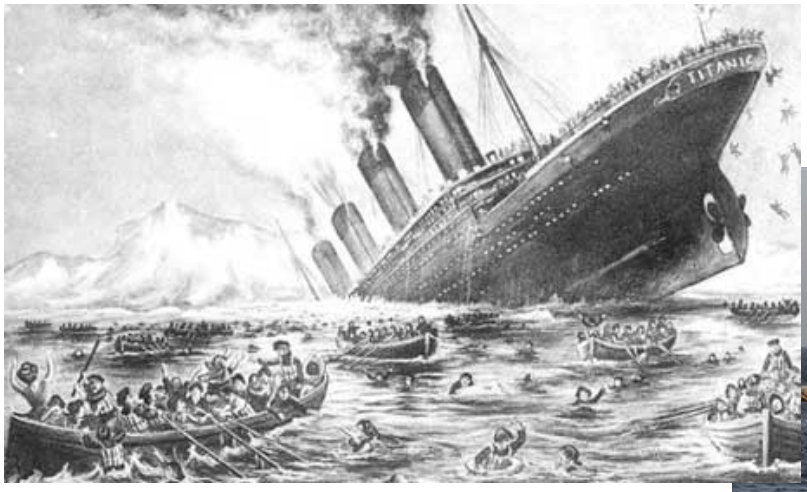
Needs and Challenges to Establishing an Effective Marine Safety Information Network to Improve Maritime Operational Safety



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About SOCP

Ship Operations Cooperative Program (SOCP) is a non-profit organization of commercial ship operators and maritime stakeholders in the United Sates. It is the only cooperative of its kind and is considered the voice of the industry in the United States. SOCP addresses and promotes commercial marine operations through the identification, development, and application of new methods, procedures, and technologies. SOCP's objective is to improve the overall competitiveness, efficiency, safety, security and environmental responsiveness of U.S. vessel operations. All U.S.-based operators and organizations that support marine vessel operations are eligible to participate in the program. The program is supported by the U.S. Maritime Administration (MARAD), and is a collaboration of industry, labor, academies and maritime organizations in the United States.

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Foreword

The purpose of this study is to determine the needs for a centralized marine safety data network, review the challenges present in studying accident prevention, and recommend next steps for establishing a more useful collection of marine safety data for safety analysis. The primary focus of the study is to enable more productive use of existing accident and safety data and better provide useful knowledge on how to prevent accidents and improve levels of safety. This study effort was supported with funding provided by the U.S. Maritime Administration. The work was administered by the Ship Operations Cooperative Program (SOCP), a collaborative group of ship operators, maritime academies, government agencies and others focused on improving ship operations.

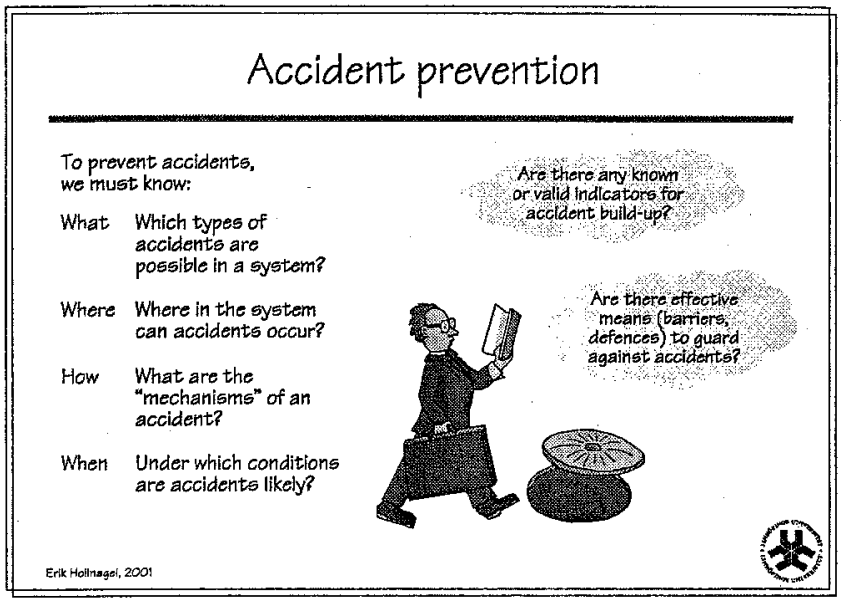

Figure 1 The need for safety data (Hollnagel, 2001)

Executive Summary

Marine accidents can and do occur. Examples include the grounding of the tanker EXXON VALDEZ with the resulting environmental damage (Skinner and Reilly, 1989); allision of the STATEN ISLAND FERRY with loss of life; and the explosion and fire on the MODU DEEPWATER HORIZON that resulted in loss of life and extensive environmental damage. The financial, environmental, and legal repercussions from major accidents can be devastating to individuals, companies, and industries. These major accidents, however, may have been prevented if lessons learned from previous marine casualties or incidents had been readily available and effectively disseminated to the industry to enable comprehensive and insightful analysis.

Data collected from marine accidents are collected by a variety of sources including Government agencies, private industry, and various organizations. Access to these findings is not always readily available or used effectively. The reasons that the information is not easily obtainable vary by source. Data collection may focus on developing safety recommendations or the objective may be on applying sanctions. The ultimate outcome of an investigative report influences the information gathering process with the current tendency of most data reporting systems to be very careful about what information is reported publically due to legal and financial concerns. To effectively pursue the goal of prevention, every piece of information available from these accident events should be pursued, evaluated, and put to best use.

Valuable incident, precursor, and voluntary safety information being gathered privately in the pursuit of preventing accidents also exist. Most of the data gathered by operating companies is not made public by them for fear of legal repercussions. Prior to an accident, these data sets are also perceived as less reputable than accident data, and where available, are highly underutilized. Sharing of such data can be very enlightening in the prevention of accidents as found by the aviation industry. In combination with data from accidents, increased sharing and use of these data resources with the application of appropriate reasoning has the potential to result in a much improved capability for predicting levels of safety and the occurrence of future accidents.

This report concludes that there is an essential need to develop a centralized, proactive marine safety information network that will enable the easy retrieval and effective use of collected data for accident prevention study. Recommendations to begin this process are offered. The many disparate sources of data need to be properly looked at and information distilled and organized from the collective with the primary objective and purpose of “preventing” future accidents. Developing proper protections of safety data from misuse will enable more of the various valuable data sets to be shared and made available for an enlightened review and

analysis. Further improvements will be possible as these systems become more popular and reporting individuals become more aware of the use and value of the reported information.

The increased perception of the issues and importance of prevention information will as well result in more reports of valuable information being provided to volunteer reporting systems. Significantly improved knowledge on how to prevent accidents and growth of a safety culture throughout the marine industry will result. The Maritime Administration as the Department of Transportation agency that promotes the marine industry is well placed to be the trusted U.S. Government agency to develop and maintain this capability. Their proactive assistance has the potential to significantly increase safety levels with only a modest investment necessary to coordinate the wealth of information that is available.

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Table of Contents

Foreword iii

Executive Summary iv

1. Introduction: The Need for a National Marine Safety Information Network 1

2. Gathering and Using Safety Data to Prevent Marine Accidents 12

2.1 Sources for maritime operational safety data 15

2.2 Lessons from others on safety data programs 20

2.3 Types of safety data and their utility 22

2.4 Legal protections regarding data/information 26

3. Current possibilities for Legal Protection from Discovery and Third Party Litigation. 30

3.1 Constraints in the collection of data 30

3.2 Barriers to sharing of collected data 31

3.3 Lessons learned from protections for other safety data systems 32

3.4 Possibility of obtaining marine third-party litigation protection 35

4. Potential Approaches for Gathering, Sharing, Analyzing, and Distributing Safety Data and Analysis Results for Accident Prevention. 37

4.1 Value of data in preventing accidents 37

4.2 Consistent national process for reporting lessons learned 43

4.3 Standards to ensure the accuracy and utility of data 44

4.4 Approach to analyzing data 45

4.5 Sharing of information useful for prevention 46

4.6 Developments in the gathering of marine safety data and analysis 46

4.7 How the safety data pieces fit together in a usable network 47

4.8 Who to Lead Establishment of an Effective Network? 48

5. Next Steps for the Marine Industry and Government in Developing a Valuable Shared Marine Accident Prevention Information System 50

5.1 Value of a Marine Safety Information Network 50

5.2 Challenges to a successful Network implementation 51

5.3 Options and recommendations for moving forward 52

6. Conclusions and Recommendations 53

References 56

Appendix A - U.S. Coast Guard Form 2692 Report of Marine Accident Injury or Death 59

Appendix B - National Transportation Safety Board (NTSB) Investigation Involvement Criteria 64

Table of Figures

Figure 1 The need for safety data (Hollnagel, 2001) iii

Figure 2 Voluntary safety data system operations to protect identities 27

Figure 3 Understanding accidents (Hollnagel, 2001) 38

Figure 4 Analysis via sequential accident modeling (Hollnagel, 2001) 39

Figure 5 Reason's Swiss cheese approach to understanding accident causation (Shappell and Wiegmann, 1988) 40

Figure 6 Super Sonic Transport (SST) before and after the “accident” 42

Figure 7 Pyramid of accident to unsafe event frequencies (adapted from Heinrich, 1931) 45

1. Introduction: The Need for a National Marine Safety Information Network

Risk will always be present in the world. The question is not how to eliminate marine risk but how to manage its level to be acceptable (Risk Management …, 1999, and Prince William Sound …, 1996). Various safety systems involving design, construction, and operational requirements, have been developed and put into place to insure safe operations in the marine environment. The International Safety Management (ISM) Code was developed recently when there was mounting concern about poor management standards in shipping.[1]

However, accidents can and do happen that have resulted in major human, financial and environmental losses. Useful data from these events are identified in accident reports following an investigation. The information or data collected is stored at various organizations both public and private. The problem lies in retrieving and consolidating the information so that effective analysis can be performed and the correct lessons-learned identified to enable the prevention of future accidents.

This report examines the hypothesis that there is a need for a national marine safety information network. The report provides a description of the potential structure for such a network and how it would enhance marine safety in the United States. The network envisioned would consolidate and complement rather than replace existing reporting and data collection processes.

This section will introduce the basic terminology surrounding marine accidents, introduce the many sources of accident information, and briefly describe some of the elements of data systems and accident analysis before introducing the concept of creating a national marine safety information network[2].

[1] ISM Code 2002 Edition Foreword iii.

[2] Safety data and safety information are used interchangeably to indicate the collection of safety information in either data base format or as accessible information that can be searched through to find clues and identify potential causes for accidents in the study of their prevention.

Definitions of Terms Regarding Accidents

The origin of terms and their delineations as used in accident analysis in the United States are introduced in 46CFR, Subpart 4.03 – Definitions:

A *marine casualty or accident* means:

(a) Any casualty or accident involving any vessel other than a public vessel that-

(1) Occurs upon the navigable waters of the Unite States, its territories or possessions;

(2) Involves any United States vessel wherever such casualty or accident occurs; or

(3) With respect to a foreign tank vessel operating in waters subject to the jurisdiction of the United States, including the Exclusive Economic Zone (EEZ), involves significant harm to the environment or material damage affecting the seaworthiness or efficiency of the vessel.

(b) The term "marine casualty or accident" applies to events caused by or involving a vessel and includes, but is not limited to, the following:

(1) Any fall overboard, injury, or loss of life of any person.

(2) Any occurrence involving a vessel that results in –

(i) Grounding;

(ii) Stranding;

(iii) Floundering;

(iv) Flooding;

(v) Collision;

(vi) Allision;

(vii) Explosion;

(viii) Fire;

(ix) Reduction or loss of a vessel's electrical power, propulsion, or steering capabilities;

(x) Failures or occurrences, regardless of cause, which impair any aspect of a vessel's operation, components, or cargo;

(xi) Any other circumstance that might affect or impair a vessel's seaworthiness, efficiency, or fitness for service or route; or

(xii) Any incident involving significant harm to the environment.

(3) Any occurrences of injury or loss of life to any person while diving from a vessel and using underwater breathing apparatus.

(4) Any incident described in § 4.05-1(a).

§ Under part 4.03-2, the term *serious marine incident* includes the following events involving a vessel in commercial service:

(a) Any marine casualty or accident as defined in § 4.03-1 which is required by § 4.05-1 to be reported to the Coast Guard and which results in any of the following:

(1) One or more deaths;

(2) An injury to a crewmember, passenger, or other person which requires professional medical treatment beyond first aid, and, in the case of a person employed on board a vessel in commercial service, which renders the individual unfit to perform routine vessel duties;

(3) Damage to property as defined in § 4.05-1(a)(7) of this part, in excess of $100,000;

(4) Actual or constructive total loss of any vessel subject to inspection under 46 U.S.C. 3301; or

(5) Actual or constructive total loss of any self-propelled vessel, not subject to inspection under 46 U.S.C 3301, of 100 gross tons or more.

(b) A discharge of oil of 10,000 gallons or more into the navigable waters of the United States, as defined in 33 U.S.C. 1321, whether or not resulting from a marine casualty.

(c) A discharge of a reportable quantity of a hazardous substance into the navigable waters of the United States, or a release of a reportable quantity of a hazardous substance into the environment of the United States, whether or not resulting from a marine casualty.

Variety of Sources for Marine Safety-Related Information

There are quite a number of safety data collection systems that are used to develop metrics and tools to help with studying the causes of accidents, gauging levels of safety, and identifying needed safety improvements. The results of such studies are used for a variety of purposes including sorting out priorities to be placed on researching or putting in place various countermeasures. The different types of resources are introduced in this report (see section 2 for more detail and background) along with the concept of the possibility of a central location from which to network, discover, and share such information. With improved availability and a better understanding of the relationships between the data sets, we can synergistically better utilize these resources for the purpose of prevention.

In the United States, the U.S. Coast Guard (USCG) is the major Federal Government agency responsible for maritime safety. USCG investigates occurrences and maintains numerous databases on marine accidents. It also has an extensive regulatory and enforcement program for the purpose of ensuring maritime safety and minimizing environmental pollution. The scope of their information and data collection efforts covers maritime movements in the U.S. and of U.S.-flag vessels anywhere in the world.

There are numerous other accident or incident data collection systems that exist in various organizations within Government and private industry. A key source for in-depth information on commercial transportation accidents is the National Transportation Safety Board (NTSB). NTSB is an agency that investigates transportation accidents under various mandates to determine causes. Their investigations include results from extensive information gathering and testimony from witnesses. Investigations of major accidents are reported by the NTSB for the purpose of better understanding what happened and preventing future accidents from occurring. The reports carefully study causal relationships and make recommendations on regulatory and preventative actions to be taken (for examples of the extensive investigations that are performed, see NTSB investigation reports at http://www.ntsb.gov/investigations/reports_marine.html). NTSB independently provides recommendations on what the regulating agencies such as the USCG should consider doing to reduce the probability of an accident.

While the USCG deals with vessels, the Bureau of Ocean Energy Management, Regulation, and Enforcement (BOEMRE) under the Department of the Interior similarly regulates stationary, marine based equipment such as drill rigs. The Occupational Safety and Health Administration (OSHA) is cognizant over marine landside type facilities such as terminals. The Army Corps of Engineers (USACE) handles design and maintenance of waterways

monitoring usage and developing improved systems. The Environmental Protection Agency (EPA) regulates emissions of pollutants from all sources. A number of other national and local government entities play various roles.

The U.S. Navy, the Military Sealift Command (MSC), the U.S. Maritime Administration, the National Oceanic and Atmospheric Administration (NOAA), and State maritime schools around the Nation are also integrally involved with the operation of many ships. These vessels because they are Government owned are not subject to USCG regulations. The respective organizations manage and keep track of these assets and collect useful data on reliability, safety, and maintenance. Most of these Government agencies and other aspects of Government collect data either directly from accidents or from related information that can be of direct use in the analysis of safety.

In addition to the Government sources of safety data which are generally publically available, virtually every company in the marine business keeps some sort of information on safety. Their efforts often include in-depth analyses of trends and they look for potentially hazardous situations and ways to minimize them. An accident of almost any sort creates significant expense and great risk for operators providing strong incentives for proactively preventing such events from occurring. Organizations for different sectors in the marine business and other safety-oriented entities also collect and maintain their own independent databases to watch trends and study specific issues when they come up. Marine insurance groups, for instance, maintain their own individual information systems which form the basis for their individual rate structures which are highly competitive. Industry associations also gather and maintain various data with which to gauge industry safety levels and identify and highlight safety lessons present.

Most individual companies, however, cannot share their information directly with each other or with other organizations because of the legal risk in the aftermath of an accident. Because of the large amount of presently unshared information, lowering the risk for sharing of data from privately collected safety information systems has great potential for improving the understanding of safety levels. These and many other sources of accident, incident, precursor, and voluntary safety reports make up a very large collection of data sets. The analysis of trends and estimation of probabilities of potential incidents and accidents from an appropriate aggregation of these data sets can do a lot to identify potential operational marine safety issues and prevent accidents from occurring. The potential is to identify the most critical issues to address in preventing accidents from happening before something actually occurs.

Information in addition to that related directly to the occurrences of various undesirable events is necessary as well to make sense of the accident or incident related information available. The first most common need is to measure how many events occur against a meaningful base metric. For many modes of transportation, the number of incidents per mile driven is but one example of the need to put frequency into perspective. Thus other data sets such as:

- Fleet Statistics
- Waterborne Traffic Statistics
- Official U.S. Waterborne Transportation Statistics
- Port Statistics
- Economic Analysis Information
- Other Marine Statistics

are necessary as well from which to analyze the true meaning of the numbers of accident or other event type occurrences. Do accidents occur only to certain fleets, designs, or owners? How does age of the asset affect probability of accidents? What time of day do most accidents occur? These are but a few of the many questions that can be raised to help our understanding of how to improve safety.

Highly valuable sources of information effective in prevention are also first-hand, magazine-published reports of various accident or "close call" situations written by mariners. The Mariners' Alerting and Reporting Scheme, launched in 1992 by the Nautical Institute is a highly popular, continuing series of articles. MARS, as it commonly known, is a way for mariners to share information about dangerous incidents, even if they did not actually result in serious damage or injury. In addition to useful information for the researcher, these very readable narratives go a long way toward advancing prevention. The long running MARS approach to providing this source of information is an excellent example of the value of this information and its role in prevention. ALERT!, the International Maritime Human Element Bulletin, is another product of the Nautical Institute that is another effective outreach initiative. Published periodically, the ALERT! Bulletin provides focused insights to elements of safety and prevention that are valuable contributions to the effort to prevent accidents (see Alert!, 2011). These initiatives are fueled by safety data without which they would not be very effective.

Centralized Information Network Infrastructure?

While there is a need for a centralized place where safety data can be found, a single and central source for doing all of the gathering, processing, and maintenance of the data is really not practical. Useful populated data systems depend upon reporting mechanisms, a consistent set of reporters, and regular users of the particular system's information. There is always a balance in every successful database between being all inclusive and providing a consistently and accurately populated data collection set that users will support through their continued use. Each successful data set that exists today and in the future depends upon a mission with specific characteristics. The possibility exists, however, of aggregating the best from each into a single, more comprehensive, rich, and valuable information source. Building a central place where a network of such resources can be accessed, can pose a highly useful next step and add value and insight from both the distribution of information and analysis points of view.

Validity of Safety Data

It must be recognized that every collection of data on accidents or unsafe situations has its advantages and shortcomings. Conclusions drawn from data present in any single database are limited in scope or value because of how the information is gathered and how that particular database and its procedures are structured. Data must be interpreted in the context of what its limitations are and not used to make overly broad conclusions. While accident investigations gather information with modern investigations including exploration of a number human factors issues not considered important in earlier years, publically available Government databases tend to contain only those data elements which originate from facts that can be easily verified. An investigator's tentative conclusion that human fatigue may have been a significant causal factor often may be absent from the database but may be interpreted from the information gathered during the investigation.

What is placed into a public database is generally very accurate and consistently gathered. Concluding trends in major causal factors and ferreting out meaningful information about the relative importance the many potential contributing causes (or even identifying what they are) is very tenuous without scouring through the investigatory information and second guessing what is found there. The number of ship collisions each year as reported by the USCG, for instance, makes for a very solid and accurate statistic (see the reports from the USCG as they were published annually for many years, Nagendran, 1994). However, this data is not nearly as useful for understanding what happened or for

concluding root[3] and possible contributing causes and their frequency. This is because human and other less hard or straight-forward factors are generally involved in most if not all accidents. The determination of which of these less certain elements contribute to the errors is usually quite difficult to determine with certainty. These and other more subjective conclusions as to causes are often not entered into data sets because of the difficulty of verifying such items and the need to defend conclusions generated from the information.

For serious accidents where an in-depth investigation has been performed, resultant determination of causal relationships including examination of the more subjective type of causes can be much more valuable and enlightening. Consider the detail and many contributing causes that are identified in the NTSB report on the EXXON VALDEZ grounding (Grounding…, 1989). In recent years, the knowledge of investigators regarding human factors and behavioral science has also increased significantly. As an example, full investigations now begin typically with determining what individuals were doing 72 hours prior to the accident to better understand if sleep loss or human fatigue was a potential causal element.

Unfortunately, accident investigations are traditionally focused on determining "who" is at fault. Even when criminal charges are not involved potential repercussions to individuals and organizations tend to overshadow and interfere with obtaining from those involved the complete and accurate story of what happened. Open recanting of the information needed to truly understand causal relationships is probably only possible through extensive study and use of information found in voluntary and anonymous reporting approaches such as through systems similar to the Aviation Safety Reporting System (ASRS, See Reynard, et. al., 1986 and http://asrs.arc.nasa.gov/overview/summary.html). These systems are built on assurances involving building up of trust over time that information provided will not be used against the reporting individual.

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[3] As defined in Wikipedia, a **root cause** is an initiating cause of a causal chain which leads to an outcome or effect of interest. Commonly, **root cause** is used to describe the depth in the causal chain where an intervention could reasonably be implemented to change performance and prevent an undesirable outcome. The term **root cause** has been used in professional journals as early as 1905, but the lack of a widely accepted definition after all this time indicates that there are significantly different interpretations of exactly what constitutes a root cause. The biggest differences in viewpoint is the issue of whether there is only one root cause or whether an outcome can have multiple root causes.

Information vs Database Resources

The nature of the traditional database is to collect succinct pieces of information in a table format useful for drawing trend type results or searching for meaningful combinations of occurrences from which to draw conclusions. Full in-depth investigations such as performed by the NTSB, however, offer a far more complete picture of what happened. Each accident report shows that there is never just one reason the accident occurred. Every accident is an extremely rare occurrence when compared to the number of incidents or unsafe situations that preceded or could have resulted in that accident but for some small intervention. There is the root cause (or root causes) but then there are a myriad of contributing causes that if any one of them had not happened the accident would not have taken place. Thus carefully gathering and utilizing every possible piece of information available regarding an accident and combining with information on non accidents in the best possible manner should be performed if we are truly serious about preventing unexpected bad things from happening in the future.

Concept of a National Marine Safety Information Network

A national marine safety information network is envisioned as a central place where all of the various sorts of information and data on marine safety and its analysis can be found. The network could have various useful attributes but would not involve a relocating of the data sources or involve changing how various sources perform their functions. Some of the attributes envisioned are summarized below:

- Provides a place to begin finding information useful for prevention
- Permits quickly finding access to the various sources of safety data available
- Recognizes and categorizes the different types of data and offers introductory guidance on their use
- Provides a place to post links to studies of trends and assessments of safety levels and approaches to prevention
- Provides a place to find useful data from other transportation modes or other industries where such data may be helpful to marine researchers
- Provides a place where the focus is on determining the levels of safety and assembling the requisite sets of knowledge necessary to predict the probability of future accidents occurring

- Provides a place to present approaches to combining statistically-correct data in with subjective-data indicators in a meaningful manner
- Provides an open holistic focus on preventing of accidents rather than assessing of blame

Rationale for a Centralized Marine Safety Information Network

There are a variety of reasons why such development is needed. Some of the more compelling are provided below:

- Every piece of data regarding an accident or unsafe safety situation is valuable and needs to be utilized to unlock the true causal relationships or clarify the general trends since every accident is a very rare occurrence and dependent on many barriers being overcome
- Currently, there are many different sources of safety data and no central place to find out what exists and where or how to find these sources
- Much reported research on causal relationships does not use the full depth of analysis necessary to conclude the best actions to take in the pursuit of improving safety
- Developing useful precursors and their trends depends upon carefully looking through all of the available data if trends are to be discovered to predict the future probability of accidents
- Proper research of trends and accident causation requires knowledgeable gathering, use and informed and comparative review of available information
- Information on the proper use of different types of safety data needs to be provided in a single location for effective guidance on what analysis approaches are appropriate
- A clearing house for research studies on marine safety would encourage more effective use of the available data

Without a centralized marine safety information network, the collective value of the data presently available or possibly obtainable in the future will not be apparent or utilized by those who can help prevent accidents.

2. Gathering and Using Safety Data to Prevent Marine Accidents

In response to public demand for marine safety, Governments in most countries gather marine accident data according to sets of standards. The purposes of Government data gathering and analysis are to track the frequency of accidents, classify their type, identify causal relationships and otherwise provide a basis for improving safety. The data is also relied upon to provide information useful in satisfying legal issues regarding which entities are at fault and in determining assessment of financial and corrective sanctions. Accident investigations are also performed to assess corrective and remedial action to be taken through regulatory efforts in design, construction, or operations. These purposes each have significant effects on the type and completeness of data that is able to be collected.

Private marine companies pay attention to safety and collect data for their own use in reducing risk and minimizing accident occurrence. Even minor events can be extremely expensive requiring companies to be continually attentive to improving safety. The incentives for minimizing the risk of an accident and its impact are very high but stiff competition does limit what is possible with the necessity to remain profitable.

Public alarm on the occurrence of a severe accident remains the greatest driver for major corrective regulatory action within an industry segment. Without significant public concern, improvements are difficult to bring about by the regulatory agencies charged with ensuring safety. This is because of the difficulty of proving the need for change and guaranteeing the effectiveness of the actions proposed.

This section of the report reviews various sources and developments in the gathering and use of safety data for accident prevention in the U.S. and in the international maritime industry. Also noted are pertinent developments in other transportation or synergistically-related industrial areas where sensitive data is shared and analyzed for prevention of accidents.

Historical Gathering and Use of Marine Safety Data

As introduced earlier, data on accidents have been collected by a variety of sources both public and private for various purposes. In connection with satisfying needs for determining causal relationships surrounding an accident situation, the data is also utilized to determine trends and needs for improvements to levels of safety through regulatory or other means.

Government is the primary source for available information on accidents. The public looks to Government to keep safety at an acceptable level. Private marine companies, as well, collect data on accidents, hazards, and unsafe situations. Rarely, however, can these sets of data be shared openly because of liability risk. Insurance companies also collect information on safety and accident frequency. They use the data to estimate risk in determining premium levels to charge. Most private data collection entities consider their data highly proprietary and rarely allow others to utilize their information.

In the United States, the USCG holds the primary responsibility for regulating maritime safety while the Occupational Safety and Health Administration (OSHA) covers the shore side portions of the maritime industry. The Department of Interior's Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE), is the federal agency responsible for overseeing the safe and environmentally responsible development of energy and mineral resources on the Outer Continental Shelf. BOEMRE handles stationary and floating marine platforms. The National Oceanic and Atmospheric Administration (NOAA) is involved with oil spill response and provides environmental information and information useful for safe navigation. NOAA also has other roles regarding safety of operations. They operate a fleet of ships that research information on the oceans, waves, currents, wind, and other areas. They gather and organize a host of navigational and other information useful for vessel operations and in performing studies of risk. Information on weather, waves, and other environmental situations are useful in understanding and preventing accidents. All of these organizations and a number of others collect data on accidents or on other attributes useful in the analysis of accident frequency or for predicting risk situations for the purpose of prevention.

Some of the primary entities gathering and utilizing marine data useful for safety analysis are summarized in the following bullets:

- Information on accidents required by the Government on maritime accident occurrences are collected by the USCG and placed into a database
- USCG investigations are carried out on more serious accidents to monitor the reporting process and gain understanding of causation
- Extensive investigations are performed by the NTSB when the seriousness of an accident exceeds certain defined thresholds
- Companies record injuries to workers and lost work time in the monitoring and management of safety incentive programs

- Hazardous occurrences on vessels in a company's fleet are recorded within tracking systems and analysis of the data performed as required of owners according to the International Safety Management (ISM) Code requirements

- Most of the data collected consists of verifiable facts on the safety situation identified and lacks further complementary pieces of information that could help provide a better understanding of root and contributing causes (this is because of the difficulty and/or expense of rationalizing and defending the value of data that is not easily verifiable in court)

Latest Developments in the Gathering and Use of Safety Data (Marine and other Industries)

Latest developments in the gathering and use of safety information in marine and other modes of transportation over the last decade and a half include the continuing and growing recognition that human factors are a major part of most accidents. A better understanding is also building on how to effectively apply behavioral science and practical analysis techniques to better study and understand these types of causes:

- While in the past, data gathering and investigations focused on assessing blame, investigations in a growing number of industries are now sensitive to identifying the various human factors causal issues that are present recognizing that human error is a natural characteristic that must be designed around

- NTSB marine investigations now look carefully to identify sleep patterns and presence of human fatigue through interviews of personnel (discussion of what the individual did 72 hours before the accident have been standard practice for about a decade now, as an example)

- Because of the potential for catastrophic or human losses that would cripple the industry (aviation crashes have a very large effect on the willingness of the public to fly), aviation, chemical, and other high profile industries have for some time now focused heavily on prevention vs. the traditional approach of waiting for accidents to occur before identifying and acting on safety issues

- Incident or precursor data is being collected in some modes of transportation on a more frequent basis to identify trends and eliminate causes before accidents occur (such data as numbers of airline runway deviations or economic health of companies, for instance, are being used proactively to predict the potential for accidents)

- Collection and analysis of hazard data as required by the maritime ISM code requirements has moved industry focus toward prevention and facilitated individual company proactive review of trends on levels of safety

- Research on transportation systems is being performed to identify and improve collection of reputable accident indicators and precursor information to better identify safety trends and learn how best to apply preventative measures prior to accidents occurring

- Volunteer safety reporting systems have been set up in a growing variety of industries with recognition that they are effective in prevention (these systems follow the lead of the long standing Aviation Safety Reporting System or ASRS which has now been in place for 35 years and has well proven its value in prevention)

2.1 Sources for maritime operational safety data

As the part of the U.S. Federal Government responsible for maritime safety and environmental pollution, USCG investigates casualties and records accident data on all ships in U.S. waters and on all ships sailing under the U.S. flag wherever the accident occurs. In addition to its regulatory functions, the 1973 Ports and Waterways Act also provides the USCG with very broad responsibility for implementing regulatory, enforcement, and proactive means to ensure safety and minimal environmental pollution in U.S. waterways.

An independent entity of the Federal Government, NTSB becomes involved when certain thresholds of impact are exceeded in an accident. NTSB must then perform a thorough, in-depth investigation with the resulting report overseen by a formal board and published. USCG and NTSB data and reports are publically available for all to examine and use.

Another source of safety data is the American Bureau of Shipping (ABS). ABS is one of the major classification societies in the world that classes ships. ABS serves a role that is complementary to that of the USCG by providing classification rules that go beyond minimal safety issues. Ships to be classed by ABS must meet various requirements. ABS and other Class Societies have a number of classifications both general and specific that owners can select to be applied when their ships are designed, built, and maintained. Most well known are the basic rules regarding structural scantlings or requirements for the thickness of plating and structural strength of the completed vessel. Ship owners looking

for insurance must get their ships “classed” (as well as making the design and operational aspects meet the USCG minimum standards) prior to insurance being available from the insurance syndicates.

Since it’s founding, ABS also been concerned with the operational side of the ships and provided standards for crewing in its early years. ABS was one of the leaders looking into the various aspects of human factors on safety of ship operations. ABS has spent considerable effort in gathering information on ergonomics useful in the design of ships from the human-centered point of view. An extensive set of guides on human factors has been developed and some classifications formalized to which a ship can be designed to meet and qualify for the classification (Card, et. al., 2005; ABS, 2001).

Other innovations in the human side of operations have also been developed by ABS. One innovation and source of safety data is called the “Mariner Personnel Safety Project”. This ABS sponsored effort was initiated with the National Safety Council (NSC) Marine Division, another safety-focused organization. The project involves work with Lamar University in the development of a database to analyze maritime near misses and incidents with a focus on lost time and personnel injuries. The database now exceeds 35,000 incidents. One of the longer term visions of this project is to eventually establish a “similar” Maritime Safety Research Center. Such initiatives offer examples of opportunities to bring together various groups and individual companies into cooperative efforts to accelerate the collection of safety data that would be useful in prevention. Standards, classifications, and guides have been pioneered by other class societies around the world as well. Class Societies are thus a source of safety data that can be utilized in various fashions in the pursuit of prevention.

The activities of the NSC and other safety-related organizations not primarily working in industries related to maritime do produce data and lessons learned in safety that can be very useful for prevention in the marine industry. The basics of safety transcend the limits of various industries. Consider the key elements of safety presented in priority order concluded by a marine-focused group studying other industries' lists of necessary elements (Landsburg, et. al., 2007 and Landsburg, 2008):

1. Management and Organizational Commitment
2. User/Stakeholder Involvement
3. Education and Awareness of All
4. Human Systems Integration (HSI) Process Ownership
5. Holistic, Enabled View

6. Funding Support
7. Documented and Technically Sound
8. Qualified Personnel
9. Open Collaborative Environment
10. Practical Applications Based on Sound Human Factors Research

These elements relate strongly to human and organizational factors which often are the root or among the several major contributing causes of most accidents. Ideally, information gathered from accidents can shed some light on these elements and infer some level of causal relationship.

Data on accidents is also gathered by individual insurance companies and syndicates. The insurance companies offer financial protection for ship operating companies and base their premiums on safety expectations of the ships they insure. Examples of these organizations include Lloyds of London, the UK P&I (Protection & Indemnity) Clubs and others. Much of the information they collect is not publically available as they consider it very proprietary. They do publish papers from time to time describing safety levels. The marine insurance industry is somewhat unique with the development of "Classification Societies" whose vessel design, construction, and operational rules must be met before insurance companies will grant insurance. These rules are essentially additional standards over and above those imposed by the Governmental agencies for the purposes of safety. The American Bureau of Shipping (ABS) is the major Classification Society for ships flying the U.S. flag but also classifies vessels for many other fleets worldwide. ABS is involved with studying and setting construction standards and checking vessels as they age to ensure standards are being maintained. ABS and USCG also work together with the USCG subcontracting the performance of certain inspection responsibilities to ABS. ABS is active and works closely with other Classification Societies around the world in researching and setting standards. The class societies also develop guides that are based on research that they publish to assist the industry in the pursuit of safe practices.

USCG and ABS are active with similar entities from other countries through the International Maritime Organization (IMO). IMO is the part of the United Nations responsible for setting of safety standards for shipping worldwide. IMO requirements and enforcement arrangements are implemented by National Governments with basic requirements binding on most of the countries of the world. Data on accidents and research studies are shared at IMO along with methodologies for investigation and sharing of such information.

A significant advancement in safety has occurred on the international front with relatively recent developments at IMO and through the International Standards Organization (ISO) as well. Worldwide, companies have moved to the ISO 9000 standards approach and verification that those standards subscribed to are being followed. ISO 9000 does not address safety specifically, but assists in ensuring an overall quality of operations. ISO 9000 certified companies formally set up their operational processes and an independent group then periodically assesses them to verify that their processes are being followed. Many of the companies in the world will not do business with another company now unless they follow ISO 9000.

Operational requirements were also significantly raised when IMO adopted the International Safety Management Code (ISM) in 1994. While the standards being followed under ISO 9000 are self selected, ISM sets uniform mandatory minimum safety standards to be followed and requires compliance to be verified in a process similar to the ISO verification process. Among the important aspects of this development regarding collection of safety data is the requirement that each ship owner collect data on hazardous situations on their vessels and analyze trends to prevent accidents and improve safety. This mandated collection of hazards by ship owners has resulted in the collection of an important and sizable amount of safety data. This data exists, is being used by the individual companies, but is not shared publically or among ship owners because of legal issues.

As mentioned earlier, USCG is the Government agency responsible for safety and environmental regulation of maritime activities taking place on the water. The occupational Safety and Health Administration (OSHA) is the Government regulatory agency that covers maritime activities taking place on the land. Shipbuilding and long shoring activities, for instance, are governed by OSHA regulations. The Center for Disease Control (CDC) is another Government organization that studies causes of injury and death including those in the marine industries. The Bureau of Labor Statistics (BLS) is the Governmental organization that keeps data on personnel including numbers of those in different job categories, including age groups, education level, injury rates for different jobs, lost time from injury, and deaths. These and many other data elements are critically useful when performing an analysis of causes and trends in safety, i.e., when building an understanding of safety levels and a reasoned approach to prevention.

The above described sources of marine data for safety analysis are only a brief overview of the resources. There are many data sets in Government, private industry, and in various independent organizations that are useful and necessary in measuring accident or unsafe

situation frequencies and in determining the levels of safety present. Some of the resources are listed here to provide examples of the many data collections that exist that are directly useful for analysis of the levels of safety:

- USCG Boating Accident Report Database (BARD)
- USCG Casualty Reporting System
- USCG Search and Rescue Management Information System (SARMIS)
- USCG Marine Casualty and Pollution Database
- USCG Marine Safety Information System (MSIS)
- USCG Marine Safety Management System (MSMS)
- USCG Marine Information for Safety and Law Enforcement (MISLE)
- USCG Casualty Maintenance (CASMAIN) system database of accidents containing seven data entry slots present for indicating the root and contributing causes of an accident
- Records from alternate approaches of safety regulation of USCG, OSHA and others that move more of the responsibility for safety into the hands of companies with good safety records
- The American Waterways Operators (AWO) and other voluntary safety programs by industry associations or individual companies
- The United Kingdom Marine Accident Investigation Branch (UK MAIB) accident database and similar data collections resident other countries
- International Regulators Forum (IRF) incident data collected from member organizations in the oil and gas industry with a goal of measuring and comparing offshore safety performance on a common set of criteria
- International Association of Drilling Contractors (IADC) Incident Statistics Program collecting and tracking safety and accident information for the drilling industry to identify causes and trends of drilling industry injuries with quarterly reports published providing a Summary of Occupational Incidents

- International Association of Oil & Gas Producers (OGP) annual report reporting data and trends on the number of fatalities, number of injuries, and total hours worked for onshore and offshore operations for member companies

- Det Norske Veritas (DNV) history on accident data collected from the offshore industry since 1975 in its Worldwide Offshore Accident databank (WOAD)

- The Norwegian SINTEF Group Independent Research Organization comprehensive event database of blowout risk assessment containing 51 different fields of description of each blowout/well release

- Maritime statistics relating to numbers of ships, waterborne traffic statistics, port and waterway information, company ownership and fleet statistics

- Economic health of companies

- EU Major Accident Reporting System (MARS) collects data on major industrial accidents for recording, analyzing and acting upon lessons learned from accidents and near misses (includes not only chemical processing, but also aviation and the nuclear industry).

- UK Confidential Reporting Program for Aviation and Marine (CHIRP) collection of voluntary reports of unsafe situations

- International Maritime Organization (IMO) statistics on frequency and location of marine piracy activities

- Magazines – Professional Mariner and other magazines feature first hand "stories" from mariners or by experts describing the key elements of accidents or close calls (These provide valuable insight as to the various operational aspects of an accident or unsafe situation, etc.).

Analysis of marine data to study safety trends and analyze impacts and prevention approaches benefits as well from examining similar data and trends in other industries.

2.2 Lessons from others on safety data programs

There is much to be learned from safety data and analysis that has been performed in many other industries. The airline industry's movement of passengers has been particularly focused on providing the highest levels of safety in order to ensure a travelling public. Aviation must be preventative as waiting for accident data to find unsafe situations can easily result in the industry having no business because risk avoidance is a major

element of individual traveler thinking. Many innovative and well-thought-through studies have been developed for the airline industry in pursuit of unearthing unsafe practices and preventing accidents from happening. Aviation safety initiatives provide the maritime industry with many approaches to apply to help improve accident prevention.

Much of the marine industry is freight oriented and very competitive. Margins of profit are very small and the competition is fierce. Exploring the utility of expensive new safety approaches is thus prohibitive for individual companies. Safety is largely based on meeting minimum Government requirements which define the competitive playing field and then at limited cost carefully applying successful safety approaches to minimize risk. In many marine markets, companies must believe very strongly in benefits before initiating significant improvements over what competitors are doing or risk rapid economic failure.

Similar economic issues are at the forefront in some sectors of the aviation industry, as well. While major airlines have become extremely safe (orders of magnitude safer per mile of travel over the automobile), the segment of the industry using smaller planes operates at far lower safety levels then their larger brothers and sisters.

The marine industry in recent years has been researching ways to increase safety in operations with many successes. Much of the research and safety initiatives originated have come from innovation and experiences from other modes of transportation. Aviation has provided lessons for all modes of transportation. Recent research and implementation in approaches to improving safety in the rail industry are proving out to be practical and effective. Rail is mostly freight oriented as maritime and their advances provide excellent evidence of the potential value for the marine industries. Safety approaches in the chemical industries also provide areas to explore in developing initiatives for improving safety.

Further description of advancements in safety data development and use in other industries is provided in Section 3.3 where some major programs to capture non-accident data are outlined. A number of different modes of transportation and other industries have recognized that much more information is needed for accident prevention then simply the collection of data surrounding accidents. The lessons described relate to how best to enable the collection and use of such data.

2.3 Types of safety data and their utility

Information collected by various resources can be categorized in a number of different ways. The basic types of data can be looked at perhaps best as three basic types with further delineation from there:

- Accidents – Information where something serious has actually happened
- Incidents – Occurrences where something happens that is not according to what should occur
- Unsafe Situations – Non-occurrences that could have resulted in an incident or accident

Accidents are generally required to be reported (46 CFR4.05-1 specifying reporting requirements to the USCG is provided in Appendix A) while incidents may or may not be required to be reported. Incidents for data collection can also be predefined situations that are thought to be predictors of accidents. Collection of how often these incidents (deviations from normal operations) occur then provides a gage of safety levels. Airplane runway deviations while on the ground in airports, for an example, are one area where such data collection takes place. The desire is to identify why regular procedures are not followed and analyze how corrections might be made to improve safety and whether such deviations are precursors to the occurrences of accidents. Incidents can also be what are commonly called near misses or close calls. The fact that occurrences of these widely-recognized major incidents (which could have resulted in extremely serious accidents with significant consequences but for some small corrective occurrence) are not recorded in any of the major accident databases used to determine levels of safety or need for implementation of preventative measures should alarm all of us!

Collection of data on unsafe situations is very important - either major occurrences or minor ones. Unsafe situation data consists of information on various items (equipment, situations, practices, etc.) that are considered unsafe even though nothing has happened. Questioning of witnesses during accident investigations often result in those being interviewed indicating that they knew something was bound to happen because of some situation that they had previously noticed and considered unsafe. One example of data collections of this type are the previously noted shipboard reporting and analysis of hazardous situations required by the ISM code. The premier example of the collection of unsafe situations is the Aviation Safety Reporting System (ASRS) which has been in operation for more than 35 years. ASRS collects some 30,000 reports of unsafe situations each year and reports the data in a public database that is used to identify problems.

How the different types of information are gathered also affects their content and utility. Accident data is collected primarily for the purpose of determining the primary causes of accidents. The data is extensively used to assess who is to blame and to determine the resulting compensation for the damages that the accident caused. This purpose tends to color what information is collected and its completeness. Incident data can be similarly limited in its content because of the reasons for and methods of its collection. The ASRS model for collecting data on unsafe situations on the other hand can evoke a very honest and forthcoming response from those who caused or were witness to what happened. This is because the identity of the individuals reporting is not known and trust in the proper use of the data and its positive effect on prevention has been built up over time. Similarly, the extensive interviewing of witnesses during accident investigations by the NTSB tends to be more forthcoming because of trust in how the information will be used and the recognition that what is said is used to prevent accidents and has protections from use as testimony in court. Quality and utility of information gathered can vary widely based on what the primary use of the data is for. The motivations of those who are collecting the data and turning it into information also matter along with the care and consistency of the methods and processes of recording.

Over the years, different types of data have been found useful in researching how better to prevent accidents from happening. While the many facets of information from accidents are not always gathered or the data available, collected data can be better employed for prevention if used in conjunction with other information. A better understanding of the potential for accidents is needed to result in better designed prevention programs that can have improved effectiveness.

The generalized description of each of these information categories is not always totally accurate as each data collection process within a category can involve different mechanisms that can significantly affect the character and value of the data collected. The following paragraphs provide some further description of limiting considerations by data category.

Accident Data

Generally speaking maritime accident and incident data is collected by Government agencies responsible for safety and accident prevention. The resulting databases and derived probability or trend information are generally available to the public. Such data collection tends to eliminate data elements where the accuracy of the data cannot be easily validated. However, many of these same data elements may be key indicators of cause or contributing factors. The suspected influence of fatigue in the cause of an accident is an example of such data.

The major maritime accident database in the United States is maintained by the U.S. Coast Guard. Ship operators are required by law to report accidents to the USCG using the form USCG Form 2692 (See Appendix A). U.S. Coast Guard personnel investigate many of these accidents, most of which are minor in nature. Form 2692 is thus the primary report shaping the collection of accident data from ships in U.S. waters and for U.S. ships involved in accidents abroad.

When certain set levels of injury or damage are exceeded, the National Transportation Safety Board (NTSB) becomes involved with the investigation. The NTSB uses U.S. Coast Guard investigation and other resources in conducting their investigations which involve a more detailed analysis of causes. NTSB investigation reports are public and involve taking significant witness testimony. Investigation findings are not admissible in court. This later feature assists with the identification of actual causes since people tend to be less guarded in their responses to questioning. While the general purpose of both USCG and NTSB accident information collection and analysis is to understand causative factors for accident prevention, a large aspect of the USCG data gathering efforts is to determine responsible parties. As a result, the ability to correctly identify all of the actual root or contributing causes involved is often limited unless the severity of the accident brings in the NTSB and their methodology into the investigation.

Incident Data

Public incident data collection is not yet prevalent in the maritime industry. In aviation, the collection of data on the occurrence frequency of particular incidents (such as excursions off the runway) has been used successfully to identify poor safety situations. Operating companies have historically studied incidents internally with an attempt to determine and reduce risk. Many have long had robust safety reporting processes for their fleets but the data is not shared publicly. With the implementation of the ISM Code as noted earlier, all vessel owners are now required to collect information on hazardous situations. These sets of information represent a wealth of information for accident prevention and are described in more detail in the following paragraph.

ISM Hazardous Data Collection

The International Safety Management (ISM) Code provides an international standard for the safe management and operation of ships and for pollution prevention. One of the ISM's 16 elements requires each shipping company to gather reports and analyses of non-conformities, accidents, and hazardous occurrences. Each company must have a safety management system in place that includes procedures ensuring that non-conformities, accidents and hazardous situations are reported to the company and investigated and

analyzed with the objective of improving safety and pollution prevention. The company must also have established procedures for the implementation of corrective action. The value of such data collection is of particular utility for prevention purposes even though their reports which come from company employees would tend not to include individual errors because of the individual's desire to avoid retribution. Because of legal issues, however, the wealth of information in ISM data collections is not shared between companies or with the U.S. Coast Guard[4] or other organizations that have responsibilities or develop rules on maritime safety. Experiences in aviation have shown over and again that unsafe situations discovered within one company and socialized there have prevented accidents for the company but that other airline companies unfortunately end up encountering these accidents because the identified unsafe situations were not likewise shared with others.

Precursor Data

Experience with precursor database systems are a relatively newer development in the maritime industry. A number of companies and the American Bureau of Shipping (ABS) have been working together to identify and monitor general metrics that have been identified and recognized as precursors to potential accidents (Grabowski, et. al, 2007). Different sets of precursor metrics are being developed for different sectors of the maritime industry. As an example from aviation, consider that some safety investigators studying the industry have used the financial health of a company as one of a series of indicators of the probability of unsafe operations. While this example may be considered rather crude, it does explain how this type of metric can be effective as precursor indicators. Precursor information is being utilized in recent maritime prevention endeavors with much to be learned about how best to determine the value of such metrics in developing valid predictions of the likelihood that an accident is about to occur (see Phimister, et. al., 2004).

Voluntary Safety Data

Voluntary safety reporting systems have been found to be very useful in identifying issues that need to be solved to improve safety levels and prevent accidents. When individuals are confident that their observations will be valued and their reports will not be used against them, they often contribute highly useful information. Such information combined with that from other sources can provide a high level of confidence in such observations.

[4] While USCG may be able to acquire this information from the ship owners, doing so on a routine basis would affect the candid reporting of issues defeating the purpose and the information would probably not be protected from public access.

The Aviation Safety Reporting System (ASRS) has 35 years of successful operations and has spawned similar efforts around the world in aviation and in other industries (Reynard, et. al., 1986). Their type of volunteer safety data system is unique because the volunteers are not anonymous permitting call-backs to verify the reported information with later preservation of confidentiality through destruction of the information on the reporter. The process also has the single-minded objective of fixing systems to prevent accidents rather than having any focus on the assignment of blame to an individual or group. The assumption that fear of retribution is a sufficient incentive to prevent future accidents is just incorrect. Humans are highly capable machines but they do take risks and make mistakes. Just as in the case of every other component, a system must be designed around known issues to minimize error.

Currently, there are a few fledgling voluntary safety reporting systems present in the maritime industry. Design of an International Maritime Information Safety System (IMISS) was performed by the U.S. marine industry with USCG and Maritime Administration facilitation in 1997-1999 (Kratz, et. al., 1999). The plans included developing an accident causation-based human factors taxonomy for reporting and classifying human error situations (Landsburg, et. al. 1999). The UK-based Chirp safety data volunteer system has since added marine reporting to its successful volunteer safety reporting aviation system (http://www.chirp.co.uk/). It is in this area that useful information sources need to be developed to assist with research and setting up of effective prevention strategies (see Safety Data Action Plan, 2002) for Department of Transportation study efforts on the desirability of expanding the collection of "near miss" data to all modes of transportation). Information from voluntary safety reporting systems has been proven highly useful in identifying and predicting potential accident causes.

2.4 Legal protections regarding data/information

There are a number of important aspects in protecting against repercussions from reporting of safety information or in the use of such information or data trends indicated by the various different safety data collection systems. The various types of protections can perhaps be classified into the following categories:

- Confidentiality Protection – Protection from release of the identity of the reporter of the information and protection of the identity of those individuals mentioned in the report to protect them from possible recriminations.

- Company Identity Protection – Protection from release of the identity of the particular companies mentioned or alluded to in the report.

- Material Discovery in Civil or Administrative Actions – Protection from the gathered or reported materials/information being legally discoverable in a civil or administrative action.

- Third-Party Legal Protection – Protection from the use of specific or industry-practice information coming out of a safety data system from use in court cases involving litigation affecting individuals or companies.

Individual identity protection is necessary in order to enable volunteered, non-required reporting of useful, in-depth information by individuals. There is always some sort of repercussion or consequence possible if the reporting of an individual's identity is made known through either public disclosure or through leaks from the system. Without such protection, the incentives for providing reports will not overcome the perception of risk that is present. Confidentiality protections can normally be provided through careful design and implementation of the system. Figure 1 illustrates how data gathering and processing can be separated into functions and provide this kind of protection (Kratz, et. al., 1999). Early functions on the reporting and gathering side can result in a de-identified set of data being entered into the database after which all original data can be destroyed.

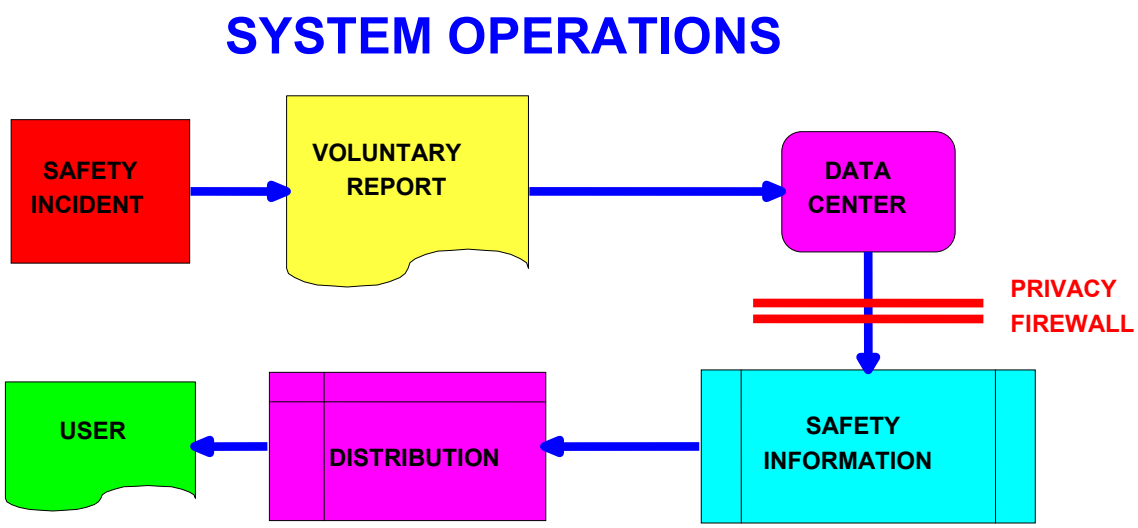

Figure 2 Voluntary safety data system operations to protect identities

The de-identification process must scrub the data adequately to eliminate those issues such as confidentiality from being present in the database. Items must be removed where there is the opportunity to identify individuals or companies involved. Some of the items usually eliminated include the following although there are many indirect pieces of information that may need to be removed or adjusted to be more generic:

- The person(s) who filed the report
- Employees referred to in the report
- The location of the event
- The carrier involved

In addition to the separation of processing efforts, there are a number of other approaches for assuring confidentiality for individuals that can be engaged. Some of these include setting up memorandums with companies or Government Agencies that agree to not using the data if obtained. Rules and sanctions can be customized to specifically exclude those individuals so identified. Systems developed to date do not try to offer these types of protections, however, if criminal activities are involved.

There are also some legal protections that can be offered to help insure confidentiality such as the provisions of the Confidential Information Protection and Statistical Efficiency Act (CIPSEA) of 2002. Under CIPSEA, the Bureau of Transportation Statistics (BTS) and other Federal statistical agencies, have the authority to protect employee identification through direct or indirect means at any time data collection is used for statistical purposes. These provisions include significant penalties for those who are involved with divulging confidentiality information.

Material discovery protection can be covered through designing the information gathering process to minimize the time the actual original material is available. Once the report of data entry is generated from analysis of the data the original information can be destroyed.

Third party legal protection is perhaps the most difficult protection to put in place with a high degree of certainty present. On the positive side, a good degree of protection is inherently present in such systems using volunteered data. This protection is based on the fact that unless the data collection is done in a statistically correct manner, conclusions from the data cannot be claimed to be the result of a properly analyzed unbiased set of data. Research results from data offered by volunteers is hardly a scientifically developed effort involving random, carefully-balanced selection of sources, i.e., all reports came from self-selected individuals. Thus, if analyses from a safety data system infers that a number of unsafe situations of a similar type exist, there is really no statistical inference that this is any more probable than not because the data is based on volunteered information rather than upon a rationalized random sampling. This argument while it can be strongly argued in court and offers protections for use in the laying of blame, does not belie the practical use of this information for prevention purposes - only the statistical correctness of the resulting inferences from the information.

Third party legal protection has been provided in at least one situation, however, and this level of protection may be necessary for some segments of the maritime industry to be comfortable legally in sharing information. The U.S. Veterans Administration (VA) in the collection of reports of medical errors obtained legal protections through legislation and has a highly valuable and effective safety data system in place (Kohn, et. al., 2000; Henriksen, et. al., 2005; and Phillips, et. al., 2005). Such legislation is very difficult to obtain, however.

In the case of accident data and the databases that are created to hold the subset of data that is thought to be able to indicate trends, there are both public (usually federal or state Government generated) and private data types. Most Government gathered data is made available via web-enabled databases these days and is publicly available. Other information and data collected but not contained in the databases can also be obtained from the agencies. The data is either freely offered by the agency in the interest of prevention or made available through the Freedom of Information laws which involves a fee to cover the expense of recovery.

3. Current possibilities for Legal Protection from Discovery and Third Party Litigation.

There is recognition by many in the United States and around the world that more information than the publicly available data collected by Governmental entities after an accident is needed to properly identify potential levels of risk and guide the design of effective accident prevention approaches. Historic company safety data gathering and the mandatory data collection requirements of the ISM have already created highly useful data and analysis resources on hazardous and unsafe situations for shipping fleets in international trade. As noted earlier, sharing of these data between companies or with the public are currently not possible because of the lack of protection from discovery and the possible subsequent use of the data in court against the company.

Such lack of protection similarly restricts the ability to develop robust voluntary safety reporting systems. These systems have great future potential for providing the information that would be really helpful in preventing accidents in the marine industry. While the ISM and company data is highly valuable, the ability to share it and enabling development of popular voluntary safety reporting systems for the marine industry have the potential to provide extremely valuable data that when combined with the accident data available is a high priority for effective prevention.

3.1 Constraints in the collection of data

As outlined in earlier sections, there are many constraints present in the collection of safety data. Most of these are dependent upon how the information will be used or the individual's or company's perceptions of how it will be used. The quality, completeness and utility of the information is also very dependent on the particular constraints present. If the Government is collecting the data for public purposes, there is general reluctance to include any insights of a subjective nature that have the possibility of not being able to be easily verified. This is true particularly if individuals reporting the information must testify in court (often a Government employee). Any subjective information brought up there will be easily rejected. Thus for publicly collected data where extensive investigation is not performed, there will not be the depth or quality of information available to be able to truly research and understand the root and the many contributing causes of the accident.

Another consideration regarding data collected by the U.S. Federal Government and governments of States or other countries is that information is generally obtainable either via publicly maintained databases, reports, or via other published materials. In the case of Government-obtained information that is not easily obtainable from those collecting it, there is (at least in the U.S.) the Freedom of Information Act (FOIA) that compels

Government agencies to provide the information. There can be costs for these services, but they are usually modest and only designed to cover the cost of retrieval. Under FOIA, however, information that is considered company proprietary sensitive has a right to privacy and may not be recovered from Government sources. Voluntary safety data systems on the other hand usually design around these access issues by de-identifying the data and destroying the original information so that the source data is easily distributable.

3.2 Barriers to sharing of collected data

Some private companies such as insurance companies have proprietary concerns about sharing collected safety data. Most companies, however, have much to gain from the sharing of safety-related information and would like to share their data with others to increase and improve the learnable lessons from everyone's data. The primary barrier to the sharing of data is that it is nearly impossible to bypass the liability risk. In other industries, there is similar concern for liability as the exposure of many companies to such risk is high. The potential risk in the maritime industry, however, is perceived by most legal counsel to be far higher than in most other industries because if an oil spill is present, the potential level of financial risk becomes extremely high.

At odds with providing legal protections that could support sharing is the legal system in the U.S. starting with the Department of Justice. In looking to provide protections for the IMISS system of voluntary safety reporting, implementing three seemingly innocuous requirements were discussed among various legal advisors:

(1) No IMISS material may be used or discovered in a civil or administrative action
(2) No IMISS material may be used to establish an industry custom or practice or prior knowledge for purposes of establishing negligence in a civil case
(3) IMISS material will be de-identified (redacted) to remove any identifiable entity

The specific wording developed to provide the basic protections listed above were edited several times and discussed with various legal entities. It would appear that nothing suggested would be found acceptable. The bottom line is that after any editing of text, there still remains a strong basic reluctance to offer any limited protections because of the problem that something not apparent could be brought up in court and the resulting findings would open up much more protection than intended. The fear on the Department of Justice side is that the result would be a loophole that could make it impossible or very difficult to successfully prosecute wrong doers.

Most Government-gathered data and information are fully usable in court to establish fact and causal relationships. Data and investigation materials gathered under the authority of

the National Transportation Safety Board (NTSB), however, enjoy special protections and may not be used in court. Investigators at the NTSB will argue strongly as to the worth of such protections. In interviewing of those after accidents, witnesses are open and NTSB is able to get a very full and complete story which leads to developing a good understanding of the true causes of the accident.

The legislative protections obtained by the VA which are the only legislative protections known to date, were essentially obtained without being reviewed by the Department of Justice (they were hidden in a piece of unrelated legislation) and clearly do not have the concurrence of the Department of Justice.

3.3 Lessons learned from protections for other safety data systems

There are many lessons to be learned from the implementation of other safety data systems. The levels of protection necessary to enable the development of a useful voluntary data collection system are of particular interest. Implementation and protections offered by the ASRS, VA, and rail systems are outlined here.

ASRS - The ASRS pioneered the use of voluntary safety data for prevention of aviation accidents. The proven value and experience of the ASRS has resulted in the creation of numerous similar systems around the world and in other industries. Such systems offer the potential to obtain truly useful safety data that can be predictive of serious risks requiring attention prior to accidents actually occurring. As discussed in earlier sections, for such systems to be effective, there must be trust that the data provided will not be used in a manner that will adversely affect the reporter, the individual company, or the industry involved.

The level of protection necessary to enable the kind of data collection and utility needed is different for each industry or sector of an industry. The ASRS has put into place legislative protections and restrictions that prevent certain uses of the data by the aviation regulatory agency, the Federal Aviation Administration (FAA). In addition, the National Aeronautics and Space Administration (NASA) administers the ASRS program to provide an additional independence from FAA that encourages trust in how the data will be utilized. The methodology for data collection and handling of information entry into the publicly available database is also designed to provide obvious protections for the reporter from identification yet permit checking the authenticity of the information. Protection from legal discovery is also provided through the destroying of the original report and records of its provider. De-identification of the reported situations is also performed in a careful manner to eliminate the ability of identifying the particular situation or associating causes with particular entities. Even after all of the protections that were set in place for the ASRS

system, it still took about five years with a lot of encouragement by Government, companies, and labor unions for sufficient trust to be built up for the number of reports to grow to a useful level (Reynard, et. al., 1986).

One protection that has not been provided for ASRS is the protection from third-party litigation. This is the situation where resultant reports from the data collection system indicate certain industry practices exist that are unsafe. A company is then sued after encountering the situation based on the argument that it should have known because of the reports that the unsafe situation existed. Generally these types of legal suits can be defeated in court because the data present in the collection system is voluntary in nature, i.e., the data is not accurate statistically because a balanced, unbiased sample data set was not used. For marine applications, the risk of not dismissing the case in court is also apparently much higher than for most other industries because of the lack of effective limitations on the compensation levels for resultant damages.

It is noteworthy that the UK CHIRP system is a variation on the ASRS model and has been very active in voluntary aviation reporting in the UK. Relatively recent, CHIRP was extended to include collection of reports from the marine industry and is on its way to building a useful maritime system of voluntary safety reporting. There are differences in the particular mechanism and protections offered based on the infrastructure in the UK differing from that in the U.S. beginning with the setting up of the system as a charitable trust but the proven value of the data is very similar.

FRA Confidential Close Call Reporting System - The Federal Rail Administration (FRA) has been working with the rail industry and labor to research the design and implementation of a voluntary safety reporting system (see FRA RR08-33 for a description of the project). Their system began with one railroad in 2007. It has been well received and other railroads have joined the demonstration effort with the system now involving four yards. Their innovative approach involves a continuous improvement, root-cause process using joint labor/management Peer Review Teams to review the information coming from the system. The Bureau of Transportation Statistics (BTS) was engaged to run the system because they have the statutory authority under CIPSEA legislation to protect the confidentiality of the data. Specific third party protections, however, are not provided.

Veterans Administration Voluntary Reporting System - The success of the Veterans Administration (VA) Voluntary Reporting System are well known in the medical community and recognized by many. As experienced with other such voluntary data systems, the reality of many reports received is that much of the information reported of high value is information that would not have been anticipated or considered important to collect or been possible to collect if using mandatory collection requirements! One anecdotal

example for instance is that right after 9/11, reports started coming in from stewardesses and stewards was that they were often being selected for random searches. The rationale by the security staff was apparently the fact that these people travel very light and are easy to check. This seeking of a lightened work day might be expected but not right after 9/11 when you would expect that everyone would want to do their utmost to ensure security? Information that is offered by individuals for the right reasons has the strong potential to prevent accidents before they ever happen partly because the problem situations are not among those normally suspected as well as the insight provided by people closest to the situation.

The argument for voluntary safety reporting carries more weight currently than it did a decade ago when the collaborative efforts of industry, USCG and the Maritime Administration were unsuccessful in obtaining the legal protections considered necessary at that time. It is hoped that at present there is a greater appreciation than in the past for the value and critical need of data obtainable through voluntary safety reporting in the maritime industry.

The Veterans Administration (VA) volunteer reporting system has proven very beneficial to safety in VA hospitals over its recent years of history. Legal protections were obtained by the VA when it created its voluntary reporting system to identify errors in its hospitals. Numerous research efforts took place prior to the VA system on medical errors that indicated that such safety issues have been present and were not being reported. Legal protections against third party litigation were instituted (apparently without review by the Department of Justice) in a bill signed into law. After passing of the bill, effective reporting systems were then quickly instituted and have pioneered significant improvements in safety levels in the VA hospitals which form a very significant part of the hospital system in the U.S. This system has been truly effective in its discovery of medical mistakes or unsafe practices and eliminating them. Recently, family physicians in private or group practice and private clinics have been looking to acquire similar protections but without success to date. The benefits of the VA system, the ASRS, and others are recognized by most experts as highly effective in increasing the levels of safety in various industries. Whether the recent successes of the VA and the long standing successes of the ASRS has made enough positive impact on the Justice Department's opinion of the importance of facilitating such accident prevention systems, however, is not a foregone conclusion. It is recognized by all that requirements and consequences are necessary. The risk of permitting minimal protections would appear to be well worth the value to be gained with the proliferation of voluntary safety reporting. The legal community is not that easily convinced, however. Their view of acquiring needed information includes the premonition that if you need it you simply require it to be provided.

3.4 Possibility of obtaining marine third-party litigation protection

The confidentiality of information is an important consideration with sharing and reporting of volunteered data but can usually be provided through modern technology and de-identification approaches. Protection from third party litigation is considered the most critical type of protection needed by the U.S. maritime industry. The aviation industry does not have legal protections against third party litigation but does encounter a legal battle from time to time. These legal challenges are usually warded off in court with the argument that the data in these systems is not truly statistically correct because the reports are all voluntary and do not represent an independent sample. The worry in maritime is that the stakes are much higher for the industry. Aviation risks are essentially limited to the value of a human life. The maritime liability risk is far higher because of the potential for extremely high environmental expenses from an accident. This risk is thus a large and difficult one to take by those companies in the maritime industry.

At this time, the very long and valuable history of the ASRS voluntary safety reporting system and with the many such systems following it around the world should offer strong evidence on the value of volunteer safety reporting systems for the marine industry. Additionally, the proven record of successes of the VA it would seem to argue strongly for the worth of protections for third party litigation for the maritime industry. Still, there will be reluctance by the Department of Justice to providing legal protections with the rationale that the ASRS did not require legal protections. Nevertheless, it would be important to make the case at this time. Additional arguments exist since the accumulated ISM data now represents a very extensive and valuable set of data available to be shared. Results from analysis of these records of hazards provide an important resource of information to share and conclude results that will advance safety. Voluntary safety systems have a proven record of providing information about safety that time and again comes up with the unexpected. The data is basically of a very different type and is perhaps the only possible way of identifying serious problems until an accident occurs exposing the unexpected situation.

If legal protections cannot be obtained, the industry should seriously consider supporting development and popularization of a voluntary safety reporting system because of its value. The robust knowledge of safety issues and more advanced system of precursor metrics is truly needed to prevent accidents and an effective volunteer reporting system can make this happen. The professional maritime industry is fortunate to have very few accidents in its operations. In contrast, our Nation's highways have a very high number of accidents that cause close to 50,000 deaths each year. There is potential for serious maritime accidents to occur, however, and these can be of a catastrophic nature. The risk

of litigation for companies in the marine industry is very high but so too is the risk of that next unexpected accident which can easily put a company (or the entire sector of the industry) out of business.

4. Potential Approaches for Gathering, Sharing, Analyzing, and Distributing Safety Data and Analysis Results for Accident Prevention.

From the previous sections, it is apparent that there are numerous sources of safety data in the marine industry. Each has its specific characteristics and purpose. There is no single place where the data can be found or the various sources and availability noted for the use of researchers. Also, the various sources of data collect different types of data using varied methodologies that are not very consistent or comparable. Some of the data sets are very accurately gathered and reliable but not as instructive as they should be. Others are perhaps more indicative of problem areas but less accurate and without the ability to be verified. Most have a record of utility that has been the rationale for their support and continued use. All perhaps can help contribute to improving safety if better utilized. This section explores the potential value of better using all of these different data sources for the purposes of studying and determining better approaches to preventing accidents.

4.1 Value of data in preventing accidents

There is no simple fix that can assure a particular type of accident from ever occurring again. There is, however, a wealth of information about accident prevention by a number of great researchers who have contributed much to achieving a better understanding of how to prevent accidents. Most have spent considerable time thinking through the human contributions to the occurrences of accidents. The human continues to top the list of root causes or is among the contributing causes that without which the accident would not have occurred. Figure 3 from Hollnagel (2001) provides a basic starting point for beginning to study how accidents can be prevented.

Over time, our thinking about accidents has evolved from looking simply at changes in technology and equipment to focusing on human factors (human error) causes, to most recently providing significant focus on the impact of organizational aspects (headquarters, shipboard, master-helmsman type relationships, etc.). These changes in understanding have come from looking at data showing statistical probabilities of causes. Early data collection systems focused on mechanical problems or situations that were prevalent in accidents.

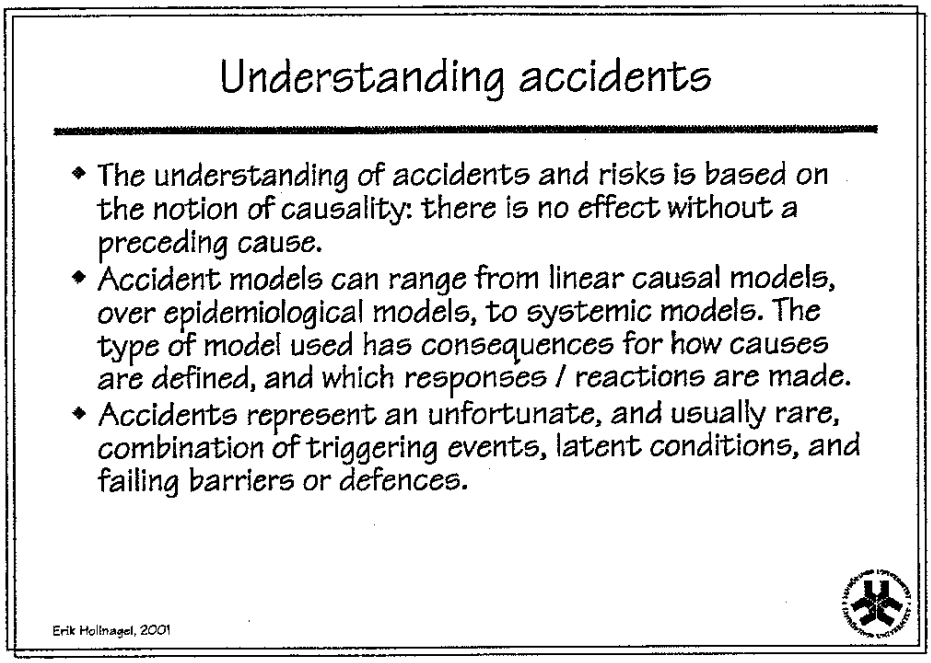

Figure 3 Understanding accidents (Hollnagel, 2001)

As background to where we have come with causal analysis, for decades, maritime accident statistics would start with listing the numbers of collisions, groundings, and allisions (hitting of a pier or bridge, etc.). The importance of improving navigational systems via adding radar or other devices, or requiring tugs to assist when in close quarters, would be evident as a causal item that could fix the problem. Every accident, however, is a series of situations. The accident where the bulk carrier MV BRIGHT FIELD allided with the Riverwalk Marketplace shopping complex damaging stores and injuring 66 people in New Orleans (see http://en.wikipedia.org/wiki/MV_Bright_Field) is but one example. The accident was directly caused by loss of power onboard the ship and the resulting inability to change the rudder angle and terminate a turn. Looking into databases that show the number of occurrences of ships losing power in the New Orleans area indicates that indeed there are quite a number of such occurrences but none of them had occurred before in critical portions of navigation through the channel and caused a significant accident. The Bright Field accident (like most) brought out the fact that we should have known something of serious consequence was bound to happen sometime and put in some measures to prevent it from occurring.

Accident analysis and improvements to safety begins with the application of simple sequential accident models to analyze causation as well depicted in Figure 4. One then determines the root causes and possible straight-forward solutions for preventing that specific accident. Often the analysis of cause and effect has stopped at this point.

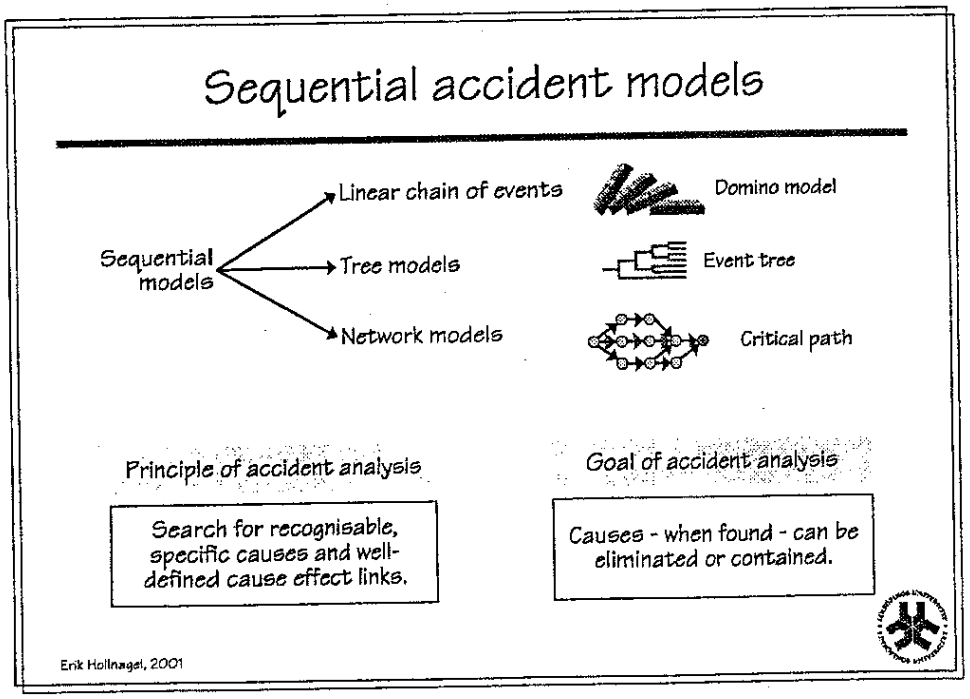

Figure 4 Analysis via sequential accident modeling (Hollnagel, 2001)

Much more can be learned from every accident. Using epidemiological and systemic models when analyzing the causes of an accident can yield important insights into cause as well as looking for those latent conditions and pathological systems that may be characteristic of the general poor "health" of the system. What conditions are endemic and just waiting for some small deviation or sequence of events to result in the accident? Examination using each of these models can offer much enlightenment as to the many various things that contributed or enabled this accident to take place:

- ***Sequential*** - search for specific causes with well-defined cause-effect links (assume that if can find, can control)
- ***Epidemiological*** - search for latent conditions and indication of system health (assume that defenses can be strengthened)
- ***Systemic*** - search for unusual dependencies and conditions (assume variability can be detected and controlled)

Most accidents are very complex when one considers the many factors that have to be in place for the accident to happen. James Reason (Reason, 1997) provides a most enlightening approach with his Swiss cheese illustration (see Figure 5) describing accident causation. What must be analyzed and thought through to provide effective prevention is truly complex. If one envisions random slices of Swiss cheese with each hole in a slice

being some individual situation that is unsafe, an accident cannot occur until all of the holes line up and it is possible for the failure to occur. In the Shappell and Weigmann methodical application of that principle to aviation accidents, human factors issues including organizational, supervision, and some other preconditions are depicted. The MV BRIGHT FIELD example in New Orleans is just as applicable – there were many events of lost power by ships in the New Orleans area resulting in no accidents (just inconveniences) until the rest of the many events are in place to enable that accident to occur.

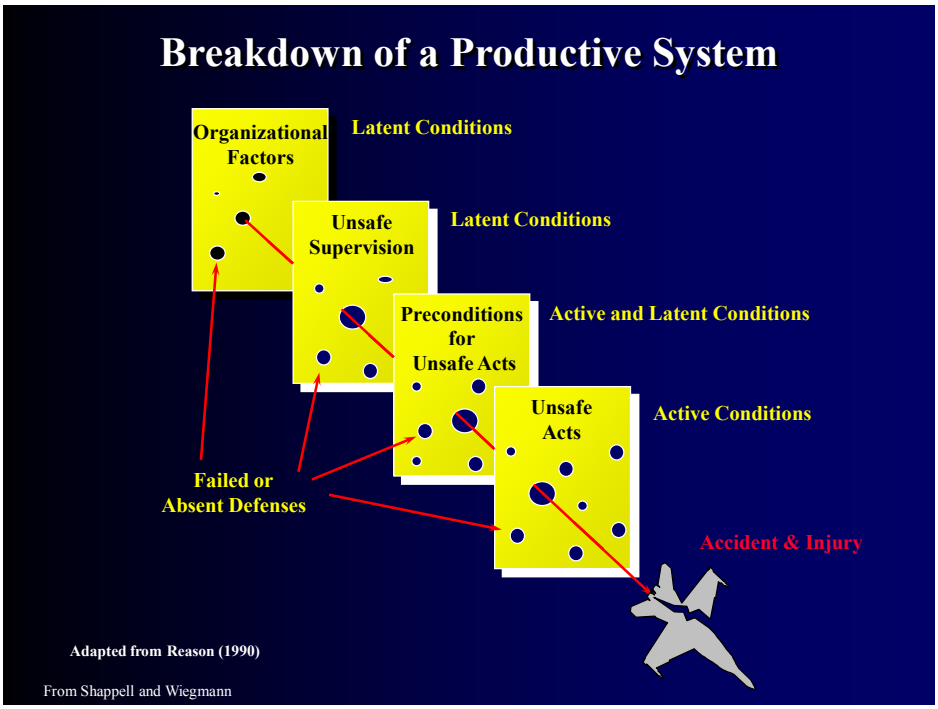

Figure 5 Reason's Swiss cheese approach to understanding accident causation (Shappell and Wiegmann, 1988)

Utility of Available Data for Prevention

Significant amounts of data and information on maritime accidents exist and much is publicly available. Results from analyses of each of these resources have proven track records that the public, Government, and private industry look to for various purposes including preventing accidents from occurring. The use of accident data by law enforcement and legal entities to assign blame and compensation for actions provides

strong support and incentives for the gathering of accident information and ensuring that the information is reliable and accurate. Often, however, the many contributing causal factors are not fully investigated or not recorded in databases for further analysis opportunities.

The level of effort in investigation of an accident does go up with the severity of the occurrence with the result that investigations of significant accidents can provide a wealth of information. All of the information gathered is highly useful in setting in place countermeasures that have a great chance of preventing that particular accident from occurring in the future. For high consequence events when the NTSB gets involved, the extensive investigations do a very good job of highlighting many of the root and contributing causes discovered. NTSB investigations also result in recommended practical changes for improving the safety net ability to prevent the individual and related accidents from occurring in the future.

In general, however, much of the reported accident information, however, lacks the full extent and value that it could have - the level of knowledge that is really needed for effective prevention. Information that cannot be verified is often absent. Even with full and significant investigatory efforts, the process itself can effectively limit the extent of what observers will offer as their “candid” observations of the full depth of causal relationships.

Accidents, especially maritime accidents, are extremely rare occurrences. Unfortunately, the real importance and utility of the information tends not to be appreciated with people focused on fixing the particular item that precipitated the event. While that issue is important to address, every accident should be recognized as a wakeup call with a real focus needing to be placed on examining the levels of safety in all related areas and adjusting where needed to prevent the many other accidents that didn't occur but have a similar level of risk present. Rather than tailoring the preventive actions to the specific accident that occurred, the accident information must be recognized as being historic in nature with all changes in design/system/operations needing to be fully examined to understand the current levels of safety and the adequacy of prevention measures.

Safety data is frequently not taken as important until a real accident occurs. Take the case of the Supersonic Transport (SST) airplane. It was recognized as having a great safety record with no accidents until it had a problem with a blown tire component hitting a fuel tank. After that event, the SST went out of service almost overnight based most likely on the concern for its safety by the traveling public. There was probably also recognition of many other safety issues that had developed and would need to be addressed. While there had been no previous accidents, there were a number of wheel blowout

occurrences. Had these and other unsafe or minor incident data been given more attention as an indicator of the level of safety and a more thorough analysis of accident possibilities performed, perhaps there would have been a better gage of safety levels indicating various preventative measures that should have been taken?

Figure 6 Super Sonic Transport (SST) before and after the "accident"

While there are presently limited incident and precursor data, such data can be highly useful for prevention if properly utilized. ISM hazard data collection and analysis offers a unique asset for maritime accident prevention. These safety data systems provide a valuable basis for improving safety within companies. However, since there is no sharing among companies and with the public, widespread application of lessons learned is seriously limited.

Voluntary safety reporting data perhaps holds the greatest potential for providing information useful for preventing future maritime accidents. Volunteer reports from individuals provide predictive information for potential accidents. In-depth interviews of people following serious accidents have resulted in statements such as "I knew something was going to happen." The amount of unsafe situations that do not cause accidents because of other intervening actions has been shown to be on the order of 10,000 to one. Such reports indicate that we are operating on very little information about safety levels. Instead, we wait for the accident to happen and then the observations by individuals interviewed brings out that there were problems. The reality also is that an incident

where an accident did not occur is usually ignored along with the many unsafe situations that could have led up to the incident. Existing accident data needs to be utilized more fully and combined in an intelligent way with incidents and information offered by all those who regularly observe unsafe situations/practices.

In the maritime industry sectors where ISM is required, there is great potential and value for developing a highly respected maritime volunteer reporting system. The system could become instantly beneficial. The ISM data already gathered by operators could be entered after proper de-identification with safety for the companies from legal issues. The combined valuable findings then could be shared throughout the industry rather than being confined to the individual companies. Such success would then help build the necessary trust and enthusiasm for acquiring the volunteered reports which then add the unencumbered individual observations that are so valuable.

4.2 Consistent national process for reporting lessons learned

As described in earlier sections, significant amounts of publicly available data and information on maritime accidents exist. Analyses and use of each of these resources (particularly the governmentally collected USCG data) are the activities that the public, Government, and private industry look to in determining trends and explaining why things happen. As much of the data collected on accidents is also utilized by law enforcement and legal entities to properly assign blame and compensation for actions, these data are accurate, robust and easily verifiable. There is thus a high level of confidence by the public in the use of this data to analyze how to prevent accidents from occurring. With the USCG providing consistent gathering and analysis of accidents with further in depth investigation by NTSB of the more serious accidents, there is a consistent national process for gathering and reporting of lessons learned. These data sets have also become easy to access over the internet permitting more people to use the data for analysis. Similar consistent sets of data are also available in other countries from which to compare the lessons to be learned.

Whether these extensive and very consistently gathered data sets and thorough investigative analyses are adequate to provide the level of understanding that is needed is of major concern. The databases offer the ability of trend analysis but the value of the results is limited by the data present. While the data is consistently gathered from many reports of accidents, most are minor accidents where there is little effort put toward analyzing causal relationships. The data is also limited because of its limited content due to the need for the data to be highly verifiable to stand up in court.

The major accidents which do get fully and intensively investigated represent a small minority of the data points present. Data from these investigations represent very

important points but in themselves do not help verify the trends or provide a reasonable assurance of the level of safety that might be indicated from an analysis of the larger data set. One will frequently see trend analysis reports ignoring these extreme points citing them as not indicative of the general trend. The facts are, however, that all accidents are extremely rare events. We must take care to properly use the information available exercising insight into the true meaning of each. We must also assemble and gather much more indicative information if we really want to understand trends in the levels of safety.

Thus, there is a consistent national process for reporting of lessons learned but it is not the best. There is also a wealth of data either being collected already for various purposes but it is not yet used effectively because it is not shared or publicly available. There is also additional information gathering and analysis that should be performed that could enable a much more valuable understanding of the real lessons that should be learned from the rare accidents and multitude of unsafe experiences that do occur.

4.3 Standards to ensure the accuracy and utility of data

The mathematics of statistics indicates that standards must be set and carefully adhered to in order for data sets to have the consistency and accuracy necessary to ensure that their use in predicting probabilities can have validity. There is a double-edged sword with setting of the standards, however, in that the standard of data element verification can be too high to yield results that will be able to identify the real causes and correct trends and not be misleading as to the lessons to be learned. This is very evident when studying rare occurrences. The cohort of data available is small and it is collected over relatively large amounts of time when there are many parameters changing and variances occurring that can influence the outcome of the analyses. This is a basic problem with safety data collection and analysis.

Heinrich (1931) reported on systematic studies he performed on accidents occurring in a number of industries. He reviewed the unsafe events leading to the accidents and separated them into different categories of seriousness. He studied the occurrence of an accident, the number of enabling incidents that occurred prior to the accident and the number of enabling unsafe situations that preceded each enabling incident. The result of the data analysis is illustrated in the shape of a pyramid as shown in Figure 4 where the relative ratios of accident to incident to unsafe situation are depicted. The illustration indicates that for every single accident that occurs, there are about 600 incidents that could have become that accident but for some situation that intervened. Also, for every one of those incidents, there are predecessor situations that led to the incident. The result is that there are about 10,000 unsafe situations taking place for every accident registered

each of which could have become that accident. His studies indicated that for different industries, the ratios of occurrences do vary but not that dramatically. During the industry-Government study efforts noted earlier that looked into setting up the IMISS voluntary safety reporting system, some early data gathered from a det Norske Veritas ongoing study of maritime event frequencies indicated that the Heinrich ratios were very similar to the ratios they were obtaining (Synergi, 1998).

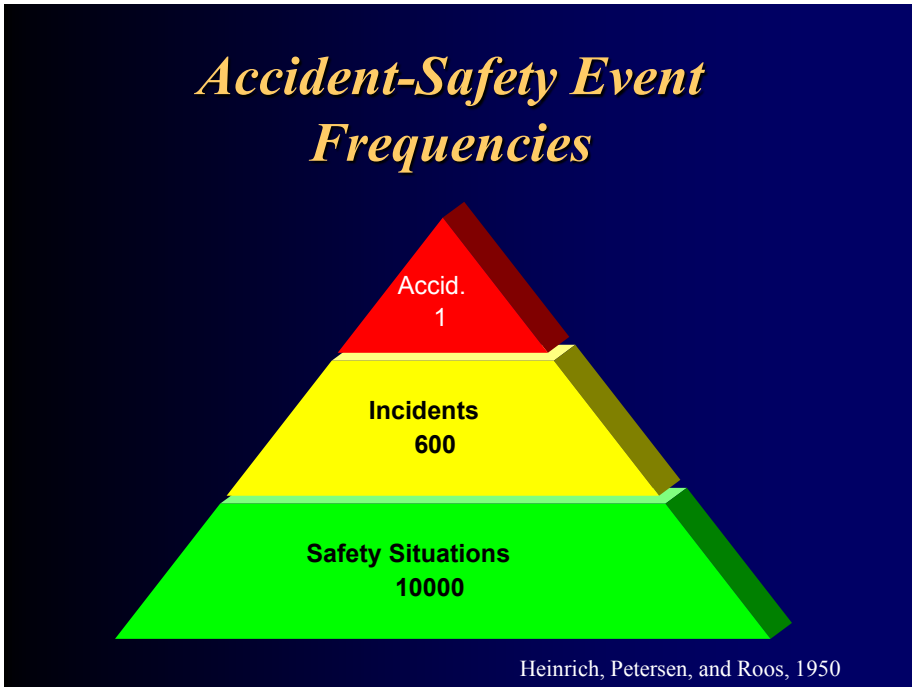

Figure 7 Pyramid of accident to unsafe event frequencies (adapted from Heinrich, 1931)

4.4 Approach to analyzing data

There is not an accepted approach for utilizing accident, incident, and collections of unsafe situational data in a rationalized manner. There are many reasons for this but as noted without more focus on looking at and recognizing the value of data other than accident data, we will continue to base decisions on a very limited understanding of accident causes and levels of safety present.

The consistency and accuracy of our Government-developed accident databases is good and their continued usage is assured. However, private accident data sets and collections of accident precursor data are available and should be recognized as highly useful and

utilized in some fashion rather than being excluded because they do not meet the verifiable tests necessary to stand up in court. They can provide very valuable information regarding trends that should be part of the dialogue on lessons learned.

The readily available accident data basically lacks the full value expected relative to prevention because it does not collect information that cannot be verified. The investigatory process limits observers' candid observations of the full depth of causal information. Accidents, especially maritime accidents, are extremely rare occurrences. As such, the real utility of information and the lack of approaches to raising the levels of safety in all related areas of safety result in the fix being tailored to the specific accident. Accident data is also historic in nature and does not bring into account improvements and changes that are continually occurring in vehicle and system design, and operations.

The level of effort in investigation of an accident goes up with the severity of the occurrence with the result that investigations of significant accidents provide a wealth of information. The information gathered is highly useful in setting in place countermeasures that have a great chance of preventing that particular accident from occurring in the future. It is believed that study of the detailed investigations of accidents in context with the other data types not normally considered or utilized can lead to a rationalized system of analysis using all types of data. This system has the potential to deliver much improved understanding as to causal relationships and their probabilities.

4.5 Sharing of information useful for prevention

The ability for private companies to share information useful for prevention declined significantly with the increase in liability risk after the occurrence of the Valdez oil spill accident. The need is recognized but the legal risk very high. The development of the ISM code and its requirement that most major shipping companies collect potential hazard data and analyze it is a valuable development in the amount of highly-useful, prevention-related data that could be shared if a means can be developed for sharing. The potential is really great for such a development at this point since most companies recognize the value of such data and the sharing of the data would result in a very significant set of data for analysis and development of results that would be beneficial for all operators.

4.6 Developments in the gathering of marine safety data and analysis

In the last two decades, vast improvements have been made in the understanding of the importance of considering human factors and applying human behavioral science to prevent accidents. Much has been accomplished in developing practical tools for designing and operating ships with a focus on improved safety and focusing the design on the

operator and designing with careful concern for the human operations required. These improvements have been aided through recognition and advances accomplished in other industries, aviation in particular. Much of the driver of the advances has been from the analysis of data on accidents and the move to further refinement and inclusion of the human element in the investigation process and collecting of causal data. Discussions within the Safety Council at the Department of Transportation resulted in identifying the management of human fatigue as a major issue and research priority for transportation safety on all modes (Partnering for Safety, 1999).

Major developments in the gathering and use of marine safety data over the last couple of decades have been the recognition of the importance of human factors in the causation chain. While the database system used by USCG to collect accident data from the required 2692 reports had long had an option to indicate multiple causes of accidents, few of these entries were made. Advances were made in investigation and coding of human-related accident causes through various research study efforts (see The Role…, 1989 and Marton, 1989 for more details on one of these research and training efforts). Also, the personnel in USCG have become trained and focused on human factors via the Prevention Through People (PTP) initiative (Prevention…, 1995) and various follow-on efforts at USCG. No longer is the single cause of "human error" considered a detailed-enough explanation to indicate accident cause. The extensive NTSB investigations, for instance, now begin with inquires designed to identify potential human fatigue present in personnel by focusing on what they were involved with and doing up to 72 hours prior to the accident.

Research efforts into accident precursors has similarly made its way into the marine industry based on positive results and advances learned from experiences in other industries.

4.7 How the safety data pieces fit together in a usable network

At this point, it is not at all clear how all of the many data sets and information collected by the different sources can be related and rationally utilized to draw conclusions. What we do know, however, is that this is the first step to developing valid relationships between the data sets and from which to develop rationalized relationships. Much more valuable information from accidents, however, is available but is not easily findable or often being used. Accident databases are highly consistent and verifiable sources of information. Combined with the full accident investigations, much can be inferred from the available information.

Precursor and incident data approaches and data collections are becoming available in the marine industry and provide a valuable addition. The relationship of the precursors to the

accidents must be studied further to validate the precursors. The data collections will gain value in predicting accident frequency with usage. These developments should be available for all to be aware of and for study as they become publicly available.

Some marine voluntary safety data systems exist, and their existence needs to be known to enable more extensive gathering of this useful information. The value of such data will continue to gain more recognition with the advent of such systems in other industries such as in the medical and rail industries. Having these data system types identified and quickly accessible via internet links will promote not only the better understanding of the different data types and their value but lead to development of more formalized methods of how the data sets can and should be used to guide us in understanding safety levels and developing more effective prevention initiatives to pursue.

4.8 Who to lead establishment of an effective network?

Many agencies of the Federal Government are involved with regulating and promoting the marine transportation system and other marine related enterprises. The USCG is responsible for maritime safety and regulates the industry. USCG receives much respect and support from the sectors of the industry they regulate. As mentioned in other parts of this report, a number of other agencies are similarly responsible for marine safety and regulate other sectors of the marine industries. USCG and other regulatory agencies are not the most appropriate entities through which to bring together and develop a broad network of safety information sources. This is in large part due to the need to engender a trusting environment where additional insights need to be forthcoming to enable uncovering additional rationale of accident causation. Sharing of data currently not shared and increased openness depends upon engendering a strong trust that the data will not be inappropriately used when regulatory needs may develop.

When the USCG and MARAD worked together with the industry to study the creation of a voluntary safety reporting system, various agencies were considered to manage the effort. A “white hat” type of agency was determined necessary for the success of the system. Based on the analysis at that time, NASA, NOAA, and MARAD were considered possible leads. MARAD is perhaps the logical and most ideal entity for establishing a trusted and effective safety information network. Located under the Department of Transportation (DOT), MARAD also works closely with the other agencies of transportation all of whom have very strong safety roles in their modes with varying degrees of regulatory responsibility. The role of MARAD is the promotion of a healthy marine industry and MARAD is also involved with many other statistical aspects of the transportation industry. The USCG (which MARAD also works closely with in many areas) is also no longer a part of the DOT. This situation provides an additional buffer from the maritime regulatory

function in Government. MARAD's roles are many but with its main purpose to engender a long-term healthy industry, the lead role for this initiative seems a natural one.

5. Next Steps for the Marine Industry and Government in Developing a Valuable Shared Marine Accident Prevention Information System

Potential next steps to take are recommended in this section. There are important initial steps the marine industry and Government can take to move toward developing a more valuable and shared marine accident prevention information system. One of the first is to recognize the need to improve the current approach through the establishment of a marine safety information network that provides a linkage to much of the data and information that is currently available.

5.1 Value of a Marine Safety Information Network

To begin to understand the value of a more organized network of safety data one needs to consider who is interested in maritime safety. It is not just the safety specialist in an organization that is involved with safety. The reality is that most everyone involved in the marine transportation industry has a strong vested interest in some facet of the safety of marine operations. Mariners and pilots are closest to the scene, responsible for safety of operations, and by far the most susceptible to being injured when safety is compromised. Accounts of causes of accidents are popular reading by this segment of the industry in various sources with the MARS series being an excellent example.

Ship owners as well have a strong interest because of the investment in the vessels and perhaps even more importantly, the impact of a loss of service on the financial success of their company. Their correct understanding of safety risks is critical for their job performance. Information on all the various aspects of safety in design and operations is needed to effectively support the financial success and actual continuance of their way of work. Governmental agencies as well have strong interests and responsibilities. The U.S. Coast Guard (USCG) is the agency responsible for regulating all aspects of the commercial and recreational maritime industries in the United States. While USCG investigates maritime accidents, the National Transportation Safety Board also has the responsibility to investigate maritime accidents after certain threshold criteria of severity are exceeded. The U.S. Navy is uniquely concerned about safety of its vessels and other assets in normal operations and concerned about continuing action after damage has been incurred. In addition to regulatory requirements for design, construction, and operations insurance provisions in the maritime industry for large vessels have grown a classification business that sets requirements and monitors the wellness of equipment and operational procedures which are a necessary element of assuring safety in the international industry. The American Bureau of Shipping is the major classification society active in the U.S.

Insurance companies require ship owners to follow the dictates of such entities before providing insurance.

5.2 Challenges to a successful Network implementation

What is needed by those interested in safety?

The fabric of organizations that study safety and set rules or guides for the industries is indeed complex. Nearly all keep information of various types relating to safety.

While the small boat recreational and fishing boat industries have a good number of accidents each year, most other sectors of the marine industry have very few. The reality, however, is that each accident, even where they are numerous occurrences each year, are very rare when compared to the number of incidents that could have become that accident (with incident data often not usually collected or studied statistically). Thus it is critical to make the best we can out of each piece of data surrounding an accident. We must integrate the few data elements available from the different sources to better study frequency and accident causes to be able to better understand and work to prevent future accidents from occurring.

One should also recognize the fact that many accidents do not result in major negative outcomes and are thus not considered in the light they should be. People seem to have little concern for minor occurrences and only become concerned when the impact of an accident is more significant. Once one recognizes there is an increased probability of an incident occurring, then more significant impact outcomes must be considered to help prevent the catastrophic occurrence from taking place.

With the many sources of accident information and data being collected in an organized fashion and the understanding that every data element needs to be considered to be able to prevent catastrophic results, it should be realized that a single resource is needed to bring together the available data. A single source is needed for collating, analyzing, and disseminating useful information regarding safety. A single source is needed where the trends of data from various sources can be rationalized and key elements of causal information pulled out and provided openly to those in industry and Government where action can take place to prevent accidents from occurring.

5.3 Options and recommendations for moving forward

Comingling and Proper Recognition of Value Added from Different Data Sets

Each type of data has a different statistical correctness, value, utility, character and reputation. There is much that needs to be done to reconcile data from differing data sets when determining levels of safety and in prioritizing which safety initiatives to pursue with limited funding. Statistically correct accident data, originating from easily validated data collections, is highly accurate but primarily of historic utility. It is not comprehensive enough to reflect all of the causation elements present. People's respect for accident information far transcends their appreciation for very significant incidents (near misses) even when it is easy to see that that the incident could have caused extremely significant catastrophes to occur. The SST airplane, for example, exemplifies this concept - while there were a number of failures of tires on landing, nothing was done to prevent such occurrences until the one accident took place which almost instantly put the service out of business. Research is needed to put in place a framework by which data/information/trends from each type of database can be utilized as an integrated informational structure that will properly assess safety levels and point to areas of interest where preventive efforts are needed. This approach may soon be realized based on the current and growing awareness of the importance of reporting unsafe situations, particularly in an industry where there are very few accidents. Public reaction to a specific accident must move from the desire to fix that particular singular occurrence to recognizing that an overall safety problem needs to be addressed.

6. Conclusions and Recommendations

There is currently a plethora of safety information, useful collected data, analyses, and approaches developed for analyzing causal relationships that contribute to the body of research into why marine accidents have occurred. Much of the valuable information collected, however, is not available or currently not able to be shared leaving analyses incomplete.

Public accident data statistics catalog the number of accidents of a particular type and record the magnitude of resulting impacts and other facts. These statistical data are highly reputable but traditionally have the effect of giving us a false sense of what levels of safety are actually present until that next unexpected serious accident occurs. Incidents and reports of unsafe situations are largely ignored along with information that is not easily verifiable. The reality, however, is that each accident is a rare occurrence and causal relationships are complicated requiring far more safety related information to be utilized to intelligently determine and apply the correct needed prevention initiatives to maintain desired levels of safety. We must utilize much more of the relevant information regarding accidents, track occurrences of incidents that can lead to accidents, study reported unsafe situations, and otherwise assemble safety information that is useful for prevention.

We must begin this collection and analysis if we are to be able to predict the probability of accidents occurring and their likely impact. While complete accuracy of such predictions is quite far off, what is really important now is to build a more comprehensive and useful data resource from which to determine what prevention initiatives are needed. What changes are most needed to minimize the occurrence of accidents? There is thus a critical need to better pull the different types of safety data together combining everything we can glean from accidents with other indicators of safety. A more intelligent and proactive network of safety information can be developed that will shed much better light on how best to address accident prevention.

Much can be done to better organize and make these valuable resources more available and provide useful guidance on their use for the purpose of prevention. It is opined that a rich network of information, analysis, education, and outreach can be achieved via removing some of the constraints to sharing by collecting links in one place with a description of the various data resources from the point of view of focusing on their use in “preventing” accidents. The following specific recommendations are suggested. These offer a starting point for the building of a rich tapestry of useful and used information on safety that can be of great benefit to marine operations:

1. **Collect and Create Methods for Sharing and Using Available Safety Data -** Because accidents are very rare occurrences, we must make the maximum effort practicable to unearth and collect all causal-related data and make it available in a useful manner. Intelligent, insightful, and useful information must be able to be drawn out and followed with widespread and effective proactive distribution to have the most effect on facilitating safety. Creation of a center for safety data collection and for data analysis and distribution can have a great positive effect through providing quick access to various data sources, providing an introduction to the information available and its use and calling attention to safety needs and managing of safety levels in the marine industry.

2. **Overcome Some of the Barriers to Sharing of Data -** Various barriers must be overcome to open up effective sharing of data. Focus on the prevention value of the data can facilitate initiation of barrier removal efforts and create more sharing through the collective creation of a central network of useful information that involves proactive analysis of trends and effective distribution of specific recommendations through appropriate resources.

3. **Reasoned Use of Available Safety Data –** Research is needed to determine relationships and relative values of different kinds of safety data and how to integrate them. Each data set and resource has a particular value that complements another. Reasoned rationale and methodology on how they can best be utilized in a coordinated fashion must be developed with a view toward maintaining and increasing safety levels - not just on preventing individual accident types that just occurred. The current almost exclusive use of sparse and historic accident data to develop trends on the probability of potential accidents is not sufficient. This is especially true for the marine industry.

4. **Voluntary Safety Reporting System -** Efforts should be initiated to establish a voluntary safety reporting system for the U.S. maritime industry that can obtain the trust of ship operators, mariners, and others working in the marine industries. Without a way to share ISM data and gather inputs from a wide range of those in the maritime industry, the U.S. industry is left to analyze safety needs and solutions based on sparse historic accident data tending to result in quick fixes of specific issues. Taking quick and usually under-analyzed, short-term solutions in response to an accident raising public demand for action is far from sufficient. We must establish a reasoned approach to maintaining safety levels and this is not possible without searching out more data consisting

of leading indicators and precursors from which to make sense of situations and properly determine safety issues and trends in the levels of safety.

5. **Legal Protections –** The potential for obtaining the minimal legal protections deemed necessary for voluntary safety reporting exists and should be pursued with the current administration. Successes emanating from the VA, ASRS, and other voluntary reporting systems can make strong arguments for creation of protected volunteer safety reporting systems. The maritime industry also has a unique opportunity over other industries because of the large amount of valuable industry information on hazards and accident prevention that has been gathered under ISM requirements but to date has not yet been shared. If the pursuit for protections does not result in attainment of the needed protection, than other less effective measures will need to be initiated to enable at least some increased levels of sharing to occur. Increased sharing will facilitate the development of better insight into causal relationships to better manage levels of safety.

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Appendix A - U.S. Coast Guard Form 2692 Report of Marine Accident Injury or Death

A vessel accident must be reported to the U.S. Coast Guard (USCG) if it occurs upon the navigable waters of the U.S., its territories or possessions; or whenever an accident involves a U.S. vessel; wherever the accident may occur. The basic vessel casualty reporting form as provided on the USCG website under the menu selection "Investigation" (at http://homeport.uscg.mil/) is provided on the following pages for reference.

46 CFR 4.05-1 specifically states that the nearest Coast Guard Marine Safety Office, Marine Inspection Office, or Coast Guard Group Office should be notified whenever a vessel is involved in any marine casualty meeting the following requirements:

- Grounding (intended or unintended)
- Loss of main propulsion, primary steering, or any control system that reduces maneuverability
- An occurrence that materially and adversely affects the vessel's seaworthiness such as fire, flooding, or damage to fire-extinguishing systems, lifesaving equipment, auxiliary power-generating equipment, or bilge pumping systems.
- Loss of life
- An injury that requires professional medical treatment (treatment beyond first aid)
- An occurrence causing property damage in excess of $25,000

OMB Control No. 1625-0001

U.S. DEPARTMENT OF HOMELAND SECURITY U.S. COAST GUARD CG-2692 (Rev. 06-04)	**REPORT OF MARINE ACCIDENT, INJURY OR DEATH**	RCS No. G-MOA MISLE NOTIFICATION NUMBER

SECTION I. GENERAL INFORMATION

1. Name of Vessel or Facility	2. Official No.	3. Nationality	4. Call Sign	5. USCG Certificate of Inspection issued at:

6. Type *(Towing, Freight, Fish, Drill, etc.)*	7. Length	8. Gross Tons	9. Year Built	10. Propulsion *(Steam, diesel, gas, turbine...)*

11. Hull Material *(Steel, Wood...)*	12. Draft *(Ft. - in.)* FWD	AFT	13. If Vessel Classed, By Whom: *(ABS, LLOYDS, DNV, BV, etc.)*	14. Date *(of occurrence)*	15. TIME *(Local)*

16. Location *(See Instruction No. 10A)*	17. Estimated Loss of Damage TO:
18. Name, Address & Telephone No. of Operating Co.	VESSEL _____ CARGO _____ OTHER _____

19. Name of Master or Person in Charge	USCG License	20. Name of Pilot	USCG License	State License
	☐ YES ☐ NO		☐ YES ☐ NO	☐ YES ☐ NO
19a. Street Address *(City, State, Zip Code)*	19b. Telephone Number	20a. Street Address *(City, State, Zip Code)*		20b. Telephone Number

21. Casualty Elements *(Check as many as needed and explain in Block 44.)*

- ☐ NO. OF PERSONS ON BOARD _____
- ☐ DEATH - HOW MANY? _____
- ☐ MISSING - HOW MANY? _____
- ☐ INJURED - HOW MANY? _____
- ☐ HAZARDOUS MATERIAL RELEASED OR INVOLVED *(Identify Substance and amount in Block 44.)*
- ☐ OIL SPILL - ESTIMATE AMOUNT: _____
- ☐ CARGO CONTAINER LOST/DAMAGED
- ☐ COLLISION *(Identify other vessel or object in Block 44.)*
- ☐ GROUNDING ☐ WAKE DAMAGE
- ☐ FLOODING; SWAMPING WITHOUT SINKING
- ☐ CAPSIZING *(with or without sinking)*
- ☐ FOUNDERING OR SINKING
- ☐ HEAVY WEATHER DAMAGE
- ☐ FIRE
- ☐ EXPLOSION
- ☐ COMMERCIAL DIVING CASUALTY
- ☐ ICE DAMAGE
- ☐ DAMAGE TO AIDS TO NAVIGATION
- ☐ STEERING FAILURE
- ☐ MACHINERY OR EQUIPMENT FAILURE
- ☐ ELECTRICAL FAILURE
- ☐ STRUCTURAL FAILURE
- ☐ FIREFIGHTING OR EMERGENCY EQUIPMENT FAILED OR INADEQUATE *(Describe in Block 44.)*
- ☐ LIFESAVING EQUIPMENT FAILED OR INADEQUATE *(Describe in Block 44.)*
- ☐ BLOW OUT *(Petroleum exporation/production)*
- ☐ ALCOHOL INVOLVEMENT *(Describe in Block 44.)*
- ☐ DRUG INVOLVEMENT *(Describe in Block 44.)*
- ☐ OTHER *(Specify)* _____

22. Conditions

A. Sea or River Conditions *(wave height, river stage, etc.)*

B. WEATHER
- ☐ CLEAR
- ☐ RAIN
- ☐ SNOW
- ☐ FOG
- ☐ OTHER *(Specify)* _____

C. TIME
- ☐ DAYLIGHT
- ☐ TWILIGHT
- ☐ NIGHT

D. VISIBILITY
- ☐ GOOD
- ☐ FAIR
- ☐ POOR

E. DISTANCE *(miles of visibility)* _____

F. AIR TEMPERATURE (F) _____

G. WIND SPEED & DIRECTION _____ _____

H. CURRENT SPEED & DIRECTION _____ _____

23. Navigation Information		24. Last Port Where Bound	24a. Time and Date of Departure
☐ MOORED, DOCKED OR FIXED ☐ ANCHORED ☐ UNDERWAY OR DRIFTING	SPEED AND COURSE _____		

25. FOR TOWING ONLY	25a. NUMBER OF VESSELS TOWED	Empty	Loaded	Total	25b. TOTAL H.P. OF TOWING UNITS	25c. MAXIMUM SIZE OF TOW WITH TOW-BOAT(S)	Length	Width	25d. *(Describe in Block 44.)*
									☐ PUSHING AHEAD ☐ TOWING ASTERN ☐ TOWING ALONGSIDE ☐ MORE THAN ONE TOW-BOAT ON TOW

SECTION II. BARGE INFORMATION

26. Name	26a. Official Number	26b. Type	26c. Length	26d. Gross Tons	26e. USCG Certificate of Inspection Issued at:

26f. Year Built	26g. ☐ SINGLE SKIN ☐ DOUBLE	26h. Draft FWD	AFT	26i. Operating Company

26j. Damage Amount	26k. Describe Damage to Barge
BARGE _____ CARGO _____ OTHER _____	

PREVIOUS EDITION IS OBSOLETE

SECTION III. PERSONNEL ACCIDENT INFORMATION

27. Person Involved	27a. Name *(Last, First, Middle Name)*	27c. Status
☐ MALE or ☐ FEMALE ☐ DEAD ☐ INJURED ☐ MISSING	27b. Address *(City, State, Zip Code)*	☐ Crew ☐ Passenger ☐ Other

28. Birth Date	29. Telephone No.	30. Job Position	31. *(Check here if off duty)* ☐

32. Employer - *(if different from Block 18., fill in Name, Address, Telephone No.)*

33. Person's Time	YEAR(S)	MONTH(S)	34. Industry of Employer *(Towing, Fishing, Shipping, Crew Supply, Drilling, etc.)*
A. IN THIS INDUSTRY -			
B. WITH THIS COMPANY -			35. Was the Injured Person Incapacitated 72 Hours or More?
C. IN PRESENT JOB OR POSITION -			
D. ON PRESENT VESSEL/FACILITY -			36. Date of Death
E. HOURS ON DUTY WHEN ACCIDENT OCCURRED -			

37. Activity of Person at Time of Accident

38. Specific Location of Accident on Vessel/Facility

39. Type of Accident *(Fall, Caught between, etc.)*	40. Resulting Injury *(Cut, Bruise, Fracture, Burn, etc.)*
41. Part of Body Injured	42. Equipment Involved in Accident

43. Specific Object, Part of the Equipment in block 42., or Substance *(Chemical, Solvent, etc.)* that directly produced the Injury.

SECTION IV. DESCRIPTION OF CASUALTY

44. Describe how accident occured, damage, information on alcohol/drug involvement and recommendations for corrective safety measures. *(See instructions and attach additional sheets if necessary).*

45. Witness *(Name, Address, Telephone No.)*

46. Witness *(Name, Address, Telephone No.)*

SECTION V. PERSON MAKING THIS REPORT

47. Name (PRINT) *(Last, First, Middle)*	47b. Address *(City, State, Zip Code)*	47c. Title
		47d. Telephone No.
47a. Signature		47e. Date

FOR COAST GUARD USE ONLY — REPORTING OFFICE:

MISLE Incident Investigation Activity Data Entry: — MISLE Incident Investigation Activity Number (if applicable)

☐ NONE ☐ PRELIMINARY ☐ DATA COLLECTION ☐ INFORMAL ☐ FORMAL

Serious Marine Incident ☐ Yes ☐ No Major Marine Casualty ☐ Yes ☐ No	INVESTIGATOR *(Name)*	DATE	APPROVED BY *(Name)*	DATE

INSTRUCTIONS

FOR COMPLETION OF FORM CG-2692

REPORT OF MARINE ACCIDENT, INJURY OR DEATH

AND FORM CG-2692A, BARGE ADDENDUM

WHEN TO USE THIS FORM

1. This form satisfies the requirements for written reports of accidents found in the Code of Federal Regulations for vessels, Outer Continental Shelf (OCS) facilities, mobile offshore drilling units (MODUs), and diving. The kinds of accidents that must be reported are described in the following instructions.

VESSELS

2. A vessel accident must be reported if it occurs upon the navigable waters of the U.S., its territories or possessions; or whenever an accident involves a U.S. vessel; wherever the accident may occur. (Public vessels and recreational vessels are excepted from these reporting requirements.) The accident must also involve one of the following (ref. 46 CFR 4.05-1):

A. All accidental groundings and any intentional grounding which also meets any of the other reporting criteria or creates a hazard to navigation, the environment, or the safety of the vessel;

B. Loss of main propulsion or primary steering, or an associated component or control system, the loss of which causes a reduction of the maneuvering capabilities of the vessel. Loss means that systems, component parts, subsystems, or control systems do not perform the specified or required function;

C. An occurrence materially and adversely affecting the vessel's seaworthiness or fitness for service or route including but not limited to fire, flooding, failure or damage to fixed fire extinguishing systems, lifesaving equipment or bilge pumping systems;

D. Loss of life;

E. An injury that requires professional medical treatment (beyond first aid) and, if a crewmember on a commercial vessel, that renders the individual unfit to perform routine duties.

F. An occurrence not meeting any of the above criteria but resulting in damage to property in excess of $25,000. Damage cost includes the cost of labor and material to restore the property to the condition which existed prior to the casualty, but it does not include the cost of salvage, cleaning, gas freeing, drydocking or demurrage.

MOBILE OFFSHORE DRILLING UNITS

3. MODUs are vessels and are required to report an accident that results in any of the events listed by Instruction 2-A through 2-F for vessels. (Ref. 46 CFR 4.05-1, 46 CFR 109.411)

OCS FACILITIES

4. All OCS facilities (except mobile offshore drilling units) engaged in mineral exploration, development or production activities on the Outer Continental Shelf of the U.S. are required by 33 CFR 146.30 to report accidents resulting in:

A. Death;

B. Injury to 5 or more persons in a single incident;

C. Injury causing any person to be incapacitated for more than 72 hours;

D. Damage affecting the usefullness of primary lifesaving or firefighting equipment;

E. Damage to the facility in excess of $25,000 resulting from a collision by a vessel;

F. Damage to a floating OCS facility in excess of $25,000.

5. Foreign vessels engaged in mineral exploration, development or production on the U. S. Outer Continental Shelf, other than vessels already required to report by Instructions 2 and 3 above, are required by 33 CFR 146.303 to report casualties that result in any of the following:

A. Death;

B. Injury to 5 or more persons in a single incident;

C. Injury causing any person to be incapacitated for more than 72 hours.

DIVING

6. Diving casualties include injury or death that occurs while using underwater breathing apparatus while diving from a vessel or OCS facility.

A. COMMERCIAL DIVING. A dive is considered commercial if it is for commercial purposes from a vessel required to have a Coast Guard certificate of inspection, from an OCS facility or in its related safety zone or in a related activity, at a deepwater port or in its safety zone. Casualties that occur during commercial dives are covered by 46 CFR 197.486 if they result in:

1. Loss of life;
2. Injury causing incapacitation over 72 hours;
3. Injury requiring hospitalization over 24 hours.

In addition to the information requested on this form, also provide the name of the diving supervisor and, if applicable, a detailed report on gas embolism or decompression sickness as required by 46 CFR 197.410(a)(9).

Exempt from the commercial category are dives for:

1. Marine science research by educational institutions;
2. Research in diving equipment and technology;
3. Search and Rescue controlled by a government agency.

B. ALL OTHER DIVING. Diving accidents not covered by Instruction (6-A) but involving vessels subject to Instruction (2), VESSELS, must be reported if they result in death or injury causing incapacitation over 72 hours. (Ref. 46 CFR 4.03-1(c)).

HAZARDOUS MATERIALS

7. When an accident involves hazardous materials, public and environmental health and safety require immediate action. As soon as any person in charge of a vessel or facility has knowledge of a release or discharge of oil or a hazardous substance, that person is required to immediately notify the U. S. Department of Homeland Security's National Response Center (telephone toll-free 800-424-8802 - in the Washington, D.C. area call 202-426-2675). Anyone else knowing of a pollution incident is encouraged to use the toll-free telephone number to report it. If etiologic (disease causing) agents are involved, call the U.S. Public Health Service's Center for Disease Control in Atlanta, GA. (telephone 404-633-5313). (Ref. 42 USC 9603; 33 CFR 153; 49 CFR 171.15)

COMPLETION OF THIS FORM

8. This form should be filled out as completely and accurately as possible. Please type or print clearly. Fill in all blanks that apply to the kind of accident that has occurred. If a question is not applicable, the abbreviation "NA" should be entered in that space. If an answer is unknown and cannot be obtained, the abbreviation "UNK" should be entered in that space. If "NONE" is the correct response, then enter it in that space.

9. Once completed, deliver or mail this form as soon as possible to the Coast Guard Marine Safety, Marine Inspection or Activities Office nearest the location of the casualty or, if at sea, nearest the arrival port.

10. Amplifying information for completing the form:

A. Block 16 - "LOCATION" - Latitude and longitude to the nearest tenth of a minute should always be entered except in those rivers and waterways where a mile marker system is commonly used. In these cases, the mile number to the nearest tenth of a mile should be entered. If the latitude and longitude, or mile number, are unknown, reference to a known landmark or object (buoy, light, etc.) with distance and bearing to the object is permissible. Always identify the body of water or waterway referred to.

B. Tug or towboat with tow - Tugs or towboats with tows under their control should complete all applicable portions of the CG-2692. SECTION II should be completed if a barge causes or sustains damage or meets any other reporting criteria. If additional barges require reporting, the "Barge Addendum," CG-2692A, may be used to provide the information for the additional barges.

C. Moored/Anchored Barge - If a barge suffers a casualty while moored or anchored, or breaks away from its moorage, and causes or sustains reportable damages or meets any other reporting criteria, enter the location of its moorage in Block (1) of the CG-2692 and complete the form except for Blocks (2) through (13). The details will be entered in SECTION II for one barge and on the "Barge Addendum" CG-2692A, for additional barges.

D. SECTION III - Personnel Accident Information - SECTION III must be completed for a death or injury. In addition, applicable portions of SECTIONS I, II and IV must be completed. If more than one death or injury occurs in a single incident, complete one CG-2692 for one of the persons injured or killed, and attach additional CG-2692's, filling out Blocks (1) and (2) and SECTION III for each additional person.

E. BLOCK 44 - Describe the sequence of events which led up to this casualty. Include your opinion of the primary cause and any contributing causes of the casualty. Briefly describe damage to your vessel, its cargo, and other vessels/property. Include any recommendations you may have for preventing similar casualties. *ALCOHOL AND DRUG INFORMATION.* Provide the following information with regard to each person determined to be directly involved in the casualty: name, position aboard the vessel, whether or not the person was under the influence of alcohol or drugs at the time of the casualty and the method used to make this determination. If toxicological testing is conducted the results should be included; if results are not available in a timely manner, provide the results of the toxicological test as soon as practical and indicate that this is the case in block 44 of the casualty form.

NOTICE: The information collected on this form is routinely available for public inspection. It is needed by the Coast Guard to carry out its responsibility to investigate marine casualties, to identify hazardous conditions or situations and to conduct statistical analysis. The information is used to determine whether new or revised safety initiatives are necessary for the protection of life or property in the marine environment.

Appendix B - National Transportation Safety Board (NTSB) Investigation Involvement Criteria

Under the terms of the Independent Safety Board Act of 1974, the National Transportation Safety Board (NTSB) may conduct an investigation of any major marine casualty, or any casualty involving public and nonpublic vessels (see http://www.ntsb.gov/info/faqs/faq-marine.htm).

However, if the casualty involves a Coast Guard and a nonpublic vessel with a least one fatality or $75,000 in property damage, then NTSB shall conduct the investigation as the lead agency. Additionally, if the Coast Guard and the NTSB agree, the NTSB shall act as the lead investigative agency in any casualty involving public and nonpublic vessels with at least one fatality or $75,000 in property damage, or any major marine casualty which involves significant safety issues related to Coast Guard functions. The Coast Guard's mandated responsibility to investigate marine casualties or accidents, including those involving injury to maritime personnel, is much broader in scope and the agency's investigative responsibility is not eliminated nor diminished in any manner, regardless of the NTSB's role in a casualty investigation. More information can be found in 49 CFR, Part 850, Coast Guard – National Transportation Safety Board Marine Casualty Investigations.

Marine accident and incident investigations are conducted by the NTSB with the sole purpose of determining probable cause(s) and using those results to ascertain measures that would best tend to prevent similar accidents in the future. These fact finding proceedings are conducted using the party system without adversity and are not conducted for the purpose of determining the rights or liabilities of any person, company or corporation. Although a Coast Guard investigation shares the same purpose of determining probable cause(s) and using the investigative results as a basis to formulate preventative recommendations, their investigation will determine whether or not there is evidence of any misconduct, negligence or willful violation of law on behalf of an involved party which may warrant administrative, civil or criminal proceedings. More information can be found in 49 CFR, Part 831, Accident/Incident Investigation Procedures, and 46 CFR, Part 4, Marine Casualties and Investigations.

NTSB normally becomes involved when a major marine casualty occurs or when a public vessel is involved. In accordance with the current Memorandum of Understanding between the NTSB and USCG, a major marine casualty is defined as a casualty involving a vessel that results in:

- The loss of six or more lives;
- The loss of a mechanically propelled vessel of 100 or more gross tons;
- Property damage initially estimated at $500,000 or more; or
- Serious threat, as determined by the Commandant (USCG) and concurred in by the Chairman (NTSB) to life, property, or the environment by hazardous materials.

Both USCG and NTSB share a common goal of promoting safety in marine transportation and developing recommendations to prevent future marine accidents. The guidelines which govern the interaction between the two agencies are detailed in a Memorandum of Understanding, commonly referred to as an MOU, dated September 12, 2002.

Marine accident and incident investigations conducted by the NTSB, however, are for the sole purpose of determining probable cause(s) and using those results to ascertain measures that would best tend to prevent similar accidents in the future.

NTSB fact finding proceedings are conducted using the party system without adversity and are not conducted for the purpose of determining the rights or liabilities of any person, company or corporation. Although a Coast Guard investigation shares the same purpose of determining probable cause(s) and using the investigative results as a basis to formulate preventative recommendations, their investigation will determine whether or not there is evidence of any misconduct, negligence or willful violation of law on behalf of an involved party which may warrant administrative, civil or criminal proceedings. More information can be found in 49 CFR, Part 831, *Accident/Incident Investigation Procedures,* and 46 CFR, Part 4, *Marine Casualties and Investigations.*