



Improving the Quality of Accident Investigation

National Transportation Safety Board
Office of Marine Safety

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ABSTRACT

The NTSB Office of Marine Safety (OMS) conducts accident investigations to prevent the reoccurrence of accidents. We compared the OMS and other agencies' investigations through interviews and analysis of reports. We found inconsistency of definitions and methods used in investigation is an area of improvement for the OMS. We made recommendations to adopt the IMO causal factors definition as probable cause definition in conjunction with E&CF analysis to improve the quality of OMS' investigations by increasing focus on safety issues.

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EXECUTIVE SUMMARY

Transportation accidents can result in the loss of human lives and material goods, along with the possibility of environmental damage. The United States congress created the National Transportation Safety Board (NTSB) as an independent accident investigation agency to prevent the reoccurrence of accidents. The NTSB conducts accident investigations to determine safety issues. Using the knowledge of safety issues, the NTSB can make recommendations to improve transportation safety. The NTSB's accident investigation quality directly influences the effectiveness of the recommendations made.

The NTSB Office of Marine Safety (OMS) strives to constantly improve their accident investigation quality so the most effective recommendations can be made to improve maritime safety. The NTSB OMS accident investigators conduct accident investigations through the steps of factual collection, causal analysis, and safety recommendations. To conduct accident investigations of the highest quality, accident investigators must utilize the most effective methods for identifying safety issues.

The goal of our project is to identify the highest quality methods that are practical to be implemented by the NTSB OMS. To do this we compared investigative methods that are available to accident investigators. We found that there are many accident investigation methods developed through academic research. The actual usability of these methods based on field experience of accident investigators is rarely published. To assess the effectiveness of accident investigation methods we chose three aspects

of quality as consistency, depth, and time efficiency. To compare the quality of accident investigation methods, we conducted interviews with experienced accident investigators from multiple renowned investigative agencies. In addition to our interviews, we compared the accident investigation reports of multiple accident investigation agencies to identify the strength of different agencies.

We identified many methods that are utilized by multiple accident investigation agencies, which are yet to be implemented at the NTSB OMS. We found that both Canadian transportation safety board and the Australian transportation safety bureau have a standard definition of probable cause and causal analysis method amongst their accident investigators. Both of these agencies use a definition similar to IMO's causal factor definition, which define probable causes as safety issues of an accident. These agencies also utilize a version of event & causal factor for their investigations. We found that there is not a standard definition of probable cause and causal analysis method in the NTSB OMS. During investigations the NTSB OMS assign a single safety issue as the probable cause; this result in a difference of opinions amongst the NTSB OMS investigators during causal analysis step of the accident investigation.

To improve the causal analysis step of the NTSB OMS' accident investigation. We made a recommendation for the NTSB OMS to adopt a standard definition of probable cause. We determine by using the IMO definition of causal factor from chapter 2.2 of MSC-MEPC.3/Circ.2 as a standard definition of probable cause will improve the quality of the NTSB OMS' accident investigation. We believe by having the standard

definition of probable cause as all safety issues of an accident, will allow the investigators to focus more in the development and implementation of recommendations. We believe the NTSB OMS should also use a standard causal analysis method such as the event & causal factors. The use of a stand causal analysis method will allow the investigators to improve their ability to compare their objective conclusions during casual analysis. We believe the adoption of a standard probable cause in conjunction with standard causal analysis method will improve the quality of the NTSB OMS' accident investigations.

1 INTRODUCTION

Investigations of transportation accidents are necessary to identify the safety issues of an accident and provide safety recommendations. The goal of these recommendations is to prevent the reoccurrence of accidents and increase transportation safety. One agency that conducts accident investigations in the United States is the National Transportation Safety Board (NTSB). The United States Congress created the NTSB as an independent agency to prevent the reoccurrence of transportation accidents, and to increase safety in all modes of transportation.

International Marketing and Statistical confirmed that the United States possesses 10,697,300 gross tons of marine shipping capacity (2004). Due to the large amount of maritime transport that occurs in the U.S. and abroad, marine accidents do occur. Therefore, the NTSB has an Office of Marine Safety (OMS), which conducts investigations for maritime transportation accidents. As an independent agency, the NTSB needs to look into all safety issues of an accident. The advancements in marine technology, management, and oversight have increased the complexity of maritime transportation. The OMS needs to utilize methods that account for these advancements.

In an effort to improve accident investigation methodology, experts of accident investigation publish books and articles that provide guides to the accident investigation process. These experts develop in-depth methods for factual collection, causal analysis, and recommendation production. These experts create an extensive amount of

theoretical literature on accident investigation. However, they have not conducted many studies on which methods investigators prefer to use.

In addition, investigators rarely publish books or articles on their investigative experience. Unlike academic researchers, marine investigative agencies such as the NTSB, the Transportation Safety Board (TSB) of Canada, and the Marine Accident Investigation Branch (MAIB) of the United Kingdom do not make information on improvements to their investigative methods readily available.

The goal of our project was to improve the quality of accident investigation for the NTSB OMS. To do this, we looked into three aspects of quality that we identified as consistency, depth, and time efficiency. Along with our research, we interviewed expert accident investigators from several agencies on their accident investigation processes. We also conducted analysis on published reports from several investigation agencies. We then analyzed the data from our interviews and research to identify areas of improvement for the OMS. We then created recommendations on specific methods to help the NTSB OMS improve effective accident investigation according to consistency, depth, and time efficiency.

2 BACKGROUND

The Center for Chemical Process Safety defines an “accident” as “an unplanned event or sequence of events that results in undesirable consequences” (1992, p.327). Accident investigators conduct accident investigations with the goal of preventing accidents from reoccurring. During these investigations, investigators gather facts about the accident to determine safety issues. Unlike criminal investigations where the causes are determined for assignment of blame, accident investigators at the NTSB strive to identify safety issues within an accident using the knowledge of causes (Leveson, 2004, P. 1). Accident investigation specialists have developed many theories and methods to aid accident investigators in factual collection, causal analysis, and safety recommendations. In addition, accident investigators utilize human and technological resources to further aid their investigations.

2.1 Factual Collection

Accident investigators cannot make any conclusions regarding an incident without the collection of accident facts. Investigators gather witness evidence, physical evidence, and documentary evidence as three forms of facts for accident investigations (Brown, et al., 1995, p. 162; Hendrick & Benner, 1987, p. 140; Greenspan, et al., 1989, p. 29). The accuracy of factual collection directly affects the validity of an investigator’s causal determination. Investigators must use proper techniques for each form of evidence to ensure the accuracy of their facts (Beitman, 2005, p. 147). Any modification of accident sites or incorrect evidence may mislead an investigation. For example,

NTSB investigators noted several witnesses who believed a missile caused the 1996 aviation accident of Trans World Airline Flight 800. These witnesses claimed they saw a missile hit the airplane prior to the explosion. The reliability and accuracy of their statements were later unsubstantiated; investigators determined from physical evidence that the explosion of a fuel pump caused the accident. The witnesses' statements misled the investigation, which caused the NTSB to waste resources.

2.1.1 Witness Evidence

Witnesses can be an unreliable source of evidence for an accident investigation as previously shown; however, they are often useful for investigators when trying to reconstruct the scene of an accident (Brown, et al., 1995, p. 125). Witnesses provide their interpretations of the events from prior, during, and after an accident. Investigators obtain clues from the witnesses' descriptions of the accident to identify safety issues. For example, in the 2008 marine accident involving the sinking of the fish-processing vessel the *Alaska Ranger*, witnesses stated the crew were all asleep during the accident. These witnesses' statements led accident investigators to further study the safety issue of the crew's sleep schedule during an expedition.

To ensure the credibility and usefulness of witness interviews, accident investigators consider multiple factors prior to interviewing witnesses. Investigators consider that witnesses might have a lack of knowledge of the events during an accident, which would cause a witness to produce false conclusions that lack the accuracy needed by accident investigators. Accident investigators also need to indicate

the date and time they interview each witness, because psychological factors can alter witnesses' interpretations of accidents over time (Lloyd-Bostock et al, 1983, P. 3; McAuliff & Kovera). Post-traumatic stress disorder is an example of a psychological factor that affects witnesses after accidents. In addition to psychological factors, a witness' responsibility and relationship to an accident can affect their response during an interview. A witness' responsibility refers to whether a witness has ties to the accident cause. A witness' relationship to an accident refers to any connections a witness may have to an accident whether financial or familial. Though accident investigations conducted by the NTSB are not criminal investigations, nor intended to assign blame to individuals or organizations, the nature of investigations may result in witnesses being dishonest during interviews. With these factors in mind, accident investigators determine the credibility of witnesses to assess the accuracy of their statements as evidence. Investigators must keep in mind the subjectivity and bias behind witness statements when using interviews as a form of evidence, and use other forms of evidence to support the details collected from witnesses.

2.1.2 Physical Evidence

Investigators often support the statements made by witnesses with physical evidence, which is the most reliable source of information (Brown, et al., 1995, p. 167; Greenspan, et al. p.30). Investigators look for any physical evidence such as video or audio recordings from prior, during, or after the time of the accident to support identification of safety issues. Audio and video recordings provide accident investigators

with vivid and credible details of the scene of an accident. Investigators also collect pertinent information from voyage data recorders (VDR). Although a VDR is a type of physical evidence, we further discuss the VDR as a technological resource in section 2.4.1. Using physical evidence along with witness statements, accident investigators reconstruct an event timeline including events leading up to an accident through the rescue and recovery operations of first responders.

Separate from video and audio recordings, physical evidence also includes measureable data (Brown, et al., 1995, p. 167; Greenspan, et al. p.30). Investigators can analyze this physical evidence using parametric equations. For example in the 2007 marine accident involving the passenger vessel the *Empress of the North*, investigators measured the physical damage done to the vessel due to the collision with ice. Investigators then analyzed the measurements using parametric equations to determine the exact movement of the vessel upon contact. This helped the investigators identify the navigational error of the pilot. Measurable physical evidence rarely degrades over time due to human factors, but environmental factors may render physical evidence perishable. These environmental factors require the timely gathering of some physical evidence. By considering physical evidence's integrity, investigators ensure its credibility.

2.1.3 Documentary Evidence

Unlike witness statements and physical evidence, documentary evidence is both non-perishable and reliable. Accident investigators often gather documentary evidence

as supplementary information for improving accident investigation quality (Brown, 1995, p. 126). Documentary evidence includes manufacturers' specifications and maintenance histories. Investigators also use public and private records such as codes, standards, and case histories as documentary evidence. Investigators gather some documentary evidence from informational databases that organizations create and maintain to aid investigations. For example in the 2008 marine accident involving the containership the *Cosco Busan*, the medical history of the vessel's pilot allowed accident investigators to determine the possible safety issue of granting an individual a license to operate a large vessel while taking prescription medications that impair judgment. In this case, documentary evidence led accident investigators to identify an additional safety issue that influenced the accident scenario.

2.1.4 Factual Collection Techniques

Accident investigators have adopted and developed many documentation and storage techniques to improve the accuracy and credibility of factual collection. One technique that is often used to document witness statements is the use of a storyboard. Storyboards allow accident investigators to organize and summarize witness statements (Walton, 2008). The use of a storyboard helps accident investigators to determine witnesses' credibility through cross-referencing of all witness statements. Accident investigators may identify convergences and corroborations of different statements, increasing the statements' credibility. Storyboards also help determine where statements do not converge and investigators can then gather extra evidence to support

which statements true. The documentation of witness statements does improve the credibility of witness evidence. However, investigators need credible physical evidence to support these statements to ensure the accuracy of an investigation.

Accident investigators perform specialized techniques to maintain the credibility of physical evidence. The Marine Accident Investigators' International Forum (MAIIF) developed thorough procedures to follow in the documenting and storing of physical and documentary evidence (Appendix E). These procedures stress the importance of the mapping, photographing, and tagging of all evidence prior to removal from the accident site. MAIIF also suggests a storage technique requiring careful packing of fragile evidence components and the enclosure of evidence that may contain chemical residue in non-absorbent material for future examination. Similar to physical evidence, investigators must preserve the integrity of documentary evidence. The MAIIF states documentary evidence should be securely stored for each investigation to avoid the alteration of documents. In addition, paper duplicates of all documentary evidence should be stored as backup in the case of an electronic failure.

Although investigators utilize techniques to help preserve the accuracy and credibility of witness, physical, and documentary evidence, investigators also need to organize all facts collected during an investigation. The use of an evidence matrix is another technique used to document all forms of evidence gathered. The MAIIF also has a proposed evidence matrix. An evidence matrix prompts accident investigators to record information on the origin, purpose, and other details pertaining to evidence. The

organization of the evidence gathered makes the determination of probable cause an easier process because the evidence is more accessible when in an easily recognizable format.

2.2 Causal Analysis

Accident Investigators conduct many methods of causal identification using the facts collected during investigations (Brown, et al., 1995, p. 137). These methods of causal identification allow accident investigators to identify causal factors of an accident and assess safety issues relating to these factors. Many accident investigation specialists have come up with accident causal theories to aid the understanding of the occurrence of accidents.

2.2.1 Accident Causal Theories

There are many accident causal theories created by accident investigation specialists. Stellman writes that multiple theories such as pure chance theory, biased liability theory, and accident proneness theory do not consider that causes of investigations can be determined (1998, p. 56.6). These theories state that accidents are inevitable. If accidents are inevitable, then their prevention is not possible; therefore, accident investigators do not find these theories useful because they do not help with the prevention of accidents. However, there are theories that do support investigators' beliefs that safety recommendations can prevent accidents.

In 1931, H.W. Heinrich developed the first accident causal theory, the domino theory, sometimes termed linear system models (Lundberg, et al, 2009). Domino theory states that a series of failures is the cause of an accident (Ridley & Channing, 2003, p. 286; Thygeson, 1977, p.44). Heinrich believed the removal of a single failure in the chain may terminate an accident. One accident model that is similar to domino theory is the “Swiss cheese” model. This model is a representation of a chain of failed or absent defensive regulations and safety mechanisms that line up to cause an accident (Reason, 1997). An example of this model is shown below in figure 2.1.

Figure 2.1 Swiss Cheese Model

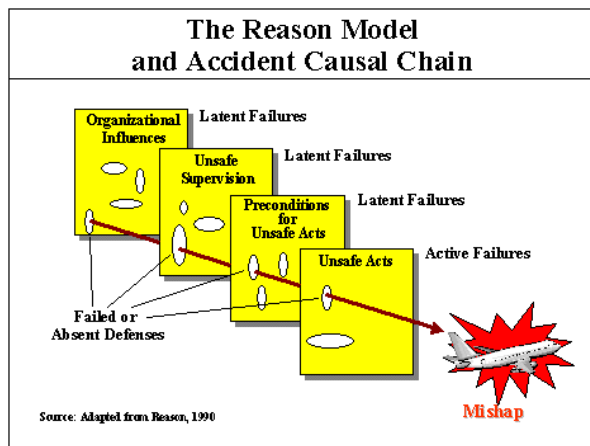


Figure 2.1 Reason’s “Swiss cheese” model (Kauffield and Luxhoj, 2003)

This model is similar to domino theory because one of the slices of cheese can be modified to stop the chain of events from happening. However, the Swiss cheese model is different because it specifically considers failures in safety regulations and management systems whereas the domino theory considers other failures as well. The

Swiss cheese model is extremely applicable for investigation agencies that make recommendations on how to improve safety regulations. Another causal theory that helps determine the failure of safety measures is the energy transfer theory, which investigators also refer to as the complex linear system model (Karmis, 2001, p. 44; Kjellen, 2000, p. 32). Energy transfer theory states that accidents occur from an initial hazard that exceeds the barrier of safety measures or accident prevention.

While these theories can help for most accidents, for large-scale accidents, investigators often use multiple causation theory as a platform for causal identification (Petersen, 1971, p. 13). Investigators who support the multiple causation theory believe the convergence of multiple failures causes accidents, which is why investigators also refer to it as complex interaction theory (Lundberg, et al, 2009). Although these theories are all useful in accident investigation, investigators often combine the beliefs behind these theories with the utilization of causal identification techniques when identifying causal factors.

2.2.2 Causal Analysis Techniques

Investigators often use causal identification techniques in conjunction with causal theories. In some cases, investigation experts develop these techniques based on causal theories. Causal identification techniques aid accident investigators with the organization of the facts collected and the determination of causal factors. Some examples of causal identification techniques that accident investigators use are

Management Oversight & Risk Tree (MORT), Why-Because analysis, Hazard Barrier and Target analysis (HBT), and Events and Causal Factors analysis (E&CF).

Management Oversight & Risk Tree (MORT) is a causal identification technique developed to identify safety issues within accidents (Johnson, 1973). Johnson created MORT based on multi-causal theory and uses logic gates in a tree format of analysis. MORT is a complex system accident investigators can utilize to identify root causes of an accident. Rather than explaining the intricacies of this intensive method, a power point presentation explaining the MORT method in detail has been included in Appendix F.

Peter Ladkin used why-because analysis to identify causal factors of the Glenbrook, NSW rail accident that occurred on December 2, 1999 (Ladkin, 2005). Why-Because analysis is an approach to accident investigations where you pick an event and ask, “why” did this occur? From the resulting “because”, or reason, the question of “why” is asked again. The why-because diagram created during the Glenbrook accident analysis is shown in figure 2.2 below.

Fig 2.2 Why-Because Analysis

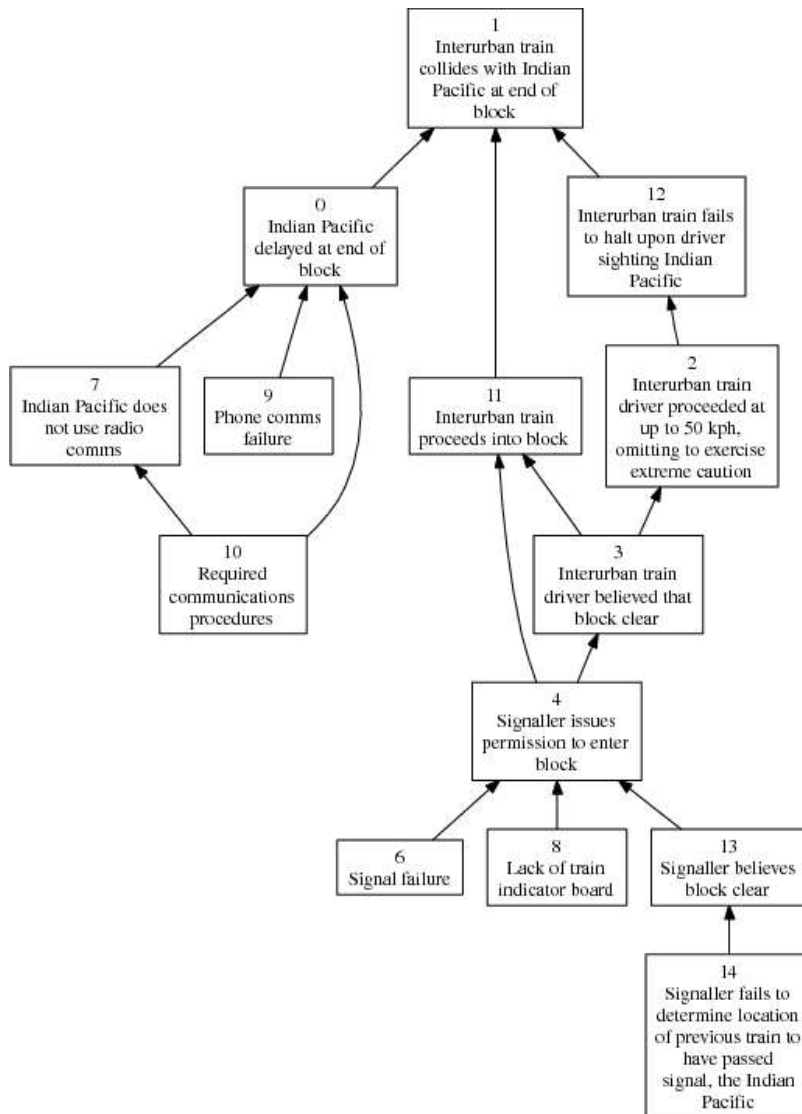


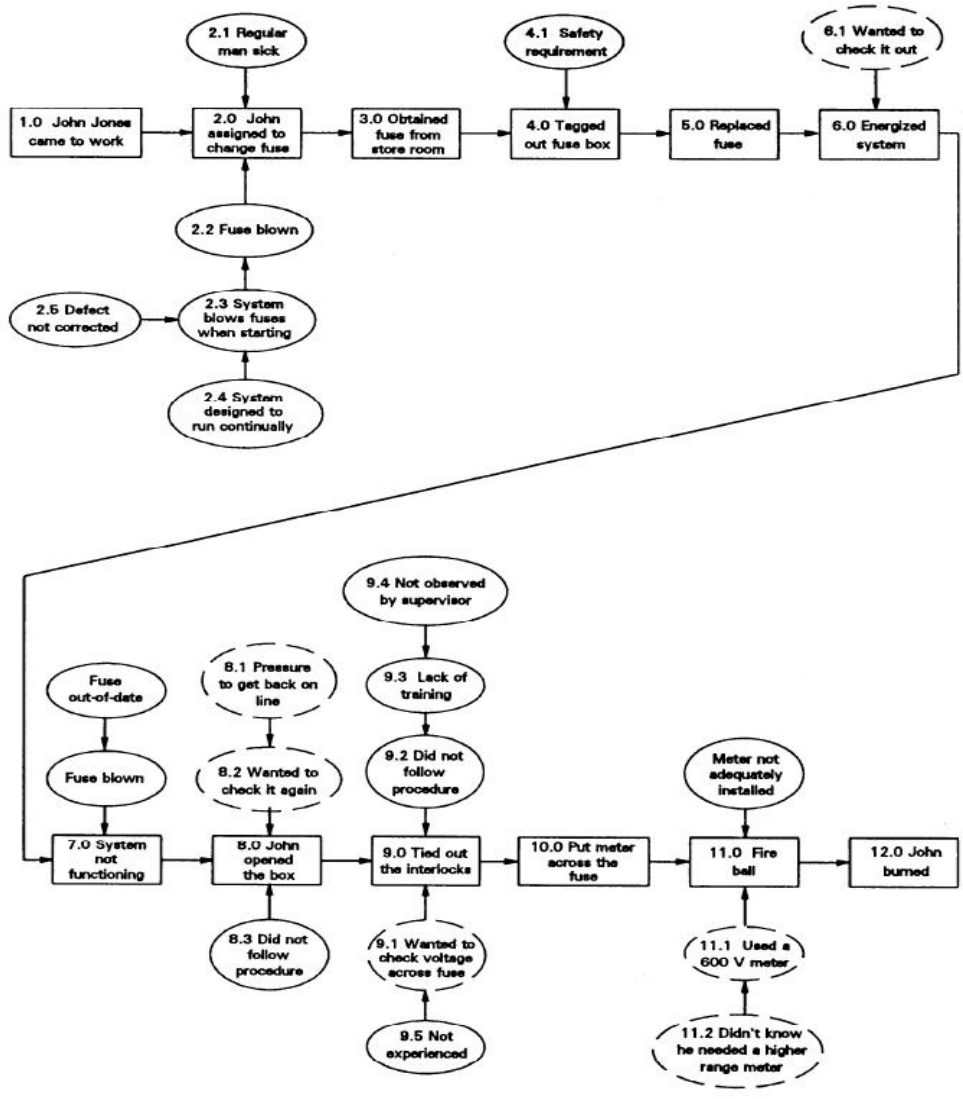
Figure 2.2 Why-Because analysis from Glenbrook NSW rail accident

In this diagram, each box is labeled with a number that corresponds to the order investigators analyzed each box. Investigators asked the initial “why” for box 0 and the resulting “because” was box 1. Investigators continued this why-because analysis until they felt that all major issues were identified.

Hazard, Barrier, and Target analysis (HBT) is another causal identification technique. HBT is modeled after the energy transfer theory, which differentiates it from E&CF. Mechanical, kinetic, thermal, chemical, electrical, radiant are the means of energy source analyzed in HBT (Goldberg, et al, 1994). Using HBT, accident investigators may determine when the prevention barrier was breached during the accident. Barrier can take forms as physical, management, and oversight. Accident investigator may find the problem within a specific barrier to raise possible safety issue for future recommendation.

Event and Causal Factors analysis (E&CF) is a cause identification technique used by accident investigators to verify causal relationships and the event timeline sequence (SCIENTECH, Inc., 1995). Investigators also use E&CF analysis to organize the accident facts collected. A generic example is included in figure 2.3 on the following page (Integrated Publishing). This example shows a timeline of events that leads up to a fireball burning John while he is changing a fuse. The E&CF analysis organizes the events into the correct order and for significant events, the causal factors leading to these events are assessed. For example, event 11 was caused by factors 11.1 and 11.2.

2.3 E&CF Example



Accident investigators utilize the causal theories and causal identification techniques above with the goal of creating safety recommendations that can effectively prevent the reoccurrence of accidents.

2.3 Safety Recommendations

The final step of the investigation process for most investigative agencies is the creation of recommendations for the accident investigation report. This step is an important part of the investigation process because the recommendations can prevent the reoccurrence of accidents. Agencies such as the NTSB issue recommendations based on the safety issues identified in the causal analysis. Wood summarized that for these recommendations to be of any use the recommendations must be feasible (as stated in Ferry, 1988, p.236). Whether the regulatory agency can practically implement and maintain the changes made from a recommendation determines the usefulness of the recommendation.

The first determining factor, the practical implementation of the recommendation, breaks down into the cost and time involved. For a recommendation to produce positive results, it must be affordable to the majority of the interest groups it directly affects. Should the recommendation yield a costly change, some interest groups may be unable to meet the financial requirement. The intended outcome of any safety recommendation is the inclusion of all interest groups; therefore, investigators must consider cost when issuing such recommendations. In addition to the cost, investigators must take into consideration the time necessary to implement the changes when creating a

recommendation. If a recommendation is going to take multiple years to implement, then investigators may consider adding restrictions or adaptations to the recommendation. Investigators determine a compromise between cost and time to create the most practical recommendations possible.

In addition to creating a practical recommendation, investigators must take into consideration the ability to maintain the changes implemented by the recommendation. “Recommendations could include review of current policy, new policy, re-training personnel on existing requirements, or additional training needs” (OSHAcademy, n.d.). Investigators must take into account the practicality of the maintenance necessary when determining the recommendation to issue.

The purpose of investigative agencies such as the NTSB is to produce recommendations based on the safety issues identified through the investigation. “The finest report fails if it merely states facts and draws conclusions. Corrective actions are needed, and the report should identify them (Ferry, 1988, p. 244).” Therefore, an accident investigators’ goal is to issue practical recommendations that can effectively prevent the reoccurrence of accidents.

2.4 Human and Technological Resources

Investigators use a variety of tools when conducting an investigation. These tools range from photogrammetry techniques to the analysis of Voyage Data Recorders (VDR). These tools may also include individuals who are experts in specific fields such as human factors, law, or naval architecture. Investigators use these tools to create a

complete picture of the entire accident in order to determine the safety issues that lead to the accident occurring.

2.4.1 Technological Resources

During the late 1990's, there was a surge of investigation agencies that wanted the IMO to require large ships to carry voyage data recorders (Brown, 1999). A voyage data recorder (VDR), also called the black box of a ship, records information regarding a ship's position, heading, radar, bridge audio, and other information. VDRs can record this information from up to 12 hours prior to an accident. These VDRs are especially helpful in investigations because of the data that they provide. There are limitations, though, because these VDRs were only required to have on passenger ships and ships with larger than 3000 gross tonnage that were built on or after July 1, 2002 (International Maritime Organization, 2002).

Along with VDRs, advancements in organizational software have made it possible for accident investigation agencies to create accident databases. These databases contain categorized information regarding all accidents that the agency investigates. One agency that has such a database is the United States Coast Guard (USCG). Their "marine accident database" contains information about all accidents concerning their geographical distributions and also other related and important information about each accident (Hottendorff & Hullmeine, 1992). Other agencies also have databases similar to the USCG's such as the European Maritime Safety Agency. This database will be part of the European Marine Casualty Information Platform

(EMCIP) (European Maritime Safety Agency, 2008). This database is a joint effort from the countries with marine investigation agencies in the European Union. This database, which EMSA is still constructing, will allow the exchange of information regarding the facts collected in each accident investigation.

While EMSA's database will only include this information, the International Maritime Organization (IMO) has created a database known as the Global Integrated Shipping Information System (GISIS). This system includes information ranging from marine casualties and incidents to condition assessment schemes and simulator information (International Maritime Organization, 2005). This database is important to the advancement of marine investigation because it provides information regarding marine investigation techniques and marine accidents to all member agencies. The investigators who access the GISIS can even search for accidents by region and vessel name.

2.4.2 Human Resources

Although these technological advancements have created a more collective marine accident investigation community, investigation agencies still need to have organization of human resources to produce timely and accurate evaluations of accidents to make databases credible. To utilize human resources, agencies should hire investigators with specialties in fields of law, naval architecture, navigation, human factors, and engineering with experience on the sea (Marine Accident Investigators International Forum, 2003). The Marine Accident Investigation Branch (MAIB) of the

United Kingdom organizes their investigators into teams with four specialists, one from each of four categories similar to the ones listed above. The MAIB can launch one of the teams on any investigation and each team will have a specialist from each category. This greatly reduces the need for the investigators to collaborate with experts from outside of the investigation team. Although this may be true, investigators must also keep up-to-date within their specialty fields. Investigators often attend workshops and seminars to keep current on the latest trends in special areas of accident investigation. The Marine Accident Investigators International Forum (MAIIF) and IMO sometimes organize these workshops through the agencies that have experience to get newly formed agencies up to date on current investigation procedures.

3 METHODOLOGY

The goal of our project is to improve the quality of the NTSB's current method of marine accident investigation. We identified the different steps of the accident investigation process to determine the protocol shown in Appendix A. We created this protocol to collect information regarding the depth of investigations, the amount of time taken to do investigations, and the consistency of each step of the process during an investigation. We interviewed investigators from all modes of transportation at the NTSB and other marine investigative agencies such as the Australian Transportation Safety Board (ATSB), the Canadian Transportation Safety Board (TSB), the Marine Accident Investigation Branch of the United Kingdom (MAIB), the Marshall Islands Maritime Authority (MIMA), and the Swedish Accident Investigation Board (SHK). We then compared and analyzed the data from these investigation agencies to identify the highest quality marine accident investigation process specifically for the NTSB Office of Marine Safety (OMS).

3.1 Interview Protocol

The first step of our methodology was to identify the steps of the accident investigation process and determine factors to describe the quality of an accident investigation. We determined that the three aspects that contribute to the quality of an accident investigation that we would research are consistency, depth, and time efficiency. The consistency of an accident investigation refers to how often the investigators at an agency use the same method for each step of the investigation

process each time they perform an accident investigation. If an agency does not use a consistent method it is possible for investigators to identify different causes of an accident. For example during the causal identification step one method might lead an investigator to discover one cause of an accident; however, if the investigator used a different method, a different cause may have been found. A consistent method guides investigators to reach conclusions through an objective process. Although consistency helps to raise the quality of an accident investigation, without depth, consistency does not make an investigation worthwhile. The depth of an investigation refers to the amount of detail that investigators cover during an investigation. The amount of depth that an investigation covers is important in determining the quality of the investigation. An in-depth investigation allows investigators to determine safety issues related to system errors, rather than just human factors and electro-mechanical failures. Although depth is important, investigators can investigate too in-depth and take too long to complete and issue their recommendations. If investigators go too in-depth they waste resources such as time. Time is an important factor because a time efficient investigation provides recommendations to the public as soon as possible and can help prevent the reoccurrence of accidents. We collected information regarding the following steps of the accident investigation process so that we could identify the highest quality accident investigation for the NTSB OMS according to these three aspects: consistency, depth, and time efficiency.

It was important for us to determine the steps of the accident investigation process so that we could create the protocol we used to interview investigators from the agencies mentioned in section 3. The steps of the investigation process that we identified are factual collection, causal identification, and safety recommendations. In addition to these steps, we looked into the utilization human and technological resources. We developed the questions in our protocol to identify any techniques and methods that the agencies we interviewed currently use.

3.1.1 Factual Collection

Gathering accident facts is an important part of the accident investigation. The questions for our protocol that targeted this step of the investigation process are 2-6 of our protocol in Appendix A. The questions involved first asking about the cooperation between the investigation agency and the first responders to the accident. Second, we asked questions to find out if any of the agencies we interviewed had specific methods or techniques for collecting evidence. Lastly, we asked if any of the agencies we interviewed had methods for identifying when the investigators gathered enough evidence to determine safety issues.

3.1.2 Causal Identification

The second step of the accident investigation is causal identification. The questions we asked regarding this step of the investigation are numbers 7-10 of our protocol in Appendix A. We created the first of these questions to identify if each of the agencies we interviewed had a set definition for probable cause. Second, we needed to

identify if there are any methods used by each agency to determine the probable causes of an accident and how long the analysis of the accident facts takes in an actual investigation. Lastly, we asked questions to try to understand how each agency knows when investigators have identified the causal factors. Investigators determine causal factors to identify safety issues and produce recommendations that can prevent causes from reoccurring and help prevent future accidents.

3.1.3 Safety Recommendation

The third step of the accident investigation process is the production of recommendations by the investigators to help prevent the reoccurrence of accidents. For investigators to provide these recommendations to the public, they must construct accident investigation reports that support their reasoning for regulatory agencies to implement the recommendations. Question number 14 from our protocol in Appendix A pertains to the production of these accident reports. We asked this question to determine if investigators feel that the report-writing step of the investigation process takes too long. If there is redundancy in this process, then the regulatory agencies can activate the recommendations sooner, which helps prevent the reoccurrence of accidents. While these three main steps of the investigation process are important, we felt that we should also investigate how the NTSB is currently utilizing human and technological resources to provide additional suggestions on the improvement of the OMS accident investigation process.

3.1.4 Human and Technological Resources

We directed questions 11-13 from our protocol in Appendix A towards understanding how the agencies we interviewed utilize human and technological resources. We asked the first question to understand how investigators keep up with the technological advances over time. We asked the second question to determine if any of the agencies we interviewed use any software programs to help manage or aid their investigations. We also investigated database programs to help organize the NTSB's accident data. We developed the interview protocol in Appendix A to interview the agencies discussed in section 3.

3.2 Identify Accident Agencies' Investigation Processes

We interviewed investigators using the protocol discussed in sections 3.1.1-3.1.4 to identify accident investigation processes currently used by agencies such as the NTSB, the Canadian TSB, the Chinese Maritime Authority, the United Kingdom MAIB, the Marshall Islands (MIMA), and the Swedish SHK. We conducted email, face-to-face, and phone interviews with investigators from these agencies to identify the investigation processes that these agencies currently use. We conducted these interviews to analyze the consistency, depth, and time efficiency of the investigative processes that each agency uses.

3.2.1 NTSB

During our interviews, we considered three different modes of transportation accidents that the NTSB investigates: OMS, Office of Aviation Safety (OAS), and Office of Highway Safety (OHS). Our objective was to identify the accident investigation

processes used by each of these three offices within the NTSB. The office of aviation at the NTSB has existed since 1967 and has performed over 124,000 aviation accident investigations (National Transportation Safety Board [NTSB], 2004, History and Mission, para. 6). The experience and success of the aviation branch has helped to create a high quality process of investigation for aviation accidents. The number of successful recommendations that the office of aviation safety has created sets this quality. Identifying the accident investigation processes that the NTSB uses for each mode of transportation was important to research so that we could compare many different possible results.

3.2.2 International Agencies

Along with identifying the accident investigation processes that the different offices of the NTSB use, we also identified accident investigation processes that international agencies use. The international agencies that we interviewed are the Canadian TSB, the Chinese Maritime Authority, the United Kingdom MAIB, the Marshall Islands (MIMA), and the Swedish SHK. We included brief descriptions of these agencies and our interview outlines in Appendix B. It was important for us to identify the processes that other international agencies use because the NTSB recognizes these agencies for their excellence in accident investigation.

3.3 Identify the Highest Quality Process for the OMS

We identified the highest quality marine accident investigation process for the NTSB OMS according to the three components of quality we determined we would consider: consistency, depth, and time efficiency. To achieve our goal of identifying the highest quality process for the NTSB we decided to provide recommendations to the NTSB on the areas of their investigation process that they could improve to increase the effectiveness of their investigations. To provide these recommendations we first compared and analyzed the investigation processes that we identified from our interviews. We performed a simple content analysis to organize the responses from these interviews. We then analyzed the content by comparing the answers to each other using consistency, depth, and time efficiency as our basis for defining the highest quality techniques and methods from the investigation processes. To determine which of these identified techniques and methods were usable by the NTSB OMS we had to perform extra research outside of the interview data that we collected. We considered the differences between the agencies that we interviewed and also the time efficiency of the report issuing for the agencies that we interviewed.

3.3.1 Comparison of Investigation Processes

The first analysis that we conducted was a content analysis of the data that we collected during our interviews. We separated the data from each interview into the topics discussed in sections 3.1.1-3.1.4. We then created excel spreadsheets with x-coordinates that represented each interviewee and y-coordinates that represented each response that the investigator could have responded with. We created an excel

spreadsheet for each of the topics/questions that we asked. We show and discuss these spreadsheets in our Results section. The content analysis that we performed was important to organize the data that we obtained through our interviews. We then analyzed the data by comparing the methods and techniques from each step of the investigation processes based on which methods would fit the NTSB's OMS.

3.3.2 Considering the Differences between Agencies

To determine the highest quality process for accident investigation, we had to consider the differences between agencies to determine which techniques and methods are applicable to the NTSB OMS. We considered differences such as size of the agency, the number of cooperators involved in the on-site evidence gathering step, and the approach of accident investigations. The size of the agency affects the applicability of techniques because the NTSB does not have the number of personnel to sustain techniques that larger agencies employ. While considering the number of personnel involved in an accident investigation, we also considered the number of personnel that the NTSB sends to an accident investigation scene compared to the number that other agencies send to the scene. Apart from the size of the investigation agencies, we also considered the approaches behind the investigations that each agency completes. We compared the recommendations created by the Chinese MSA, which is a regulatory agency, with the OMS recommendations using keywords that relate to compliance with regulations.

3.3.3 Comparing Investigation Process Length

We obtained data regarding the time efficiency of the total report writing times for six different agencies. The six different agencies that we considered include the ASTB, three branches of the NTSB, the MAIB, the SHK, the TSB, and the New Zealand Transportation Accident Investigation Commission (TAIC). We looked up the amount of time taken to write each of the past ten reports from each agency's website. Then we entered this data into an excel spreadsheet to calculate the average report time for each agency. We then considered several different factors that might affect the investigation length such as the number of investigators in each agency, the number of reports produced in the past three years, the number of recommendations each report made, and the number of recommendations that have been implemented. We did this special comparison between the NTSB OMS and MAIB because the MAIB has a significantly shorter investigation process.

4 RESULTS

We conducted research in areas of accident investigation and interviewed several expert accident investigators to improve the quality of investigation at the NTSB OMS. Through our research and interviews, we identified the process and approach of accident investigation used by different offices of the NTSB and foreign agencies. During our interviews with accident investigators from these agencies, we also identified specific methods used for each step of the investigations. In addition to understanding how these agencies conduct accident investigations, our interviewee provided us with opinions on effectiveness of certain accident investigation methods along with insights on possible areas of improvement. Using all of the information gathered through our research and interviews, we were able to determine some areas of improvement for the NTSB OMS to achieve a more effective accident investigation according to consistency, depth, and time efficiency.

4.1 Accident Investigation Process and Approach

Based on our research, we identified two types of accident investigation agencies. There are authoritative agencies that have power to regulate marine transportation such as the MSA, and the MAMI. The others are Independent agencies that do not have power to regulate marine transportation, such as the NTSB, the MAIB, the SHK, the TAIC, and TSB. Both authoritative and independent agencies conduct accident investigation with the goal of improving marine safety. The distinct difference between authoritative and independent agencies is their accident investigation

approach. Accident investigation approach defines accident investigators' mindset during investigation. Independent agencies clearly define their approach through disclaimers within their reports, as shown below.

"The Independent Safety Board Act, As codified at 49 U.S.C Section 1154(b), precludes the admission into evidence or use of Board reports related to an incident or accident in a civil action for damages resulting from a matter mentioned in the report." – the NTSB

"The Transportation Safety Board of Canada (TSB) investigated this occurrence for the purpose of advancing transportation safety. It is not the function of the Board to assign fault or determine civil or criminal liability." - TSB

"SHK investigates accidents and incidents with regard to safety. The sole objective of the investigations is the prevention of similar occurrences in the future. It is not the purpose of this activity to apportion blame or liability." – the SHK

"Regulations 2005 shall be the prevention of future accidents through the ascertainment of its causes and circumstances. It shall not be the purpose of an investigation to determine liability nor, except so far as is necessary to achieve its objective, to apportion blame." – the MAIB

"It is not a function of the ATSB to apportion blame or determine liability. However, an investigation report must include factual material of sufficient weight to support the analysis and findings. At all times the ATSB endeavors to balance the use

of material that could imply adverse comment with the need to properly explain what happened, and why, in a fair and unbiased manner.” – the ATSB

“The Transport Accident Investigation Commission is an independent Crown entity established to determine the circumstances and causes of accidents and incidents with a view to avoiding similar occurrences in the future. Accordingly, it is inappropriate that reports should be used to assign fault or blame or determine liability, since neither the investigation nor the reporting process has been undertaken for that purpose.” –the TAIC

Those disclaimers above show the independent agencies’ approach to accident investigation, which is not to assign faults or blames. Authoritative agencies does not follow the same approach because their executive duties. Authoritative agencies also affect each accident’s outcome due to their duties of execution of regulation and the responsibility of search and rescue. The approach of not assigning faults and blames allow accident investigators of independent agencies to be able to evaluate all safety issues of an accident without biases.

Table 4.1 Accident Report NTSB OMS

	Number Key Word	of	Length Report	of
Athena 106	5		68	
Ethan Ellan	9		54	
Cosco Busan	13		147	
Axel Spirit	5		37	
Kition	0		36	
Shuttle II	4		57	
Empress of the North	20		113	
Alaska Ranger	2		83	
Crown Princess	3		95	
Queen of the West	1		21	
Average	6.2		71.1	
Median	4.5		68	

Table 4.1 shows the number of time key words (violate, violation, comply, compliance) appeared in 10 of the latest major NTSB OMS accident reports. This table also includes the length of each respective report in pages.

Table 4.2 Accident Report MSA

	Number Key Word	of	Length Report	of
Dubai World and Zhelinyu 2261	4		10	
CSCL NingBo and JinHaiDa	18		15	
Jin Sheng and Golden Rose	11		18	
Han Jin Gothenburg and Chang Tong	6		24	
Afflatus and Wen Yue	5		23	
CMB Biwa and Lu Ri Yu 1608	8		23	
An Jin	1		14	
New Ferry 85 and Dong Qu No.1	7		21	
Harvest and Jin Hai Kun	8		21	
BBC Ontario and Zhexiangyu 48038	2		10	
Average	7		17.9	
Median	6.5		19.5	

Table 4.2 shows the number of time key words (violate, violation, comply, compliance) appeared in 10 of the latest major MSA accident reports. This table also includes the length of each respective report in pages.

Independent agencies conduct accident investigations without bias, which allows them to achieve more depth in their investigations compared to authoritative agencies. The MAMI publishes the results of their accident reports in the form of safety advisories. The MAMI's safety advisories do not include information on factual collection and cause analysis; the lack of this information does not allow the public to scrutinize their work. However, some authoritative agencies do publish their accident investigations such as the MSA. According to the last 10 major reports provided by both the NTSB OMS and the MSA, the NTSB produced in average a longer report in pages. We do not believe the length of an accident investigation report directly influences the depth. Based on our analysis of accident investigation reports, the keys words violate, violation, comply, and compliance are used in context with regulations. Within the shorter MSA reports, there is in average more use of those key words described. This data shows the MSA reports focus more on the enforcement of regulation compared to the content of NTSB OMS reports. The longer length of NTSB OMS report shows the NTSB OMS discusses safety issues other than the area of regulation compliance within their report. In summary, the analysis between the reports of the NTSB OMS and MSA provided support that independent agencies achieve more depth in accident investigation compared to authoritative agencies.

4.2 Accident Investigation Methods

As described previously, the independence of accident investigation agencies greatly improves the depth of their accident investigations by providing accident

investigators an unbiased investigation approach. To further improve the quality of the OMS accident investigation according to the three aspects of quality that we considered, we have interviewed expert investigators from many agencies. We asked questions regarding the factual collection, causal analysis, and safety recommendations steps of the overall accident investigation process. We have conducted a content analysis on these investigators' responses to questions of our interview protocol (Appendix A).

Table 4.3 Content Analysis

NTSB		
International Agencies		
1	Rob Henry	OMS
2	Barry Strauch	OMS
3	Tom Roth-Roffy	OMS
4	Larry Bowling	OMS
5	John Delisi	OAS
6	Mark Bagnard	OHS
7	Ken Potter	TSB
8	Sanny Shamoun	SHK
9	Alan Blume	MIMA
10	Mike Travis	MAIB
11	Mike Walker	ATSB
12	Mabito Hamada	JTSB

Gathering Evidence													
Evidence Checklist	1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
Uses Evidence Checklist				X		X	X	X					4
No Evidence Checklist	X	X							X	X	X	X	6
N/A			X		X								2

Checklist (Designation)	1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
Agency Designated Checklist							X	X					2
No Designated Checklist	X	X	X	X	X				X		X		6
N/A						X				X		X	3

Evidence Priority (First)	1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
Witness		X	X	X					X	X			5
Physical	X				X		X				X		4
Documentary													0
N/A						X		X				X	3

Determining Probable Cause	1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
Definition of Probable Cause													
Uses a Probable Cause Definition				X	X		X				X		4
Does not Use a Probable Cause Def.	X	X	X			X		X	X	X		X	8

Probable Cause= P.C.	1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
Agency Has definition for P.C.							X				X		2
Agency does not have P.C. Def.	X	X	X	X		X		X		X		X	8
N/A					X				X				2

Causal Analysis	1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
Designated Method							X			X	X		3
Non-designated Method	X	X	X	X	X			X				X	7
N/A						X			X				2

Causal Analysis Method	1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
Event Cause Timeline	X		X				X	X		X	X		6

Producing Recommendations	1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
Report Writing													
Redundancy in Report Writing	X	X	X	X							X		5
No redundancy					X	X	X	X	X	X			6
N/A												X	1

Utilizing Human and Technological Resources	1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
Human													
Cooperative learning within the agency			X								X		2
Workshops/seminars	X	X	X	X	X	X	X		X	X	X		10

On the Job Training														4
N/A								X						3

Software	1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
Utilizes software	X				X	X	X				X		5
Does not Utilize Software		X	X	X				X	X	X			6
N/A												X	1

Software is Useful				X	X	X	X				X		5
Software is Not Useful									X	X			2
N/A	X	X	X					X				X	5

Kind of Software Used	1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
Scene reconstruction Software						X							1
Simulation Software							X						1
Causal Event Software					X		X						2
Organizational Software	X						X		X		X		4
N/A		X	X	X				X				X	5

Table 4.3 shows the content analysis of our interview. Where existence of key content with responses are mark with checks according to respective interviewee.

4.2.1 Factual Collection

We have identified factual collection of accident investigation is done initially through gathering of evidence in the forms of documentary, physical, and witness. To evaluate the consistency of evidence gathering, we interviewed investigators on whether their agencies provide a documented methodology for factual collection. From our responses, we determined evidence checklists are the only form of documented methodology for factual collection. Evidence checklists consist of items that investigators need to gather during the factual collection step of accident investigations. We found that the TSB is the only agency that provides a checklist for their investigators, and the TSB modeled their checklists specifically for different accident types. (Potter, personal communication, 11/17, 2009) 30% of the interviewees

responded with the usage of evidence checklists. These accident investigators utilize either personalize checklists or adaptations of other organizations' checklists. (Bowling, personal communication, 11/19, 2009; Shamoun, personal communication, 11/19, 2009)

Other than the 30% of the accident investigators who utilize checklists, the rest of the accident investigators responded that they do not use checklists during their investigations, or do not care for their usage. For those investigators who do not utilize checklists, some stated the usage of evidence checklists might be constraining (Strauch, personal communication, 11/2, 2009). These accident investigators believe the usage of evidence checklists is constraining because the possibility of overlooking important evidence that are not within the checklists. There are other statements of aversion regarding evidence checklist related to its time efficiency (Travis, personal communication, 12/3, 2009). These accident investigators oppose the usage of evidence checklists because if all evidence of checklists is gathered, accident investigators may dramatically lengthen the duration of factual collection. As shown in appendix C the TSB's evidence checklists contain approximately 1500 items in total. These statements provided insight into why some accident investigators dislike the usage of evidence checklist.

Although some investigators dislike the use of a checklist, some accident investigators do utilize evidence checklists for factual collection (Potter, personal communication, 11/17, 2009). These interviewees stated accident investigators could

use evidence checklist as a guideline for their factual collection. In addition, their responses stated that evidence checklists could prevent accident investigators from overlooking simplistic evidence, which can cause accident investigators to revisit accident site after the initial on-site investigation. Although the investigators we interviewed did not agree on if a checklist is useful, we did find that all investigators, whether they dislike and support the use of evidence checklists, converged in one common conclusion. This conclusion is evidence checklists can serve as an aid especially for inexperienced accident investigators.

Along with our questions regarding the use of an evidence checklist, we have also analyzed investigator's opinions on which form of evidence should receive priority during accident investigations. From the interviewees' responses, we found 50% of the accident investigators prioritize witness evidence. These investigators stated multiple field situations that correspond to witness evidence's degradability. Multiple accident investigators who are human factor specialists stated, even though accident investigation of independent agencies is not interested in determining blame, over time, witnesses may modify their responses to associate less involvement in the accident with themselves (Strauch, personal communication, 11/2, 2009). Other human psychological factors accident investigators mentioned are as described in section 2.1.1. Accident investigators did state a non-psychological factor that results in the degradability of witness evidence. The majority of the crewmembers and other personnel who are involved in accidents may serve as witnesses and have duties after the occurrence of

an accident. These witnesses' obligations may cause accident investigators to have difficulties in approaching them (Blume, personal communication, 11/19, 2009). If accident investigators do not conduct interviews in a timely manner, they may not be able to make contact with the desired witnesses.

Second to the support of witness evidence, 25% of the accident investigators prioritize physical evidence. Some accident investigators stated in the case of marine accidents, vessels typically maintain their location after the accident (Roth-Roffy, personal communication 11/10, 2009). In addition, environmental factors do not harm majority of physical evidence on vessels, thus timeliness of physical evidence gathering does not take the same priority like other forms of investigations. Those accident investigators who prioritize physical evidence stated that the factors mentioned in section 2.1.2 can perish physical evidence (Henry, personal communication, 10/30, 2009) Accident investigators also mentioned, due to the current regulations, physical evidence such as VDRs are not in the sole jurisdiction of the accident investigation agencies. There is a possibility the vessel owners may modify devices such as the VDR prior to when accident investigators are able to arrive on scene.

Accident investigators have full jurisdiction over documentary evidence due to their subpoenas. Thus, no accident investigators chose documentary evidence as their priority. Some investigators stated, in some cases documentary evidence may be the only form of evidence that accident investigators can gather in accident investigations due to the complete loss of vessels. These accident investigators raised the point that

oftentimes, the prioritization of evidence gathering is situational. Because accidents vary case by case, 25% of the accident investigators did not provide a response to their preference of evidence priority.

4.2.2 Causal Analysis

Causal analysis is a step of accident investigation, where accident investigators use the factual data of the accidents to determine safety issues through probable causes. To determine the safety issues of accidents, accident investigator must have a definition of probable cause. Without a definition of probable cause, accident investigators will not have a defined goal while conducting causal analysis. From our interviews, we have determined that TSB and ATSB are the only two agencies with a clear definition of probable cause that their whole agency utilizes. Both the TSB and ATSB use a definition that is similar to the IMO definition of causal factors (Potter, personal communication 11/17, 2009; Walker, personal communication, 12/10, 2009). The IMO definition was recently changed to a definition where all safety issues within an accident are considered as causal factors.

From our interviews, we have determined that the NTSB OMS does not have an organizational wide accepted definition for probable cause. Some accident investigators of the NTSB OMS have adopted their own personal definitions. One investigator uses the definition of probable cause adopted from the USCG (Bowling, personal communication, 2009). The USCG defines their definition of probable cause as the root cause of an accident.

With a set definition of probable cause, accident investigators may use causal analysis methods to determine safety issues of accidents. Fifty percent of the investigators we interviewed stated that the usage of a causal analysis method is not necessary. These investigators believe they are able to determine the safety issues using purely their expertise (Strauch, personal communication, 11/2, 2009). Accident investigators stated that MORT is a time consuming method of causal analysis. From our research we have found that MORT has around 1500 items that are arranged into a fault tree as shown in Appendix F. The fifty percent of investigators who do use causal analysis methods each stated a different method. However, through further research we determined each different method is an adaptation of the Events & Causal Factors method (E&CF). From our interviews, we have gathered that the ASTB, the MAIB, and the TSB all highly recommend their accident investigators to use a form of E & CF analysis. E & CF is explained in detail in section 2.2.2. An example of the MAIB's usage of E & CF is shown in Appendix G. In addition to the use of the E & CF method, the TSB and the SHK recommended investigator to use Why-Because analysis throughout the investigation (Potter, personal communication, 11/17, 2009; Shamoun, personal communication, 11/14, 2009). These agencies believe investigators should maintain a "why-because mindset". From our research, why-because analysis is a method developed to ensure accident investigation objectivity (Ladkin, 2005). Why-because analysis uses factual data to determine causal factors in a very similar manner as the E&CF method.

During our research, we found that HBT method is documented in all of the accident investigation guidebooks. However, we did not find any accident investigators who utilize HBT through our interviews. HBT is a causal analysis method use to analyze prevention barriers within accidents. One investigator of the NTSB stated during the *Exxon Valdez* accident investigation, the NTSB board utilized HBT for the creation of a recommendation (Woody, personal communication, 12/2, 2009). In this case, the NTSB board utilized HBT to determine the capability of a prevention barrier in reaching the desired level of safety.

4.2.3 Safety Recommendation

Independent agencies notify the public of safety issues, and provide recommendations to improve safety through accident investigation reports. The NTSB, ATSB, MAIB, SHK, and TAIC are all independent agencies and have identical purposes for their accident investigations. They strive to use unbiased facts to determine accident causes. We were unable to fully assess the depth of each agency's investigation reports due to the scope of this project. Therefore, we identified each agency's depth as what they strive to achieve based on their mission and investigative approach.

Based on our determination that each independent agency strives for an identical depth, we were able to compare the time efficiency of the whole accident investigation process. This time efficiency is the total amount of time it takes an agency to publish an accident report with recommendations from the day of the accident. We have compiled the time in weeks for the last 10 major accident investigations by marine,

aviation, and highway office of the NTSB along with the ASTB, the MAIB, the SHK, the TAIC, and the TSB.

Table 4.4 The NTSB Office of Marine Safety Report Time

Brief Accident Description	Report Time (In Weeks)
Athena 106	35
Ethan Ellan	42
Cosco Busan	67
Axel Spirit	70
Kition	76
Shuttle II	76
Empress of the North	77
Alaska Ranger	79
Crown Princess	80
Queen of the West	84
Average	69
Median	76

Table 4.4 shows the amount of time in weeks it took the NTSB OMS to publish an accident report after the accident. There is a large variance of the total time. The median is higher than the average due to few accidents that took exceptionally shorter time to complete.

Table 4.5 The NTSB Office of Aviation Safety Report Time

Brief Accident Description	Report Time (In Weeks)
Boeing 767-200, N799AX	52
Aerospatiale SA365N1, N92MD	56
Embraer ERJ-170, N862RW	60
Jet CL600-2B19, N8905F	62
Cessna 500, N113SH	73
Eurocopter AS350B2, N613TV	79
McDonnell Douglas DC-9-82, N454AA	80
Cessna 310R, N501N	81
DHC-6-100, N203E	111
Cessna Citation 550, N550BP	119
Average	77.3
Median	76

Table 2 shows the amount of time in weeks it took the NTSB OAS to publish an accident report after the accident. There is a large variance of the total time.

Table 4.6 The NTSB Office of Highway Safety Report Time

Brief Accident Description	Report Time (In Weeks)
Collision, Upper Pittsgrove Township, New Jersey	19
Run-Off-The-Bridge and Rollover, Sherman, Texas	64
Rollover, Mexican Hat, Utah	67
Collapse Highway Bridge Minneapolis, Minnesota	67
Override of Elevated Exit Ramp Atlanta, Georgia	71
Railroad Crossing Accident in Elmwood Park, Illinois	133
Chain-Reaction Collision, Lake Butler, Florida	134
Rollover Following Collision, Osseo, Wisconsin	152
Override Following Collision, Huntsville, Alabama	156
Run-Off-the-Road and Rollover Turrell, Arkansas	202
Average	106.5
Median	102

Table 3 shows the amount of time in weeks it took the NTSB OHS to publish an accident report after the accident. There is a large variance of the total time.

Table 4.7 The MAIB Report Time

Brief Accident Description	Report Time (In Weeks)
Pacific Sun	15
Jo Eik	29
Vallermosa	39
Maggie Ann	40
Stena Voyager	42
Ville de Mars	42
Riverdance	42
HMS Westminster & Princess Rose	51
Eurovoyager	53
Abigail H	54
Average	40.7
Median	42

Table 4 shows the amount of time in weeks it took the MAIB to publish an accident report after the accident. There is a large variance of the total time.

Table 4.8 The TSB Report Time

Brief Accident Description	Report Time (In Weeks)
L'Acadien II	32
Algomarine	39
Fireboat 08-448B	55
Big Sister	59
Sea Urchin	60
Skalva	68
Fair Jean	89
Queen of the North	97
Sichem Aneline	102
Kometik	135
Average	73.6
Median	64

Table 5 shows the amount of time in weeks it took the TSB to publish an accident report after the accident. There is a large variance of the total time. The median is lower than the average due to few accidents that took exceptionally longer time to complete.

Table 4.9 The SHK Report Time

Brief Accident Description	Report Time (In Weeks)
Astral	47
Tinto	47
SFC-7153	48
Listerland	49
Team Joker	52
MT Prospero	53
St. Erik	64
Atlantis Alvarado	83
Finnbirch	109
MT Bervik	146
Average	69.8
Median	52.5

Table 6 shows the amount of time in weeks it took the SHK to publish an accident report after the accident. There is a large variance of the total time. The median is lower than the average due to few accidents that took exceptionally longer time to complete.

Table 4.10 The ATSB Report Time

Brief Accident Description	Report Time (In Weeks)
Van Gogh	37
Atlantic Eagle	44
MSC Lugano	44
Saldanha	48
Great Majesty	48
Malu Sara	49
Francoise Gilot	54
Iron King	62
Northern Fortune	67
Enterprise	90
Average	54.3
Median	48.5

Table 7 shows the amount of time in weeks it took the ATSB to publish an accident report after the accident. There is a large variance of the total time. The median is lower than the average due to few accidents that took exceptionally longer time to complete.

Table 4.11 The TAIC Report Time

Brief Accident Description	Report Time (In Weeks)
Pursuit	40
Cruise Cat	41
Santa Maria II	51
Kimihia	52
Anatoki and Lodestar Forest	60
Shikari	67
Taharoa Express	101
Kotuku	101
Mildford Sovereign	111
Walara K	119
Average	74.3
Median	63.5

Table 8 shows the amount of time in weeks it took the ATSB to publish an accident report after the accident. There is a large variance of the total time. The median is lower than the average due to few accidents that took exceptionally longer time to complete.

Figure 4.1 Comparison of Report Time.

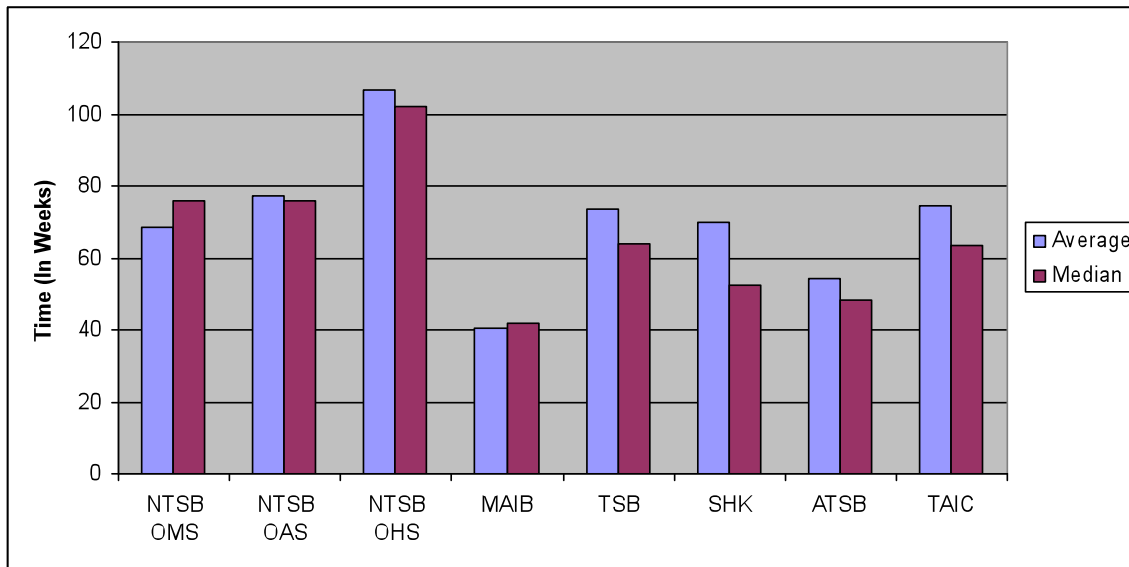


Figure 1 shows the comparison between the average and median of time in weeks it took each respective agency to produce an accident report after the accident. The MAIB has an overall lowest time for producing reports compare to the rest of the agencies. The NTSB OHS has the highest overall time in producing reports. Though the ATSB's time in producing reports is longer than MAIB, it also has a lower overall time compare to some of the other agencies.

The NTSB OMS takes approximately 6 months longer in average to produce an accident investigation report compare to the MAIB. As determined, both NTSB and the MAIB strive for the same depth during their accident investigations. Because the MAIB's excellent time efficiency in producing accident investigation reports, we were especially interested in comparing those reports of the NTSB OMS and the MAIB.

Table 4.12 The NTSB OMS vs. MAIB Comparison

	The NTSB OMS	The MAIB
Number of Investigators	10	20
Number of Investigations Between 2007-09	10	70
Average Investigation Time	69	40.7
Average Number of Findings	15.3	12.2
Average Number of Recommendations	4.3	3.7
Average Report Length	71.1	48.3
Recommendation Acceptance Rate	74.6%	92.7%

Table 4.12 shows the comparison between the NTSB and the MAIB regarding the number of investigators, the total number of investigation conducted between the years of 2007 to 2009, and the average time in weeks it takes for 10 of the latest major accident reports to be published. This table also shows the average number of recommendations and findings for 10 of the latest major accident reports for both the NTSB OMS and the MAIB. The recommendation acceptance rate shown for the NTSB is gathered form the total acceptance rate of recommendations to date. The MAIB acceptance rate is base on the MAIB annual reports from 2003-08.

We have found that the MAIB has two times the amount of accident investigator compare to the NTSB OMS. The MAIB produce 7 times the amount of accident investigations compare to the NTSB OMS. The MAIB produce slightly fewer findings and recommendations compare to the NTSB OMS per accident investigation. The average length of the MAIB’s accident investigation report is shorter than those of the NTSB OMS. As stated previously, the length of accident investigation reports do not directly influence their depth. We also compared the acceptance rate of recommendations between the NTSB and the MAIB. The NTSB conducted 3 accident investigations in the year of 2008, with the issuance of 8 recommendations in total. We were unable to determine an acceptance rate for the 8 recommendations. We gathered the acceptance rate for all 2342 of the NTSB OMS’ recommendations, which is 74.6%.

We have found the MAIB produce 117 recommendations in 2008, and 635 from 2003 to 2008. The acceptance rate of the 635 recommendations is 92.7%. Base on these data, we believe further assessment of the difference between the methods used by the NTSB OMS and the MAIB should be conducted.

We believe there is a possibility for improvements on the report writing and recommendation step of the NTSB OMS' accident investigations. During our interviews, we collected data regarding whether or not each investigator believes there is a redundancy during the report-writing step of their accident investigations. All of the investigators of the NTSB OMS responded during their interview that they believe there is a redundancy in their report writing process. One accident investigator stated the accident investigation board contributes to 1/3 of the overall report writing time (Strauch, personal communication, 11/2, 2009). Accident Investigators stated that though the report revision process of the NTSB is long, but it ensures the quality of the NTSB's reports (Henry, personal communication, 10/24,2009). Two investigators stated there is a lack of agreement between accident investigators and management regarding report content (Roth-Roffy, personal communication, 11/10, 2009; Bowling, personal communication, 11/19, 2009).

Base on our case study of the *cosco busan*, difference of opinion on report content amongst accident investigators resulted from their determination of probable cause. Multiple accident investigators believe the pilot was the probable cause of the accident. In the final report the NTSB OMS stated the master was the probable cause.

One of the board member during this investigation believed the VTS and USCG should be included as probable causes. We believe there is a considerable difference in the determination of probable cause amongst accident investigators during the NTSB OMS' accident investigation.

Through our comparison of accident investigation reports of the independent agencies, we have found a difference in report content. Those reports produce by the MAIB, the TSB, and the ATSB have an additional section termed "action taken". Through our interviews we have found that the MAIB, the TSB, and the ATSB discuss and implement some recommendations of their accident investigation prior to the publication of the accident investigation report (Travis, personal communication, 12/3, 2009). The "action taken" section of these agencies' reports specifically addresses the implementation of recommendations. The MAIB accident investigator we interviewed stated the MAIB is able to tailor their recommendation to be better suited for the recipients by working closely with them before the publication of the accident investigation report.

4.2.4 Human and Technological Resources

In addition to methods of accident investigation, we conducted interview in utilization of human resources and technology by the accident investigation agencies. Keeping investigators' knowledge of accident investigation techniques, marine engineering, and safety systems up to date is an important responsibility of accident

investigation agencies. Investigators must be knowledgeable about technological advances to perform accurate accident investigations. We asked about accident investigator training to determine effectiveness of the NTSB OMS's current methods are for educating investigators. Currently the NTSB OMS accident investigators stated the training they receive is "pretty good" (Bowling, Personal Communication, 11/19, 2009). From our interviews, we determined that all but one agency we have interviewed utilize workshops and seminars to train investigators in specific areas of development. Some accident investigators believe cooperative learning between investigators could help to improve the effects of workshops and seminars (Roth-Roffy, personal communication, 11/10, 2009). Through cooperative learning, accident investigators that attend workshops and seminars could share beneficial information with the other accident investigators. One problem with workshops is the limitations of budget provided for training. Some accident investigators stated that the problem with budget is due to timeliness of dispersal. Some workshops that the investigators would like to attend are already passed, when the available funding arrives (Bowling, personal communication, 11/19, 2009).

While workshops and seminars are one way that investigators can stay current with technology, other methods of trainings are available. From our interviews with the

foreign agencies, we have found many methods of training for accident investigators. Both TSB and MAMI utilize the method of “on the job training” (Potter, personal communication 11/17, 2009; Blume, personal communication, 11/19, 2009). Both agencies send their investigators on observational trips on liquid natural gas carriers. Other than on the job training, an accident investigator of the JTSB noted that MAIIF is a very useful conference for accident investigators to exchange their skills (Hamada, personal communication, 12/11, 2009). This Japanese investigator is attending English training seminar just so he may attend MAIIF in the future.

Other than training of accident investigators, we have gathered other forms of human resource utilization through our interviews. Those investigator of the NTSB OMS stated that the NTSB office of engineering help perform forensic testing for accident investigations (Bowling, personal communication, 11/19, 2009). The NTSB OHS stated during the investigation of Minnesota bridge collapse, the FBI aided majority of the engineering study that dramatically speed up the accident investigation (Bagnard, personal communication, 11/19, 2009). The NTSB AHS also mentioned the support of FBI, specifically in the area of factual collection (Delisi, personal communication, 11/4, 2009). Investigators of TSB utilize third party firms to support their analysis of physical evidence during accident investigations (Potter, personal communication, 11/17, 2009).

Accident investigation agencies may utilize technology to synergistically aid accident investigator's work. Computer software is a form of technology that can help accident investigators with file management and analysis of accident investigations. From our interview we gather the NTSB OAS and OHS utilize simulation software for scene reconstruction of accidents (Delisi, personal communication, 11/4, 2009; Bagnard, personal communication, 11/19, 2009). As stated previously the NTSB office of engineering conducts a portion of the forensics analysis for the NTSB OMS. The NTSB offices of engineering specifically conduct analysis of VDRs using MADAS. MADAS is the only simulation software use for marine accident reconstruction. From our interviews, we have determined all foreign marine accident investigation agencies utilize MADAS.

There is also software to help accident investigators with causal analysis step of their investigations. TSB provide software for accident investigators to create evidence diagrams (Potter, personal communication, 11/17, 2009). This software TSB utilize ultimately allow the investigators to conduct the entirety of why-because analysis on the computer. Although the TSB utilizes this software, majority of accident investigators that we interviewed do not find this technology useful. Some accident investigators from the NTSB OMS do believe creating event causal charts on the computer isn't different compare to using pen and paper (Strauch, personal communication, 11/2, 2009; Roth-Roffy, personal communication, 11/10, 2009; Henry, Personal Communication, 10/30,

2009). Accident Investigators from the MAIB also does not find causal identification software useful (Travis, personal communication, 12/3, 2009). One investigator also commented that causal analysis software is expensive, being around 300 dollars per license (Bowling, Personal Communication, Nov. 19, 2009).

We also looked into other computer technological resources such as informational database for accident investigation. Through our interviews with NTSB marine investigators, we found that some investigators believe the NTSB lacks a database for them to see trends within accidents (Stolzenberg, personal communication, 12/9, 2009). Accident investigators explained the NTSB never built a database for accident trends analysis due to the low numbers of accident investigation conducted yearly. Currently, with the globalization of communication between marine accident investigation agencies, the IMO has established the GISIS. The USCG and NTSB provide their reports to the GISIS along with all marine investigative agencies that are members of the IMO (Scheffer, personal communication, 12/11, 2009). Although this database is comprehensive of all accidents submitted by IMO member agencies, data mining to find trends in accidents is difficult. When searching the database, an investigator must search either by region or vessel name. The database does not have the capability to search by accident type. Further utilization of GISIS may help the NTSB accident investigators in their cause analysis.

5 CONCLUSIONS

Through the analysis of our interviews and research, we identified some areas of improvement for the NTSB OMS. We considered the methods for each steps of the accident investigation process and the approach of accident investigation agencies. In addition, we looked into the utilization of human and technological resources. Though each of these areas has possible improvements, we believe improvements of the cause analysis step of the accident investigation would be the most practical for the NTSB OMS. To solve the inconsistency of causal analysis, we recommend the NTSB OMS adopt a standard probable cause definition. By using a standard definition, the NTSB OMS can reduce discrepancies amongst accident investigators in their determination of probable cause. We believe the NTSB OMS should adopt the IMO causal factor definition as their definition of probable cause. The IMO causal factor definition is shown in chapter 2.2 of Appendix D.

The IMO definition defines a causal factor as any causes within an accident that are safety issues pertaining to the occurrence of the accident. The NTSB's mission is to prevent future reoccurrences of accidents through the issuance of safety recommendations. To accomplish the NTSB OMS' mission, accident investigators must make recommendations to prevent reoccurrences of pertaining safety issues. Thus, the identification of all causal factors, as defined by the IMO, allows the accident investigators to create effective safety recommendations.

Using the IMO causal factors definition as the standard probable cause definition will allow the accident investigators of the NTSB OMS to improve the consistency of their accident investigation. A goal of NTSB OMS accident investigators is to define the probable cause of an accident. By having a standard definition, the NTSB OMS accident investigators will have a common goal in investigation. Currently the NTSB OMS accident investigators traditional believe probable cause as a single safety issue, and the rest of the safety issues are contributing causes. Accident investigators of the NTSB OMS have different background and expertise, which cause them to each safety issues differently. We believe the determination of a single safety issue as probable cause over others is subjective, and is one of the causes of difference in opinions amongst investigators. We believe adopting IMO causal factor definition will also further ensure the independency of the NTSB OMS. By not assigning a single safety issue as probable cause eliminates the possibility of third parties from inferring the assignment of probable cause as blame.

Maritime safety can only be achieve with the contribution of all those involved in marine transport. It is important for the NTSB OMS to cover all levels of depth in their accident investigation, in effort to make helpful recommendation to everyone involved in marine transport. The use of IMO definition of causal factor as the standard definition of probable cause will assure all those involved in accident and those who are capable in aiding the prevention of accident to be addressed as probable. Overall, this will allow

the NTSB OMS to have the capability of achieving the highest depth required to make effective recommendations.

The usage of the IMO causal factor definition as the standard probable cause definition will also increase the time efficiency of accident investigation. As explain previously, the difference of opinion amongst accident investigators resulted in redundancy of report-writing step of accident investigation. We believe the usage of the IMO causal factor definition will eliminate the redundancy, and preventing the elongation of time in report production. With all safety issue addressed as probable cause, accident investigators may spend more time on making the most effective recommendation. Determination of which recommendation to make is an objective process as explained in section 2.3.

To further ensure the consistency, depth, and time efficiency of accident investigation, we recommend that all NTSB OMS accident investigators to use event & causal factor method in conjunction with the IMO causal factor definition as the probable cause definition. From our interview, we have determined that many investigators are already using event & causal factor method for cause analysis. Event & causal factor method ensures objectivity of cause analysis, because accident investigators must draw conclusion from facts. By using this method accident investigators may be able share logics of their causal analysis, thus improve cooperation.

6 RECOMMENDATIONS

To the NTSB OMS:

R-1. Adopt MSC-MEPC.3/Circ.2 Chapter 2.2 as standard probable cause definition

R-2. Utilize events & causal factors analysis to determine probable causes for all accident investigations.

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GLOSSARY

Allision: when a moving object strikes a stationary object

AMSA: Australian Maritime Safety Authority

AS: Aviation Safety

ATC: Air Traffic Control

ATSB: Australian Transportation Safety Board

AVDR: Audio/Video Data Recorder

CG: Coast Guard

E&CF: Events and Casual Factors

EMCIP: European Marine Casualty Information Platform

EMSA: European Maritime Safety Agency

FAA: Federal Aviation Administration

FBI: Federal Bureau of Investigation

FDR: Flight Data Recorder

FMEA: Failure Mode and Effect Analysis

GAO: Government Accounting Office

GISIS: Global Integrated Shipping Information System

HAZOP: Hazard Operability Analysis

HBT: Hazard, Barrier, and Target Analysis

HQ: Headquarters

HS: Highway Safety

IIC: Investigator In Charge

IMO: International Maritime Organization

ISIM: Integrated Safety Investigation Methodology

JTSB: Japan Transport Safety Board

LNG: Liquid Natural Gas

LNGC: Liquid Natural Gas Carrier

MADAS: Marine Accident Data Analysis System

MAIB: Marine Accident Investigation Branch

MAIIF: Marine Accident Investigators International Forum

MCARMI: Maritime and Corporate Administrator of the Republic of the Marshall Islands

MIMA: Marshall Islands Maritime Authority

MOU: Memorandum Of Understanding

MS: Marine Safety

MSA: Maritime Safety Administration

MORT: Management Oversight & Risk Tree

MTO: Man-Technology-Organization

NASA: National Aeronautics and Space Administration

NTSB: National Transportation Safety Board

OAS: Office of Aviation Safety

OHS: Office of Highway Safety

OJT: On the Job Training

OMS: Office of Marine Safety

PI: Principle Issue

PIMM: Principle Issue Management Model

PMI: Principle Maintenance Inspector

POI: Principle Operations Inspector

PRC: Peoples' Republic of China

RADAR: Radio Detection And Ranging

RPM: Revolutions Per Minute

SATB: Swedish Accident Investigation Board

SHK: Statens Haverikommmission

TAIC: Transport Accident Investigation Commission

TIMS: Total Information Management System

TSB: Transportation Safety Board

US: United States

USCG: United States Coast Guard

VDR: Voyage Data Recorder

VTS: Vessel Traffic Service

APPENDIX A

Interview Protocol

1. Gather specific information of the interviewee. (Name, Agency, Job Description, Years in current position, Contact information) Confirm previously gathered information with interviewee.
 - a. Please give further detail of your position?
2. What agency conducts the initial observation of the accident site?
 - a. What is your opinion of your agency's relationship with the agency identified by the previous response?
 - b. Does the agency of initial observation provide adequate information prior to your agencies' investigation?
3. What is the typical routine of your on-site investigation?
4. How often are accident sites revisited for gathering of additional facts?
5. How do you make sure all the facts are gathered?
6. Does your agency have a documented methodology for collecting accident facts?
7. How do you define a probable cause?
8. How are probable causes determined using the collected facts?
 - a. Is there a method that you particularly prefer? Why?
 - b. How many weeks does it typically take for the analysis identified by the previous response to be done?

9. How do you determine if you have found all the probable causes of accident investigations?
10. Does your agency have a documented methodology for probable cause analysis?
11. How do investigators keep themselves up to date with technological advances in investigation, engineering, and system dynamics?
12. What areas of training are you personally interested in receiving?
13. Does your agency use any software to manage or aid your investigations?
14. Do you find that there is redundancy in the report writing part of your investigations?
15. Do you have any information regarding accident investigations such as methods developed by your agency to improve the thoroughness of investigations that would help our project?
16. May we contact you for additional questions?

APPENDIX B

INTERVIEW TRANSCRIPTS

NATIONAL TRANSPORTATION SAFETY BOARD (UNITED STATES)

OFFICE OF MARINE SAFETY

ROB HENRY

10/30/09

Chief of Marine Accident investigation Team-A

NTSB 19 years

USCG 22 years

OMS has an advantage over other modes because CG does preliminary and consults with us.

Some of the difficulties for us are the isolation and remote locations of some accidents such as Dutch harbor which takes 2 days to get to.

Foreign vessels- very similar usually in US territorial waters very few investigations occur in other territorial waters.

-

Cooperation:

Goes up and down. Depends on Coast Guard person in command and his personal opinions and relationships.

Issues come up on high profile accidents such as cruise ships where both want to lead.

MOU- 2002 held up pretty well, they obviously can't investigate where they've been part of the cause

In the MOU there are defining questions to determine if CG defers to NTSB- yes, if scored over 100 pts

Eg crown princess, regardless didn't take any longer than normal

-

Preliminary: "not really" "enough to let us know we want to get involved" just basics- where?, fire, sinking, explosion, etc...

eg: Orange Sun- originally sounded like ship problem either mechanical or ship failure got on scene and was human error

-

On Scene:

Organizational mtg, end of the day mtg,

Management of the on-scene investigation- follows definition of "interested parties" lawyer relations, investigations are formal board military style

SLOW when CG leads investigation by their rules and regs slow- frustrating ie Lady Mary

-

Additional visits to scene: "depends"

Typically on scene for two weeks

If sunk and needs to be salvaged: Lake George Ethan Allen issue with scaling had to go back and get laser plotting for workable lines and hull form

-

Problems:

Subpoena authority not international

Interviews are confidential most other places such as UK where as NTSB is public forum can create issues such as if UK ran investigation

-

Late 90s: the principles of accident investigation

Fault tree, MORT red page tag

Jim Scheffer will talk about different schools

Events and casual factors- used today

-

Typical training and workshops:

Most recent version of PIMM made in-house and it's not done

Timeline- stickies on a wall ie Norway

Tom Roth-Roffy- boiler explosion ask for event and casual stuff huge timeline

-

Depth:

Defined by if can be used in practical and applicable safety recommendation

A lot of things will just get noted- eg fatigue (will check sleep cycle- 72 hrs normal up to 2 weeks), drugs, prescription

Mort- space shuttle and Three Mile Island but otherwise too much work n a typical NTSB investigation.

-

Multinational: kinda

MAIIF- gathered himself

IMO- "not that useful"

ABS- Jack Spencer

MORT-time consuming detailed

Binders:

black- interviewing witnesses, basic logic tools, sort of precursor to future books

pink- old code for IMO

wht- early work NTSB early protocols, authorities used to develop management on scene... referenced earlier

wht- universal course- pipeline training

wht (above)- old thing... something

spiral- seal on front- workshops turn of century good overview

white spiral- workshop to enhance 6

wht- MAIIF 2002 used to rewrite some NTSB life saving protocols

red- root cause analysis ABS

blue spiral- department of energy

wht spiral- course to apply MORT turned into SMART

BARRY STRAUCH

11/2/09

Chief of Marine Accident investigation Team-B

3 yrs OMS 15yrs OAS

26 USCG

Oversees investigations of team-B

Is human factors specialist for OMS

-

Cooperation:

USCG- field level on-scene good, HQ "less good but ok"

NTSB/USCG- Complimentary function but not identical

Many recommendations go to CG and they don't agree with them and they die off

-

Transition to OMS (biggest):

understanding the culture and the overseeing agencies in marine world

-

Preliminary:

USCG- where, fire, fatalities, specs, home state; only notifies us if meets NTSB standards

-

On Scene:

Organizational meeting, closeout meeting, field notes → IIC

-

Additional visits to scene:

“most of the time”

-

Evidence gathering (make sure all is collected):

Rescues have highest priority- they may destroy the physical evidence

Witness statements most important to collect when first on scene due to the psychological degradation of reliable testimony

Navigation wise Human Error or Mechanical Error

“in my experience if you don’t go back and gather more evidence you haven’t done a good job”

We usually match the witness statements to physical and electronic data and compare to other statements to confirm

“I could give a 24 hour course on interviewing and psychological effects”

-

Tools:

they’re all useless, made by academia and not investigators; no method that fits all situations you would end up trying to force things into the equation

Certain questions you have to ask:

usually the simplest answer is usually the right one

“we never accept the notion that bad things happen, we always look for a cause and have an investigation however it may be simple”

Errors occur then we work backward from the errors to the something that could cause this and we stop. Some of these tools force this and don’t fit.

Cosco Buson

Captain stayed out of operation of ship while pilot was on board; the pilot handled all navigation responsibilities. "cold face"

"I challenge you to find any analytical tool that takes into account cultural factors, there are NONE" the interaction and "cold face" may have lead to the captain distancing himself from the operation of the vessel and thus allowing the accident to happen

-

Writing of reports- "couple months" this depends on the complexity of the accident & the workload of the investigators at that time (other investigations underway)

-

Depth (make sure the causes are identified deep enough, potentially could go forever)

Root cause- we don't use "root cause" it's an academic term there might be multiple causes

Depth- good question, no firm answer; simple logic guides questioning where do you stop (the Commandant is too far removed to bring the matter to him on why the pilot was still allowed a license)

-

Currency:

Keep licenses current, send people to schools/workshops, work with parties and they consult

Victor- what about a journal club where investigators get together and share what they've seen/read in reports?

Brits-good reports; not great unit factors they say pilot error we say what the factors are on pilot that caused him to error

Academic environment can give assignments real world at work not practical (no journal club)

-

Anything to add, what would you change, part that should be improved/

Different drafts- ask directors what their role is in drafts, how long does it take to return drafts with comments in entirety not partially, ask director and deputy director: activities but mainly duration, also management director and what he expects from directors in review process get idea from him

Board: the political board is 1/3 of the time

TOM ROTH-ROFFY

11/10/09

Marine Engineer- Accident Investigator

Norway- group chairman of engineer group

11 yrs NTSB OMS

Preliminary Agency:

USCG- they're in every port, Miami PD and others because of explosion they weren't sure of criminal implications if any

-

Agency Relationship:

Relationship- TWA800 "typically good historically we've had some troubles" with HQ

FBI- not usually bad- MOU

USCG- sometime problematic, previous OMS Director fought with CG so some trouble at HQ levels: Staten island explosion 8-10 yrs? Primacy issues whose going to lead and whose going to join, Jack has made it better

Possibly in bed with CG too close adversarial "buddy buddy" go drinking together

Cosco Buson- CG changed their report to match ours... strange...?

-

Preliminary Assessment:

"In general they give us what they have"

-

Evidence Priority

Conflicted on what to do first. Witness evidence is perishable should get first at the same time you want to get on the ship and familiarize yourself with the scene maybe look at some documents depends on accident, complexity, people involved, etc... generally they teach us to collect perishable evidence first

Position evidence-explosion or machine comes apart you need to document or photograph this before it gets moved

Complete loss: "whole in the water", in this situation they would probably go to the company first and try and review specs or records etc...

Obviously more challenging however, depends on situation: vessel size and water depth, may be able to raise vessel, dive, or ROV

The navy sub & Japanese vessel off Hawaii: raised vessel & extensive search due to cultural and & international relations

-

Additional Visits:

Return to scene for additional evidence: previous director-NO, budget constraints

Jack- YES, now they seem to constantly going back

Must have warranted reason or something developing in order to get authorization

-

Depth:

No real tool. Get back have meeting, talk about safety issue see what they want to pursue

Through collaborative decision and what they decide to follow

OMS- no particular method or tool, varies by circumstances of the case

Previous director- tried to push event timeline causal theories, fault tree I have personally used, MORT we should use that more but don't use in more structural and rigid way

The more experienced guys “we know what to look for and how to do it”

Use tools for the new guys?- “in the beginning”

Margarine liked because more easily visually displayed and the connections.

Norway- took 4 yrs because months stopped and started again etc.... over and over

-

Probable Cause:

Probable cause- collaborative agreement

Probable cause xyz

Contributing cause xyz

Cosco Buson- spent a lot of time determining roles of pilot & master

-

Misc. Problems/ Comments:

RAND report- currency-management changes, GAO, the problems have been ID'd not sure if they've been addressed

Budgeting- electronic propulsion, critical thinking workshop

Cooperative learning in OMS between investigators could help

Eric Fields- deputy of strategic management, wrote himself the job, it never goes anywhere

Revision 300b board order

Management \leftrightarrow team relations awful

Management needs to have a better appreciation for on-scene investigation and what they go through.

LARRY BOWLING

11/19/09

Sr. Accident Investigator

2 yrs NTSB

21 yrs USCG Accident Investigator

Preliminary Assessment:

USCG- in potential criminal something other; fire, grounding- NTSB does better job of documenting

Cosco Buson- CG was closer to "true site documentation got on the ship, time left, etc..."

A lot of investigators there however only interested in pollution assessment and response package

8-9-10 whole bunch of people

"We ran lead however CG ran their own parallel investigation"

-

Relationship:

"Symbiotic one you need both agencies it is a system of checks and balances"

"Relationships gotten a lot better"

"can they be better certainly, only both sides" but for the most part they're a lot better than they were" B+

-

On scene:

“I have not ran lead IIC on NTSB”

IIC organizational mtg, get in groups

Things he can/has done:

Engineering-small

Deck-small/large

Survival-all

Human factors- don't like to get involved

-

Evidence Priority:

“It's a big depends” “depending on the scenario”

Documentary-license, etc...

Evidence gathered by CG (checklist)

That leaves physical and witness evidence- depends on time allocated

-

Additional Visits:

NTSB-“most cases I have to go back to the actual site at least once”

VTS- vessel traffic service (ATC for ships however unlike ATC not mandatory for all vessels)

-

Depth:

What have we accomplished what do we want to accomplish- daily within the group

We then tell IIC we have everything we need

Cost: San Francisco- anything that could be done once we got back we did due to costs: \$50 car per day no in/out \$450 hotel per day

IMO- guidance checklist, experience, steal and pilfer from CG, there is no situational checklist for each scenario

-

Probable Cause:

“I use IMO definition” it’s a bit of a sore spot I have asked for this office’s definition of probable cause

DNV-class society- SCAT system

CG- used to have one called root cause

“Here you round table it, sometimes it works sometimes it doesn’t”

How long does SCAT take?

“Depends on the scope of the incident”

Alaskan Ranger- 5 days: isolated out pilot, propulsion, etc and they were all independently analyzed
↓ ↓

“Doesn’t have to be one probable cause can be multiple with a ton of contributing causes”

“This office has borrowed from” other systems

-

Currency:

Networking- CG-here-other countries

Websites, conventions, interaction with other mariners

“No not really we got pretty good training here”

-

Misc.

Ways to improve the process:

Top 3 for time:

Streamline report process

Minimize window for editing cycling

OMS definition of “Probable Cause”

PIMM: “good model and I think it’ll work”

-

Software:

Helpful however, software- \$300/license

OFFICE OF AVIATION SAFETY

JOHN DELISI

Deputy Director Office of Aviation Safety

(202) 414- 6344

Rm 5404

11/5/09

Factual report from investigative groups:

Then old model says you would analyze

4 pilots none typewritten in 707

Determination of probable cause

New model- "constantly analyzing facts"

-

Evidence Priority:

AVDR: audio/video data recorder, collected

ATC communication

Very early develop a timeline

-

Depth:

PIMM:

Fuel truck no longer a PI

Stronger headwinds

No declaration of an emergency

PI=ATC & language between pilot and JFK: said "expedited" return instead of emergency

Add PI's as we go along, investigation is never closed they can go back and reopen if new circumstances or evidences is found

FAA- regulating agency in every aspect, by law a party in every aviation investigation

FBI will go to accidents as long as necessary until it is determined that there is no criminal activity to cause the accident

NASA facility in Huntsville AL

FBI involvement- does that slow you down? "slightly"

Egypt air 1999

-

Evidence Priority:

On-scene about one week documenting as it lies and key things

Documenting perishable evidence: logs, etc...

#1 flight data recorder & flight audio recorder

-

Additional Visits:

Wreckage stored in hangar and they may go back 3-4... times over next couple months

Wind sheer warning system that did not go off, we needed chip from computer system never did find it

Witness interviews are typically the least valuable evidence they get unless from the crew in cases where aircraft is not a total loss resulting in total fatalities.

-

Cause analysis:

Convert FDR parameter data into animation and see with flight simulator;

closed: just data result

open: with pilot correction or compensative responses

Voice recorder-not only voices but other sounds such as engine RPMS through sound spectrum software the computer can determine RPMS

-

Misc.

AA 587- JFK A300 finite element analysis

PMI

POI

Principle maintenance inspector

Principle operations inspector

Depth: "our charter is determine the probable cause"

2 nights earlier during maintenance check

Not the actual cause: elevator stuck in position

They are looking for that chain of events

Release recommendations during investigation

Industry 99% self regulated by the individual airlines watching themselves

Pilots are the last line of defense, no statistics on how many accidents are prevented by crew/pilots

-

Suggestions:

Improvement for OMS: get more comfortable with identifying the probable cause

Snag (OAS): getting investigators to analyze facts, problems conveying data into understandable situational scenario

SIMPLE Analysis & Answer

Staff draft- staff reviews

AS-1 – John DeLisi reviews (1 week)

Goal: 6 major 10 brief reports a year

Teams: random lottery depending on rotation when accidents occur

8-9 special factors

OFFICE OF HIGHWAY SAFETY

MARK BAGNARD

11/23/09

OHS

Division chief of investigation division

4 yrs

12 yrs highway investigator

Preliminary Assessment:

Typically it will be whatever local law enforcement has jurisdiction

-

Relationship:

it is generally very good. We're fortunate in OHS that many people have a law enforcement background.

-

Evidence Priority:

Well it depends on if they have an intent to file criminal charges. If it's a case where they will take it down the road to prosecution they will provide extraordinary support for us.

-

Notification of accident:

Majority of them are through the communication center occasionally when it's in an area where we've worked before they may contact us directly but it's usually through the communication center.

-

On scene:

We have two investigative teams that we rotate who are on call. Each team has an IIC and five group chairman: highway, motor carrier, survival, human performance, and vehicle. When we get on scene those five individuals will go out and look at their specific section of

the investigation. What we do to get the big picture is at the end of the day we'll have a meeting and everyone will discuss their finds and everyone weighs in on what happened in the accident.

-

Additional visits:

It would be very low. We only go back when we find something new or we have an issue with the police and their original documentation.

-

Depth:

We have had one in the past but I couldn't tell you the last time it was used. We're currently in the process of revising that. We do have a set of protocol for each group chairman as far as what is the minimum to be examined. What we don't want to do is get in the habit of using a checklist where you may overlook something by following the checklist too closely.

-

Probable cause:

Not that I'm aware of. We look for the probable cause based on what we have found we look for the why and the how the accident occurred.

-

Methods/analytical tool:

We do more with the work planning meeting and we'll sit down with the project manager of that case and let each group chairman go over their findings and using this we'll start defining a probable cause.

-

Analysis:

We have two sides to the office HS-20 which is the investigation side and then HS-30 which is the writing side.

Time analysis time: work planning meeting week 6 majority of analysis is completed, might not be in a final report but mostly collected.

One year but I think it's technically 15 months

-

Redundancy:

Team draft review-office draft review- management office review

Every step is necessary at least with the way we are doing it with the staff to have the first crack at it and then it goes to management. I think each step is important.

-

Currency:

Mainly that has to do with the annual training program. We will routinely send investigators to the manufacturers to see what happens in the process.

-

Software:

We use a lot of CAD software. When we document a scene we use a total station to construct a 3D view of the actual accident scene in real time.

-

Preliminary Assessment:

85-90% is provided by the police or the first responder. However, we just need to watch their level of interest in the case. If they plan you file criminal actions their involvement will be that much more than if it's just an accident where they gather the details but go no farther.

TRANSPORTATION SAFETY BOARD (CANADA)

KEN POTTER

Manager of Investigation Operations-Head Office

4 yrs TSB

12yrs Safety Analyst, Marine engineering specialist

11/17/09

Current Position:

Manager of operations- I'm responsible for supporting investigations right across the country with specialists such as naval architects engineers and laboratory engineering services and such as well I'm responsible later on in the process for both the safety analysis the analysis of the facts that are gathered and the safety communication that is advisory letters or writing of recommendations and having them pass through the board here for approval. On top of that taking off that hat and putting on my third I'm also the manager of the central and arctic region so all investigations in the central part and of the country and about 60degrees north fall under my responsibility directly.

-

Preliminary Assessment:

We try to get there first but of course we never beat the first responders so typically there will be police, fire fighters, or Coast Guard, or Search and Rescue on the scene first before us.

-

Relationship:

We generally have a very good working relationship with the first responding agencies in particular those we work with before Royal Canadian mounted police cg department of national defense we have MOU's with so pretty much between us and them everyone knows whose doing what to whom.

The TSB provides information to those first responders regarding what we expect. For example, obviously they are responsible for saving life if they can, generally we let them

know that we'd like them to look at the site try not to disturb it too much if possible and we'll often interview them after the fact to say what did you see when you got there?

-

Evidence Priority:

Once our people deploy and get to the site they obviously identify themselves to the officers or the first responders or the officers on the ship in this case. They'll take a look at the site itself in this case it was an engine failure. The team will do a brief pass through look and the engine room look at the environment they're in. they also look very carefully at safety when they board a ship one of the first considerations is this site safe for me to be there. Quite often with foreign vessels there are things taken for granted on board that we sorta shake our heads at so we're very cognitive of occupational safety and health issues. Once on board depending on the size of the vessel if it has a VDR we immediate download that as quickly as possible. Following that we'll get an idea on whose involved and decide who we want to interview and set up an interview plan. This is all of course going on while the ship is trying to be salvaged or people are trying to do their own things. We try to accommodate them while this is going on as much as possible. As necessary the team in the field will brief the staff at head office or if necessary request assistance from specialists. So if they need a naval architect we will dispatch one. at the same time the team on board is scoping the investigation saying how far are we going with this what are the initial issues we are seeing communicating those issues back to head office where the analysts here will start doing background research statistical research previous occurrence that sort of thing. On site investigations here can last anywhere from one day to two months depending on the severity and scope of the occurrence. Usually the average I'd say is two-four days after that length of time you've interviewed all of your witnesses you've collected your hard evidence your physical evidence for example if you need parts analyzed steel samples that sort of thing you've collected them and are bringing them back to head office.

Generally it would be, Yes secure the physical evidence and then go into the interview phase once you've seen around the scene what has gone on. You can't just leap into interviews right away.

-

Additional Visits:

Not very often we're usually pretty thorough about it. We'll occasionally have to go back and talk to witnesses but not at the site itself. or maybe occasionally and I'll say maybe once twice a year we'll have to go back and look at some physical evidence again but generally we're pretty thorough on our first pass through.

-

Depth:

We have a series of manuals called manuals of investigation and they provide the moi volume 2 is specific to field investigation and it provides guidance for the collection of evidence how to treat that evidence process it what to look for that sort of thing. As well we have checklists for various interviews and for various types of accidents like if it's a tanker accident we'll have a checklist for tanker accident, fishing vessel different checklist for that. But those are used by some investigators not all. Generally the moi provides the guidance necessary for the conduct of their investigation. I will say that generally once an investigator has used one he won't open it in the field he will generally know what to look for.

-

Evidence Checklist:

I think sometimes an investigator will be come very pedantic with the checklist and actually miss something he may have picked up on. But somewhere there's a balance between intuition and the checklist and experience of course as well. I should point out too that our investigators in the field aren't acting in isolation. They'll be call back and briefing us here at head office and our people here including myself and the other managers will be challenging what they've done and suggesting where they may wish to look.

-

Probable Cause:

We use expression called "causes and contributing factors" we have a formal procedure for analyzing an occurrence the events and the facts of an occurrence which leads us to that cause and contributing factor or the probable cause as you described it. We call it the ISIM (integrated safety investigation methodology) and essentially what we do is take a safety significant event and we drill down from it, we'll just ask a question "why did that happen?" and then we answer it "because this..." and then we'll continue a why-because analysis until we come to that underlying factor that you can't drill down anymore. So in other words to come to that probable cause we're applying a scientific methodology to the accident and the facts.

-

Analysis (Length):

We start it immediately and we encourage our investigators in the field, when they're doing interviews or collecting evidence in the field to start looking at in their mind a why-because. Typically we'll start an events diagram and start the analysis of those events the why-because analysis of those events within two or three days of the occurrence. Once the events or the information comes in they'll start it in the hotel at night after being in the field

during the day. And the analyst back at head office will start it as well in support of the field team. So almost immediately and the reason we do that is because if you have to go back later if you have to track people down it can be very difficult and their memories fade or they might not have the information you need.

-

Currency:

We have an annual training plan put together for the marine branch here. Obviously it's limited by the budget considerations we have towards training. But what we try to do is identify emerging areas of technology, safety training, and refresher training and assign that training to the investigator that will most benefit from it.

That seems to be a constant theme here. Send me out on a ship send me out on a trip from A to B so I can observe. And we've been doing that. For example for the last six months we've been sending staff on Liquid Natural Gas Carriers (LNGC) from Canada to Trinidad just to observe.

-

Depth: what is the usual turnaround?

Our own standard and this is internal here is to try to have an investigation from start to finish and completed and the report out the door to the public in one year or less.

-

Redundancy:

Typically it can go back between management, myself, or the team because we work in teams 4, 5, 6 times and take six weeks.

-

Software:

Absolutely. We download VDRs. MADAS -NTSB /MAIB. As far as records keeping and safety analysis for ex our ISIM process there's an analysis tool within our computer system here that allows us to do event diagrams, to do the drill down, the why-because, to do the risk analysis all of that process is done electronically. Lastly we have a system it's essentially a records management systems called TIMS transportation investigation management system that allows us to manage files electronically. We've moved in that direction that all records for an investigation are electronic and everyone has access from them instantly. So someone can be in the field and pull a document from the head office server or I can pull a document from the west coast office no problem at all.

STATENS HAVERIKOMMISSION (SWEDEN)

SANNY SHAMOUN

MTO Expert (Man-Technology-Organization)

4 yrs Human factors specialist

11/19/09

Preliminary Assessment:

Our agency, people working with our board. The Swedish accident investigation board would do that. The coast guard may arrive first and they will notify us but we don't depend on them for any collection of evidence we do our own investigation.

-

Relationship:

I don't have that much experience working with the maritime administration but my colleagues have and from what I've heard they have a good relationship.

-

On scene:

When something happens we get information from the police they call us and tell us an accident has happened. The board decides whether or not to investigate. Our team goes to the sight and we begin documenting the area

-

Evidence priority:

Depends what has happened. We try to do both. If we are going as a team with 2 or 3 sometimes 4 or 5 people we try to divide so we can do everything.

-

Depth:

We follow a checklist we have to see what we look at and collect. We also all have different backgrounds and we all have different questions we want to ask so between us all everything is covered.

-

Additional Visits:

Depends on how big the accident is. I say usually 1 or 2 times. It depends on how many people you have to talk to and if you can talk to all of them on the first trip. It's more than once I can say.

-

Probable Cause:

We don't have a defining guideline. We try to go as far as we can and we do this by asking the question why did this happen and when we don't get an answer to this question we believe we have gone far enough into the cause of this accident.

-

Analysis:

No there are so many methods that you can use we haven't defined a method to use. I try to use a method called M2 method? Or event cause method I think it's based on a method cause human performance method. When you do these investigations you try to have a team with specialists with different backgrounds. You try to do an event cause analysis. There are so many methods out there and I prefer because the method really focuses on the direction between man technology and organization.

-

Time:

Law says it should take one year. We have to finish the report by one year after the accident but because we're not that big it sometimes takes more than one year.

-

Report writing:

Sometimes one person is writing a report and sometimes takes parts from other writers. It depends on how many people are writing the report it complicates it with more people even though it's more resources.

-

Redundancy:

We have two steps to writing the report. We send it to all investigator team members and they say what they think about it. And then the investigation lead has to proof that report. And when we think it's good enough we send it to the other agencies that have some interest in the report that we worked with. They can say what they think about the report

before it's final. Also the people we have interviewed can read the facts we have gathered from their interviews.

-

Software:

No.

MARSHALL ISLANDS MARITIME AUTHORITY

ALAN BLUME

Deputy Commissioner of Maritime Affairs

11/23/09

2 yrs

USCG

Current Position:

I've been overseeing current investigations as well as doing some myself.

-

Preliminary Assessment:

Most times we do it in house. A lot of the times we will get the report of a casualty from a vessel operator and basically we will do a triage and decide if we need to send somebody.

-

Guidelines for Launch:

Primarily, we're in the process of revising the process for the implementation for the IMO code. It's very much on a case by case bases that we decide to launch or not. This is based on current resources and workload, sometimes we may investigate remotely and ask them to collect things and send it to us.

-

On scene:

Typically it'd be a team of one maybe two and we draw as much as we can on other organizations working in the areas. We try to maximize on what is already being done by others. If we need an expert contractor in a particular area we'll work with the operator saying you do the contracting and we'll get the information. A typical routine is what do we know, assessing what is known, what type of casualty was it, where and when was it, and then starting to put the questions together from there taking it piece by piece. Again it depends on the nature of the accident.

-

Evidence Priority:

Give the situation which one are you most likely to lose first and then to try and preserve first. Is it shift change and they're trying to get people home and the fact that memories start to fade. At the same time directing the chief engineer these are the documents that need to be put together.

-

Additional visits:

Generally no.

-

Depth:

We don't have anything documented it tends to fall on the investigator and working with the office back and forth.

-

Probable Cause:

In terms of a written standard definition, no. In terms of a working definition that's sitting down and what is the potential scope of causal factors for this particular casualty. And then starting to work back which one is proximate and attempting to identify that one root cause that one event that if it were not to have happened would the accident have come to happen. We recognize there's a whole chain of casual factors that lead up to the accident.

-

Analytical Method:

No we don't have a textbook procedure that we use. What we do now is very much based on the experience of the individuals doing the investigation and others who have reviewed it to flush it out.

-

Report Writing:

It really depends; a lot of this can be done relatively quickly once the casualty has occurred. In terms of completion and going from start to finished product that can be affected by workload because you might be working two or three investigations at a time. I say we shoot for 6 months but I'd say that's more of a target. On scene- 1-4 days, analysis/writing

-

Currency:

In addition to being inspectors we're very hands on with what's going on in the fleet. We also handle a lot of LNG vessels so we put on a course for our personnel that deal with LNG vessels. And there are few of us who will take part in training as it arises and share the wealth.

LNG-liquid natural gas

OJT-on the job training

-

Software:

No, we have used a documenting catalog just to organize everything but otherwise no.

MARINE ACCIDENT INVESTIGATION BRANCH (UNITED KINGDOM)

MIKE TRAVIS

12/3/09

Current Position:

Principle Inspector of bracket development

5 principle inspectors, with people working under them

Head of technical department

Took over this year from technical manager

5 years at the MAIB

At sea for 12 years as a marine engineer

Size – 42 individuals

Operational side, 7 officers, 16 investigators, 1 tech, 1 manager, 4

-

Preliminary Assessment:

Only located in South Hampton, so either police or Coast Guard and the accident is reported to them. Given instructions to stay clear of anything that might be construed as evidence. Unless they are aware of degrading evidence, the first responders are asked to steer clear of evidence. Prefer to gather our own evidence.

-

Relationship:

Relationship goes through phases; we have primacy for all evidence. Everyone understands their own role, but sometimes they do grind gears.

-

Notification

Notification from Coast Guard or through live event footage. Sometimes a more official notification. Administrative officer puts on database and immediately takes it to principle

inspectors to gather team for duty/standby, etc. Duty principle makes first assessment
Usually two inspectors, but sometimes a whole team if it is a major accident.

-

On scene:

Continues to make arrangements from base to make sure scene is protected and begin to arrange interviews. Interview witnesses, then inspect scene during the interview process. Other people become apparent through this process and then they interview these people as they become apparent.

-

Additional Visits:

Usually 2 day deployment coming back on the third day. Don't usually go back, make every attempt to make sure they gather everything they need in one trip. If we do return to the vessel, then the ships staff is no longer there, etc. If the ship needs to be salvaged, then they do have to go back or if they realize they need extra evidence that they did not gather.

-

Depth:

Almost entirely based on experience of the investigators, talk to head investigators back at base to make sure they have everything, so collaboration. References as a pre-deployment training aid to ensure investigators are comfortable with the process when arrive on site

-

Evidence Checklist:

Used by the rookies, but they made it better by trying to show all new inspectors a variety of accident investigations so they get different perspectives. Use of checklists can be too constraining, if it isn't complete enough or if it is too long, etc.

-

Probable Cause:

No definition, use the basis below

-

Causal Analysis:

Based on Canadian with an accident analysis diagram with timeline. We Use it on-site and when returned to base. We put it on whiteboard with the whole team. Using the accident

analysis diagram we go over all significant events on the timeline. Other models, Canadian model had a lot of analysis that goes greatly from the evidence through the recommendations. Use cause and events diagram to suit vocabulary also to define the root causes.

-

Party System:

Fair idea of what the recommendations could be, so they gather the people that would implement these recommendations and have a meeting where they assist them in making a feasible recommendation. Recommendations are "smart and workable". People who are carrying out these recommendations are involved in the process so less reluctant to adopt when they are issued. Working with the people who they are scrutinizing helps with the process and cooperation.

-

Length:

Length of analysis

Publish recommendations within 6 month goal in reality it does get stretched. Usually minor accidents can keep up with that.

Whiteboard meeting within 2 weeks have a presentation ready for everything that involves the accident and people in the branch comment on what may help the investigation along

Chief inspector decides on basis of recommendations that could come out from the accident, could stay as a preliminary examination if recommendations do not seem to be significant with no published report

Based solely on lessons that need to be learned from the accident

-

Report Writing:

*Setting a date for recommendations meeting, set early, but balanced with when they can finish the analysis

*3 weeks for analysis, but could be less

*Duty system forces the organization of the team to be ready for whiteboard analysis

*Allocate resources within a month of the accident

*Once every two weeks have meetings

*Couple accidents that increased length due to illness

*Pressure from the bosses

-

Workload:

Teams usually have multiple cases going

Allocate different jobs such as lead inspector

5 concurrent investigations, now spread is more even

Some teams become more loaded, but it just happens

When this exerts extreme pressure, basis of availability takes priority

All of the investigators are chief engineers or naval architects

Each one gets nominated to an area as a specialist, it is their responsibility to keep up with technological advances in their areas and share with everyone

If this is too much work for one person, then

If needed, they can do in-house training or training with another agency

-

Database:

Decent process management tool that they are looking for

Current database is ok, but are being pushed towards a European Database

Management and cost is beyond what they can muster

Basic office tools work sufficiently well

Could make use of other tools, but it isn't needed

-

Report Writing

Initial inspector writes it, then with the team they put up a draft to chief inspector

Then the chief inspector puts it out to the public

Report writing skills training to help the investigators

Want to keep them precise and short

-

Accident Trends:

A lot of fishing vessel accidents. Often very frustrating because no matter how many recommendations are made, accidents still tend to happen.

Timber vessel accidents during periods

Fatigue based groundings

More small vessel accidents

-

Depth Issues:

Essential to cover all facts from the accident

Not essential for detail of analysis in the report if the facts analyzed are not important to recommendations

External testing are included, but as an annex so not to make the report longer

Keep the report precise

Recently adopted method of taking notes during interviews

So that everyone understands everyone's interviews

AUSTRALIAN TRANSPORTATION SAFETY BUREAU

MIKE WALKER

ATSB Aviation

12/10

Sr. Investigator

14 yrs

Preliminary Assessment

It varies quite a bit here it could be police, emergency services, or the operator. If it is more of an airline incident then you expect it to be the airline or the ATC let us know. If it's a more of an accident you would expect it to be the police on ODSSTAR?

Marine: No Coast Guard odstar covers marine as well. Yeah they would get notified by ODSSTAR. Also there is the Australian maritime Safety Authority (AMSA) and they're like a national organization. With marine at the moment things like fishing vessels that sort of craft they're all registered and dealt with on a state by state basis. And each state does their own investigation. So AMSA deal with just international shipping.

Aviation: in terms of the general aviation accident it will be secured like a crime scene and wait for us. If we can't get there for some time we will ask them to take pictures and document the scene. Under our legislation they are allowed to remove bodies and personal effects however, if they do that we ask them to take pictures before they move items so that we can see. That is about their involvement.

On scene (evidence Checklist)

That's been a bit of contentious point. Some investigators develop their own but for the most part no, we don't use checklists. We just find that there is such a variety of situations that no checklist can cover them all and we tend to rely on the experience and teamwork within the team to cover everything. There are checklists and they are certainly used better as guidelines.

Evidence Priority

I guess that does depend, that would really depend on the situation. I guess we would really like as much intelligence on the situation before we go to the accident site. In general it would be go to the site and make documentation. And then wreckage and witnesses for general aviation. Its found with the witness that their memory is better in two hours than in two days than in two weeks then in two months. However since we probably won't get to them within to hours they don't end up the first priority once on-scene. We want to get perishable evidence that would be affected by rain and those things.

Length on-scene

For a general aviation accident probably say 2-4 days on the site. Air transport which we've had recently none of which were fatal take a little longer they would go 5-6 days.

Additional visits

It's been a sore point in the last year investigators have had to go back because something was missed so they had to go back to the wreckage and find bits. The idea is let's do everything we can even if it takes another day longer and don't rush and avoid having to go back. Sometimes going back is unavoidable because we find a failure with some system that there was no way we could be aware of that without further research. But in general almost all events we shouldn't need to go back. So we've been giving people more training about being on the site and interviewing on the site. So additional visits would be very low.

Probable cause

Yes absolutely. We don't call it probable cause we have big problems with using the word cause and with the concept of probable cause as do many agencies in the industry. And we've worked quite extensively on the area I'll send you some paperwork on the topic. The term we use is "contributing safety factors" and defining safety factor and then what is a contributing safety factor. And the definition is quite different from others and quite detailed and used throughout the agency. When we merged the different transport divisions all the divisions use the definition now. I can tell New Zealand doesn't have a definition but they're looking at ours. Canada has some kind of definition but they haven't elaborated it. MAIB they don't have any standard definition used throughout the agency. I believe now the IMO definition is very similar to the ATSB definition it might use a different term but it's quite similar in structure to our definition.

Causal Analysis

We developed something called analysis policies and analysis guidelines and tools. And certainly some modes are adopting these ideas more than others. In marine, investigators probably haven't been using the materials as much as our aviation. There are things we want all investigators to do. We want them to do some form of sequence of events analysis or timeline of the event. We want them to do a thorough process of identifying all the factors given general tools and checklists to consider. We want them to go through a thorough process of testing all of those things we have something called an evidence table weighing all the bits of evidence against each other for its involvement.

Report writing

Level 4- lowest level of investigation -6 months 8 pages

Level 3- 12 months

Level 2- 18 months

Level 1- we've never had one of these

We don't get a lot of our reports out within these time frames. Redundancy: yes it's a major problem for us. We have what is called a peer reviewer depending on what type of investigation they review and then pass on to team leader and so on. Each stage can take some time in the past we've had problems with writing styles and word usage things that don't have any real affect on readability. We're trying to encourage the philosophy is you should finish all analysis before doing your report writing. Some start writing before all the analysis is done making it take a long time.

Currency

In terms of systems, for some investigators they believe they should be spending more time training than doing investigation. In term of investigation training we have something called a diploma with 12 modules which I guess would be called on the job training. They include communication, interviewing, managing an investigation, using a computer, etc... we also have a class a four day course on cause analysis which we do; and have a 2 day course on interviewing; one week course in human factors for all investigators.

Software

We developed our own system call SIIMS (Safety Investigation Information Modes and Systems) it's similar to the Canadian TIMS. All our documentation is electronic and goes on this system which is basically folders you can organize it that way. Everything having to do with the investigation is stored there and in real time. We also use SharePoint with logs and document management, contacts, project aspects, and communications.

JAPAN TRANSPORT SAFETY BOARD

MABITO HAMADA

Marine Accident Investigator

12/10

Preliminary Assessment:

It depends on situation and kind of casualty. Typically, we get initial information of casualty from Japan Coast Guard. We made memorandum of understanding with JCG regarding providing initial information. After we grasp initial information regarding occurrence of casualty, our investigation will be carried out as soon as possible by investigator belonging to JTSB or belonging to district office.

-

Relationship:

Basically initial information of occurrence is enough for our investigations, and our investigation is carried out smoothly under the MOU previously mentioned, separately from the JCG. In view of providing initial information, relationship is good.

-

On scene:

Inspecting the location; measuring, taking photos, taking sample, sketching, etc... Gathering evidence. Especially, records of AIS, VDR and radar (objective evidence) are important. Interviewing in person, questioning by document and listening by phone call.

-

Additional Visits:

It depends on the situation of casualty. Dare to say, until I feel that gathering of evidence is sufficient.

-

Depth:

Like anybody, I cannot confirm that I make sure all the facts are gathered. Dare to say, if I could make final investigation report smoothly and naturally with pure mind, I feel above surely.

-

Evidence Checklist

Under preparation of the investigation manual. In my opinion, documented methodology is not necessary for collecting accident facts. We could understand how to treat accident facts, especially evidence, by IMO code. Most important issue is how to protect witnesses and concerned parties, I think.

-

Probable Cause:

It depends on situation and it is difficult to explain. But, I could say that it will be defined by even eye and mind with no knowledge.

-

Time on scene:

It depends on situation

-

Depth:

Finally, we determine that by discussion of the Board.

-

Currency:

When I face difficult problems, I ask experts for analysis. So, it is important to make connections with experts.

I would like to receive training of English for entering International meeting. My English is mariner's style, not fit for ordinary situation like as above meeting.

ADDITIONAL COMMENTS

WILLIAM WOODY

Sr. Accident Investigator

11/30/09

OMS has no office wide definition for probable cause.

The board used barrier analysis during their examination of the Cosco Buson.

JIM SCHEFFER

Associate Director of Investigation Quality

12/11/09

From time to time we have accessed GISIS to gather trend data etc. The USCG is the recognized unit for the administration (US) to IMO. In the past the NTSB has submitted its investigations to IMO through the CG. On the other hand NTSB-OMS has a recognized analyst to IMO-GISIS (myself), reviewing IMO member state accident report.

APPENDIX C

TSB Evidence Checklist

LEAD INVESTIGATOR NAUTICAL CHECKLIST

To successfully carry out his duties the Lead Investigator Nautical should consider the following checklist items.

GENERAL

Determine evidence available;

Review and assess vessel records;

Document evidence;

Recognize and analyse material failure;

Protect perishable evidence;

Seize evidence useful to investigation;

Seize or photocopy charts, documents, logs;

determine requirement to use simulators;

evaluate hull/engine/machinery/various systems;

analyse, interpret electronic data and submit to Team Leader;

sort out information and evidence gathered and inform Team Leader;

DOCUMENTARY EVIDENCE

VESSEL

General arrangement plan;
capacity plan;
tonnage certificate;
classification society certificates; recommendations / reservations / conditions of class;
crew list;
standing orders;
ISM documentation;
note of protest;
maintenance reports;
maintenance record prior to sailing;
inspection, repair and maintenance schedule; logs;
mate's receipts and adjoining clauses;
bill's of lading;
charter-party;
engine logs;
engine data recorder;
course recorder printout;
ECDIS download;
working chart with original markings;
radio log and radio messages;
ocean routeing messages;
draft survey's and accompanying calculations;
deck log abstracts including loading and discharging operations;

hold cleaning operations;
previous voyage if heavy weather encountered;
ventilation records;
temperature records;
bilge sounding records;
statement of facts at load and discharge port;
notice of readiness at load and discharge port;
cargo manifest;
cargo securing manual(IMO code of Safe Practices for cargo stowage and securing);
stowage plan;
correspondence; charterers; shippers; agents; stevedores; supercargo;
photographs and video; by crew; by shipper; by cargo owners;
computer stability printout;

INJURY TO PASSENGERS AND/OR CREW

name
address
date of birth
next of kin
nationality
rating
accident type, time, place
cease work
incapacitated totally or partially
Location of ship at time of occurrence (port or sea)

nature of work
supervision of work
accompanied in work place
unusual task
authorization to perform work
witness to accident
related to a shipping accident
medical treatment onboard and ashore
shore treatment
negligence, misconduct, default
alcohol, drugs, test
environment, lighting, noise, weather, access

SEARCH AND RESCUE

- DF bearing of distress message taken;
 - GMDSS distress messages;
- message relay;
time of mayday call;
type of mayday call;
time of tasking rescue units;
continuous listening watch on distress frequencies;
- SAR manual consulted;
 - surface/air communications;
 - RCC response;

assigned units (air and surface);

- course and speed;

Medevac;

MAN OVERBOARD

- Delay between accident and time of notification;

Lifebuoy with light, flare or smoke signal released;

- Avoiding action taken;
- Position of lifebuoy as search datum noted;
- Ship manoeuvre;
- Lookouts posted to keep person in sight;
- 3 long blasts sounded;
- Rescue boat crew assembled;
- Master informed;
- Engine-room informed;
- Vessel and man overboard position plotted (Manually and/or electronically);
- Radio broadcast performed;

Positions up-dated in radio room;

ABANDONMENT

Number of lifeboats;

Type of lifeboats (stern or side launching, covered or open construction, capacity, motorized ?);

Structural condition of lifeboats;

Equipment and provision;

Type and condition of lifeboats release system;

Boarding and launching arrangement;

Number and Type of liferafts ;

Condition of liferaft (date of inspection, equipment and provision);

Stowage location of liferafts;

Number and accessibility of Survival suits;

Was crew properly attired (lifejacket, warm clothing, survival suits etc);

Was crew properly trained;

Was the vessel listed;

Sea and weather condition;

Lighting condition;

Was there time to prepare survival equipment prior to abandonment signal;

Was the decision to abandon appropriated and timely;

Abandonment signals given (type, effectiveness);

Was there any problem during the launching;

Efficiency of passenger control;

Was there a distress call sent, by what means and was there a reply to it;

Did the EPIRB and associated equipment activate;

Time spent in craft before rescue;

CONFINED SPACE ENTRY

Purpose and type of space;
Reason for entry;
Pre-entry;
Space segregated by blanking pipes, valves, elec equip;
Vented;
Atmosphere test reading (oxygen 21%, hydrocarbon less 1%, toxic gases ppm measure);
Space cleaned;
Space tested;
Determined safe;
Permit required, requested, obtained, copy (Chemist certificate);
arrangement for continued checks;
continuous venting of space;
adequate access;
adequate lighting (explosion proof);
rescue & resuscitation equipment available;
responsible person designated;
constant attendance;
Buddy system used;
communications equipment tested by all concerned;
emergency and evacuation procedures established;
equipment used operational;
personnel properly clothed;
instructions given to persons concerned;
understanding of communication procedures;
agree on a report interval;
must vacate in event of immediate ventilation failure;

familiar with breathing apparatus used;
breathing apparatus tested;
breathing apparatus gauge tested operational;
breathing apparatus capacity air supply sufficient;
breathing apparatus face mask not leaking (check for beard);
emergency signals tested;
rescue harness on;
use of lifelines where practicable;
permit signed by master, responsible person, person entering;
date and time of signature;
job completed, date and time;
space secured against entry date and time;
Officer of the watch duly informed date and time;
completion of permit signed by responsible person;
check for permit period validity;

VOYAGE PLANNING

APPRAISAL

Information related to the basic manoeuvring characteristics and navigation equipment of the vessel, navigation charts, sailing directions, buoyage, navigation marks and other aids such as RACONS, lights, leading lights; current and tide tables, ship=s arrival draft and weather;

PREPARATION

voyage planning;

Draw intended track on chart;
inspect for isolated dangers;
establish safety margins;
draw guidelines for manoeuvres as required;
determine final abort point considering turning circle and stopping distance;
determine possible safety actions to emergency situations;
navigator's notes
leading lights and marks;
buoyage system;
sketch proposed track;
isolated dangers;
wheel over positions;
key positions for parallel indexing;
currents and tidal streams;
briefing for bridge team;
test gear before departure;
check instruments;
keep logs;
master pilot exchange of information;
bridge equipment familiarisation;
bridge and deck lighting
emergency in case of power failure
synchronization of bridge equipment

UNDER WAY / MAKING WAY

OOW is sole lookout (STCW 3.2.1.1)

Sufficient rest

Anticipated workload allows OOW to maintain proper lookout & remain in full control;(undertake duties interfering with safe navigation)

Back-up assistance has been clearly designated

OOW knows who, how and when to call for back-up

MONITORING

monitor at all times;

comply with plan;

check voyage with navigational aids;

visual fixes and radar fixes;

use of on board navigation equipment;

use of parallel indexing;

- safety margins using dotted lines;

- wheel over positions;

- range and bearing information;

control of speed and heading;

track intended;

course steered;

path followed;

errors or omission by pilot;

action too late;

AMVER, AMFAX;

PREPARATION FOR ARRIVAL

local regulations

VHF channels selected

navigation equipment prepared and checked

steering gear checked

engine switch from bunker to diesel (if applicable)

port communications, special berthing, loading requirements

ANCHOR WATCH

plot ship=s position

use of appropriate chart

frequency of position checks

proper look-out

inspection round onboard

weather reports

weather records

state of sea

current and tide

check for dragging anchor

readiness of engine

exhibit proper lights and shapes

proper sound signals

comply with local regulations

RESTRICTED VISIBILITY

navigation equipment fully operational

VHF channels

fog signalling apparatus

navigation lights

watertight doors

look-outs

master informed

Safe speed

change in voyage plan

consider anchoring

HEAVY WEATHER SAILING

master and crew informed of heavy weather forecast

movable objects secured

ship=s accommodation secured

weather deck openings secured

speed and course adjusted accordingly

crew warned not go outside

safety lines

monitoring weather reports

SHIPPING ACCIDENT

DISTRESS ALERT FREQUENCIES

use of selective calling (DSC)

VHF channel 16

VHF 70

MF 2182 kHz

MF 2187.5 kHz

HF 4207.5 kHz

HF 6312 kHz

8414.5 kHz

12577 kHz

16804.5 kHz

the distress alert should indicate which frequency the follow up message will be transmitted and the mode of transmission (telephony or telex)

the distress alert by satellite should be transmitted with absolute priority to a Rescue Coordination Centre (RCC)

COLLISION

- weather;
- sea state;
- tide/current;
- course own ship;
- speed own ship;
- who detected other vessel;
- first radar contact;

- speed;
- course;
- time;
- distance;
- plotting;

range in use

Radar mode in use, True Motion/ Ship=s head up

number of radar sets in use

- ARPA memory bank;
- first visual contact;
- what means;
- distance;
- bearing;
- lights and shapes;
- apparent course;
- time;
- first radio contact;
- personnel on bridge;
- composition of watch;
- manoeuvres to minimise collision effect;
- speed change;
- course change;
- light and sound signals;
- when made;
- when heard;
- change of course and/or speed of other vessel;

- col regs obeyed;
- emergency alarm sounded;
- angle of impact;
- time of impact;
- accuracy of clocks;
- position of impact;
- course at impact;
- speed at impact;
- charted course;
- course recorder graphic;
- bell book and/or data logger (ECDIS);
- ingress of sea water;
- watertight and fire doors closed;
- deck lighting switched;

Action after impact

- communication before and after impact;
- crew and passenger muster;
- vessel position;
- radio room up-dated;
- sounding of bilge and tanks;
- distance from bridge to bow;
- vessels in vicinity;
- communication with vessels in vicinity;
- independent witnesses;
- photographs and video;
- scrap paper/course calculations;

STRIKING

- date and time of incident;
- position and number identification of pier;
- visibility;
- sea state;
- state of tide and currents;
- old or new object;
- damage to vessel;
- damage to object;
- position of object identified on chart/notship;
- photographs and video;
- fixed/floating object;
- safety of port(information and pilot service);
- environmental interests;

GROUNDING

- last known accurate position;
- method of position fixing;
- time of impact;
- accuracy of clocks;
- position of impact;

- course at impact;
- gyro/magnetic compass error

speed at impact;

- charted course;
- course recorder graphic;
- bell book and/or data logger (ECDIS);
- ingress of sea water;
- watertight and fire doors closed;
- draft;
- tide prediction;
- current information;
- radar performance;

range in use;

- visibility;
- engine stopped;
- emergency alarm sounded;
- watertight and fire doors;
- engine-room informed;
- lights and shapes exhibited;
- pre-stranding draft;

Squat;

- bilges and tanks sounded;
- hogging or sagging;
- overside soundings;
- vessel position;
- speed reduction;

- traffic;
- heading after grounding;
- damage reports;
- mechanical breakdowns;
- radio communications with passing traffic;
- anchors;
- vessel response;
- tug assistance;
- date and time of assistance;
- change of steering mode;
- number of pumps on;
- nature of bottom;

FLOODING

- emergency alarm;
- emergency stations;
- watertight doors closed;
- master informed;
- engine-room informed;

Damage stability;

- vessel position up-dated to radio room;
- life boat/life raft muster at stations;

FOUNDERING

- weather conditions;
- shifting of cargo;
- breaking of bulk;
- structural defects;
- explosion;
- liquefaction of bulk cargo;
- stability;
- water ballast;
- vessel history;
- last witnesses;
- last stevedores;
- last contact with owners;
- date and time of last port departed;
- voyage plan;
- port of call;
- ETA;
- type of cargo;
- last radio communications;
- owners;
- passing vessels;
- previous mechanical breakdowns, electrical failures and equipment malfunction;

MECHANICAL FAILURES

standard procedures identifying crew duties and responsibilities;

for narrow channel navigation
for propulsion emergencies
for steering gear failure
for electrical system failure
to perform emergency anchor deployment
to conduct fuel switching
last drill
procedure for crewing in normally unattended machinery spaces
voice communication between bridge and engine control station/emergency steering station/anchor station;
preventative maintenance records
up to date manufacturer=s technical publications
sufficient tools, spare parts
previous and/or present mechanical failures reported to VTS / pilot / change of crew
anchors ready for immediate release
power immediately available for anchor release

MAIN ENGINE FAILURE

- master informed;
- rudder and bow thrusters used to best advantage;
- preparation to anchoring;
- not under command shapes and lights;
- bunker quality on board/shore lab tests;
- specific gravity;
- viscosity;

- compatibility;
- water content;
- vessel position;
- danger of grounding;
- wind and current direction;
- anchorage;
- need for towage;
- port of refuge;

STEERING FAILURE

- engine room informed;
- emergency steering engaged;
- not under command lights and shapes;
- appropriate sound signals;
- way taken off ship;

prior testing of manual steering gear

multiple power units

use of two or more power units simultaneously

last main steering check

last auxiliary steering check

last remote steering check

last check power supply

last cross check of rudder indicator vs actual rudder movement

last alarm check

isolating arrangements
maximum full rudder angle
timing of rudder movement
communications between bridge and steering flat
change over procedures
emergency steering drills
records of steering checks and drills

INSTRUMENT FAILURE

GYRO/COMPASS FAILURE

- alternative means;
- magnetic compass used for steering;
- master informed;
- gyro maintenance;
- engine room informed;
- failure of other navigational equipment;

BRIDGE CONTROL/TELEGRAPH FAILURE

- switch to engine room control;
- engine room informed;
- master informed;
- bridge/engine-room communications;

GPS FAILURE

- determine type of receiver;
- simultaneous (track four or more satellites at a time);
- multi channel receiver;
- sequential (measure one satellite at a time);
- single channel receiver;
- number of satellites measured;
- number of channels the receiver has;
- Antenna connection
- Antenna location
- compare data with other equipment;
- receiver clock malfunction;
- power source regular;
- temperature affects reliability;
- determine data set to be displayed on monitor;
- check position and velocity when vessel stationary;
- good receiver will change reading very little;
- poor receive will fluctuate all over the place;
- dual frequency receiver;
- very sophisticated;
- eliminate ionospheric error;
- sequential;
- less accurate;
- single channel;
- starved-power;

- portable;
- run small batteries;
- position reading only once or twice per min;
- more accurate than loran;
- velocity reading questionable;
- continuous running;
- not limited by power source;
- can measure velocity if no acceleration or course change;
- do not monitor position continuously;
- cannot trust velocity if cheap receiver clock;
- fast multiplexing;
- moves from satellite to next faster;
- runs continuously;
- two channel;
- doubles the system's signal-to-noise ratio;
- can lock onto satellite under more adverse conditions;
- track satellites closer to horizon;
- velocity measurements more accurate;
- will use more power than single channel;
- simultaneous;
- will monitor four or more satellites at a time;
- instantaneous position and velocity;
- used in high dynamic and/or accuracy applications;
- used for surveying or scientific purposes;
- track all satellites in view instead of calculating position;
- four times signal-to-noise of single channel;

-large power consumption;

-three channel receiver compromise;

-one channel to measure time;

-two channels to establish radio lock on next satellite;

-S/A selective availability determined by Dept of Defence;

RADAR FAILURE

position on bridge

familiar model

Radar frequencies

consulted operator=s manual

former experience with radar

SEN certification

ARPA certification

check of all controls

malfunction of controls

tuning difficulty

brilliance/gain adjustment

presentation restriction

habit to use which presentation

gyro malfunction

distortion at quay side

electronic bearing line too thick

multiple echo

side lobe effect
distortion in one quadrant
difficulty in identifying landmarks with raster
compare Tx/Rx and monitors
heading marker error with landmark / athwartships
parallax
multiple vector on single target
arpa map presentation accuracy
radar error forgotten to apply
metal calculation further to course alteration
radar error reported by crew
understand crew radar error interpretation
comparison pilot and crew radar error
comparison of error before and after impact
error on different scales
aerial size
aerial location
nature of radar breakdown
electrical power failure
radar technician on board/shore
bridge radar log

ECDIS

training school
approved instructor

experience in general
familiarity with model aboard
PC platform or closed system
PC platform (other use)
PC performance
software licence
licence expiry date
servers in user;
nav equip link; GPS, DGPS, Radar, ARPA, gyro;
previous malfunction
records; log;
Blackbox, voyage history;
vessel and voyage entries
modification of entries
choice of maps
S57, Seamaps, BSB, ARC
manual correction saved
reinsert manual corrections after shut down
navigator's own selected options
screen light intensity
note time frame between accident and download (max 72 hours)

NAVI SAILOR - TRANSAS

config / exit - shut down Transas

SAIL SAFE - Q.MAR

FIRE

DISCOVERY

- who discovered fire;
- place and time discovery of fire;
- factor which drew attention to fire;
- reason for presence near fire;
- presence of other people before fire;
- observe someone leave site before the fire;
- last person known to have visited the compartment;
- wind;
- progress of fire;
- evidence of an accelerant;
- colour of flame;
- colour of smoke;
- smell of fire;
- Origin and heat source.
- hear explosion;
- forced entry into compartment (ARSON);

ALARM

- who sounded alarm;

- call out "fire on board";
- operate nearest fire alarm;
- inform crew member;
- telephone navigation bridge;
- emergency alarm sounded;
- master informed;
- engine-room informed;
- PA announcement re fire;
- identify yourself in emergency message;
- stop loading/discharging operation;
- time fire party arrived;

FIRE FIGHTING OPERATION

- crew member in charge of fire party;
- equipment on hand;
- equipment used;
- life boat/life raft muster stations;

Boat lowered to embarkation deck level;

- crew reach emergency stations;
- passengers requested to follow escape route to lifeboats;
- check no one missing;
- check man overboard;
- keep children on permanent observation;
- select proper life jackets for children and passengers;
- check clothing of passengers;
- all concerned notified of seat of fire;

- ventilation;
- automatic fire doors;
- fire doors jammed in open position;
- watertight doors closed;
- deck lighting switched on;
- vessel position to radio room;
- activate quick closing system;
- remote valve shut-off system;
- close all manual operated valves on LPG-system;
- switch off all electrical supply;
- stop all ventilation to compressor and motor room;
- fire box nearby;
- fire extinguisher on hand;
- fire hose;
- universal connection;
- emergency fire pump;
- isolate space and source of fuel
- contact fire shore brigade;
- plan initial attack;
- activate halon/CO2 fire fighting system;
- start water irrigation in front of bridge;
- cool down cargo area with water spray;
- assist fire shore brigade;
- stand-by engine;
- use of fire tugs;
- time to extinguish;

- start water irrigation system in front of bridge;
- start water irrigation over tank area;

SITE SURVEY

- determine who had access to site before inspection;
- determine if voluntary or involuntary;
- determine basic elements;
- flammable matter (fuel);
- ignition source (heat);
- source of oxygen;
- installation;
- electric (spark);
- chemical (reaction);
- mechanical (friction);
- check for out of place objects;
- trace origin of fire;
- search for most damaged area;
- search for lowest site of combustion;
- check for depth of carbonisation in flammable material;
- check if source has origin outside vessel;
- check openings which have created air draft;
- was the compartment opened or closed;
- put cigarette in appropriate container;
- use of naked light;
- use of candle;

- hang object near electric bulb;
- electric iron/other gadget in cabin;
- search for timers;
- electric motor;
- wiring should not burn unless motor completely burned;
- internal burning if bronze bearings seized on shaft;
- if motor running during fire, parts melted inside;
- electrical panel;
- check proper fuses;
- short circuit will burn entirely the fuse;
- overload or partial short circuit will melt only the fuse band;
- insulating material on wiring will have deteriorated on both sides of the short circuit;
- detect fire/smell/smoke;
- gas leak will cause explosion;
- check piping;
- check inappropriate location of gas apparatus;

INDICATION OF ARSON

- trailers between sources of fire;
- candles;
- matches wrapped around flammable material;
- chemicals out of place;
- recipient which contained the accelerant;

- if liquid accelerant used, traces will be found in joints and corners where liquid flowed;
 - way it was declared;
 - span of time before declaring fire;
 - insurance policy;
 - financing vessel;
 - replacing vessel;
 - vessel for sale;
 - dissension between crew/operators/owners;
 - crew member recently fired;
 - absence of personal effects in cabin;
- fully clothed crew members half way through the night;
- missing or non-operational fire fighting equipment;

HISTORY

- carry out fire patrol;
- explosimeters readings;
- gas freeing of tanks;
- confirm fire doors closed;
- confirm doors access to companionways closed;
- last housekeeping;
- tank cleaning;
- smoke in bed;
- extinguish cigarette;
- change installations recently;

- modify vessel recently;

-

EVIDENCE

- take photographs before removing objects for future analysis;
- take note of all persons manipulating evidence;

CARGO OPERATIONS

LOADING

- previous cargo;
- weather encountered;
- ballast distribution;
- condition of holds prior to load;
- bilge suction checked;
- ballast tanks pressed up;
- Cargo Securing Manual (1 July 1996);
- fixed securing arrangements;
- description (pad-eye, eyebolts, etc);
- location;
- portable securing gear;
- location;
- stowage;
- inventory and breaking strength;

- examples of correct use of gear;
- lashing taking in to consideration vessel movement;
- name load port;
- date and time of arrival;
- loading berth;
- cargo types;

chemical and physical properties;

safe containment of cargo measures;

protective clothing;

loading temperature;

counter measures against accidental personal contact;

- instructions before loading;

cargo stowage plan;

- method of loading;
- ship's equipment;
- shore equipment;
- grabs;
- elevator;
- loading sequence;
- date and time of loading;
- quantity loaded;
- stoppages;

cargo water spray system;

- marking of cargo (where, when and who);
- break away from moorings;
- stop loading;

- emergency procedures;
- stand-by at fire station next to cargo crossover;
- stand-by to start water irrigation if spillage;
- quick closing;
- try to secure moorings;
- stand-by to drop anchor;
- stand-by engines;
- call stand-by tugs;

procedure for cargo transfer;

- overloading;
- quick closing;
- emergency procedures;
- stop all engines and work;
- check hose couplings;
- check pumping rate;
- frequency of ullage checks;

LASHING, STOWAGE & TRIMMING

- specific instructions;
- involvement of shore labour;
- method of cargo handling;
- dunnage;
- supplier;
- nature;
- who carried out trimming operations;

- who carried out lashing operations;
- number and dimension of lashing wires;
- draft survey;
- bill's of lading consistent with mate's receipt;
- details of closing of hatches;
- who;
- any problems encountered;
- photograph and video of damaged equipment;
- lashing under time pressure to get underway;
- inadequate number of wire lashings;
- mismatched and improvised lashing gear;
- use of damaged lashing gear;
- blocking and bracing;
- too many varieties of securing gear on board

CONTAINERS

- flat shoe plate (deck & hatch covers);
- cones in shoe plates;
- bottom tier on resting on cones;
- twist locks between each tier;
- diagonally fitted lashings;
- D-rings on deck;
- penguin hook on containers;
- D-rings/turnbuckles/wire lashings/penguin hooks;

UNDERWAY

- date of sailing;
- speed;
- course intended and followed;
- periods of heavy weather;
- method of assessment of wind speed;
- weather damage to deck fittings and equipment;
- use of ocean routeing or other similar service;
- radio contact with other vessels (names);
- ballast distribution and changes during sailing;
- hatches opened at sea;
- readings;
- cargo temperatures;
- bilge soundings;
- seawater temperatures;
- air temperatures;
- means to counteract synchronous rolling;
- assessment of storm;
- take early action in deteriorating weather;

DISCHARGING

- name port;
- date and time of arrival;
- draft survey on arrival;

- name and time of berth;
- instructions given concerning discharging;
- discharge equipment (ship or shore);
- date time of discharging;
- quantity discharged;
- method of cargo handling;
- problems during discharging;
- ballast pumping sequence;
- involvement of shore labour;
- hose burst, fractured pipe;
- activate quick closing system;
- emergency procedures;
- start fire alarm;
- start water irrigation if spillage on deck;
- fire-fighting equipment and breathing apparatus stand-by;
- prepare emergency party;
- start fire pump;
- stop all engines and work if necessary;
- break way moorings;
- stop loading;
- emergency procedures;
- stand-by at fire station next to cargo crossover;
- stand-by to start water irrigation if spillage;
- quick closing;
- try to secure moorings;
- stand-by to drop anchor;

- stand-by engines;
- call stand-by tugs;
- tidal direction and strength;

LOSS, SHORTAGE OR DAMAGE OF CARGO

- first report of loss, damage or shortage;
- who reported;
- joint inspection;
- parties involved in inspection;
- where cargo stored;
- segregation of damage cargo from good cargo;
- abandoned cargo (jettisoned);
- weather conditions;
- packing deficiency;
- equipment failure;
- type of dunnage;
- method of stowing and lashing;
- damage report;
- master;
- chief engineer;
- other personnel involved;
- photograph and video of damage cargo;
- log books and records;
- routeing change imposed;
- port of refuge;

- shore assistance provided;
- port authority provisions;

FISHING VESSEL OPERATIONS

fatigue;

Number of crew adequate for operation;

hours of continuous work;

hours of rest;

feel strain;

denial of physical deterioration leading to disability;

back injury or pain affect bodily movement;

ship motion;

body reaction to ship motion;

weather;

shipping seas

maintain posture;

afterdeck poor design;

poor or fully equipped;

equipment used as designed;

maintenance of equipment;

new equipment better but present installation works;

willingness to try new fishing methods;

intended operation;

converted from one fish species to catch another;

life saving equipment accessible;

PASSENGER VESSEL OPERATIONS

PASSENGER BRIEFING WHEN BOARDING;

familiar with emergency exits;

aware of muster station;

read instruction placard;

study diagrams, video etc.;

found life jacket;

tried on life jacket;

respiratory masks if available;

participate at boat drill;

INSTRUCTIONS

was it well understood;

communications;

- conduct of passengers;
- evacuation;
- boat drills;
- preventive measures;
- read instructions on back of cabin door;
- safety regulations;
- reporting fires;

- sounding alarm;
- passengers understand ship whistle signal;
- how to dress and what to take to assembly station;
- demonstrate how put on life jacket;
- how to enter/conduct/leave lifeboat;
- brief on prohibited areas, decks, spaces;

REPORTING OF SHIPPING ACCIDENT

abnormal situation;

inform crew member;

alarm immediately given afterwards;

odour, smoke, fire

accident incident;

PA announcement re fire;

move away from danger zone;

- protective measures for children;

attending passengers after alarm;

directed towards muster station;

passengers going to their cabins;

passengers going inside vessel;

request relative at muster station;

passengers follow instructions;

practice daily going to muster station;

inform on present situation to raise confidence;

escort helpless passengers;

do not use lift/elevators;
obey instructions;
clear entrance/access to lifeboat/life raft;
no pushing while embarking;
keep survival equipment on;
provisions distributed by the officer;
discipline in lifeboat;
lookout for people overboard;
attend people requiring medical aid;
no drinking of sea water;
send distress radio call;
fire rockets;

TANKER (OIL) OPERATIONS

PRE-ARRIVAL;

info from terminal;
compatibility manifold/hose support, fairleads/lines, bitts;
info from cargo;
exchange of info ship / shore terminal;
vessel defects;
functional test, vessel machinery etc and operational equip;
openings secured;
crude oil washing 24 hour notice;

agreement on working language;
minimum crewing (Safe Manning Document);
certification crew;
tugs assistance;
required depth;
shelter sea swell;
manoeuvring area;
emergency anchorage;
alternate anchorage;
weather conditions;
weather forecast;
forecast monitoring;
ice conditions;
proper crew clothing;
traffic density;
physical configuration of terminal;
port authority notification;
radio contact;
fender;
mooring plan;
mooring procedures;
towing wires;
quick release moorings;
automatic winches;
overhanging protrusions;
upright, trim, list;

advise local traffic;
lookout;
engine room notice;
clean-up operation procedures;
hoses tested and certificates;

TRANSFER OPERATION

transfer procedures;
watch supervision;
communication means;
emergency shut down;
ready to move procedures;
safe access away from hoses;
life saving equipment near access;
life buoy near gangway;
connect/disconnect procedures;
flanges fully bolted;
flanges marked;
tools available for rapid disconnection;
hose lifting equipment operational;
scuppers and drip trays;
unused cargo connections;
blank flanges fully bolted;
valves sealed shut;
valves monitoring;

remote operated valves;
double check valves;
cargo tank lids;
openings are closed gas tight;
opened during ullage and sampling only;
tank venting;
venting procedures accepted by ship and shore;
open to atmosphere via open ullage;
flame screen on open ullage ports during venting;
fixed venting using Inert Gas System (IGS)
shore venting using vapour circulating system;
hand torches approved and operational;
portable VHF approved and operational;
pagers and portable phones shut off;
radar and main radio shut off;
portable electrical equipment prohibited;
supply cables disconnected;
ship shore communication cables away from work zone;
accommodation doors windows shut;
doors kept unlocked;
signs posted near doors;
air conditioning intakes shut;
window type air cond shut off;
smoking prohibited on board and jetty;
no smoking placards;
naked lights, fire, spark formation;

hot work permitted subject to port authority;
no naked lights placards;
emergency escape;
lifeboat ready;
sufficient manning;
competent personnel ship and shore;
mooring wire with fibre tail;
cathodic protection procedure;
pumproom ventilation;
mechanical ventilation;
continuous ventilation;
close ullage ports unless design dictates otherwise;
gas displaced vented via vent stack;
vent stack velocity valve;
gases clear of cargo deck;
tank washing procedures;
illumination safe access, transfer work and emergency area;
all round red navigation light;
b flag;

Inert Gas System (IGS) and Crude Oil Wash (COW)

fixed oxygen analyser and recorder;
calibration of equipment;
filter cleaning or replacement;
portable oxygen and hydrocarbon meters;

test using operations manual or manufacturer;
inert gas delivered;
oxygen below 5% in inert gas delivery;
oxygen below 8% in volume in tanks;
positive pressure of tank atmosphere (100mm gauge);
crude oil wash plan;
crude oil wash abort condition;
machines used properly set;
sufficient drive units;
must not move a drive unit more than twice;
valves and lines properly set;
no pipeline in machinery space;
heater sufficiently isolated;
hydrant valves blanked off;
valves fixed to tank washing shut off;
tank washing system pressure tested for normal operation;
stripping monitoring equipment;
remote read out facilities;

FIRE + SPILL + EMERGENCY

ship shore fire main;
sufficient pressure;
international connection;
fire notice;
emergency fire control plans;

plans storage in weather tight enclosure outside deckhouse;

contingency plan;

- hose burst, fractured pipe;
- activate quick closing system;
- emergency procedures;
- start fire alarm;
- start water irrigation if spillage on deck;
- fire-fighting equipment and breathing apparatus stand-by;
- prepare emergency party;
- start fire pump;
- stop all engines and work if necessary;

procedure to report pollution;

list of authorities to notify;

action taken to control discharge;

procedures, contact for coordinating shipboard action;

evacuation procedures if required;

first informed of situation;

- time of spill;
- quantity of spill;
- tanks affected;
- method to limit spill;
- sealing;
- oil boom;
- transfer of products;
- slop tanks;
- ullage/when; whom; records;

- capacity plan;
- temperature of liquid;
- situation monitored by whom;
- use of inert gas system;
- damage assessment;
- action taken;
- contingency plan;
- last practice date and place/boat,fire,spill drills;
- inform master;
- inform local traffic;
- call assistance;
- movement of ship;
- duty personnel;
- VTS;
- remote valve shut-off system;
- oil record book;
- leakage in void space;
- activate quick closing system;
- liquid pumped in undamaged tank or ashore;
- accommodation doors and ventilation closed;
- smoking and naked lights prohibited;
- fire-fighting equipment and breathing apparatus;
- emergency parties;
- water ballast below damaged cargo tank to be circulated to avoid freezing and fracture of steel hull;
- re-liquefaction plant used to reduce tank pressure;

TANKER (CHEMICAL & PRODUCT) OPERATIONS

determine ship type I, II, III;

certificate of fitness;

surveys;

determine personnel certification, level I, II;

exemption for non-compliance;

reference document tp 8120;

before 1July86; Bulk Chemicals Code(BCH)/after International Bulk Chemical Code (IBC);

- IMO type I and II have double bottoms and wing tanks/type III similar to tanker;

- marine pollution Marpol 73/78;

Material Safety Data Sheet (MSDS) sheet valid 3 years;

MSDS issue date;

MSDS supplied by manufacturer or shipper;

label removed altered;

reference documentation on board;

procedure and arrangement manuals;

information accessible to crew;

training of crew;

call CANUTEC (613) 996 - 6666 for information;

cargo record book, 3 years on board;

inspection, certification documents;

experience with chemicals on board;

too familiarized, not paying attention;

had problems with chemical before;

coating contamination;

pre-ventilation;
tank cleaning, inert gas, vents;
inert gas system operational and in use;
cargo plan from crew or shore;
cargo plan approval;
cargo reactivity;
product purity;
connections traced by shore crew;
manifolds marked, labelled;
cargo name confused with another product;
reference of product;
cargo dissolve with adjacent products;
ventilation system affect health;
cargo loaded in predetermined tank (change);
gauge reading;
gauge reset;
remote reading of cargo state;
overfilling;
warning signs;
Frame pumps, submerged pumps;
limit of portable pumps;
deep well cargo pump in each tank;
pump repair, maintenance;
pump vibration;
regulate pump flow with throttle valve;
pump restrictions;

pump damage by product;
pump room on board, checks;
heat exchangers;
heated tanks;
slop tank in use;
safety clothing used;
respirator storage bag, bin, facility;
respirator operational limit, expiry date;
change of cartridge, seals;
equipment checked by competent person;
fitness for using safety equipment;
victim wished to sit down or lay down before coma;
medical first aid guide;
ship shell plating, inspection, pitting, thickness;
positioning of all cofferdams;
pressure from shippers, buyers, sellers;
- inspection of tanks by shipper's surveyor/clean&dry;
- during voyage-check temperature/pressure/check state of inhibitor in cargo;
duration of voyage;
regular checks;
inhibitors added;
temperature control;
use of intrinsically safe equipment in use on deck;
telex and other media info source;
estimate quantity of spill;
contingency plan;

tank coating damaged;
tank coating compatible with cargo;
certificate for access;
colour of certificate
calibration manual of equipment;
equipment model, serial number;
sensitivity of metre, equipment;
number of documents;
test method;
previous three cargos, piping, tank;
purging cofferdams, tanks, pipes;
evaluate condition before entering tank;
satisfied with tank condition;
certificate of inhibition;
lifetime of inhibitor;
inhibitor on board;
discharge procedures;
wash procedures;
static build up, recirculating water, steam;
tank cleaning product, info, security measures;
drainage of vent system;
load rate;
load change made by qualified person;
flame screen in place;
alarms, by-pass, over-ride, isolate, shut down;
no protein foam for fire fighting;

pump room with CO2 or other smothering chemical;
foam compatible with products carried;
sufficient supply of foam;

Ro-Ro SHIP OPERATIONS

sill below the uppermost load line;
hydraulic securing device provided;
alternate securing device by gravity;
mechanically locking the hydraulic system;
audible alarm;
emergency source;
alarm in engine-room;
television surveillance system;
bow door alarm on navigation bridge;
water leakage detection system;
monitor in engine-room;
monitor position of inner and outer bow door;
number of securing devices;

OPERATING AND MAINTENANCE MANUAL

approved copy;
last amendments;
surveyor endorsement;

OPERATING PROCEDURES MANUAL

info opening closing doors;

kept on board;

posted instructions;

VISUAL INSPECTION

hull, door side support, hinging arms and welding;

check for cracks

repairs;

thickness measurements by surveyor;

corrosion;

deformation (no visible deformation accepted);

hinges and bearings, trust bearings;

clearances measured at annual surveys;

dismantling for measurement purposes at special surveys;

clearance not to exceed;

securing, supporting and locking devices;

check surveyor annual survey data;

clearances;

thickness measurements at special surveys;

corrosion maximum allowed (15%);

packing material, rubber gaskets;

acceptable permanent compression of seals (10%);

cracks, hardening due to ageing renewed;

over painting;
grease on packing (against ice cold climate);
drainage arrangement;
test of bilge system between inner outer door;
non return valves at special surveys;
shell and outer doors;
operation during opening and closing operation;
smooth symmetrical movement;
proper working of hinges, trust bearing, locking device;
securing supporting and locking devices;
run smoothly without interference;
mechanical lock;
hydraulic lock to remain locked in event of fluid loss;
open/close position properly indicated at remote control;
control panels inaccessible to unauthorized;
instruction placard all secured and locked before departure;
sealing arrangement;
hose test at annual survey;
indicator system;
test at annual survey;
on bridge, visible indication and audible alarm;
harbour / sea functions;
lamp test function;
must not be possible to turn off indicator light;
fail safe performance;
power source for doors independent of indicator system;

condition of sensors and protection from water, ice, damage;
water leakage detection system;
work test at annual survey;
audible alarm on bridge panel and engine room panel;
television surveillance system;
working test at annual survey;
monitor in engine-room and bridge;
electrical equipment; + opening closing securing door at annual survey;

FAST FERRY OPERATIONS

- land impede navigation
- congested channel
- pilotage technique applied
- weather conditions good
- plotting on traditional chart
- manual plotting
- electronic chart
- radar provide essential checking
- doubt as to position or navigation situation
- situation assessed visually or electronically
- check vessel's track
- check surrounding dangers
- speed of navigation (above 40 kn)
- safety margins
- visibility twice stopping distance
- traffic separation schemes
- approach systems
- pass close to dangers to navigation
- keep a time-table vs safe operation
- darkness
- poor visibility
- aids to navigation appropriate to fast navigation
- lights flash too slowly
- rough sea

- familiarity with route
- requirement to follow designated route
- route government approved
- improvements of navigational marks
- speed guidelines
- speeds government approved
- two independent navigation systems on board
- electronic chart
- radar
- radar differentiate between buoys and vessels
- distance to go to alter course
- primary system used at night different to daytime system
- equipment failure trigger reduction of speed
- fast keep out of way of slow moving traffic (good vis)
- in poor visibility, radar assessment before visual contact
- what is effective speed reduction in poor visibility
- with small draft, fast ferry avoid shipping lane
- small craft outside shipping lanes
- assisted by traffic control

BULK CARRIER OPERATIONS

stability data;

IMO Safe Practice for Solid Bulk Cargoes (BC Code);

load unload limits set by designers;

max forces and moments on ship hull;

general loading unloading instructions;
max load per unit surface on tank top;
max load per hold;
approved stability and loading booklet;
hatch openings of sufficient size;
approved loading instrument to calculate stress;
hatches in good condition;
requirement to keep tween deck hatches closed or opened;
initial high free-fall drop;
vessel suitable for access to terminal;
list light tested prior to loading;
air draught;
details and capacity of vessel cargo handling gear;
previous loading unloading port;
preceding (3) cargoes;
OBO last oil cargo discharge;
content of slop tanks, inerted, sealed;
date, place, authority of last gas free certificate;
gas in pipelines and pumps;
water depth at berth;
water density;
maximum size ship for berth;
cargo handling equipment not inhibit safety;
monitoring equipment;
fendering;
number and type of mooring lines;

safe access to wharf;
certification of loading equipment;
last calibration of loading equipment;
training of shore crew regarding loading equipment;
work schedule of shore personnel (fatigue);
terminal nominal loading unloading rate;
conveyor weight meters within 1% of rated quantity;
quantities of cargo to be run off and empty conveyor;
dist from waterline to top hatch coaming;
dist from ship's side to hatch coaming;
agreement on loading unloading procedures;
intended load plan;
check list completed prior to loading;
intended cargo plan signed by master and terminal personnel;
restrictions mentioned;
loading sequence;
properties of cargo requiring special attention;
advance info on cargo;
advance info on cargo handling;
trimming procedures;
actual loading/unloading plan;
master and terminal advised on amendments to load plan;
procedure to follow intended loading plan;
numbers of loading unloading cranes;
advise accordingly when changing number of cranes;
if loading unloading hull limits attain, master to stop ops;

amendments to load plan changed only both parties agree;
continuous monitoring by personnel;
crew proficient in shore language used;
cover initially all tank top;
repairs delaying loading unloading ops;
arrival and proposed departure draft;
time required for de-ballasting;
keep vessel upright;
any restrictions on de-ballasting;
suspended time to ensure de-ballasting;
advise terminal if deviation to de-ballasting plan;
check list completed during loading;
harmonization between de-ballasting and loading;
during loading compare loaded weight with draught;
sufficient crew on board to monitor cargo ops;
action to be taken in case of rain/weather change;
contact person ashore;
terminate de-ballasting before trimming;
advise terminal when trimming commences to run off conveyor;

report damage to ship;
hot work repairs during cargo ops;
copy of plans lodged with appropriate authority/port state;
load plan kept six months in terminal archives;

UNLOAD

take in to consideration hull stress and hold damage;
master and terminal have accessible info;
unloading plan in writing;
possibility of the discharge of flammable vapours;
ventilation of cargo spaces;
unloading and ballasting according to agreed plan;
ship=s draught read regularly;
damage and/or hazard reported to both master and terminal;
vessel kept upright;
unload uniformly both sides of each hold;
unload one side at one end and opposite at other end/twist;
rates / sequence not modified until ship/terminal notified;
notification when each hold is terminated;

APPENDIX D, E, F, G

The following appendixes are included in the project folder as separate files.

Appendix D --- msc-mepc_3-circ.2.pdf

Appendix E --- Appendix E (MAIF Witnesses and Interviews Chapter4).pdf

Appendix E (Physical Evidence Chapter5).pdf

Appendix F --- MORT.pdf

Appendix G --- Appendix G [E&CF MAIB (OLIVIA JEAN)].pdf



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MSC-MEPC.3/Circ.2
13 June 2008

CASUALTY-RELATED MATTERS

Code of the International Standards and Recommended Practices for a Safety Investigation into a Marine Casualty or Marine Incident

- 1 The Maritime Safety Committee, at its eighty-third session (3 to 12 October 2007), and the Marine Environment Protection Committee, at its fifty-seventh session (31 March to 4 April 2008), approved the Code of the International Standards and Recommended Practices for a Safety Investigation into a Marine Casualty or Marine Incident (Casualty Investigation Code).
- 2 The Maritime Safety Committee, at its eighty-fourth session (7 to 16 May 2008), adopted the Casualty Investigation Code by resolution MSC.255(84) and a new regulation 6 in chapter XI-1 of the SOLAS Convention by resolution MSC.257(84) to make the Code mandatory. The Committee agreed that the Casualty Investigation Code should take effect on 1 January 2010, noting that the effective date should be the same as the date of entry into force of the new SOLAS regulation XI-1/6.
- 3 The annex to this circular is the Casualty Investigation Code, the text of which is identical to the text of the Code adopted by MSC 84.
- 4 Governments are invited to start implementing the Code of the International Standards and Recommended Practices for a Safety Investigation into a Marine Casualty or Marine Incident on a voluntary basis prior to the effective date of the Code.

ANNEX

**CODE OF THE INTERNATIONAL STANDARDS AND RECOMMENDED
PRACTICES FOR A SAFETY INVESTIGATION INTO A MARINE CASUALTY
OR MARINE INCIDENT (CASUALTY INVESTIGATION CODE)**

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Foreword

1 This Code incorporates and builds on the best practices in marine casualty and marine incident investigation that were established by the Code for the Investigation of Marine Casualties and Incidents, adopted in November 1997 by the International Maritime Organization (the Organization), by resolution A.849(20). The Code for the Investigation of Marine Casualties and Incidents sought to promote co-operation and a common approach to marine casualty and marine incident investigations between States.

Background

2 The Organization has encouraged co-operation and recognition of mutual interest through a number of resolutions. The first was resolution A.173(ES.IV) (Participation in Official Inquiries into Maritime Casualties) adopted in November 1968. Other resolutions followed including: resolution A.322(IX) (The Conduct of Investigations into Casualties) adopted in November 1975; resolution A.440(XI) (Exchange of Information for Investigations into Marine Casualties) and resolution A.442(XI) (Personnel and Material Resource Needs of Administrations for the Investigation of Casualties and the Contravention of Conventions), both adopted in November 1979; resolution A.637(16) (Co-operation in Maritime Casualty Investigations) adopted in 1989.

3 These individual resolutions were amalgamated and expanded by the Organization with the adoption of the Code for the Investigation of Marine Casualties and Incidents. Resolution A.884(21) (Amendments to the Code for the Investigation of Marine Casualties and Incidents resolution A.849(20)), adopted in November 1999, enhanced the Code by providing guidelines for the investigation of human factors.

4 The International Convention for the Safety of Life at Sea (SOLAS), 1948, included a provision requiring flag State Administrations to conduct investigations into any casualty suffered by a ship of its flag if an investigation may assist in identifying regulatory issues as a contributing factor. This provision was retained in the 1960 and 1974 SOLAS Conventions. It was also included in the International Convention on Load Lines, 1966. Further, flag States are required to inquire into certain marine casualties and marine incidents occurring on the high seas*.

5 The sovereignty of a coastal State extends beyond its land and inland waters to the extent of its territorial sea**. This jurisdiction gives the coastal State an inherent right to investigate marine casualties and marine incidents connected with its territory. Most national Administrations have legal provisions to cover the investigation of a shipping incident within its inland waters and territorial sea, regardless of the flag.

* Reference is made to the United Nations Convention on the Law of the Sea (UNCLOS), article 94(7) or requirements of international and customary laws.

** Reference is made to the United Nations Convention on the Law of the Sea (UNCLOS), article 2 or requirements of international and customary laws.

Treatment of Seafarers

6 Most recently, the International Labour Organization's Maritime Labour Convention, 2006 (which has not yet come into force), provides a provision for the investigation of some serious marine casualties as well as setting out working conditions for seafarers. Recognizing the need for special protection for seafarers during an investigation, the Organization adopted, in December 2005, the "Guidelines on Fair Treatment of Seafarers in the Event of a Maritime Accident" through resolution A.987(24). The Guidelines were promulgated by the IMO and the ILO on 1 July 2006.

Adoption of the Code

7 Since the adoption of the first SOLAS Convention, there have been extensive changes in the structure of the international maritime industry and changes in international law. These changes have potentially increased the number of States with an interest in the process and outcomes of marine safety investigations, in the event of a marine casualty or marine incident, increasing the potential for jurisdictional and other procedural differences between affected States.

8 This Code, while it specifies some mandatory requirements, recognizes the variations in international and national laws in relation to the investigation of marine casualties and marine incidents. The Code is designed to facilitate objective marine safety investigations for the benefit of flag States, coastal States, the Organization and the shipping industry in general.

PART I
GENERAL PROVISIONS

Chapter 1

PURPOSE

1.1 The objective of this Code is to provide a common approach for States to adopt in the conduct of marine safety investigations into marine casualties and marine incidents. Marine safety investigations do not seek to apportion blame or determine liability. Instead a marine safety investigation, as defined in this Code, is an investigation conducted with the objective of preventing marine casualties and marine incidents in the future. The Code envisages that this aim will be achieved through States:

- .1 applying consistent methodology and approach, to enable and encourage a broad ranging investigation, where necessary, in the interests of uncovering the causal factors and other safety risks; and
- .2 providing reports to the Organization to enable a wide dissemination of information to assist the international marine industry to address safety issues.

1.2 A marine safety investigation should be separate from, and independent of, any other form of investigation. However, it is not the purpose of this Code to preclude any other form of investigation, including investigations for action in civil, criminal and administrative proceedings. Further, it is not the intent of the Code for a State or States conducting a marine safety investigation to refrain from fully reporting on the causal factors of a marine casualty or marine incident because blame or liability, may be inferred from the findings.

1.3 This Code recognizes that under the Organization's instruments, each flag State has a duty to conduct an investigation into any casualty occurring to any of its ships, when it judges that such an investigation may assist in determining what changes in the present regulations may be desirable, or if such a casualty has produced a major deleterious effect upon the environment. The Code also takes into account that a flag State shall* cause an inquiry to be held, by or before a suitably qualified person or persons into certain marine casualties or marine incidents of navigation on the high seas. However, the Code also recognizes that where a marine casualty or marine incident occurs within the territory, including the territorial sea, of a State, that State has a right** to investigate the cause of any such marine casualty or marine incident which might pose a risk to life or to the environment, involve the coastal State's search and rescue authorities, or otherwise affect the coastal State.

* Reference is made to the United Nations Convention on the Law of the Sea (UNCLOS), article 94 or requirements of international and customary laws.

** Reference is made to the United Nations Convention on the Law of the Sea (UNCLOS), article 2 or requirements of international and customary laws.

Chapter 2

DEFINITIONS

When the following terms are used in the mandatory standards and recommended practices for marine safety investigations they have the following meaning.

- 2.1 An *agent* means any person, natural or legal, engaged on behalf of the owner, charterer or operator of a ship, or the owner of the cargo, in providing shipping services, including managing arrangements for the ship being the subject of a marine safety investigation.
- 2.2 A *causal factor* means actions, omissions, events or conditions, without which:
- .1 the marine casualty or marine incident would not have occurred; or
 - .2 adverse consequences associated with the marine casualty or marine incident would probably not have occurred or have been as serious;
 - .3 another action, omission, event or condition, associated with an outcome in .1 or .2, would probably not have occurred.
- 2.3 A *coastal State* means a State in whose territory, including its territorial sea, a marine casualty or marine incident occurs.
- 2.4 *Exclusive economic zone* means the exclusive economic zone as defined by article 55 of the United Nations Convention on the Law of the Sea.
- 2.5 *Flag State* means a State whose flag a ship is entitled to fly.
- 2.6 *High seas* means the high seas as defined in article 86 of the United Nations Convention on the Law of the Sea.
- 2.7 *Interested party* means an organization, or individual, who, as determined by the marine safety investigating State(s), has significant interests, rights or legitimate expectations with respect to the outcome of a marine safety investigation.
- 2.8 *International Safety Management (ISM) Code* means the International Management Code for the Safe Operation of Ships and for Pollution Prevention as adopted by the Organization by resolution A.741(18), as amended.
- 2.9 A *marine casualty* means an event, or a sequence of events, that has resulted in any of the following which has occurred directly in connection with the operations of a ship:
- .1 the death of, or serious injury to, a person;
 - .2 the loss of a person from a ship;
 - .3 the loss, presumed loss or abandonment of a ship;
 - .4 material damage to a ship;

- .5 the stranding or disabling of a ship, or the involvement of a ship in a collision;
- .6 material damage to marine infrastructure external to a ship, that could seriously endanger the safety of the ship, another ship or an individual; or
- .7 severe damage to the environment, or the potential for severe damage to the environment, brought about by the damage of a ship or ships.

However, a marine casualty does not include a deliberate act or omission, with the intention to cause harm to the safety of a ship, an individual or the environment.

2.10 A *marine incident* means an event, or sequence of events, other than a marine casualty, which has occurred directly in connection with the operations of a ship that endangered, or, if not corrected, would endanger the safety of the ship, its occupants or any other person or the environment.

However, a marine incident does not include a deliberate act or omission, with the intention to cause harm to the safety of a ship, an individual or the environment.

2.11 A *marine safety investigation* means an investigation or inquiry (however referred to by a State), into a marine casualty or marine incident, conducted with the objective of preventing marine casualties and marine incidents in the future. The investigation includes the collection of, and analysis of, evidence, the identification of causal factors and the making of safety recommendations as necessary.

2.12 A *marine safety investigation report* means a report that contains:

- .1 a summary outlining the basic facts of the marine casualty or marine incident and stating whether any deaths, injuries or pollution occurred as a result;
- .2 the identity of the flag State, owners, operators, the company as identified in the safety management certificate, and the classification society (subject to any national laws concerning privacy);
- .3 where relevant the details of the dimensions and engines of any ship involved, together with a description of the crew, work routine and other matters, such as time served on the ship;
- .4 a narrative detailing the circumstances of the marine casualty or marine incident;
- .5 analysis and comment on the causal factors including any mechanical, human and organizational factors;
- .6 a discussion of the marine safety investigation's findings, including the identification of safety issues, and the marine safety investigation's conclusions; and
- .7 where appropriate, recommendations with a view to preventing future marine casualties and marine incidents.

2.13 *Marine safety investigation Authority* means an Authority in a State, responsible for conducting investigations in accordance with this Code.

2.14 *Marine safety investigating State(s)* means the flag State or, where relevant, the State or States that take the responsibility for the conduct of the marine safety investigation as mutually agreed in accordance with this Code.

2.15 *A marine safety record* means the following types of records collected for a marine safety investigation:

- .1 all statements taken for the purpose of a marine safety investigation;
- .2 all communications between persons pertaining to the operation of the ship;
- .3 all medical or private information regarding persons involved in the marine casualty or marine incident;
- .4 all records of the analysis of information or evidential material acquired in the course of a marine safety investigation;
- .5 information from the voyage data recorder.

2.16 *A material damage* in relation to a marine casualty means:

- .1 damage that:
 - .1.1 significantly affects the structural integrity, performance or operational characteristics of marine infrastructure or a ship; and
 - .1.2 requires major repair or replacement of a major component or components;
or
- .2 destruction of the marine infrastructure or ship.

2.17 *A seafarer* means any person who is employed or engaged or works in any capacity on board a ship.

2.18 *A serious injury* means an injury which is sustained by a person, resulting in incapacitation where the person is unable to function normally for more than 72 hours, commencing within seven days from the date when the injury was suffered.

2.19 *A severe damage to the environment* means damage to the environment which, as evaluated by the State(s) affected, or the flag State, as appropriate, produces a major deleterious effect upon the environment.

2.20 *Substantially interested State* means a State:

- .1 which is the flag State of a ship involved in a marine casualty or marine incident; or
- .2 which is the coastal State involved in a marine casualty or marine incident; or
- .3 whose environment was severely or significantly damaged by a marine casualty (including the environment of its waters and territories recognized under international law); or
- .4 where the consequences of a marine casualty or marine incident caused, or threatened, serious harm to that State or to artificial islands, installations, or structures over which it is entitled to exercise jurisdiction; or
- .5 where, as a result of a marine casualty, nationals of that State lost their lives or received serious injuries; or
- .6 that has important information at its disposal that the marine safety investigating State(s) consider useful to the investigation; or
- .7 that for some other reason establishes an interest that is considered significant by the marine safety investigating State(s).

2.21 *Territorial sea* means territorial sea as defined by Section 2 of Part II of the United Nations Convention on the Law of the Sea.

2.22 A *very serious marine casualty* means a marine casualty involving the total loss of the ship or a death or severe damage to the environment.

Chapter 3

APPLICATION OF CHAPTERS IN PARTS II AND III

3.1 Part II of this Code contains mandatory standards for marine safety investigations. Some clauses apply only in relation to certain categories of marine casualties and are mandatory only for marine safety investigations into those marine casualties.

3.2 Clauses in Part III of this Code may refer to clauses in this part that apply only to certain marine casualties. The clauses in Part III may recommend that such clauses be applied in marine safety investigations into other marine casualties or marine incidents.

PART II

MANDATORY STANDARDS

Chapter 4

MARINE SAFETY INVESTIGATION AUTHORITY

4.1 The Government of each State shall provide the Organization with detailed contact information of the marine safety investigation Authority(ies) carrying out marine safety investigations within their State.

Chapter 5

NOTIFICATION

5.1 When a marine casualty occurs on the high seas or in an exclusive economic zone, the flag State of a ship, or ships, involved, shall notify other substantially interested States as soon as is reasonably practicable.

5.2 When a marine casualty occurs within the territory, including the territorial sea, of a coastal State, the flag State, and the coastal State, shall notify each other and between them notify other substantially interested States as soon as is reasonably practicable.

5.3 Notification shall not be delayed due to the lack of complete information.

5.4 **Format and content:** The notification shall contain as much of the following information as is readily available:

- .1 the name of the ship and its flag State;
- .2 the IMO ship identification number;
- .3 the nature of the marine casualty;
- .4 the location of the marine casualty;
- .5 time and date of the marine casualty;
- .6 the number of any seriously injured or killed persons;
- .7 consequences of the marine casualty to individuals, property and the environment;
and
- .8 the identification of any other ship involved.

Chapter 6

REQUIREMENT TO INVESTIGATE VERY SERIOUS MARINE CASUALTIES

- 6.1 A marine safety investigation shall be conducted into every very serious marine casualty.
- 6.2 Subject to any agreement in accordance with chapter 7, the flag State of a ship involved in a very serious marine casualty is responsible for ensuring that a marine safety investigation is conducted and completed in accordance with this Code.

Chapter 7

FLAG STATE'S AGREEMENT WITH ANOTHER SUBSTANTIALLY INTERESTED STATE TO CONDUCT A MARINE SAFETY INVESTIGATION

- 7.1 Without limiting the rights of States to conduct their own separate marine safety investigation, where a marine casualty occurs within the territory, including territorial sea, of a State, the flag State(s) involved in the marine casualty and the coastal State shall consult to seek agreement on which State or States will be the marine safety investigating State(s) in accordance with a requirement, or a recommendation acted upon, to investigate under this Code.
- 7.2 Without limiting the rights of States to conduct their own separate marine safety investigation, if a marine casualty occurs on the high seas or in the exclusive economic zone of a State, and involves more than one flag State, then the States shall consult to seek agreement on which State or States will be the marine safety investigating State(s) in accordance with a requirement, or a recommendation acted upon, to investigate under this Code.
- 7.3 For a marine casualty referred to in paragraph 7.1 or 7.2, agreement may be reached by the relevant States with another substantially interested State for that State or States to be the marine safety investigating State(s).
- 7.4 Prior to reaching an agreement, or if an agreement is not reached, in accordance with paragraph 7.1, 7.2 or 7.3, then the existing obligations and rights of States under this Code, and under other international laws, to conduct a marine safety investigation, remain with the respective parties to conduct their own investigation.
- 7.5 By fully participating in a marine safety investigation conducted by another substantially interested State, the flag State shall be considered to fulfil its obligations under this Code, SOLAS regulation I/21 and article 94, section 7 of the United Nations Convention on the Law of the Sea.

Chapter 8

POWERS OF AN INVESTIGATION

8.1 All States shall ensure that their national laws provide investigator(s) carrying out a marine safety investigation with the ability to board a ship, interview the master and crew and any other person involved, and acquire evidential material for the purposes of a marine safety investigation.

Chapter 9

PARALLEL INVESTIGATIONS

9.1 Where the marine safety investigating State(s) is conducting a marine safety investigation under this Code, nothing prejudices the right of another substantially interested State to conduct its own separate marine safety investigation.

9.2 While recognizing that the marine safety investigating State(s) shall be able to fulfil obligations under this Code, the marine safety investigating State(s) and any other substantially interested State conducting a marine safety investigation shall seek to co-ordinate the timing of their investigations, to avoid conflicting demands upon witnesses and access to evidence, where possible.

Chapter 10

CO-OPERATION

10.1 All substantially interested States shall co-operate with the marine safety investigating State(s) to the extent practicable. The marine safety investigating State(s) shall provide for the participation of the substantially interested States to the extent practicable*.

Chapter 11

INVESTIGATION NOT TO BE SUBJECT TO EXTERNAL DIRECTION

11.1 Marine safety investigating State(s) shall ensure that investigator(s) carrying out a marine safety investigation are impartial and objective. The marine safety investigation shall be able to report on the results of a marine safety investigation without direction or interference from any persons or organizations who may be affected by its outcome.

* The reference to “extent practicable” may be taken to mean, as an example, that co-operation or participation is limited because national laws make it impracticable to fully co-operate or participate.

Chapter 12

OBTAINING EVIDENCE FROM SEAFARERS

12.1 Where a marine safety investigation requires a seafarer to provide evidence to it, the evidence shall be taken at the earliest practical opportunity. The seafarer shall be allowed to return to his/her ship, or be repatriated at the earliest possible opportunity. The seafarers human rights shall, at all times, be upheld.

12.2 All seafarers from whom evidence is sought shall be informed of the nature and basis of the marine safety investigation. Further, a seafarer from whom evidence is sought shall be informed, and allowed access to legal advice, regarding:

- .1 any potential risk that they may incriminate themselves in any proceedings subsequent to the marine safety investigation;
- .2 any right not to self-incriminate or to remain silent;
- .3 any protections afforded to the seafarer to prevent the evidence being used against them if they provide the evidence to the marine safety investigation.

Chapter 13

DRAFT MARINE SAFETY INVESTIGATION REPORTS

13.1 Subject to paragraphs 13.2 and 13.3, where it is requested, the marine safety investigating State(s) shall send a copy of a draft report to a substantially interested State to allow the substantially interested State to make comment on the draft report.

13.2 Marine safety investigating State(s) are only bound to comply with paragraph 13.1 where the substantially interested State receiving the report guarantees not to circulate, nor cause to circulate, publish or give access to the draft report, or any part thereof, without the express consent of the marine safety investigating State(s) or unless such reports or documents have already been published by the marine safety investigating State(s).

13.3 The marine safety investigating State(s) are not bound to comply with paragraph 13.1 if:

- .1 the marine safety investigating State(s) request that the substantially interested State receiving the report to affirm that evidence included in the draft report will not be admitted in civil or criminal proceedings against a person who gave the evidence; and
- .2 the substantially interested State refuses to provide such an affirmation.

13.4 The marine safety investigating State(s) shall invite the substantially interested States to submit their comments on the draft report within 30 days or some other mutually agreed period. The marine safety investigating State(s) shall consider the comments before preparing the final report and where the acceptance or rejection of the comments will have direct impact on the interests of the State that submitted them, the marine safety investigating State(s) shall notify the substantially interested State of the manner in which the comments were addressed. If the marine safety investigating State(s) receives no comments after the 30 days or the mutually agreed period has expired, then it may proceed to finalize the report.

13.5 The marine safety investigating State(s) shall seek to fully verify the accuracy and completeness of the draft report by the most practical means.

Chapter 14

MARINE SAFETY INVESTIGATION REPORTS

14.1 The marine safety investigating State(s) shall submit the final version of a marine safety investigation report to the Organization for every marine safety investigation conducted into a very serious marine casualty.

14.2 Where a marine safety investigation is conducted into a marine casualty or marine incident, other than a very serious marine casualty, and a marine safety investigation report is produced which contains information which may prevent or lessen the seriousness of marine casualties or marine incidents in the future, the final version shall be submitted to the Organization.

14.3 The marine safety investigation report referred in paragraphs 14.1 and 14.2 shall utilize all the information obtained during a marine safety investigation, taking into account its scope, required to ensure that all the relevant safety issues are included and understood so that safety action can be taken as necessary.

14.4 The final marine safety investigation report shall be made available to the public and the shipping industry by the marine safety investigating State(s), or the marine safety investigating State(s) shall undertake to assist the public and the shipping industry with details, necessary to access the report, where it is published by another State or the Organization.

PART III

RECOMMENDED PRACTICES

Chapter 15

ADMINISTRATIVE RESPONSIBILITIES

15.1 States should ensure that marine safety investigating Authorities have available to them sufficient material and financial resources and suitably qualified personnel to enable them to facilitate the State's obligations to undertake marine safety investigations into marine casualties and marine incidents under this Code.

15.2 Any investigator forming part of a marine safety investigation should be appointed on the basis of the skills outlined in resolution A.996(25) for investigators.

15.3 However, paragraph 15.2 does not preclude the appropriate appointment of investigators with necessary specialist skills to form part of a marine safety investigation on a temporary basis, neither does it preclude the use of consultants to provide expert advice on any aspect of a marine safety investigation.

15.4 Any person who is an investigator, in a marine safety investigation, or assisting a marine safety investigation, should be bound to operate in accordance with this Code.

Chapter 16

PRINCIPLES OF INVESTIGATION

16.1 **Independence:** A marine safety investigation should be unbiased to ensure the free flow of information to it.

16.1.1 In order to achieve the outcome in paragraph 16.1, the investigator(s) carrying out a marine safety investigation should have functional independence from:

- .1 the parties involved in the marine casualty or marine incident;
- .2 anyone who may make a decision to take administrative or disciplinary action against an individual or organization involved in a marine casualty or marine incident; and
- .3 judicial proceedings.

16.1.2 The investigator(s) carrying out a marine safety investigation should be free of interference from the parties in .1, .2 and .3 of paragraph 16.1.1 with respect to:

- .1 the gathering of all available information relevant to the marine casualty or marine incident, including voyage data recordings and vessel traffic services recordings;
- .2 analysis of evidence and the determination of causal factors;
- .3 drawing conclusions relevant to the causal factors;
- .4 distributing a draft report for comment and preparation of the final report; and
- .5 if appropriate, the making of safety recommendations.

16.2 **Safety focused:** It is not the objective of a marine safety investigation to determine liability, or apportion blame. However, the investigator(s) carrying out a marine safety investigation should not refrain from fully reporting on the causal factors because fault or liability may be inferred from the findings.

16.3 Co-operation: Where it is practicable and consistent with the requirements and recommendations of this Code, in particular chapter 10 on Co-operation, the marine safety investigating State(s) should seek to facilitate maximum co-operation between substantially interested States and other persons or organizations conducting an investigation into a marine casualty or marine incident.

16.4 Priority: A marine safety investigation should, as far as possible, be afforded the same priority as any other investigation, including investigations by a State for criminal purposes being conducted into the marine casualty or marine incident.

16.4.1 In accordance with paragraph 16.4 investigator(s) carrying out a marine safety investigation should not be prevented from having access to evidence in circumstances where another person or organization is carrying out a separate investigation into a marine casualty or marine incident.

16.4.2 The evidence for which ready access should be provided should include:

- .1 survey and other records held by the flag State, the owners, and classification societies;
- .2 all recorded data, including voyage data recorders; and
- .3 evidence that may be provided by government surveyors, coastguard officers, vessel traffic service operators, pilots or other marine personnel.

16.5 Scope of a marine safety investigation: Proper identification of causal factors requires timely and methodical investigation, going far beyond the immediate evidence and looking for underlying conditions, which may be remote from the site of the marine casualty or marine incident, and which may cause other future marine casualties and marine incidents. Marine safety investigations should therefore be seen as a means of identifying not only immediate causal factors but also failures that may be present in the whole chain of responsibility.

Chapter 17

INVESTIGATION OF MARINE CASUALTIES (OTHER THAN VERY SERIOUS CASUALTIES) AND MARINE INCIDENTS

17.1 A marine safety investigation should be conducted into marine casualties (other than very serious marine casualties – which are addressed in chapter 6 of this Code) and marine incidents, by the flag State of a ship involved, if it is considered likely that a marine safety investigation will provide information that can be used to prevent marine casualties and marine incidents in the future.

17.2 Chapter 7 contains the mandatory requirements for determining who the marine safety investigating State(s) are for a marine casualty. Where the occurrence being investigated in accordance with this chapter is a marine incident, chapter 7 should be followed as a recommended practice as if it referred to marine incidents.

Chapter 18

FACTORS THAT SHOULD BE TAKEN INTO ACCOUNT WHEN SEEKING AGREEMENT UNDER CHAPTER 7 OF PART II

18.1 When the flag State(s), a coastal State (if involved) or other substantially interested States are seeking to reach agreement, in accordance with chapter 7 of Part II on which State or State(s) will be the marine safety investigating State(s) under this Code, the following factors should be taken into account:

- .1 whether the marine casualty or marine incident occurred in the territory, including territorial sea, of a State;
- .2 whether the ship or ships involved in a marine casualty or marine incident occurring on the high seas, or in the exclusive economic zone, subsequently sail into the territorial sea of a State;
- .3 the resources and commitment required of the flag State and other substantially interested States;
- .4 the potential scope of the marine safety investigation and the ability of the flag State or another substantially interested State to accommodate that scope;
- .5 the need of the investigator(s) carrying out a marine safety investigation to access evidence and consideration of the State or States best placed to facilitate that access to evidence;
- .6 any perceived or actual adverse effects of the marine casualty or marine incident on other States;
- .7 the nationality of the crew, passengers and other persons affected by the marine casualty or marine incident.

Chapter 19

ACTS OF UNLAWFUL INTERFERENCE

19.1 If in the course of a marine safety investigation it becomes known or is suspected that an offence is committed under article 3, *3bis*, *3ter* or *3quarter* of the Convention for the Suppression of Unlawful Acts Against the Safety of Maritime Navigation, 1988, the marine safety investigation Authority should immediately seek to ensure that the maritime security Authorities of the State(s) concerned are informed.

Chapter 20

NOTIFICATION TO PARTIES INVOLVED AND COMMENCEMENT OF AN INVESTIGATION

20.1 When a marine safety investigation is commenced under this Code, the master, the owner and agent of a ship involved in the marine casualty or marine incident being investigated, should be informed as soon as practicable of:

- .1 the marine casualty or marine incident under investigation;
- .2 the time and place at which the marine safety investigation will commence;
- .3 the name and contact details of the marine safety investigation Authority(ies);
- .4 the relevant details of the legislation under which the marine safety investigation is being conducted;
- .5 the rights and obligations of the parties subject to the marine safety investigation;
and
- .6 the rights and obligations of the State or States conducting the marine safety investigation.

20.2 Each State should develop a standard document detailing the information in paragraph 20.1 that can be transmitted electronically to the master, the agent and the owner of the ship.

20.3 Recognizing that any ship involved in a marine casualty or marine incident may continue in service, and that a ship should not be delayed more than is absolutely necessary, the marine safety investigating State(s) conducting the marine safety investigation should start the marine safety investigation as soon as is reasonably practicable, without delaying the ship unnecessarily.

Chapter 21

CO-ORDINATING AN INVESTIGATION

21.1 The recommendations in this chapter should be applied in accordance with the principles in chapters 10 and 11 of this Code.

21.2 The marine safety investigating State(s) should ensure that there is an appropriate framework within the State for:

- .1 the designation of investigators to the marine safety investigation including an investigator to lead the marine safety investigation;
- .2 the provision of a reasonable level of support to members of the marine safety investigation;
- .3 the development of a strategy for the marine safety investigation in liaison with other substantially interested States;
- .4 ensuring the methodology followed during the marine safety investigation is consistent with that recommended in resolution A.884(21), as amended;
- .5 ensuring the marine safety investigation takes into account any recommendations or instruments published by the Organization or International Labour Organization, relevant to conducting a marine safety investigation; and
- .6 ensuring the marine safety investigation takes into account the safety management procedures and the safety policy of the operator of a ship in terms of the ISM Code.

21.3 The marine safety investigating State(s) should allow a substantially interested State to participate in aspects of the marine safety investigation relevant to it, to the extent practicable.

21.3.1 Participation should include allowing representatives of the substantially interested State to:

- .1 interview witnesses;
- .2 view and examine evidence and make copies of documents;
- .3 make submissions in respect of the evidence, comment on and have their views properly reflected in the final report; and
- .4 be provided with the draft and final reports relating to the marine safety investigation^{*}.

21.4 To the extent practical, substantially interested States should assist the marine safety investigating State(s) with access to relevant information for the marine safety investigation. To the extent practical, the investigator(s) carrying out a marine safety investigation should also be afforded access to Government surveyors, coastguard officers, ship traffic service operators, pilots and other marine personnel of a substantially interested State.

21.5 The flag State of a ship involved in a marine casualty or marine incident should help to facilitate the availability of the crew to the investigator(s) carrying out the marine safety investigation.

* The reference to 'extent practical' may be taken to mean, as an example, that co-operation or participation is limited because national laws make it impractical to fully co-operate or participate.

Chapter 22

COLLECTION OF EVIDENCE

22.1 A marine safety investigating State(s) should not unnecessarily detain a ship for the collection of evidence from it or have original documents or equipment removed unless this is essential for the purposes of the marine safety investigation. Investigators should make copies of documents where practicable.

22.2 Investigator(s) carrying out a marine safety investigation should secure records of interviews and other evidence collected during a marine safety investigation in a manner which prevents access by persons who do not require it for the purpose of the investigation.

22.3 Investigator(s) carrying out the marine safety investigation should make effective use of all recorded data including voyage data recorders if fitted. Voyage data recorders should be made available for downloading by the investigator(s) carrying out a marine safety investigation or an appointed representative.

22.3.1 In the event that the marine safety investigating State(s) do not have adequate facilities to read a voyage data recorder, States with such a capability should offer their services having due regard to the:

- .1 available resources;
- .2 capabilities of the read-out facility;
- .3 timeliness of the read-out; and
- .4 location of the facility.

Chapter 23

CONFIDENTIALITY OF INFORMATION

23.1 States should ensure that investigator(s) carrying out a marine safety investigation only disclose information from a marine safety record where:

- .1 it is necessary or desirable to do so for transport safety purposes and any impact on the future availability of safety information to a marine safety investigation is taken into account; or
- .2 as otherwise permitted in accordance with this Code^{*}.

* States recognize that there are merits in keeping information from a marine safety record confidential where it needs to be shared with people outside the marine safety investigation for the purpose of conducting the marine safety investigation. An example is where information from a marine safety record needs to be provided to an external expert for their analysis or second opinion. Confidentiality would seek to ensure that sensitive information is not inappropriately disclosed for purposes other than the marine safety investigation, at a time when it has not been determined how the information will assist in determining the contributing factors in a marine casualty or marine incident. Inappropriate disclosure may infer blame or liability on the parties involved in the marine casualty or marine incident.

23.2 States involved in marine safety investigation under this Code should ensure that any marine safety record in its possession is not disclosed in criminal, civil, disciplinary or administrative proceedings unless:

- .1 the appropriate authority for the administration of justice in the State determines that any adverse domestic or international impact that the disclosure of the information might have on any current or future marine safety investigations is outweighed by the public interest in the administration of justice; and*
- .2 where appropriate in the circumstances, the State which provided the marine safety record to the marine safety investigation authorizes its disclosure.

23.3 Marine safety records should be included in the final report, or its appendices, only when pertinent to the analysis of the marine casualty or marine incident. Parts of the record not pertinent, and not included in the final report, should not be disclosed.

23.4 States need only supply information from a marine safety record to a substantially interested State where doing so will not undermine the integrity and credibility of any marine safety investigation being conducted by the State or States providing the information.

23.4.1 The State supplying the information from a marine safety record may require that the State receiving the information undertake to keep it confidential.

Chapter 24

PROTECTION FOR WITNESSES AND INVOLVED PARTIES

24.1 If a person is required by law to provide evidence that may incriminate them, for the purposes of a marine safety investigation, the evidence should, so far as national laws allow, be prevented from admission into evidence in civil or criminal proceedings against the individual.

* Examples of where it may be appropriate to disclose information from a marine safety record in criminal, civil, disciplinary or administrative proceedings may include:

- 1 where a person the subject of the proceedings has engaged in conduct with the intention to cause a destructive result; or
- 2 where a person the subject of the proceedings has been aware of a substantial risk that a destructive result will occur and having regard to the circumstances known to him or her it is unjustifiable to take the risk.

24.2 A person from whom evidence is sought should be informed about the nature and basis of the investigation. A person from whom evidence is sought should be informed, and allowed access to legal advice, regarding:

- .1 any potential risk that they may incriminate themselves in any proceedings subsequent to the marine safety investigation;
- .2 any right not to self-incriminate or to remain silent;
- .3 any protections afforded to the person to prevent the evidence being used against them if they provide the evidence to the marine safety investigation.

Chapter 25

DRAFT AND FINAL REPORT

25.1 Marine safety investigation reports from a marine safety investigation should be completed as quickly as practicable.

25.2 Where it is requested, and where practicable, the marine safety investigating State(s) should send a copy of a draft marine safety investigation report for comment to interested parties. However, this recommendation does not apply where there is no guarantee that the interested party will not circulate, nor cause to circulate, publish or give access to the draft marine safety investigation report, or any part thereof, without the express consent of the marine safety investigating State(s).

25.3 The marine safety investigating State(s) should allow the interested party 30 days or some other mutually agreed time to submit their comments on the marine safety investigation report. The marine safety investigating State(s) should consider the comments before preparing the final marine safety investigation report and where the acceptance or rejection of the comments will have direct impact on the interests of the interested party that submitted them, the marine safety investigating State(s) should notify the interested party of the manner in which the comments were addressed. If the marine safety investigating State(s) receives no comments after the 30 days or the mutually agreed period has expired, then it may proceed to finalize the marine safety investigation report*.

25.4 Where it is permitted by the national laws of the State preparing the marine safety investigation report, the draft and final report should be prevented from being admissible in evidence in proceedings related to the marine casualty or marine incident that may lead to disciplinary measures, criminal conviction or the determination of civil liability.

25.5 At any stage during a marine safety investigation interim safety measures may be recommended.

* See chapter 13 where provisions with respect to providing interested parties with reports on request may alternatively be included as a mandatory provision.

25.6 Where a substantially interested State disagrees with the whole or a part of a final marine safety investigation report, it may submit its own report to the Organization.

Chapter 26

RE-OPENING AN INVESTIGATION

26.1 Marine safety investigating State(s) which have completed a marine safety investigation, should reconsider their findings and consider re-opening the investigation when new evidence is presented which may materially alter the analysis and conclusions reached.

26.2 When significant new evidence relating to any marine casualty or marine incident is presented to the marine safety investigating State(s) that have completed a marine safety investigation, the evidence should be fully assessed and referred to other substantially interested States for appropriate input.

Chapter 4

Witnesses and Interviews

Collecting Data

Collecting data is a critical part of the investigation. The detailed information collected by the accident investigation team is the foundation for the entire investigation, including the analyses and conclusions. These in turn become the basis for identifying preventive measures to preclude recurrences. Consequently, it is important to ensure that all relevant information is collected and that the information is accurate.

Gathering and analyzing information is an interdependent process that takes place throughout the first three weeks of the investigation cycle. As preliminary analysis is conducted on the initial evidence, gaps will become apparent, requiring the team to collect additional evidence. Generally, many data collection and analysis iterations occur before the team can be certain that all pertinent evidence has been gathered and analyses are finalized.

Three key types of evidence are collected during the investigation:

- ***Human or testimonial evidence*** includes witness statements and observations.
- ***Physical evidence*** is matter related to the accident (e.g., equipment, parts, debris, hardware, and other physical items).
- ***Documentary evidence*** includes paper and electronic information, such as records, reports, procedures, and documentation.

Collecting evidence can be a lengthy, time-consuming, and piecemeal process. Witnesses may provide sketchy or conflicting accounts of the accident. Physical evidence may be badly damaged or completely destroyed. Documentary evidence may be minimal or difficult to access. Thorough investigation requires that team members be diligent in pursuing evidence and adequately explore leads, lines of inquiry, and potential causal factors until they gain a sufficiently complete understanding of the accident.

The process of collecting data is iterative. Preliminary analysis of the initial evidence identifies gaps that will direct subsequent data collection. Generally, many data collection and analysis iterations occur before the team can be certain that all analyses can be finalized. The process of data collection also requires a tightly coordinated, interdependent set of activities on the part of several investigators.

TIP

It maybe helpful for the lead investigator to designate one team member to oversee evidence collection and to maintain a master list of evidence collected to date.

The process of pursuing evidentiary material involves:

- Collecting human evidence (locating and interviewing witnesses)
- Collecting physical evidence (identifying, documenting, inspecting, and preserving relevant matter)
- Collecting documentary evidence
- Examining organizational concerns, management systems, and line management oversight
- Preserving and controlling evidence.

Collecting Human Evidence

Human evidence is often the most insightful and also the most fragile. Witness recollection declines rapidly in the first 24 hours following an accident or traumatic event. Therefore, witnesses should be located and interviewed immediately and with high priority. As physical and documentary evidence is gathered and analyzed throughout the investigation, this new information will often prompt followup questioning.

Locating Witnesses

Principal witnesses and eyewitnesses are identified and interviewed as soon as possible. Principal witnesses are persons who were actually involved in the accident; eyewitnesses are persons who directly observed the accident or the conditions immediately preceding or following the accident. General witnesses are those with knowledge about the activities taking place prior to or immediately after the accident (the previous watch, for example). Prompt arrival on scene by team members and expeditious interviewing of witnesses helps ensure that witness statements are as accurate, detailed, and authentic as possible.

Table 6-1 lists sources that investigators can use to locate witnesses.

Conducting Interviews

Witness testimony is an important element in determining facts that reveal causal factors. It is best to interview principal witnesses and eyewitnesses first, because they often provide the most useful details regarding what happened. If not questioned promptly, they may forget important details.

Preparing for Interviews

Much of the investigation's fact-finding occurs in interviews. Therefore, to elicit the most useful information possible from interviewees, interviewers must be well prepared and have clear objectives for each interview. Interviews can be conducted after the team has established the topical areas to be covered in the interviews and after the lead investigator has reviewed with the board the objectives of the interviews and strategies for obtaining useful information. Table 6-2 provides guidelines for interview

People's memories, as well as their willingness to assist an investigative board, can be affected by the way they are questioned. Based on the availability of witnesses, team members' time, and the nature and complexity of the accident, the lead investigator and team members must determine who to interview, in what order, and what interviewing techniques to employ. Some methods that previous accident investigation boards have found successful are described below.

TIP

A witness interview is not an interrogation. Investigators should convey the sense of a cooperative, informal meeting.

Individual Versus Group Interviews.

Depending on the specific circumstances and schedule of an accident investigation, investigators may choose to hold either individual or group interviews. Generally, principal witnesses and eyewitnesses are interviewed individually to gain independent accounts of the event. However, a group, interview may be beneficial in situations where a work crew was either involved in or witness to the accident. Moreover, time may not permit interviewing every witness individually, and the potential for gaining new information from every witness may be small. Sometimes, group interviews can corroborate testimony given by an individual, but not provide additional details. The team should use their collective judgment to determine which technique is appropriate. Advantages and disadvantages of both techniques are listed in Table 4-3. These considerations should be weighed against the circumstances of the accident when determining which technique to use.

Table 4-3 Group and individual interviews have different advantages.

	Individual Interviews	Group Interviews
Advantages	<ul style="list-style-type: none"> ▪ Obtain independent stories ▪ Obtain individual perceptions ▪ Establish one-to-one rapport 	<ul style="list-style-type: none"> ▪ More time-efficient ▪ All interviewees supplement story; may get more complete picture ▪ Other People serve as “memory joggers”
Disadvantages	<ul style="list-style-type: none"> ▪ More time-consuming ▪ May be more difficult to schedule all witnesses 	<ul style="list-style-type: none"> ▪ Interviewees will not have independent stories ▪ More vocal members of the group will say more and thus may influence those who are quieter ▪ “Group Think” may develop; some individual details may get lost ▪ Contradictions in accounts may not be revealed.

Interviewing: Do’s and Don’ts. Table 4-4 lists actions that promote effective interviews, and Table 6-5 lists actions to avoid while conducting interviews.

Table 4-4. Interviewing Do’s.

Create a Relaxed Atmosphere
<ul style="list-style-type: none"> ▪ Introduce yourself and shake hands. ▪ Be polite, patient, and friendly. ▪ Treat witnesses with respect.
Prepare the Witness
<ul style="list-style-type: none"> ▪ Describe the investigation’s purpose: to prevent accidents, not to assign blame ▪ Explain that witnesses may be interviewed more than once. ▪ Stress how important the facts given during interviews are to the overall investigative process.
Record Information
<ul style="list-style-type: none"> ▪ Rely on a court reporter to provide a detailed record of the interview. ▪ Note crucial information immediately in order to ask meaningful followup questions.
Ask Questions
<ul style="list-style-type: none"> ▪ Establish a line of questioning and stay on track during the interview. ▪ Ask the witness to describe the accident in full before asking a structured set of questions. ▪ Let witnesses tell things in their own way; start the interview with a statement such as “Would you please tell me about...?” ▪ Ask several witnesses similar questions to corroborate facts. ▪ Aid the interviewee with reference points; e.g., “How did the lighting compare to the lighting in this room?” ▪ Keep an open mind; ask questions that explore what has already been stated by others

<p>in addition to probing for missing information.</p> <ul style="list-style-type: none"> ▪ Use visual aids, such as photos, drawings, maps, and graphs to assist witnesses. ▪ Be an active listener, and give the witness feedback; restate and rephrase key points. ▪ Ask open-ended questions that generally require more than a “yes” or “no” answer. ▪ Observe and note how replies are conveyed (voice inflections, gestures, expressions, etc.).
<p>Close the Interview</p>
<ul style="list-style-type: none"> ▪ End on a positive note; thank the witness for his/her time and effort. ▪ Allow the witnesses to read the interview transcript and comment if they so desire. ▪ Encourage the witness to contact the board with additional information or concerns. ▪ Remind the witness that a follow-up interview may be conducted.

Table 4-5. Interviewing Don'ts.

<ul style="list-style-type: none"> ▪ DO NOT rush the witness while he/she is describing the accident or answering questions.
<ul style="list-style-type: none"> ▪ DO NOT judge, display anger, refute, threaten, intimidate, or blame the witness.
<ul style="list-style-type: none"> ▪ DO NOT suggest answers.
<ul style="list-style-type: none"> ▪ DO NOT make promises that cannot be kept (for example, unrestricted confidentiality).
<ul style="list-style-type: none"> ▪ DO NOT use inflammatory words (“violate,” “kill,” “lie,” “stupid,” etc.).
<ul style="list-style-type: none"> ▪ DO NOT omit questions during the interview because you think you already know the answer.
<ul style="list-style-type: none"> ▪ DO NOT ask questions that suggest an answer, such as “Was the odor like rotten eggs?”

It is important to create a comfortable atmosphere in which interviewees are not rushed to recall their observations. Interviewees should be told that they are a part of the investigation effort and that their input will be used to prevent future accidents and not to assign blame. Before and after questioning, interviewees should be notified that follow-up interviews are a normal part of the investigation process and that further interviews do not mean that their initial statements are suspect. Also, they should be encouraged to contact the team whenever they can provide additional information or have any concerns.

Interviewees should be aware of whether the information that they provide during the investigation may or may not be precluded from release to the public. Following these guidelines will help ensure that witness statements are provided freely and accurately, subsequently improving the quality and validity of the information obtained.

Use of an Interpreter

Preferably an interpreter will be supplied by a government approved interpretation service. However, sometimes one must hire an interpreter on scene. Local embassies or consulates and universities are good sources to inquire about interpreter availability. If necessary, contact a commercial interpreter firm and arrange for an interpreter to travel to the scene. This is costly but, without adequate interpreter services, the investigation cannot be properly conducted.

When using an interpreter in interviewing it is important that the interpreter be fluent in the language and dialect spoken by the witness. The interpreter must also have a proper command of the language of the investigator.

The interpreter must be able to grasp technical marine terms, and it may be necessary to arrange a prior meeting and/or have a list of common nautical terms available so that the interpreter has time to research the appropriate translation. The interpreter must be able to pass to the witness the information, as well as reflect the attitude and manner of expression you wish to convey. Further, the interpreter must be able to recognize any idiosyncrasies in the answers a witness may give and bring them to your attention, along with the reply.

The witness should generally be seated in a chair opposite you with the interpreter in between but slightly to one side, so that the interpreter may conveniently face either the investigator or the witness as the conversation flows. Questions should be directly to the witness using the first person. The questioner should not refer to the witness in the third person, or ask the interpreter to "ask him" or "tell him" anything. Further, attempt to keep questions short. However, should it be necessary to pose a lengthy question, instruct the interpreter to translate the question in "bite size" pieces. In such instances, explain to the interpreter that you will pause occasionally to allow the interpreter an opportunity to translate incremental portions of the question.

An interpreter should:

- 1.) merely act as a vehicle for accurately interpreting and passing information back and forth between you and the witness.
- 2) imitate your voice inflection and gestures as much as possible.
- 3) not carry on a conversation with the witness, other than directed by you.
- 4) pass on faithfully everything the witness said, including trivial remarks and exclamations.
- 5) not evaluate the conversation him or her self.

Using an interpreter complicates an interview and can often more than double the time it take to complete the interview. Such interviews can be successful if they are well planned and

controlled. At the conclusion of an interview, when the witness has left, it may be worthwhile asking the interpreters assessment of the witness.

Evaluating the Witness's State of Mind

Occasionally, a witness's state of mind may affect the accuracy or validity of testimony Provided. In conducting witness interviews, investigators should consider:

- The amount of time between the accident and the interview. People normally forget 50 to 80 percent of the details in just 24 hours.
- Contact between this witness and others who may have influenced how this witness recalls the events.
- Signs of stress, shock, amnesia, or other trauma resulting from the accident.
- Details of unpleasant experiences are frequently blanked from one's memory.

Investigators should note whether an interviewee displays any apparent mental or physical distress or unusual behavior; it may have a bearing on the interview results. These observations can be discussed and their impact assessed with other members of the team.

Investigators should also be aware of cultural differences that may be expected and the sub-cultures that may be on board a ship, particularly those with multi-national crewing.

Issues of status and loss of face may be encountered from time to time. There may be a tendency for an interviewee to provide answers that he/she thinks the interviewer wants to hear, or a tendency to agree, just out of politeness. In other cases, the use of English or other common language may have different meanings or inferences.

Under any of these circumstances an interpreter may prove really useful.

Chapter 5

Physical Evidence

Collecting Physical Evidence

TIP

To ensure consistent documentation, control, and security, it may be useful to designate a single team member or the administrative coordinator to be in charge of handling evidence.

The investigative team proceeds in gathering, cataloging, and storing physical evidence from all sources as soon as it becomes available. The procedures for access to, and the controlling of, evidence maybe subject to National Legal requirements which vary from country to country. The most obvious physical evidence related to an accident or accident scene often includes solids such as:

- Equipment
- Tools
- Materials
- Hardware
- Pre- and post-accident positions of accident-related elements
- Scattered debris
- Patterns, parts, and properties of physical items associated with the accident.

Less obvious but potentially important physical evidence includes fluids (liquids and gases). Ships use a multitude of fluids, including chemicals, fuels, hydraulic control or actuating fluids, and lubricants. Analyzing such evidence can reveal much about the operability of equipment and other potentially relevant conditions or causal factors. Care should be taken if there is pathogenic contamination of physical evidence (e.g., blood); such material may require autoclaving or other sterilization. Specialized technicians experienced in fluid sampling should be employed to help the team collect and analyze fluid evidence. If required, expert analysts should be requested to perform tests on the fluids and report results to the team.

High speed vessel collisions or accidents involving explosions by result in an accident scene that is contaminated with human blood, body fluids or tissue remains. Upon entering such a scene, the investigative team must take proper precautions to protect itself from exposure to bloodborne pathogens. When handling potential bloodborne pathogens, universal precautions such as those listed in Appendix I, Chapter 5 should be observed to minimize potential exposure. All human blood and body fluids should be treated as if they are infectious. The precautions listed should be implemented for all potential exposures. Exposure is defined as reasonable anticipated skin, eye, mucous membrane, or parenteral contact with blood or other potentially infectious materials. Physical evidence should be systematically collected, protected, preserved, evaluated, and recorded to ultimately determine how and why failures occurred and whether use, abuse, misuse, or nonuse was a causal factor.

Documenting Physical Evidence

Evidence should be carefully documented at the time it is obtained or identified. The Accident Investigation Physical Evidence Log can help investigators document and track the collection of physical evidence. In a multi-investigator team investigation, the use of an evidence log will prevent several investigators asking for the same piece of evidence, thereby avoiding duplication of effort. Additional means of documenting physical evidence include sketches, maps, photographs, and videotape.

Sketching and Mapping

Sketching and mapping the position of debris, equipment, tools, and injured persons may be initiated by the team as soon as it arrives on scene. Position maps convey a visual representation of the scene immediately after an accident. Evidence may be inadvertently moved, removed, or destroyed, especially if the accident scene can only be partially secured. Therefore, sketching and mapping should be conducted immediately after recording initial witness statements.

Precise scale plottings of the position of elements can subsequently be examined to develop and test accident causal theories.

Photographing and Videotaping Physical Evidence

Photography is a valuable and versatile tool in accident investigation. Photos or videos can identify, record, or preserve physical accident evidence that cannot be effectively conveyed by words or collected by any other means.

Photographic coverage should be detailed and complete, including standard references to help establish distance and perspective. Videotapes should cover the overall accident scene, as well as specific locations or items of significance. A thorough videotape allows the team to minimize trips to the accident scene. This may be important if the scene is difficult to access or if it presents hazards.

Good photographic coverage of the accident is essential, even if photographs or video stills will not be used in the investigation report. However, if not taken properly, photographs and videos can easily misrepresent a scene and lead to false conclusions or findings about an accident. Therefore, whenever possible, accident photography and videotaping should be performed by professionals. Photographic techniques that avoid misrepresentation, such as the inclusion of rulers and particular lighting, may be unknown to amateurs but are common knowledge among professional photographers and videographers.

Even if photos are taken by a skilled photographer, the investigation team should be prepared to direct the photographer in capturing certain important perspectives or parts of the accident scene. Photographs of evidence and of the scene itself should be taken from many angles to illustrate the perspectives of witnesses and injured persons. In addition, team members may wish to take photos for their own reference. If available, digital photography will facilitate incorporation of the photographs into the investigation report. However, if this is not practical, high-quality 35mm photographs can be scanned for incorporation in the report.

As photos are taken, a log should be completed noting the scene/subject, date, time, direction, and orientation of photos taken, as well as the photographer's name and camera settings.

Inspecting Physical Evidence

Following initial mapping and photographic recording, a systematic inspection of physical evidence can begin. The inspection involves:

- Surveying the involved equipment, vehicles, structures, etc., to ascertain whether there is any indication that component parts were missing or out of place before the accident
- Noting the absence of any parts of guards, controls, or operating indicators (instruments, position indicators, etc.) among the damaged or remaining parts at the scene
- Identifying as soon as possible any equipment or parts that must be cleaned prior to examination or testing and transferring them to a laboratory or to the care of an expert experienced in appropriate testing methodologies
- Noting the routing or movements of records that can later be traced to find missing components
- Preparing a checklist of complex equipment components to help ensure a thorough survey.

These observations should be recorded in notes and photographs so that investigators avoid relying on their memories. Some investigators find a small cassette tape recorder

useful in recording general descriptions of appearance and damage; however, the potential failure of a recorder, inadvertent tape erasure, and limitations of verbal description suggest that verbal recorded descriptions should be used in combination with notes, sketches, and photographs.

Removing Physical Evidence

Following the initial inspection of the scene, investigators may need to remove items of physical evidence. To ensure the integrity of evidence for later examination, the extraction of parts must be controlled and methodical. The process may involve simply picking up components or pieces of damaged equipment, removing bolts and fittings, cutting through major structures, or even recovering evidence from beneath piles of debris. Before evidence is removed from the accident scene, it should be photographed and its position noted on an appropriate sketch of the scene. Remember, once it has been moved, it will never be able to be returned to exactly the same position that it occupied before it was moved. It should then be carefully packaged and clearly identified. The readiness team or a pre-assembled investigator's kit can provide general-purpose cardboard tags or adhesive labels for this purpose.

Equipment or parts thought to be defective, damaged, or improperly assembled should be removed from the accident scene for technical examination. If improper assembly is suspected, investigators should direct that the part or equipment be photographed and otherwise documented as each subassembly is removed.

Items that have been fractured or otherwise damaged should be packaged carefully to preserve surface detail. Delicate parts should be padded and boxed. Both the part and the outside of the package should be labeled. Greasy or dirty parts can be wrapped in foil and placed in polyethylene bags or other nonabsorbent materials for transport to a testing laboratory, command center, or evidence storage facility. If uncertainties arise, subject matter experts can advise the board regarding effective methods for preserving and packaging evidence and specimens that must be transported for testing.

When preparing to remove physical evidence, these guidelines should be followed:

- Normally, extraction should not start until witnesses have been interviewed, since visual reference to the accident site can stimulate one's memory
- Extraction and removal or movement of parts should not be started until position records (measurements for maps and photographs) have been made
- Be aware that the accident site maybe unsafe due to dangerous materials or weakened structures
- Locations of removed parts can be marked with orange spray paint or wire-staffed marking flags; the marking flags can be annotated to identify the part removed and to allow later measurement

- Care during extraction and preliminary examination is necessary to avoid defacing or distorting impact marks and fracture surfaces
- The lead investigator and team members should concur when the parts extraction work can begin, in order to assure that board members have completed all observations requiring an intact accident site.

Collecting Documentary Evidence

Documentary evidence can provide important data and should be preserved and secured as methodically as physical evidence. This information might be in the form of logbooks, equipment readouts, course recorder traces, licenses, documents, certificates, papers, photos, videotape, magnetic tape, or electronic media, either at the site or in files at other locations.

Some work/process/system records are retained only for the workday or the week. Electronic data is often stored in a memory buffer and is overwritten as new data is acquired. Once an accident has occurred, the investigator must work quickly to collect and preserve these records so they can be examined and considered in the analysis.

In some cases it may be necessary to obtain the services of a suitably competent translator.

Accident investigation preplanning should include procedures for identifying records to be collected, as well as the people responsible for their collection. Because records are not always located at the scene of the accident, and some documents may be overlooked in the preliminary collection of evidence.

Documents often provide important evidence for identifying causal factors of an accident. This evidence is useful for:

- Thoroughly examining the policies, standards, and specifications that molded the environment in which the accident occurred
- Indicating the attitudes and actions of people involved in the accident
- Revealing evidence that generally is not established in verbal testimony.

Documentary evidence generally can be grouped into four categories:

- Management control documents that communicate management expectations of how, when, where, and by whom work activities are to be performed
- Records that indicate past and present performance and status of the work activities, as well as the people, equipment, and materials involved

- Reports that identify the content and results of special studies, analyses, audits, appraisals, inspections, inquiries, and investigations related to work activities
- Follow-on documentation that describes actions taken in response to the other types of documentation.

Collectively, this evidence gives important clues to possible underlying causes of errors, malfunctions, and failures that led to the accident.

Analysis of documents may involve two major aspects, cross checking documents from different sources that contain the same information or scientific analysis.

Analysis could include cross checking the bridge movement or "bell" book with the engine room records. It cannot be emphasized enough that contemporaneous records, those made at the time, are of value, fair copies of log books, e.g. the scrap log copied out in a fair hand are of limited value. Of greater value is the cross checking of ship's records with external sources such as VTS tapes, harbor control tapes or log books, cargo terminal records, police records, customs records, or even TV or radio recordings.

Investigators must keep an open mind and think latterly asking "who else may have similar information".

Photocopies. Investigators should be sensitive to the possibility that photocopies of documents may not truly depict the original document. Erasures and/or the use of "white out" correction liquids, which may be apparent on the original document, may not show up on a photocopy of the document. Further, as in the case of logbooks, entire pages may be removed. If the investigator does not examine the original document, he will not know for sure that the photocopy provided him is, in fact, a true and accurate copy. Before photocopies of documents are accepted, the investigator should compare the copy with the original to assure that there have been no alterations to the original.

Marine Documents. A list of maritime documentation that may be collected or reviewed during a marine accident investigation can be found on Appendix II of Chapter 5. The list while lengthy, is far from complete. The specific documents needed by the investigator will vary depending on the type of accident.

International Safety Management System

Accident investigations must thoroughly examine organizational concerns, management systems, and line management oversight processes to determine whether deficiencies in these areas contributed to causes of the accident. The investigation team should consider the full range of management systems through all levels of management in accordance with the International Safety Management (ISM) Code. It is important to note that this focus should not be directed toward individuals.

The ISM Code documentation should be inspected as a matter of routine. It is important to ensure that the procedures in the code are adhered to.

The ship operator's "Documentation of Compliance" is valid for 5 years, subject to annual verification. The ship's "Safety Management Certificate" is valid for 5 years subject to periodical verification by the administration.

All aspects of the code are important to an investigator and include but are not confined to the following.

- ◇ Training (ISM Code 6.3)
- ◇ Passage planning and procedures with pilot embarked (ISM Code ?)
- ◇ Information and language of ISM Code.(ISM Code 6.6)
- ◇ Plans, instructions, check lists for the safety of the ship and pollution prevention.(ISM Code 7.0)
- ◇ Emergency preparedness (ISM Code 8.0)
- ◇ Reporting non-conforming incidents (ISM Code 9.1)
- ◇ Corrective Action (9.2)
- ◇ Maintenance (ISM Code 10.1)
- ◇ Critical equipment (ISM Code 10.3)
- ◇ Documentation (ISM Code 10.1)
- ◇ Record of internal audits (ISM Code 12.3)

If there was a departure from the code it is important to identify the non-conformity to establish whether the departure was consistent with reasonable decision making (see Course 1.3.4). Depending upon the incident it may also be necessary to check the ship's reporting of "non-conforming incidents"(ISM Code 9.1) and the management receipt of such records and subsequent action, which may include a record of corrective action (ISM Code 9.3).

Preserving and Controlling Evidence

Preserving and controlling evidence are essential to the integrity and credibility of the investigation. Security and custody of evidence are necessary to prevent its alteration or loss and to establish the accuracy and validity of all evidence collected. The point of contact is responsible for assuring that a chain of custody is established for all evidence removed from the accident scene before the board arrives. The board chairperson is responsible for establishing an evidentiary custody protocol to ensure that all evidence is well documented at the accident scene and carefully controlled when it is removed and stored after the board arrives. Evidence control procedures similar to the following guidelines will help assure that evidence is not adulterated, corrupted, or lost and that subsequent engineering tests, if conducted, and other analytical results are valid.

- Evidence should be photographed and/or videotaped in its original location immediately following the accident, provided it does not interfere with rescue or amelioration activities.
- A log should be maintained stating the location, date, and time that photos and videos are taken. The Accident investigation Photographic Log Sheet can be used for this purpose. Avoid using photographic attachments that digitally record the date and time on the negative because these images become a permanent part of the photo and may obscure evidence or important details in the photo or video. The computerized/printed date on the back of photos provided by film processors should be used in conjunction with, not in lieu of, a photo log, because the date on photos gives the day the film was processed, not the day the photos were taken.
- Board members should prepare and sign an inventory of all evidentiary items collected, including statements regarding:
 - Lists of items removed from the scene
 - Date and time items were removed from the scene
 - Person who removed items from the scene
 - Location where those items will be stored.
- Evidence should be controlled by signature transfer (signatures of the recipient and the person relinquishing custody) and made available only to those who need to examine and use the evidence during the accident investigation. The Accident Investigation Physical Evidence Log Form may be used for this purpose.
- Secure storage should be obtained immediately, and access to evidence controlled throughout the investigation.
- Access to the room or suite of offices used by the investigation board should be restricted. No one other than board members, advisors, and support staff should have access to the board's office space; this includes janitorial staff.
- The board chairperson should determine the disposition of evidence at the conclusion of the investigation.

Documentary evidence can easily be over-looked, misplaced, or taken. Documents can be altered, disfigured, misinterpreted, or electronically corrupted. Computer software and disks can be erased by exposure to magnetic fields. As with other evidence collected during the investigation, documentary evidence should be collected, inventoried (logged), controlled, and secured (in locked containers, if necessary.)

APPENDIX I - Chapter 5

Universal Precautions to Prevent Contact with Bloodborne Pathogens

On December 6, 1991, the U.S. Occupational Safety and Health Administration (OSHA) issued the regulation called "Occupational Exposure to Bloodborne Pathogens (BBP)," found in Title 29, Section 1910.1030 of the Code of Federal Regulations. The standard covers those occupations having a high potential for exposure to bloodborne pathogens, including law enforcement, emergency response, and accident investigation personnel. Individuals covered by this standard should observe Universal Precautions to prevent contact with human blood, body fluids, tissues and other potentially infectious materials. Universal Precautions require that employees treat all human blood, body fluids, or other potentially infectious materials to be infectious for hepatitis B virus (HBV), human immunodeficiency virus (HIV), and other bloodborne pathogens. Appropriate protective measures to be taken to avoid direct contact with these materials include:

- Use barrier protection at all times.
- Prohibit eating, drinking, smoking, or applying makeup at the accident scene/mass disaster.
- Use gloves when there may be hand contact with blood or other potentially infectious materials. Gloves should always be worn as if there are cuts, scratches, or other breaks in the skin. In some instances where there is heavily contaminated material, the use of double gloves is advisable for additional protection.
- Change gloves when contaminated or as soon as feasible if torn, punctured, or when their ability to function as a barrier is compromised.
- Always wash hands after removal of gloves or other personal protective equipment (PPE). The removal of gloves and other PPE should be performed in a manner which will not result in the contamination of unprotected skin or clothing.
- Wear safety goggles, protective facemasks or shields, or glasses with side shields to protect from splashes, sprays, spatters, or droplets of blood or other potentially infectious materials. These same precautions must be taken when collecting dried stains for laboratory analyses.
- Use disposable items, such as gloves, coveralls, shoe covers, etc., when potentially infectious materials are present.
- Place contaminated sharps (e.g. broken glass, needles, knives, etc.) in appropriate leak-proof, close-able, puncture-resistant containers when these sharps are to be discarded, transported, or shipped. If transported or shipped, containers should be appropriately labeled.
- DO not bend, recap, remove, or otherwise handle contaminated needles or other sharps.
- Use a protective device, such as a CPR mask, when performing mouth-to-mouth resuscitation.
- Decontaminate all equipment after use with a solution of household bleach (diluted 1:10), 70% isopropyl alcohol, or other appropriate disinfectants.
- After all evidence has been collected and the crime scene has been released, the owner or occupants of the affected property should be made aware of the potential risks from bloodborne pathogens.
- Evidence containing blood or other body fluids should be completely dried before it is packaged and shipped to the laboratory for analysis. Appropriate biohazard warning labels must be affixed to the evidence container indicating that a potentially infectious material may be present.

APPENDIX II - Chapter 5

A. Plans, Diagrams and Lists

1. General arrangement plans
2. General arrangement of engineroom machinery (elevation & plan views)
3. Shell expansion plans
4. Capacity plan
5. Main engine control system plans and description
6. Main engine fuel oil supply and return pumping/piping and tanks plans
7. Fuel oil service and transfer pumping/piping system plans and description
8. Fuel oil tank venting piping plan
9. Engineroom ventilation system plans
10. Passenger and crew ventilation system plans
11. General loading plans and procedures
12. Ullages and ullage tables
13. Bilge pumping and piping diagram and system description
14. Cargo pumping & piping plans and system description
15. Cargo tanks venting piping plans
16. IGS plans and system description
17. Ballast pumping & piping plans and description
18. Ballast tanks venting piping plans
19. Ballast tank coatings
20. Damage control plan (fire doors dampers, etc)
21. Fire detection plans and system description
22. Firemain piping & pumping system and description
23. CO piping system diagram and system description
24. Foam piping system diagram and description
25. Halon system diagram and description
26. One line electrical distribution diagram
27. List of bridge/radio room communication equipment
28. List of vessel navigation equipment

B. Statutory and Other Certificates

1. Gross tonnage/deadweight tonnage
2. Copy of the U.S. Certificate of Inspection (U.S. vessel only)
3. Copy of Cargo Ship Safety Construction Certificate
4. Copy of Cargo Ship Safety Radio Certificate
5. Copy of Cargo Ship Safety Equipment Certificate
6. Copy of MODU Certificate
7. Copy of Passenger Ship Safety Certificate
8. Copy of International Load Line Certificate
9. Copy of International Oil Pollution Prevention Certificate
10. Copy of Certificate of Class for Hull and Machinery
11. Copy of Vessel Radio Communication License

12. Minimum Safe Manning Certificate
13. Ship's Certificate of Registry
14. Copy of Control Verification Certificate
15. Copy of Certificate for fire extinguishing system inspection
16. International Safety Management System (ISM) Documentation
17. Copies of Officers' licenses and STCW Certificates ratings STCW certificates

C. Charts, Log Books and Other Records

1. Chart of area of casualty
2. Bunkering records
3. Crew list with addresses
4. Name and addresses of *previous* master, chief mate, and chief engineer
5. Passenger list with addresses
6. Passenger boarding passes
7. Cabin assignments for passengers and crew
8. Terminal generated checklist and cargo loading/discharge data sheets
9. Vessel generated checklist and cargo loading/discharge data sheets
10. Liquid cargo data sheets
11. Analysis of cargo samples
12. Deck log (smooth and rough)
13. Cargo control room log (smooth and rough)
14. Engine log (smooth and rough)
15. Radio log (smooth and rough)
16. Boiler/main engine maintenance log
17. Original of course recorder printout at time of casualty
18. List of certificated lifeboatman
19. On-board crew conducted repair and maintenance records for one year prior to accident
20. On-board repairs conducted by shore side company or personnel
21. Vessel repair/spare parts requisitions to company
22. Copy of last shipyard repair/survey specifications
23. Classification survey reports (annual and special and damage surveys)
24. Copy of the bridge record card
25. Port State and Flag State inspection reports (annual & drydocking)
26. Independent survey reports by insurance, towing, and/or fire/explosion specialist.
27. Copy of Control Verification Examination Booklet
28. Passenger and crew medical log (ship's doctor/purser)
29. Shore Fire Department response records
30. Dangerous Stores Manifest
31. Trim and Stability Booklet

D. Operating Procedures and Manuals

1. Oil transfer procedures for cargo and bunkers (fuel)
2. From the vessel's operation manuals:
main and emergency electrical power system description, engineroom control system, mooring gear on deck, cargo pumping and piping system description, ballast pumping and piping system description, steering and control system, boiler automation control system
3. List of safety manuals maintained on vessel
4. Company and vessel procedures for tank opening and entry
5. Oxygen Analyzing equipment specifications (model & type) and operating manual
6. Combustible gas analyzer (model & type) and operating manual
7. Description of the vessel's planned maintenance system
8. Lifeboat and liferaft launching plan
9. Vessel Evacuation Plan
10. Copy of posted firefighting procedures for engine room and other spaces
11. Specific company orders to masters/chief engineers
12. Standing orders of ship master/chief mate/chief engineer.
13. Company training records for officers and crew
14. Company training and safety manuals
15. Station Bill
16. Company/vessel firefighting procedures
17. SAR data, including communication tapes from RCCs involved
18. Operating manual including stability control (MODU)

E. Miscellaneous

1. 8x10 pre-accident color photo of vessel (profile view)
2. General vessel characteristics
3. Bunker analysis from terminal and samples on vessel and at terminal
4. Fuel oil heating in tanks and through engineroom heaters
5. Type of tank gauging system
6. Previous accidents to this vessel, sister vessels, type and class
7. Loading Plan for last cargo(s)
8. Cargo regulations
9. Type of blowers (fans) used to vent tanks
10. Description of all temporary and permanent post-casualty repairs
11. List of the quantity and location of steel plating and internals (including piping) removed post-casualty prior to drydocking and at drydocking
12. Copy of next shipyard repair/survey specifications
13. Company organization chart

Reference

- Lecture slides were taken from material published by Stephenson in:
 - System Safety 2000, Van Nostrand Reinhold, 1991.

Overview

- Developed by Bill Johnson in 1970's for DOE
- MORT chart contains approximately 1500 items arranged into a large/complex fault tree
- Primarily used for accident investigation

Purpose of MORT

- To provide a systematic tool to aid in planning, organizing, and conducting an in-depth, comprehensive **accident investigation** to identify those specific that are *LTA* and need to be corrected to prevent the accident from recurring.
- Can also be used for inspection, audit, or appraisal purposes.

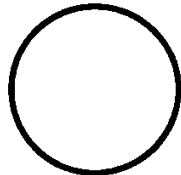
Symbols

- Symbols used on the MORT chart are fundamentally the same as those used on other analytical trees and FTA.

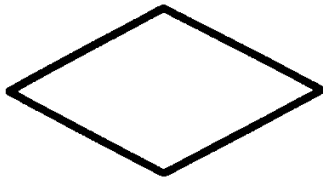
Event Symbols



General event symbol



Basic event symbol



Undeveloped terminal event



Satisfactory event



Normally expected event

Logic Gates



And-gate



Or-gate



Constraint symbol



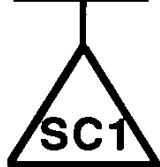
Gate constraint



Event constraint

Transfers

Event



Transfer in from element SC1



Transfer out from element SC3

A

Drafting break transfer



Assumed risk transfer

Abbreviations

- *LTA* - "less than adequate"
- *DN* - "did not"
- *FT* - "failed to"
- *HAP* - "hazard analysis process"
- *JSA* - "job safety analysis"
- *CS&R* - "codes standards and regulations"

Definition

- *Accepted or Assumed Risk* - Very specific risk that has been identified, analyzed, quantified to the maximum practical degree, and accepted by the appropriate level of management after proper thought and evaluation.
- *Losses from Assumed Risks* are normally those associated with earthquakes, tornados, hurricanes, and other acts of nature.
- *Amelioration* - Post-accident actions such as medical services, fire fighting, rescue efforts, and public relations.

Advantage

- It aids the accident investigator by identifying root causes of the accident.
- Provides a systematic method of evaluating the specific control and management factors that caused or contributed to the accident.
- Serve as planning and organizational tool for the collection of evidence and other relevant information.

Disadvantage

- Extremely time consuming and tedious when learning about and first using the MORT chart.
- This approach would be classified as overkill for most accidents.

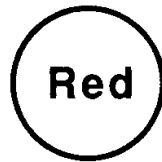
Input Requirements

- In a nut-shell, extensive. Detailed information regarding:
 - Hardware
 - Facilities
 - Environment
 - Policies & Procedures
 - Personnel
 - Implementation plans
 - Risk assessment programs
 - Project documents, etc...

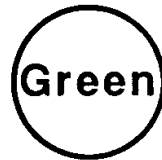
General Approach

- MORT analysis effort begins immediately after the accident occurs.
- Performed by a trained investigator.
- MORT chart is used as a working tool to aid in the gathering and storage of information.
- General method for working through the chart is from known to unknown.
- The top of the chart is typically addressed very early in the investigation.

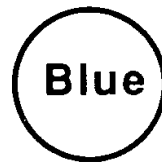
Color Coding



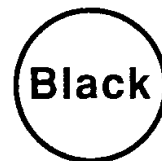
LTA



OK



Need more
information



Not
applicable

Color Coding (Red)

- Any factor or event found to be *LTA* is colored *red* on the chart.
- Should be addressed in the accident report with appropriate recommendations to correct the deficiency.
- Use judiciously! (Must be supported by facts)

Color Coding (Green)

- Any factor or event found to be *adequate* is colored *green* on the chart.
- Use judiciously! (Must be supported by facts)

Color Coding (Black)

- MORT chart is designed to encompass any accident situation, therefore not all parts of the chart may be relevant to the particular accident that is being investigated.
- **Any factor or event found to be *not applicable* is color coded *black* (or simply crossed out) on the chart.**

Color Coding (Blue)

- Indicates that the block has been examined, but insufficient evidence or information is available to evaluate the block. Suggests to collect more data.
- Typically these are colored with a **blue dot or check mark** due to the fact that they should change color prior to completing the investigation.
- All **blue** blocks should be replaced with another color by the time the accident investigation is complete. But this may not always be the case!

General Approach (con't)

- Since this is a working document, neatness does not count (to a point!).
- Make notes on the chart as you feel necessary.
- For most investigations, analysis tends to begin at the *specific control factors* and *management control factors* blocks of the tree.

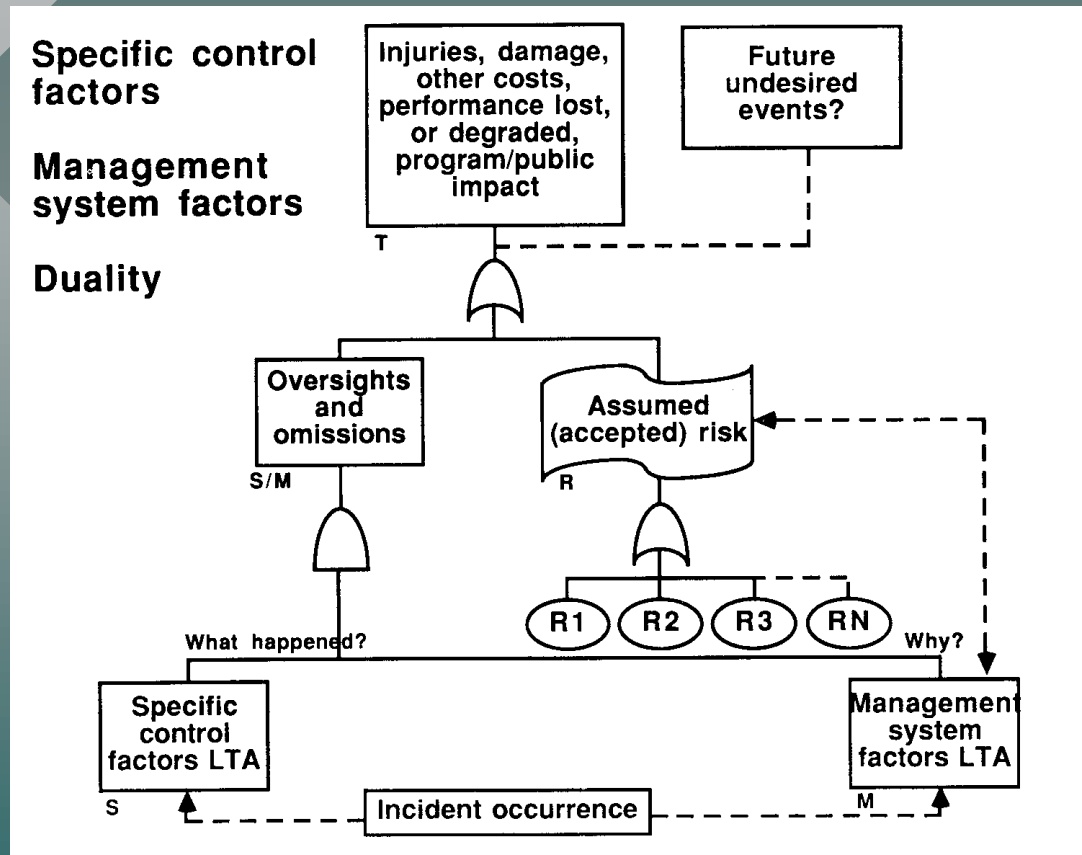
Specific Control Factors

- Tends to answer questions about what happened.
- Addresses the accident documentation requirements.
- MORT tends to answer these questions in more detail than many traditional methods.

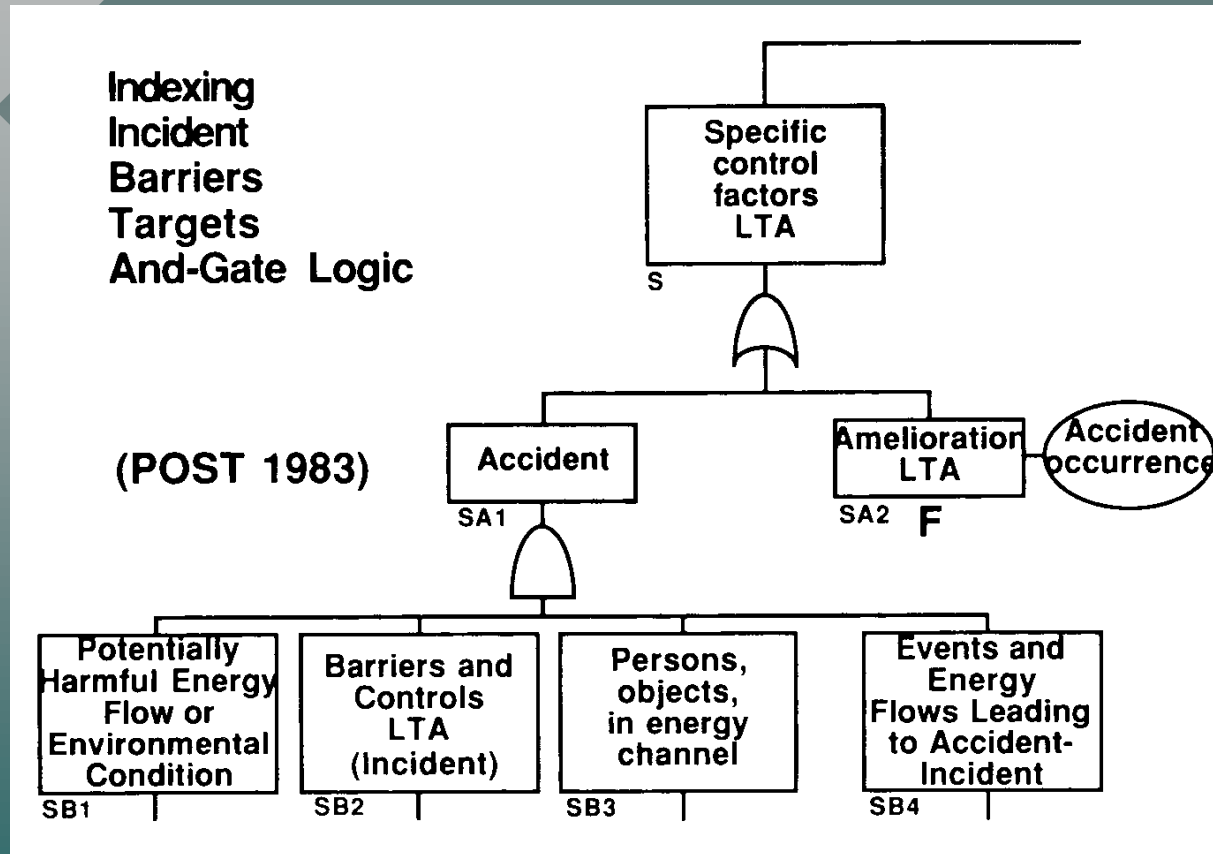
Management Control Factors

- Policy *LTA* - Not typically a problem with major organizations.
- Implementation - Need be sure the policy is actually implemented and not just a “paper policy.”
- Risk Assessment System - Need to ensure that risks are properly identified, evaluated, and reported to management. Oversights or omissions can also be a problem in this area.

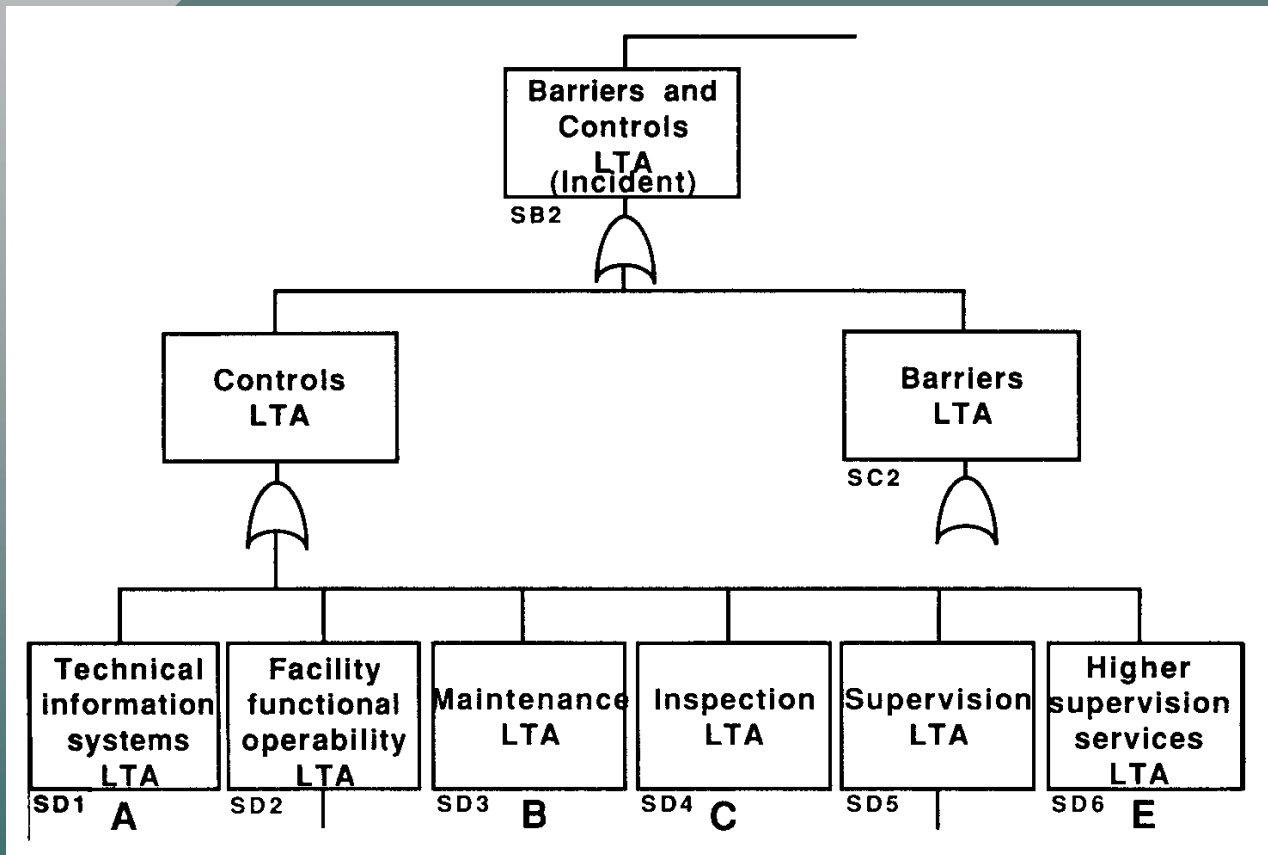
Top Events



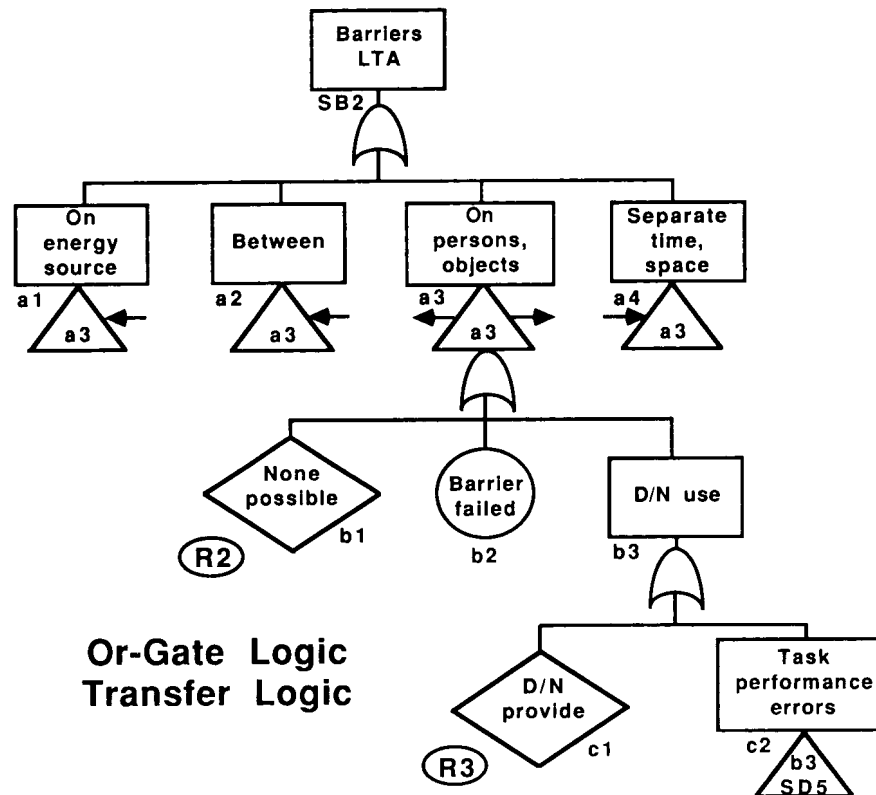
Specific Control Factors



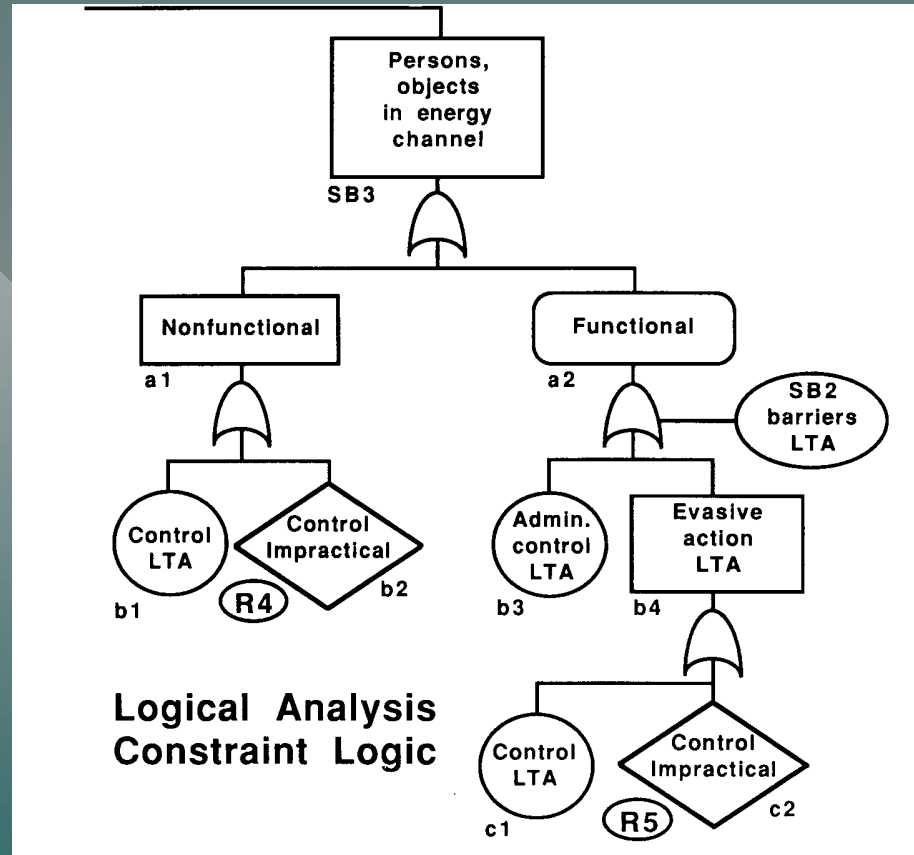
Incident



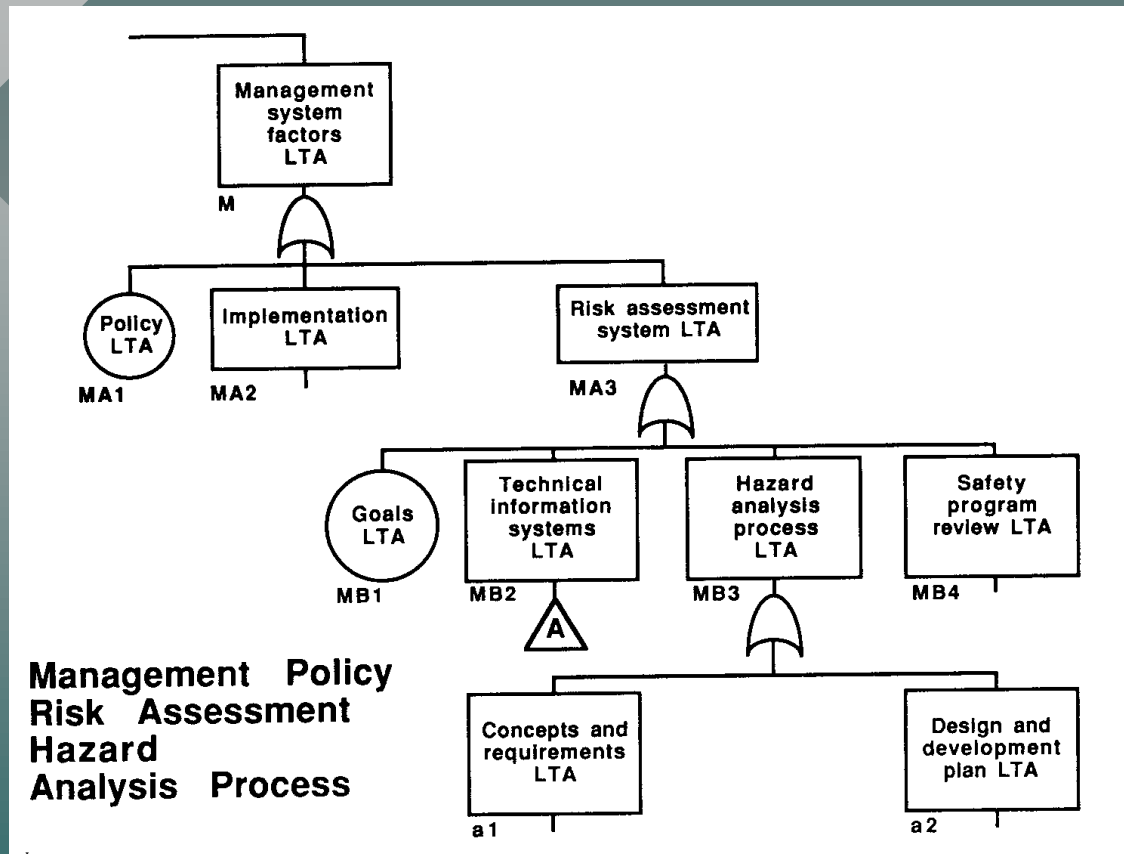
Barriers



Targets



Management Control Factors



Olivia Scan - Accidents to Person

Clemons / Sizes / Lightways

8/10/09
 A.M. (20060)
 OLIVIA SCAN
 (OT) SCANS
 SHAREHAM

8/10/09
 094005
 SHOTS
 FIRST-MAN-
 FOR SCANNERS

9/10/09
 OT SHOTS
 THROUGHT
 TO AT-ALL
 CLEAR SCANS

10/10/09
 0835
 OT SHOTS
 TRAIL AS
 SUM

NO DEURS
 WINTEREINE
 LENS

NO IFVC OUBA

GHANIAN
 CLEAR
 SCAN SPANS

LAVIAN
 CLEAR SPANS

hours of
 rest

10/10/09
LOIS OS
HAULS HAULS
TRIDEEK.

WILL CREW
ON DECK
-NO REGS.

MARK AND BRAD
SIMPLY CUSTOM FISH
HAULS UP STOPS
SIDE - OUTSIDE
WATER WITH 5x
CUSTOMER CREW

WIRE COMMAND
UNDERWAY

NO RECORDS
ON BOARD

NO ANSWERS
RECORDS

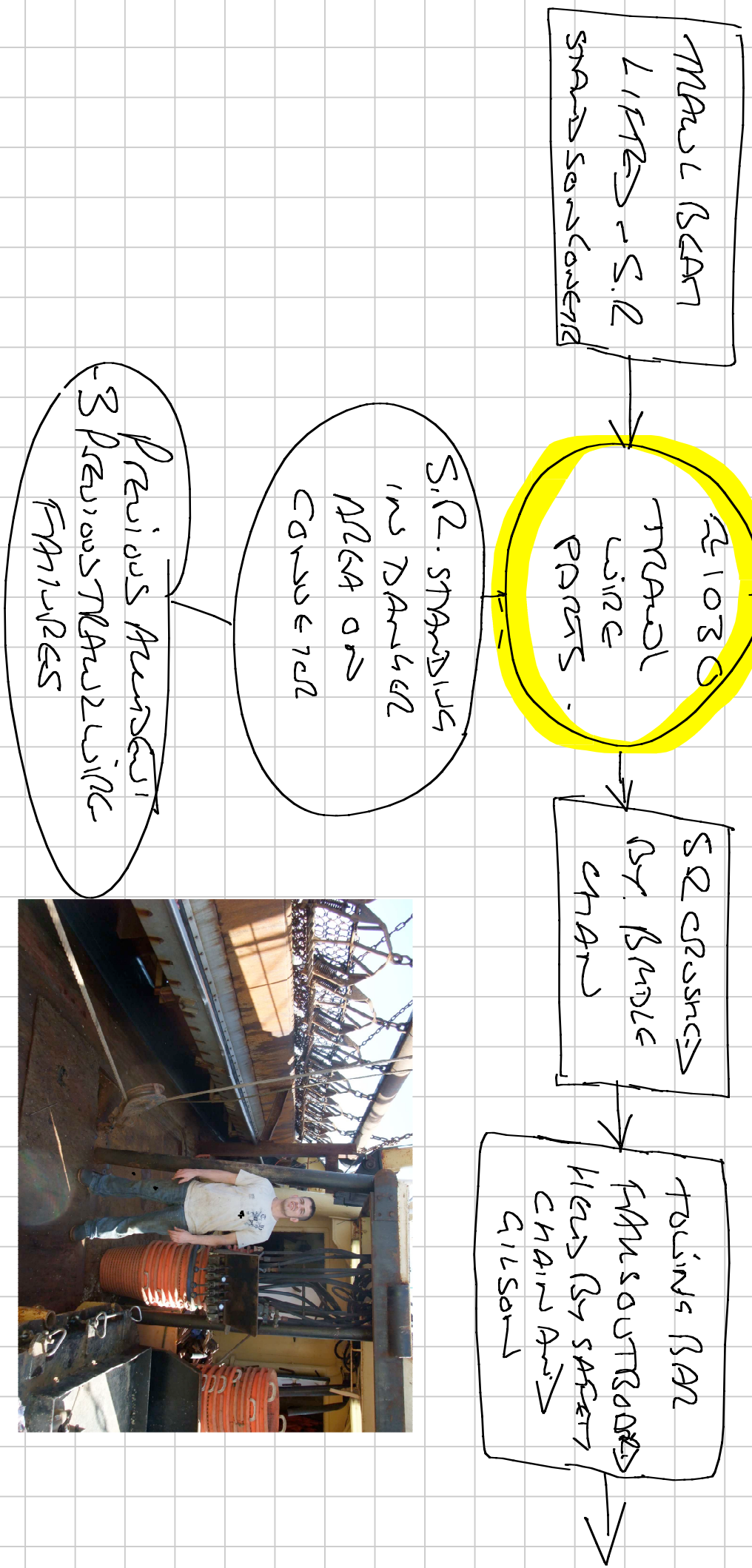
SCOTT
HOLKSON
MURPHY
BAR. WITH BIG
DINNER

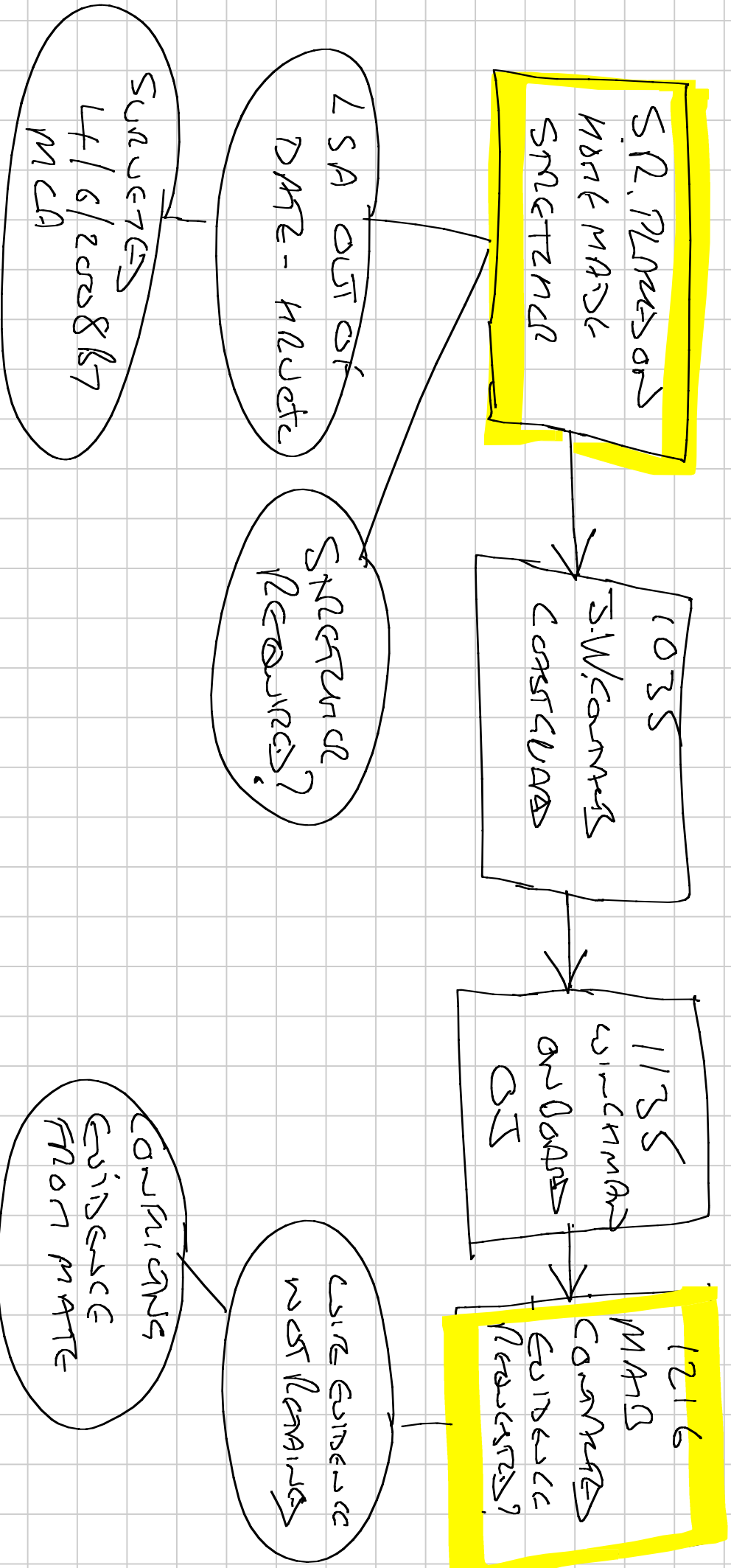
SID. HAULS
UP PORT BENT
BIG DINNER (S.N.) AFF
+ LITTLE DINNER (S.N.) AFF
PURE SAFETY CHAIRS
ON TAIL BAR

Access
Restrooms
by CONVEYOR

CHANGE
WHEN RECORDS

(SR2)
 Scott Levine Standards Converter





SAFEM ISSUES

1/ LOLDER Applications

2/ hours are best

3/ SAFE Access only year / Bulmar height

4/ MCA Summit / Inspection / Suffolk EST - (Sias)

- LSA

- CERTIFICATION

- RECORDS.

PREVIOUS ACCIDENTS

- 1/ 17/11/2007. - MAUL CARE POND - 1 INSURED FOOT - not reported
- 2/ 7000000 MAUL WIRE PHILINES - NO ISSUES -
- 3/ Philomena - 5 MIDSEASERS WITH INSTRUMENTS
- 3 ISSUES / 1 COLLISION / FAMILY
- 4/ TORREACHAN - 1 INSURER.