of severity of the consequences.

Table 7- Risk identification and analysis (mission execution phase)

Identified risk	Likelihood of risk occurrence [§]	Possible Consequences	Severity rating [§]
1- Mix up or confusion in issuing of commands/ instructions, either by the SMC or at the distress scene by OSC;	3	♦ This might lead to failure of the mission due to conflicting information and commands; this eventually leads to loss of lives of those in distress	2
2- Inability to deal with unplanned media relations	3	♦ Hindrance of the SAR mission execution; ♦ Instigation of un-necessary panic within the general public especially the relatives of the victims through speculations; ♦ Damaging the public relations of the SAR organisation.	3

[§] Based on the scale ratings in table 2a and 2b, section 4.1

3- Jamming the SAR communications network with unnecessary communication workloads;	3	♦ This might lead to the failure of the mission resulting in unnecessary loss of lives. It is not possible to coordinate the rescue mission without an effective communications network.	3
4- Inability to provide first aid to the survivors after rescuing them from danger;	2	♦ Leads to loss of lives or extended injuries to the already rescued victims.	3
5- Equipment failure;	2	♦ Might lead to failure of the mission.	3
6- An accident or a mishap occurs to the rescue unit en route to the scene of distress;	1	♦ Mission cannot proceed and therefore no lives will be saved.	3
7- Survivors too far from immediate help; distress scene too remote ⁵¹ ;	3	♦ Survivors might die before they can get any form of assistance from the SAR response units.	3
8- Inability to cope with a big incident involving so many casualties (mass rescue operations);	1	♦ Leads to <u>massive</u> loss of lives of the victims. ♦ Causes a lot of commotion within and outside the SAR organisation;	4

⁵¹ Far away from the nearest SAR facility

		<ul style="list-style-type: none"> ◆ Hugely indents the public image of the SAR organisation; ◆ Weakens the economical competitive advantage of the affected country at the international arena. 	
9- Improper utilisation of resources.	3	◆ <u>Either</u> leads to failure of the mission <u>or</u> leads to extensive wastage of resources that could have been utilised for another mission.	3
10- Inability to deal with un-planned volunteer responses;	2	◆ Hinders the smooth execution of the rescue operations especially at the scene of distress.	2

4.4.2 Risk Categorisation and Prioritisation (Step 2)

Table 8- Risk categorisation and prioritisation (mission execution phase)

Identified risk	Priority number^{**}	Category[⊕]
1. Survivors too far from immediate help; distress scene too remote.	9	Very urgent
2. Jamming the SAR communications network with un-necessary communication workloads.	9	Very urgent

^{**} Refer to section 4.1 (step 2) for the meaning of the priority number

[⊕] This column indicates the degree of urgency required to mitigate a particular risk.

3. Inability to deal with <u>un-planned</u> media relations.	9	Very Urgent
4. Improper utilisation of resources.	9	Very urgent
5. Equipment failure.	6	Relatively urgent
6. Inability to provide first aid to the survivors after rescuing them from danger.	6	Urgent
7. Mix up or confusion in issue of commands/ instructions at the scene of distress.	6	Urgent
8. Inability to deal with un-planned volunteer responses.	4	Consider (mitigating)
9. An accident or a mishap occurs to the rescue unit en route to the distress scene.	4	Consider
10. Inability to cope with a big incident involving so many casualties (mass rescue operations).	4	Consider

4.4.3 Risk Control Measures (step 3)

The mission execution phase is a critical phase and requires a high level of planning and coordination. To this end therefore, it is imperative to ensure that all the possible unwanted events that can deter the successful completion of the mission are catered for well in advance prior to the commencement of the operations to minimise surprises that could be encountered. In light of this, therefore, the following are the various risk control measures corresponding to each of the prioritized risks in section 4.4.2. Like in the previous phases, the probable root causes for the identified risks shall be identified first before devising appropriate remedial measures corresponding to each risk.

1. Survivors too far from immediate help; location of distress scene too remote;

Sometimes it happens that the scene of distress is too far from the nearest SAR facilities, and as such, it might take a lot of time before the SAR units could arrive at scene to assist the survivors.

a) Possible root causes:

- ◆ SAR resources and facilities not evenly distributed to cover a wider area within the allocated search and rescue region (SRR);

b) Appropriate control measures:

- ◆ The SAR services should be distributed evenly throughout the entire SRR by setting up localised rescue sub-centres (RSC) or alerting posts. However, the distribution of these RSCs should be based on the traffic density in a particular area. As a matter of fact, they should be located in areas that have a high possibility of occurrence of accidents. In addition, the distance from the nearest alerting post should be put into consideration also; in other words, the RSC should not be too close to each other. It should also be ensured that these RSCs have full time watch-standers to maintain a 24-hour watch in as far as it is practically possible. With this arrangement in place, it becomes easier to respond to distress alerts anywhere within the SRR within the shortest possible period of time.

2. Jamming the SAR communications network with un-necessary communication workloads.

Jamming the SAR communications network should be avoided as much as possible during the mission execution; reason being that without good communication, nothing can be achieved as far as SAR operations and coordination are concerned.

a) Possible root causes

- ◆ Too many in-coming calls from various sources⁵² both from within and outside the SAR organisation;
- ◆ Poor and un-coordinated use of the communications equipment by the SAR personnel from within the organisation.

b) Appropriate risk control measures

Communication is an integral part of any successful SAR mission. The following measures can assist in reducing the communication failures resulting from jamming the SAR communications system during the mission execution:

- ◆ A comprehensive communications plan for the entire mission should be prepared by the responsible personnel prior to the commencement of the mission; it should be incorporated in the SAR action plan and distributed to all relevant personnel within the SAR organisation, especially the operations team.

As a minimum, a good communications plan for the SAR mission should contain:

- i. A list of dedicated and declared⁵³ frequencies/channels along with the description of their functions/use and corresponding IDs⁵⁴; for instance, dedicated channels to cater for public relations matters, on-scene coordination, hospital/MEDICO⁵⁵ arrangements, SAR mission coordination, administrative tasks, homing, logistics and supplies, etc.

⁵² Politicians, relatives of victims, the media, etc

⁵³ Publicised

⁵⁴ For example: Alpha 1, Alpha 2, Bravo 1, Bravo 2, etc.

⁵⁵ This term is used to refer to medical advice given by doctors to the SAR personnel during or after the operations. It is the exchange of medical information and recommended treatment to the survivors before they are delivered to a medical facility ashore.

This will make it easy for those involved in the mission to know which channels they can access certain people or teams and as such will minimise possibilities of jamming the system.

- ii. Communications procedures; where does the authorisation to use certain frequencies/channels come from.
 - iii. The names of individuals (if practically possible) who are assigned communication equipments like the radios and the frequencies at which they can be reached.
 - iv. All the important notes that might be beneficial to the mission execution.
-
- ◆ Optimal use should be made of all existing communications equipment and facilities if practicable possible (IAMSAR manual, vol. II, 2001-2003, P. 2-17).

3. Improper utilisation of resources.

Usually, and in most jurisdictions, SAR resources are scarce; presumably the biggest challenge for any SAR organisation. Poorly utilising the already meagre resources can be a huge setback as far as SAR service provision is concerned.

a) Probable root causes:

- ◆ Poor planning of resources usage;
- ◆ No planning at all on usage of resources;
- ◆ Over-responding to an incident by un-necessarily deploying too much resources;
- ◆ Extended un-necessary SAR operations that may not yield any good results.
- ◆ Also, poor initial search planning that leads to searching the wrong areas during the rescue operations can cause unnecessary wastage of resources.

b) Appropriate risk control measures

- ◆ Qualified and experienced personnel should do the initial search planning. Proper search planning helps in determining the approximate quantity of resources that might be needed for deployment to carry out the operations;
- ◆ Knowing when⁵⁶ to suspend or to end a search operation that might not succeed due to some reasons that could be beyond the control of the SAR organisation;
- ◆ A properly drawn plan on how to utilise the available resources during the mission execution can be very helpful. A good plan for resource usage should cater for:
 - i. How to get access to the available resources;
 - ii. How to allocate the available resources;
 - iii. The quantity and locations of the available resources;⁵⁷
 - iv. How to get extra or additional resources in case they are; needed to supplement the available and declared resources;
 - v. The personnel in charge of resources (the logistics section, maybe);

2. Equipment failure;

More often, the equipment used to conduct SAR operations un-expectedly fail at the time when they are most needed. This is bad because it jeopardises the successful completion of the mission.

a) Possible root causes:

- ◆ The principal root cause for this risk is lack of regular maintenance for all the equipment that might be used for the operations;

⁵⁶ The proper timing; this depends on the prevailing circumstances

⁵⁷ Most of the resources used in the SAR operations are normally not located in one place; for instance some could be in various government ministries, NGOs, Private institutions, etc

- ◆ Poor equipment handling during the operations.

b) Appropriate risk control measures:

- ◆ All the equipment that might be used for SAR operations should always be kept in a continuous state of readiness. This must be ensured through carrying out regular inspections, testing and maintenance of the equipment. Testing can be carried out during the exercises to confirm the effectiveness and reliability of the equipment.
- ◆ All the SAR operational personnel should be trained on how to use and properly handle the SAR equipment.

3. Mix up or confusion in issue of commands/ instructions at the scene of distress.

It is not very uncommon, in poorly organized SAR missions, for confusions to arise at the scene of distress during the operations.

a) Possible root causes:

- ◆ No particular person has been designated to be in charge of coordinating the on-scene operations;
- ◆ The person in charge of the on-scene coordination is incompetent;
- ◆ Ambiguity of the person in charge of on-scene coordination.

b) Appropriate risk control measures:

- ◆ Always, and whenever possible, there should be one particular designated person to be in charge of coordinating the on-scene operations. Normally, this person is called the On-Scene Coordinator (OSC).
- ◆ To minimise coordination ambiguities at the scene of distress, the OSC should be chosen on the basis of his/her knowledge and experience; preferably, the OSC coordinator should be the most experienced person

amongst the available choices. In most cases, however, the OSC coordinator need not be nominated during the initial stages of the mission. To this end therefore, any person(s) or facility to first arrive at the scene of distress can assume the role of OSC until the responsible SAR authorities decide it otherwise. For better coordination of actions, the OSC should be communicated to every one at the scene of distress.

4. Inability to deal with unplanned media relations.

To the majority of people, it is an unfortunate but yet a realistic fact that bad news is more interesting than good news. The media, if not well planned for in advance, is one of the greatest enemies for successful SAR operations. As a matter of fact, some SAR missions fail to successfully rescue those in distress because of failure in dealing with the media.

On the contrary, however, the media can be a very useful SAR support resource if well planned for; they can keep the general public well informed of what is exactly⁵⁸ going on about the mission and hence helps in lessening the tension amongst the relatives of the victims.

a) Possible root causes of the media risk:

- ◆ The initial SAR plans that were drawn did not cater for the media briefings;
- ◆ The entire SAR organizational set up does not cater for media relations;
- ◆ No properly trained personnel within the SAR organizational set up, and especially at the RCC, to deal with the media in case there is disaster;
- ◆ The person(s) nominated to deal with the media at the time of the incident messes up the briefings;

⁵⁸ Based on factual information from the SAR organisation and not speculations

b) Appropriate risk control measures

- ◆ Planning how to deal with the media in case of a disaster should be an integral part of any SAR organisation. Effective management of media relations is as vital as effective coordination and execution of the SAR mission itself;
- ◆ All the personnel nominated to deal with the media within the SAR organisation should be given proper training on how to carry out this responsibility in case of a disaster.
- ◆ The SAR organisation, and especially the RCC, should establish a good relationship with the mainstream media companies in the country/region. This should be done during the normal working day without first waiting for the disaster to strike. In this way both parties get to know each other; the media learns about the activities of the SAR organisation, and the SAR organisation learns about the media and how to deal with them in a professional manner.
- ◆ In the event of an incident, the personnel designated to deal with the media should endeavour to give out (to the media groups) sufficient information about the incident and the actions being taken to rescue the survivors. The ICAO/IMO joint working group on harmonisation of aeronautical and maritime SAR activities developed some useful guidelines on how the SAR organisation should handle the media.⁵⁹

5. Inability to deal with unplanned volunteer responses.

It is a well-known customary practice that volunteers will always come in to assist the victims of a disaster, any time and anywhere, even without being called upon to do so. Although volunteers provide tremendous support to the SAR operations, failure to properly manage and coordinate them during the operations at the distress scene might end up jeopardising the rescue mission.

⁵⁹ See COMSAR Circ. 3/9/5

a) Possible root causes:

- ◆ Poor mission planning that does not anticipate volunteer participation;
- ◆ Untrained volunteers may have difficulties in understanding the instructions issued out by the OSC, and this can bring about some confusion and uncoordinated actions at the scene of distress leading to a possible failure of the mission.

b) Appropriate risk control measures:

- ◆ Always, the SAR organisation must anticipate for volunteer participation. To this end, the SAR action plan should cater for volunteer responses and how best to deal with them at the distress scene during the operations. In particular, the plans should address the probable roles that the volunteers can be assigned at the scene of distress.
- ◆ The OSC at the scene of distress should brief all the volunteers on what is expected of them, and thereafter assign them appropriate roles putting into consideration their capabilities.

6. Inability to provide first aid to the survivors after rescuing them from danger.

It can be a very unfortunate situation for the victims to die after the rescuers have done the most difficult part of rescuing them from danger. Failure to provide initial medical care to the already rescued victims can result in their death or extended injuries; also, poorly administering the medical care can be as disastrous.

a) Possible root causes of this risk

- ◆ None of the SAR personnel present at the scene of distress has basic professional knowledge in administering first aid care to the survivors;
- ◆ Provision of initial medical care to the survivors was not catered for during the mission planning phase;

- ◆ Emergency pack containing first aid medicine and medical equipment forgotten ashore in an attempt to get to the scene of distress as quickly as possible (hurrying);
- ◆ Undermining the importance of providing initial medical care to the rescued victims.

b) Appropriate risk control measures:

- ◆ All SAR emergency personnel should be given sufficient training in provision of basic first aid care. This will enable them to provide basic life support services to the rescued victims before they are delivered to the shore-based medical facilities;
- ◆ While the speed of response to rescue the victims in distress is of primary importance in any successful SAR mission, care must be taken to ensure that the SAR responding crafts depart with all the required medical kits, equipment and personnel with knowledge of administering first aid care to the survivors;
- ◆ Provision of first aid to the already rescued victims should always be given priority;
- ◆ For complicated medical cases that could be beyond the expertise of the emergency personnel, there should be proper arrangements in place for the rescue personnel in charge of administering first aid to survivors to secure medical advises from reputable medical practitioners ashore if need be. In addition, there should also be proper arrangements for the swift medical evacuation (MEDVAC) of critically ill survivors in as far as it is practically possible.

7. An accident or a mishap occurs to the rescue unit en route to the distress scene;

In unfortunate circumstances, an accident may occur to the SRU personnel either en route to, or from the scene of distress. This can be disastrous because it not

only leads to the failure of the mission but also throws a lot of panic amongst the other SRUs.

a) Possible root causes:

- ◆ Bad or unfavourable weather conditions;
- ◆ Cruising at too high speeds in an attempt to get to the scene of distress as quickly as possible;
- ◆ Taking bad routes with many hazards on the way to or from the scene of distress;
- ◆ Poor operating condition of the rescue crafts used by the SAR emergency personnel;
- ◆ Poor design and construction of the rescue craft;
- ◆ The crew of the rescue crafts not well trained or lack experience and exposure to SAR operating environment;
- ◆ *Force majeure*.

b) Appropriate risk control measures

- ◆ Devise contingency measures to prepare for cases of bad weather. This can be reflected in the design and construction of the rescue crafts; for instance, the crafts could be designed and constructed to withstand adverse weather conditions.⁶⁰ Some rescue crafts are designed to have positive stability at all angles of heel so that even if it capsizes, it rights itself back to the upright (stable) position.⁶¹
- ◆ It is a simple fact that the victims of a disaster will not benefit from a rescue craft that has ran aground or capsized en route to the distress scene. To this end therefore, proper route planning to (and from) the

⁶⁰ Weather proof

scene of distress should always be given due consideration before the mission commences and it should always be remembered that the shortest route is not always the safest;

- ◆ The crew of the rescue crafts should be well trained⁶², and if possible, should have sufficient exposure and familiarisation to the SAR operational environment, possibly through regular exercises;
- ◆ Although speed is of primary importance as far as SAR operations are concerned, too much of it can be disastrous. In this regard, therefore, the operator of the rescue craft should avoid un-necessary over-speeding especially when the weather conditions are not that favourable. Over-speeding can also lead to excessive fatigue amongst the SAR personnel even before the commencement of the rescue operations at the distress scene;
- ◆ Last but not least, all the rescue personnel should be provided with personal protective equipment (PPE) that can increase their chances of survival in case of a mishap.

8. Inability to cope with a big incident involving so many casualties (mass rescue operations).

A mass rescue operation (MRO) is one that involves the need for immediate assistance to large numbers of persons in distress such that the capabilities normally available to the SAR authorities are very inadequate. MROs, although are low probability events, can be very disastrous in case they occur. Very often, SAR service providers fail to cope with such big incidents when they occur.

⁶¹ Self-righting; but this only works if there is no shift of personnel and all the equipment onboard, i.e. no shift of cargo. In other words, the rescue personnel must be securely fixed in one position using the seat belts.

⁶² Training should address among other things, personal survival at sea in case of an accident, how to escape from a capsized vessel, how to re-right a capsized vessel in order to continue with the mission, etc.

- a) Possible root causes:
- ◆ No contingency measures that are in place to deal with such incidents in case they occur;
 - ◆ Failure of the SAR organisation to recognise that such incidents, although very rare, can actually strike;
- b) Appropriate risk control measures.
- ◆ Firstly, the SAR organisation must recognise that anything can happen and that that a big incident that involves large numbers of casualties can actually occur any time;
 - ◆ Secondly, the SAR organisation should develop appropriate contingency measures to deal with big incidents in case they occur. Such measures may include, but are not limited to:
 - i. Liaising with all the emergency service providers in the country/region prior to the incident, and to make necessary arrangements in form of agreements that can enable the pooling together of all the available resources from different sources to deal with the disaster in case it strikes;
 - ii. If SAR services are not provided on a regional basis, the SAR organisation should consider to enter into agreements with other SAR service providers in the neighbouring States primarily to solicit for their cooperation and assistance in case of a big incident that one single SAR organisation in the country cannot handle. If such an arrangement is put in place, inter-operability of the equipment used within the region should be given due consideration when buying new equipment, especially the communication gadgets.

- ◆ Additionally, the SAR organisation should put into consideration the guidelines for mass rescue operations developed jointly by IMO and ICAO.⁶³

4.5 Mission Conclusion Phase

This is the stage when the SAR mission comes to an end. However, just like in the previous phases, there are certain things that can go wrong during this stage and impair the successful completion of the entire operation. Efforts invested in the previous phases can be ruined by certain undesirable events (risks) that might occur in this final phase.

4.5.1 Risk identification and analysis (step 1)

Table 9 shows a list of possible events that, if not catered for during the mission conclusion phase, can jeopardise the successful completion of the mission, and might also negatively impact on the effectiveness of the future SAR missions.

In addition, the table shows the likelihood of occurrence of each risk, the possible corresponding consequences, and the possible degree of severity of the consequences (in case of risk occurrence).

⁶³ For details of these guidelines, see COMSAR/Circ.31, dated 6th February, 2003

Table 9- Risk identification and analysis (mission conclusion phase)

Identified risk	Likelihood of risk occurrence[§]	Possible Consequences	Severity rating[§]
1- Mission concluded prematurely on the basis of wrong information that: - the distress situation does not exist any more or never existed in the first place; - all the survivors have been rescued	3	♦ Unnecessary loss of lives of survivors that are not yet rescued due to the wrong belief that every body has been rescued; ♦ Unnecessary loss of lives of those in distress due to the wrong belief that no distress situation existed leading to failure to respond to the emergency;	3
2- Failure to conduct a post debrief on the incident.	2	♦ Mistakes or wrong things that might have been committed during the mission will not be un-veiled and are most likely to be repeated during the next SAR mission. This is very bad because the SAR personnel are not provided with a chance to learn from their mistakes.	2
3- Inability of the rescue team to		♦ The rescue team cannot quickly and effectively respond to another	

[§] Based on the scale ratings in tables 2a and 2b, section 4.1

quickly return to a state of readiness	3	emergency situation when called upon	2
4- Inability to effectively cater for the rescued survivors.	2	♦ The <u>already</u> rescued persons might die if not well cared for; that would be very bad especially after investing tremendous efforts to rescue the survivors.	3

4.5.2 Risk Categorisation and Prioritisation (Step 2)

In table 10, the risks identified in the previous section (4.5.1) are categorised and prioritised for mitigation on the basis of their likelihood of occurrence and the degree of severity of the consequences.

Table 10- Risk Categorisation and Prioritisation

Identified risk	Priority number ^{**}	Category [⊕]
1- Mission concluded prematurely on the basis of wrong information	9	Very Urgent
2- Inability of the rescue team to quickly return to a state of readiness	6	Urgent
3- Inability to effectively cater for the rescued survivors	6	Urgent
4- Failure to conduct a post debrief on the incident	4	Consider

^{**} Refer to section 4.1 (step 2) for the meaning of the priority number

[⊕] This column indicates the degree of urgency required to mitigate a particular risk.

4.5.3 Risk Control Measures (step 3)

The following are the risk control measures corresponding to the prioritised risks in the previous section. Just like in the previous phases, the possible root for the risks will be established first and thereafter, the appropriate risk control measures shall be devised.

1- Mission concluded prematurely on the basis of wrong information.

a) Possible root causes

- ◆ Bad mission planning and coordination;
- ◆ Incompetence of the SMC, the person entrusted with the overall authority to declare the mission concluded.

b) Appropriate risk control measures

- ◆ Only one person (usually the SMC⁶⁴) should be authorised with the powers and responsibility of declaring the mission to be concluded. The mission should always be concluded on the basis of the following measures:
 - i. If no distress situation exists any more;
 - ii. If there is evidence that all the survivors have been rescued, and this should be ensured through proper counting of the survivors and then cross-checking the results of counting with the total number of persons who were believed to be onboard. It should also be noted that, the already rescued survivors might be used to provide some useful information regarding the total number of persons that were most likely to be onboard, and the possible locations of the un-rescued persons.

⁶⁴ Search and rescue mission coordinator or commander

- i. If all possible measures to rescue the survivors have failed, and further searching may not yield any fruitful results and could be wastage of resources.

The SMC or whoever is charged with the responsibility of concluding the mission should be a very competent person. When he/she has finally decided to call off the mission, efforts must be made to notify all the responsible SAR authorities, and especially the rescue teams about the termination of the mission.

2- Inability to effectively cater for the rescued survivors.

Failure to care for the already rescued survivors can be a very big setback to the rescue team; especially after doing all the hard part of retrieving them from danger.

a) Possible root causes

- ◆ Ignorance of the rescue team on the implications of neglecting the survivors at the time when they need intensive care;
- ◆ Survivors not debriefed;
- ◆ No resources to cater for the medical needs of the survivors.

b) Appropriate risk control measures

- ◆ All SAR personnel should be sensitised about the implications of not providing proper care to the already rescued survivors;
- ◆ Debriefing is not only for the SAR team, but also for the survivors as well. The survivor debriefing is aimed at getting the following information:
 - ii. The survivors medical history, so you can know how to handle them; and
 - iii. The nature and extent of injuries they might have sustained.

However, according to the IAMSAR manual, volume II, proper care should be taken to avoid over-questioning of the survivors because that can worsen their condition. Also during the questioning, a calm voice should be used (2001-2003 amendments, P. 6-15).

- ◆ The SAR authorities should always ensure sufficient availability of trained and experienced personnel who can provide proper care to the already rescued survivors.

3- Inability of the rescue teams to quickly return to a state of readiness.

a) Possible root causes

- ◆ Team members so stressed, tired, exhausted or worn out;
- ◆ Team members very disappointed presumably due to any of the following circumstances:
 - Failed mission;
 - Death of the rescued survivors while en route ashore;
 - Victims found already dead at the scene of the distress;
 - Etc.

b) Appropriate risk control measures

- ◆ There is no doubt that SAR operations are very stressful, tiring and extremely exhaustive. However, one of the best ways of minimising the after-effects of the SAR operations to the operational personnel is to address it through training. All the SAR operational personnel should be subjected to such training and exercises that can instil high levels of resilience and endurance in their bodies to enable them cope with the stressful and demanding conditions during the rescue operations.
- ◆ **Death of victims:** All SAR operational personnel should always be counselled to cope with the realities of their profession that sometimes

victims may die; sometimes death could be inevitable. They should always keep this at the back of their minds so that whenever they come across such situations, it does not bother them so much despite the fact that they still feel sympathetic to both the victims and their families for the deaths.

- ◆ **Failed mission:** Just in the same manner as for the death of victims, it should be brought to the attention of SAR personnel that sometimes the mission may not be successful due to some reasons. The point of central concern should be to find out what went wrong during the mission so that mistakes that lead to the failure of the mission are sorted out before the next rescue encounter. Normally, this should be done during the debriefing session.
- ◆ Motivate the rescue team to arouse their commitment towards the rescue activities.

4- Failure to conduct a post debrief session at the end of the operations.

In plain language, debriefing means to question and discuss in details about the completed mission. In SAR, debriefing is conducted to sort out things that went wrong during the mission execution. In addition, debriefing also helps the rescue team personnel as well the survivors to deal with the physical or psychological traumas that they might have experienced during the entire mission.

a) Possible root causes

- ◆ Poor SAR mission planning that does not cater for the debriefing session;
- ◆ The rescue teams are scattered at the end of the mission.

b) Appropriate risk control measures

- ◆ During the planning stages of the SAR mission, proper arrangements should always be made to cater for the debriefing of all the personnel

who participated in the rescue mission at the end of the operations. This, when done properly, helps to sort out mistakes that were committed during the rescue operations. The idea here is to learn from the past wrong actions so that similar mistakes can be avoided in the future operations. One principal thing to note here is that, members should avoid the culture of blaming each other for the mistakes that were committed during the mission, as that practice will not take them anywhere close to improving the effectiveness of the SAR service delivery.

4.6 Cost Benefit Analysis and Action Planning

After devising all the appropriate counter measures for the identified risks, it is very important to examine the cost effectiveness of implementing each measure. Normally this is done by comparing the costs involved in implementing a given risk control option with the corresponding benefits⁶⁵ that come with implementing the measures.

If the costs of mitigating a particular risk far out-weigh the over-all benefits, then it is advisable to accept the risk. However, in such cases of risk acceptance, appropriate⁶⁶ contingency measures should be put into place to minimize the effects of the consequences in case of risk occurrence.

Usually, the risk analysis process provides more than one possible risk control option to deal with a particular risk. To this end therefore, the decision makers should select the most cost effective risk control options for implementation.

⁶⁵ For SAR, benefits are measured in terms of the SAR system's effectiveness; how many more lives are likely to be saved by implementing the control measures.

⁶⁶ With due regard to the identified risk under consideration

The selected cost effective risk control options should then be transformed into an appropriate action plan that will promote the efficient and effective delivery of the SAR services. Figure 4.1 shows a summary of the risk management process.

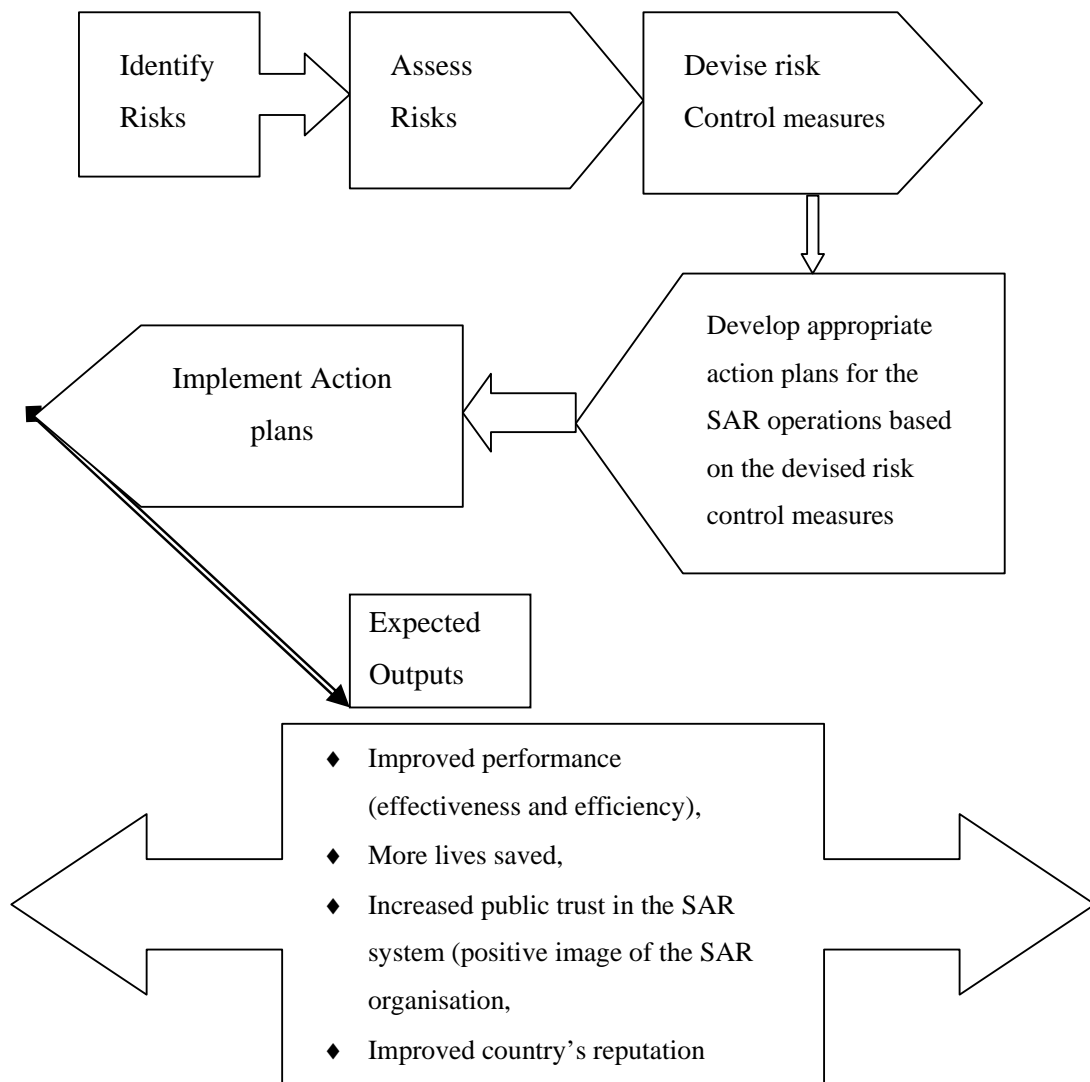


Fig. 4.1: A summary of the risk management process

Figure 4.1 gives a thumbnail overview about the entire risk management process. Some of the core benefits associated with a properly implemented risk management concept have been highlighted in the figure as outputs. This brings us to the end of chapter 4. In the next chapter, conclusions for the study will be drawn and appropriate measures that are necessary to achieve good results shall be recommended.

5 Conclusion and Recommendations

5.1 Conclusion

The primary purpose of this thesis was to enhance the effectiveness of maritime SAR service provision through application of the concept of risk management. This has been achieved by practically demonstrating how the concept can be systematically applied to SAR activities at the operational level to develop appropriate risk control measures that can be used as a basis for formulating reliable action plans (or operational procedures) for the SAR operations that are based on risk.

The process involved the identification of risks at each of the four phases of SAR at the operational level, assessing the risks and then devising appropriate counter measures⁶⁷ to cater for the risks.

Of course some will argue that not all the possible potential risk scenarios (for each of the four selected SAR phases) were dealt with in the analysis; **true**, it was not possible to deal with each and every risk scenario. This is so because the thesis cannot provide a comprehensive and perfect ready-to-apply solution that fits any

⁶⁷ The various counter measures that were suggested for each risk scenario in the analysis were not my personal views; rather, they were obtained from various academic sources after carrying out a research to find suitable/appropriate solutions for a given risk.

SAR organization.⁶⁸ Besides, if each and every potential risk scenario were to be dealt with, the analysis would be too bulky and perhaps confusing to the readers. However, the thesis can be used by the interested SAR organizations (in developing countries) as a basis⁶⁹ to develop their own action plans for SAR operations that are based on a comprehensive risk assessment, giving consideration to the techniques employed in this study. What this means is that, each SAR organization should identify their own risks⁷⁰ that are likely to deter the effective provision of the SAR services in their areas of jurisdictions⁷¹, and then follow the risk management principles that were applied in this thesis in order to come up with appropriate action plans or operational procedures that put into consideration the identified risks. This makes some sense because different SAR organizations have different challenges depending on the system set-up. For instance, while there could be a very big risk of false alerts in one SAR system, it may not necessarily be a risk in another SAR system set-up.

A well developed SAR action plan that puts into consideration all potential risks that are likely to occur within the system makes it possible for the SAR organization to know how to act or what to do in almost every SAR encounter. This contributes handsomely to the effectiveness of the SAR system and maximizes the achievement of the desired objectives/goals of the SAR organisation.

In addition, having knowledge of the risks that are most likely to occur within the system enables the SAR managers (decision makers) to make sound and coherent decisions with respect to the following:

⁶⁸ There is no one size that fits all; it is a common adage.

⁶⁹ Standard

⁷⁰ Events that are likely to go wrong in their SAR system set-ups

⁷¹ Could be SRR, territorial waters or inland water bodies

- i. Determining the staffing requirements: the sufficient number of personnel with desired competences⁷² that are required for implementing the devised action plans for the SAR activities;
- ii. Determining which personnel are to be employed on a full-time basis and which ones to employ on a part time basis;⁷³
- iii. Development and preparation of effective contingency plans for the rescue operations that are based on anticipated risks;
- iv. Minimising operating costs through prioritisation of tasks with respect to the identified potential risks;
- v. Sourcing of the right type and sufficient quantity of equipment that can effectively handle and contain the anticipated risks;
- vi. Determining the right number of facilities, assets and resources that are required for the efficient execution of the SAR activities, based on the identified risks;
- vii. Identification of training needs with due regard to the identified risks and corresponding risk control measures.

5.2 Recommendations

If properly implemented, the concept of risk management can go a long way in improving the effectiveness of the SAR system. The risk management process per se helps the SAR organization to achieve its desired goals.

The following measures are recommended for better results:

1. During the process of risk identification, at least all the responsible personnel should be involved so that everyone can suggest what they think can probably go

⁷² Personnel who poses the right skills and knowledge necessary to implement the action plans

⁷³ This helps in minimising administration costs.

wrong within the system. All possible events that are likely to go wrong should be identified irrespective of how minor they might seem to be. There are various ways in which risks can be identified and the following are some of them:

- Examine past mission execution reports, and especially the debriefing reports;
- Consult experienced SAR operational personnel: Experienced SAR operational personnel within the SAR organisation are a very big resource when it comes to identifying risks within the SAR system;⁷⁴
- Consult outside experts: People who are not part of the SAR organizational staff can provide very useful expert opinions on what they think can possibly go wrong within the SAR organization;
- Regarding the equipment, regular inspections and testing can reveal some things that can go wrong during the actual mission;
- Distribute a questionnaire to all the relevant SAR personnel within the organization asking them for their opinion about what can go wrong within the system;
- Exercises can reveal a number of events that are likely to go wrong during the actual mission execution; use them regularly.

2. After all the possible potential risks have been identified, then collective efforts should be made to strike off the list all those risks with a low likelihood of occurrence and less degree of severity (minor impact in case of risk occurrence). Figure 2.1 (P. 12) should be used as a basis for deciding which risks should be dealt with and which ones to ignore;

⁷⁴ This was the method that was used in this analysis; questionnaires were distributed to the experienced SAR operational personnel in the field requesting them to identify what was most likely to go wrong in their SAR systems.

3. Putting into consideration the techniques employed in this study, the risks which remain on the list should be thoroughly analyzed and assessed in order to devise appropriate counter measures to cater for them;
4. A cost benefit analysis of the proposed risk control measures should be performed to determine the most appropriate and cost effective options that will enhance the effective provision of the SAR services;
5. A comprehensive⁷⁵ action plan that puts into account all the identified risks should be prepared. The action plan adopted should be well documented and its implementation tracked as part of the reporting process.

In addition to the above, the following measures should also be put into consideration:

- i. **Risk communication:** there should be an interactive exchange of information about the identified risks amongst all the risk assessors, SAR coordinators (managers), SAR mission coordinators, the RCC personnel, SAR operatives, all the SAR stakeholders, the general public and all other interested parties. This helps to inform everyone about the potential risks, their associated consequences and what to do to minimize or prevent them from occurring. The best way of communicating risks should be the openness of the manner in which risk based-decisions are made and through regular meetings (with the stakeholders).
- ii. The risk management process should be a continuous undertaking by the responsible personnel within the SAR organization because new types of risks keep emerging every day and there is a need to provide for them;
- iii. The SAR system's effectiveness should be a collective responsibility of all the authorities responsible for public safety in the country. For instance, not much can be achieved by the SAR organization to improve the SAR system in the country if

⁷⁵ Covering all the four SAR phases

there are no safety regulations⁷⁶ put in place by the responsible government authorities;

- iv. Although this thesis is concerned with only maritime SAR activities, it is normally recommended to harmonize both maritime and aeronautical SAR activities. Also, if possible, a regional approach to providing SAR services is normally preferred to the individual country approach;
- v. Volunteer SAR services should be encouraged and supported whenever there is a possibility to do so.
- vi. In order to access some assistance for SAR resources from the international community, it is highly recommended that the responsible countries ratify⁷⁷ at least two conventions: the SOLAS convention and the Convention on maritime SAR;
- vii. Mariners should be sensitized about the implications of not adhering to safety measures prescribed to them while out there at sea; the SAR system should be used as the last resort after all other safety measures have failed;
- viii. Training: in this study, training was repeatedly recommended as one of the risk control measures for dealing with almost every risk scenario. This is so because without proper training of the SAR personnel, nothing much can be achieved, however concrete the action plans might be; without properly trained and qualified SAR personnel to make sound decisions and to take appropriate actions, information contained in the action plans will always remain just information (USCG SAR Proceedings, P.69). In this regard therefore, training should always be given priority if action plans are to be turned into realistic goals. In line with this, the International Maritime Organisation has developed some model courses which can be used as a reference guide by the SAR decision makers to select appropriate training courses for their staff; these include, *inter alia*:
 - Training for Maritime Search and Rescue Mission Coordinator (model course 3.14);

⁷⁶ Regulations that cover the construction, onboard safety equipment, crew training, operating procedures, etc

⁷⁷ In case they have not done so to-date.

- Training for Maritime SAR Administrator (model course 3.13, vol. 1);
- Compendium for Maritime SAR Administrator (model course 3.13, vol. 2).

These model courses are very helpful because they specify clearly the technical content and levels of knowledge expected to be achieved by the trainees at the end of the training course.

- ix. The effectiveness of the implemented risk control measures should be continuously monitored. If there is no change, or if there are only minor changes in the effectiveness of the SAR service provision after implementing all the relevant control measures, then the risk control process is probably not worth the resources expended on it and an immediate review of the process should be conducted. Feedback on the implementation and the effectiveness of the adopted action plans can be obtained from the risk reporting process, internal reviews and other available information.

Finally, it is hoped that this thesis will be of great assistance to improving the quality of SAR services in the countries⁷⁸ that might have difficulties in applying the risk management concept to SAR activities.

⁷⁸ Most notably the developing countries

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APPENDICES

Appendix 1: SAMPLE QUESTIONNAIRE

1.0 Introduction

This questionnaire is in support of how to apply the concept of risk management to improve the effectiveness of SAR service provision mostly in developing countries. The research is being conducted by a student at World Maritime University in Malmö, Sweden.

2.0 Background Information

To be of practical value, managing risk needs to be an integral part of the management planning and review processes to support priority setting and decision-making by clearly informing managers about key risks, the likelihood of their occurrence and their impact.

With respect to search and rescue service provision, failure to manage risks can hugely threaten the overall objectives of a SAR system set-up.

It is therefore of paramount importance that potential risks which can hinder the objectives of the SAR organization are identified and suitable remedial measures put into place in order to reduce the impact on resources and enhance the services that are provided.

NOTE:

- 1- By definition, risks are those things, which can go wrong unexpectedly and impair ones ability to meet the set objectives.
- 2- Generally, SAR can be categorically divided into two major parts:
 - a) the management level, and
 - b) the operational level

At the operational level SAR can be chronologically (in the order of occurrence) divided into four major phases, namely:

- i. Emergency phase (Ship or person in danger)
- ii. Initial response from the SAR system
- iii. Actual mission or activation of the rescue operation
- iv. Mission conclusion

One of the preliminary steps in managing risk is the identification of risks and their sources.

In light of the above, therefore, this questionnaire seeks your implicit experience and knowledge in the field of SAR service provision to identify things, which can go wrong (risks) at each of the phases mentioned above using your SAR organisation a reference.

PHASE	WHAT CAN GO WRONG? (Hazard or risk Identification)
1. Emergency phase	<i>i. False alert or distress signal (For example)</i>
	ii.
	iii.
	iv.
	v.
	vi.
	vii.
2. Initial Response	<i>i. Delay in response or longer response time (For example)</i>
	ii.
	iii.
	iv.
	v.
3. Actual mission	<i>i. inadequacy of required/needed resources (For example)</i>
	<i>ii. mix up or confusion in issue of command</i>
	iii.

	iv.
	v.
	vi.
	vii.
4. Mission conclusion	<i>i. Mission concluded prematurely (For example)</i>
	ii.
	iii.
	iv.
	v.
	vi.

Please also respond to the following questions:

Part A

- i. How often do the identified risks interfere with the successful provision of the SAR services in your organisation?
- ii. Does your organization have in place a streamlined system for managing the identified risks? No / yes

- iii. If YES, please suggest ways in which your organization/department manages those risks; what tools and strategies have proven very effective to manage those risks

Part B

- (i) Have you or your organization ever faced an emergency situation(s) which overwhelmed the capacity of the search and rescue operations?
Yes / No.
- (ii) If YES, what are the reasons why you failed to foresee or predict that such a disaster which can overwhelm your capacity to handle can strike?
- (iii) How did you then react in such a situation?
- (iv) What lessons did you then learn from the incident?
- (v) If NO, what do you attribute your success to i.e. why have you been successful in that regard?

Part C

- i. How many rescue operations do you conduct on average per year?
- ii. How successful are those operations?
- iii. Number of failed operations:
- iv. Any specific reasons for the failure of those operations?
- v. Number of successful operations:.....

Do you consider your organization/SAR unit as being successful as far as SAR service provision is concerned?

YES/NO

Thank you very much for responding to these questions