Building a Toolbox for Risk-based Decision Making Within Your Organization

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Abstract

Risk-based decision making (RBDM), also referred to as risk-informed decision making, relies on timely incorporation of important risk-related information into an organization's decision-making processes. To succeed with RBDM, you must not only follow the fundamental steps of RBDM, but you must also use the right risk assessment tool(s) to provide the right information.

This paper explores how an organization can determine what types of risk assessment tools and uses for those tools are most suitable for its specific applications. The paper does not, however, focus on describing which tool works best in which situation (many other papers have addressed this topic in the past). Rather, it emphasizes the process that an organization should use in assembling and rolling out its risk assessment toolbox. The paper relates this process by describing the multiyear process the U.S. Coast Guard (Coast Guard) has used to refine its risk assessment toolbox, which its field units around the country use to help identify and manage marine transportation system risks. Although the examples are based on the Coast Guard's marine applications, any organization trying to institutionalize the use of more formal risk assessment tools will benefit from this paper.

Introduction

The Coast Guard has always been in the business of risk management and has made great strides in moving from what was mostly a reactive marine safety strategy to one that is much more proactive. However, Coast Guard senior management has taken a further step by establishing a risk capability goal that requires a cultural shift in integrating risk management and risk decision making into all business activities. Part of the strategy for accomplishing this is to deploy high quality and contextual risk decision-making tools.

Risk-based technologies and their use in decision processes represent the most logical way for the Coast Guard to determine where to focus resources to achieve its goals in safety, protection of natural resources, mobility, maritime security, and national defense. In 1998, the Marine Safety & Environmental Protection Directorate at Coast Guard Headquarters (G-M) initiated an effort to develop a risk management toolbox for field marine safety personnel with the Coast Guard's Research & Development (R&D) Center. The risk management toolbox that was finally developed was promulgated in January 2001 to marine safety field units by a Commandant's Instruction (i.e., policy) to encourage its use. The *Risk-based Decision-making (RBDM) Guidelines (Guidelines)* contain (1) a description of G-M's RBDM model, (2) the basic principles of risk decision making, risk assessment, risk management, and risk communication, (3) guidance on tool selection for issue-specific decision making, (4) guidance on managing risk analysis projects, (5) guidance on developing the decision framework, (6) step-by-step procedures on validated risk analysis tools, (7) specific Coast Guard examples using each of the tools, and (8) guidance and descriptions of available data sources to use in risk analysis applications.

This paper provides an overview of the process steps used by the Coast Guard to develop a comprehensive risk-based decision-making toolbox of risk assessment and risk management analytical methods. Marine safety field personnel will use the *Guidelines* to enhance the distributed decision making throughout the Coast Guard using a risk-based approach. The goal of this program is to provide tools that help ensure better decision making in the field by producing decisions that are rational, repeatable, supportable, and defendable.

Step 1 – Determine User Needs and Wants

The first step was for the Coast Guard to gain a thorough understanding of the organization's business activities and decision issues that could benefit from more formal risk decision making. The R&D project started with a user-needs assessment of RBDM requirements by marine safety field personnel. The user-needs evaluation provided a compass heading for the long-haul process of (1) developing the RBDM concepts, (2) identifying the tools, and (3) testing/validating the toolkit for real organizational safety- and environmental-related decision-making situations.

Step 2 – Develop the Plan

Next, the R&D project developed a strategy for evaluating risk tools in the context of Coast Guard marine safety decision-making situations. The added value of the R&D Center effort in testing these tools was to help G-M determine which methods should ultimately be included in its *risk toolbox*. G-M wanted to deploy a reasonably complete toolbox of methods, even if some of the methods might be used less than others. The project plan required the following:

- Developing a better understanding of the decision needs in the field
- Developing a better understanding of existing field RBDM processes
- Developing new/capturing existing RBDM best practices
- Mapping risk tools to Coast Guard RBDM activities
- Developing the *Risk-based Decision-making Guidelines* as a field guide of RBDM best practices

Through this plan, the project team developed a taxonomy matrix (see Figure 1) that mapped typical Coast Guard marine safety decision-making activities to major families of risk analysis tools. This was based on prior government and industry experience with a myriad of risk tools that were applicable to the Coast Guard's various decision situations. There were many tools to choose from. The project team (G-MSE, R&D Center, and EQE International, Inc.) selected an initial grouping of prescriptive, what-if, logic modeling, and process tools that should address many typical marine safety decisions. The team assigned testing priorities (high, medium, or low, using a color-coded scheme) to the cells in the matrix. The highest test priorities were given to tools most likely to be used for various applications. To test the applicability and effectiveness of tools for the various applications, the team used three test beds: (1) a critical review of past (post-facto) field unit risk tool applications, (2) a critical review of marine industry RBDM best practices, and (3) specially selected field demonstration workshop with volunteer Marine Safety Offices (MSOs).

Figure 1 also shows the test application results. Entries in each cell of the matrix indicate cases where the project team found successful use of that type of tool for that application. The matrix cells were populated with the field units that participated in the specific application test and the organizations that participated in the marine industry survey. Tables 1, 2, and 3 list the specific examples that correspond to the codes in the cells of Figure 1. The process for collecting these case study examples is described in Steps 3, 4, and 5.

Field Applications of Risk-based Decision Making	*Outcome Measures*	*Loss Exposure Measures*			*Process and Situation Measures*	
		Prescriptive Tools	***"What-if"-type Tools***	***Logic Modeling Tools***	***Weighted Factor Tools***	***Root Cause Analysis Tools***
Associated Decision-making Activities	Pareto	Checklists • Equipment • Human error	PrHA PrRA/CRA What-if HAZOP FMEA Guide Word Change Analysis	Event Tree Fault Tree HRA	Relative Ranking/Risk Indexing	5-Whys/FTA Change Analysis Event Charting Root Cause Map
Strategic Business Activities						
Establishing regulatory priorities	(IS12)		(WS1)		(IS12)	
Changing regulatory requirements	(IS12)	(WS7), (WS9)	(IS2), (IS13)	(WS6), (WS7), (WS9)	(IS12) , (PF3), (PF11), (WS9)	
Establishing port and waterway management priorities	(IS12), (IS14)	(IS6)	(IS5), (IS9), (IS14), (WS1), (WS10)		(IS5), (IS7), (IS9), (IS12), (PF3), (PF5), (PF6), (PF7), (PF8), (PF10), (WS2), (WS10)	
Establishing specific monitoring and surveillance plans	(IS8), (IS10), (IS12), (IS14)	(IS6), (IS8), (IS10), (WS8)	(IS14), (WS3), (WS5), (WS8)	(WS3), (WS6)	(IS12) , (PF5), (PF6), (WS8)	
Establishing specific loss prevention controls for different activities	(IS8), (IS10), (IS12), (IS14)	(IS6), (IS8), (IS10), (WS1), (WS7), (WS8)	(IS4), (IS5), (IS14), (WS1), (WS5), (WS8), (WS11)	(WS6), (WS7), (WS14)	(IS3), (IS10), (IS11), (IS12) , (PF3), (PF5), (PF6), (PF8), (PF10), (PF11), (WS8), (WS14)	
Establishing response priorities		(IS6)	(WS1), (WS10)		(PF7), (WS10)	
Establishing specific response plans		(IS6)	(WS10), (WS11)	(WS6)	(IS11)	
Determining the equivalency among different requirements		(WS7)	(WS13), (IS3), (IS13)	(WS7)		
Approving and controlling marine events			(WS1), (WS5)			
Planning for changes in waterway demands			(PF4)		(PF5), (PF6), (PF11)	(PF2)
Tactical Business Activities						
Establishing enforcement priorities	(IS8), (IS10), (IS12), (IS14)	(IS8), (IS11)	(IS3), (WS1), (WS10)		(IS3), (WS2)	
Establishing specific enforcement plans	(IS8), (IS10), (IS12), (IS14)	(IS8), (WS9)	(WS3)	(WS3), (WS9)	(WS9)	
Monitoring port and waterway operations	(IS12)	(WS8)	(WS5), (WS8), (WS10)		(PF1), (PF3), (PF7), (PF8), (PF9), (WS8)	
Establishing investigation priorities	(IS8), (IS12)		(WS1), (WS10)			
Dealing with nonconformances	(IS8), (IS10)	(IS6)			(WS2)	
Conducting investigations	(IS8), (IS10)	(IS8)				(IS8), (IS10), (WS4), (WS12)
Directing response actions					(PF8)	

Figure 1 – Taxonomy of Coast Guard Marine Safety Decision-making Activities and Major Families of Risk Analysis Tools (Populated with Identified Applications within the Coast Guard or the Marine Industry)

Table 1 – Post-facto Reviews

Post-facto Survey No.	Tool Used	Location and Risk-based Decision-making Application
PF1	Relative Ranking	MSO Anchorage – Rural Bulk Facility Inspection Matrix
PF2	Root Cause Analysis	MSO Boston - Passenger Vessel Risk Management Work Group
PF3	Relative Ranking	MSO Boston – Spill Occurrence/Transfer Notices
PF4	Change Analysis	MSO Boston – High-speed Ferries, Safety Improvement Study
PF5	Relative Ranking	MSO Charleston - Risk Assessment Matrix
PF6	Relative Ranking	MSO Detroit - Business Planning
PF7	Relative Ranking	MSO Jacksonville - Vessel Risk Factor
PF8	Relative Ranking	MSO/Group LA/LB – Port Activity Risk Index
PF9	Relative Ranking	MSO Morgan City – Facility Inspection Matrix
PF10	Relative Ranking	MSO San Francisco – Harbor Safety Committee Port Risk Assessment Questionnaire
PF11	Relative Ranking	G-MSE - Passenger Vessel Association Risk Guide

Table 2 – Industry Reviews

Industry Survey Contact No.	Tool Used	Organization Type
IS1	Failure, Modes, and Effects Analysis (FMEA)	Classification Society
IS2	Relative Ranking, What-if	Marine Risk Consulting Firm
IS3	Hazard and Operability (HAZOP)	Shipping Firm
IS4	Relative Ranking, Event Tree	Marine Risk Consulting Firm
IS5	Checklist	Trade Organization
IS6	Relative Ranking	Trade Organization
IS7	Pareto, Checklist, 5-Whys	Passenger Vessel Operator
IS8	Guide Word, What-if	Marine Risk Consulting Firm
IS9	Pareto, Checklist, Risk Indexing	Trade Organization
IS10	Risk Indexing, Checklist	Trade Organization
IS11	Pareto, Risk Indexing	Foreign Government Agency
IS12	Change Analysis	Foreign Government Agency
IS13	Pareto, What-if	United States Government Agency

Table 3 – Marine Safety Office Workshops

Workshop No.	Tool Used	Location and Risk-based Decision-making Application
WS1	Preliminary Risk Analysis (PrRA)/Guide Word/Change Analysis/Human Error Checklist	Activities Baltimore – Baseline Risk Profile of Water-side and Shore-side Activities
WS2	Relative Ranking	MSO Buffalo/MSD Massena – Prioritizing Vessels for Coast Guard Inspection
WS3	Fault Tree Analysis (FTA)/FMEA	MSO Buffalo/MSD Massena – Establishing Specific Inspection Plans
WS4	5-Whys/FTA/Root Cause Map™	MSO Buffalo/MSD Massena – Chronic Grounding Incidents in the St. Lawrence Seaway
WS5	Change Analysis/What-if/PrRA	MSO Charleston – Raising the *HUNLEY*
WS6	Event Tree	MSO Charleston – Operating Gaming Vessels from Myrtle Beach
WS7	FTA/Human Error Checklist/Human Reliability Analysis (HRA)	MSO San Francisco – Bridge Staffing for Ferries
WS8	Preliminary Hazard Analysis (PrHA)/Checklist/Risk Indexing	MSO San Francisco – Marine Construction Activities
WS9	Event Tree/Checklist/Relative Ranking	MSO Mobile – Stability Letters on Small Passenger Vessels
WS10	Relative Ranking/PrRA	MSO Mobile – Establishing Planning Priorities
WS11	HAZOP	MSO Mobile – Oil Spills and Fires/Explosions During Fuel Barge Filling at Small Marine Terminals
WS12	Event Charting	MSO Mobile – Barge Grounding in Apalachicola Bay
WS13	Event Tree/Risk Indexing	MSO Providence – Equivalent Lifesaving Requirements on Small Passenger Vessels Operating in Protected Waters
WS14	What-if Analysis	MSO Providence – Risk-based Approval of Operations Plans for Intentionally Grounding Small Passenger Vessels in Narragansett Bay

Step 3 – Complete Post-facto Review

Case study development began with a retrospective look at how decisions were being made in the organization. Several organizational elements were already employing risk tools. In terms of Coast Guard post-facto reviews, it was important to recognize the work that the field units were already doing and that several good RBDM application examples already existed. The purposes of the Coast Guard post-facto review were to (1) evaluate field unit applications of RBDM and their implementation strengths and weaknesses and (2) use this knowledge in the development of the *Guidelines*.

The project team identified a dozen field applications using risk tools and developed a post-facto protocol as an instrument to evaluate the traits of these applications. Figure 2 illustrates this protocol, which examined effectiveness, tool utility, buy-in, and quality of information generated for decision making. The review of the post-facto applications demonstrated that field units have been using relative-ranking/risk-indexing tools almost exclusively with mixed results. This appeared to be their hammer in a single-tool toolbox. The need for a more diverse risk toolbox was evident.

Step 4 – Determine Marine Industry Benchmarks

Other agencies/industry are also applying RBDM. The project team decided to review and assess how other marine industry organizations evaluate risk. The project team evaluated trade organizations, commercial shipping and passenger vessel operators, marine consulting firms, port authorities, and other government agencies. Surveys asked the following questions of these organizations:

- Are risk assessments or other types of safety/hazard assessments used in your organization?
- What was the objective of the assessment?
- Were decisions changed as a result of the assessment?
- How was the assessment conducted (what types of assessment tools were used)?
- Are examples available of the assessment?

All of the risk applications obtained during the marine industry survey fit well into the categories defined in the taxonomy of Coast Guard decision issues. This validated the efficacy that the *Guidelines* could have if they were more broadly applied outside the Coast Guard to other elements of the Marine Transportation System (e.g., Harbor Safety Committees, Advisory Committees).

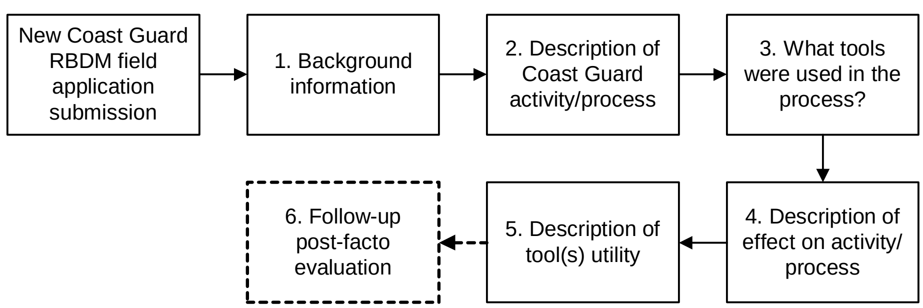

Figure 2 – Post-facto Protocol

Step 5 – Test the Risk Tools Contextually at MSOs

The Coast Guard chose not to put forward any risk tools that had not been validated/used in a real Coast Guard application. To be accepted by users, it is critical that toolbox tools provide practical, efficient, and effective improvements in decision-making processes. With respect to the Coast Guard project, the most productive test bed, in terms of diversity of tools applied, proved to be the MSO RBDM application workshops. Twenty-four RBDM tool applications were demonstrated during these workshops. The workshops' results were used to (1) determine and demonstrate the applicability of the various risk tools used and (2) help make the final tool selections for the *Guidelines*. The MSO workshop approach involved:

1. Developing multiple-problem statements that would support the project testing priorities while also meeting a specific decision need of the unit.
2. Collecting background information on the issue and identifying/inviting local stakeholders to participate if needed.
3. Providing preliminary RBDM training to the unit on the first day.
4. Applying the RBDM process and selected analysis tools (including facilitated work groups to conduct risk analysis and/or develop risk-based decision job aids). Minutes of the work groups were kept, and a report documenting each tool's application was prepared.
5. Finally, the R&D Center staff conducted follow-up discussions with unit team leaders to assess the effectiveness of the tools implemented and their thoughts/perceptions about the RBDM process.

Although the intent of this phase of the project was to introduce as many risk tools to the field as possible, the team also sought to exercise them on typical field problems that address unit issues of real concern. In many instances, the outcomes of the workshops were risk-based job aids or results that were applied to a specific decision or some routine decision-making activity. Some examples include:

- An officer in charge of Marine Inspections decision job aid to evaluate which vessels in MSO Mobile's area of responsibility warrant a stability evaluation
- A tool to qualitatively rank MSO Mobile's Geographic-specific Tactical Response Plan planning priorities along the Florida Panhandle and a preliminary risk analysis tool to investigate the magnitude of environmental mishap risk
- A HAZOP review approach to evaluate fuel barge filling operations at small marine terminals with MSO Mobile
- An FMEA approach to analyze Enhanced Seaway Inspections along the St. Lawrence Seaway with MSO Buffalo/MSO Massena
- A risk change analysis tool for evaluating marine event risks to a port. This was applied to the CSA *HUNLEY* salvage operations with MSO Charleston and OPSAIL 2000 with Activities Baltimore
- An event tree analysis approach to evaluate risk associated with high-capacity passenger vessels in Myrtle Beach with MSO Charleston
- An HRA approach to evaluate bridge staffing on ferries with MSO San Francisco
- A marine construction risk management worksheet to evaluate marine construction waivers with MSO San Francisco
- A port risk-profiling tool for quantitatively evaluating mishap risk based on the unit's own activity hierarchy
- An MSO Providence Captain of the Port risk tool for assessing equivalent lifesaving requirements on small passenger vessels operating in protected waters in response to new lifesaving requirements

Although all of the initial tools identified for evaluation were useful, some of the tools were found to be too complex to apply without expert facilitation. They were deemphasized in the *Guidelines* (i.e., common cause failure analysis and human reliability event tree analysis). Figure 3 illustrates the typical field unit decisions and the analysis tools included in the January 2001 version of the *Guidelines*.

Prevention-related Decisions

Managing Port and Waterway Operations

- What actions should be taken to address port and waterway operations posing the greatest risk to safety and environmental protection?
- What actions will minimize risk for specific operations or systems of special concern?
- How can the risk of upcoming changes in port and waterway operations best be managed?
- Does a proposed alternative compliance strategy provide the same level of protection as the established requirements?
- How should the Coast Guard plan monitoring and surveillance activities to minimize risk?

Conducting Inspections

- Which types of inspections should a unit emphasize to minimize risk?
- What should a unit inspect? How should Coast Guard resources best be allocated among various vessels and facilities?
- Which evaluation points should a unit emphasize during an inspection?
- What actions should be taken in response to a recognized deficiency?

Preparedness-related Decisions

- What accidents or locations should a unit emphasize in response planning?
- What strategies will minimize the risk associated with a specific accident scenario?

Response-related Decisions

- What investigative actions should be taken to prevent recurrence of accidents?
- What actions should be taken to minimize operations risks during response actions?

Figure 3 – Decision Situations and Tools Included in the *Guidelines*

Step 6 – Identify Potential Data Sources

In the process of defining a risk toolbox, the project team observed the importance of applying data sources to RBDM. Users desired guidance in obtaining data and needed a fundamental means to defend the quality of data they chose. At present in the Coast Guard, there is no one-stop shopping for marine safety data sources to support RBDM. Therefore, the project team developed a data sources compendium as a companion to the *Guidelines* to provide initial guidance and preliminary information that will help users select data for marine safety RBDM applications.

The compendium helps analysts avoid common pitfalls that lead to data misuse or misinterpretation. To avoid these pitfalls analysts must (1) understand what information is required by the decision maker, (2) determine how well the data characterize the risk model parameter(s) being analyzed, and (3) provide both analysis results and any uncertainties created by a less than perfect fit between the risk model and the data.

Step 7 – Deploy and Market

One of the clear lessons learned in reviewing the current state of risk-based decision making was that, while a very similar set of tools was distributed in 1997, there were no promotion, educational, or support activities to help ensure its use. Therefore, the project team established ambitious promotional, educational, and support initiatives to improve the probability of successful implementation and actual use of the new *Guidelines*. These initiatives included the following:

- Developing a Coast Guard Risk Web site
- Preparing promotional articles in various marine safety publications
- Converting the paper-based *Guidelines* into a searchable electronic version
- Creating handheld "wizard wheels" to help streamline tool selection
- Providing presentations to the highest levels of Coast Guard leadership
- Integrating RBDM at major educational accession points (i.e., TRACEN, Academy, LDC)
- Conducting two separate workshops where approximately 130 field personnel from all across the nation were brought in for a brief introduction to the new RBDM process and toolbox

The two *Guidelines* rollout workshops were key aspects to successfully launching the new *Guidelines* and obtaining field buy-in. Attendees at each of the 2½-day workshops (in Potomac, Maryland, and St. Louis, Missouri) received their own set of *Guidelines* and supporting material. First, the RBDM process was covered extensively. Individual tools were quickly presented on the afternoon of the first day and completed on the morning of the second day. Then, attendees rotated through four separate sessions where some of the actual MSO contextual testing results were presented. On the opening of the last day, participants were given the opportunity to apply the RBDM process and select tools to solve problems facing them at their respective units. It was encouraging to see eager and excited members getting up to present their examples to the group. In closing the workshop, the available support activities (as addressed in the next step) were highlighted and promoted.

Step 8 – Provide Support to the Field

As previously noted, the lack of support/motivation to use the *Guidelines* as released in 1997 was a significant reason for the minimal impact or awareness of the basic tools. Therefore, the project team is providing significant support to correct this facet of the new program. A "Help Desk" is being established to address field unit questions on how to use the RBDM process, which tool(s) would be best suited for its particular application, and any other aspects that users may need help on. To further facilitate continual training in this area (a key requirement in achieving such a massive paradigm shift), a Web-based training program is also under development. The success of the past MSO workshops is being capitalized upon by offering facilitation services to certain units facing major decisions that will have wide-reaching application to other units throughout the Coast Guard. In line with this desire to share/leverage good RBDM frameworks, a Best Practices recognition mechanism is being developed via the Risk Web site.

Another lesson that the project team has observed is…"If you build it, they will come!" Even though the *Guidelines* were developed to support the G-M organization, members of other Coast Guard Directorates have been extremely impressed with the *Guidelines*. They are actively pursuing using the *Guidelines* for their own benefit. Recall that the majority of MSO workshops used to validate the tool usage (and subsequently the majority of examples within the *Guidelines*) were marine safety related. The time is right to conduct a truly integrated risk management approach within the Coast Guard. In the vein of field support, facilitation and examination in applying the RBDM process across all facets of Coast Guard operations are being considered at a level of the organization that will likely include operational, support, personnel, and (of course) marine safety aspects. The key to successfully accomplishing/ demonstrating this will be correctly scoping the analysis effort. With too little support, the exercise will be unrepresentative and misleading. Yet, with too much effort, it will fall under its own weight.

Conclusion

The *Guidelines* describe G-M's risk management toolbox in support of its risk capability goal. The reader is encouraged to view an electronic version of the *Guidelines* on the Coast Guard Internet *http://www.uscg.mil/hq/g-m/risk/e-guidelines/html/index.htm.* The evaluation process developed (i.e., decision/tool taxonomy mapping approach) was successful in creating a risk toolbox that will address many of the Coast Guard's prevention, response, and preparedness-related marine safety decisions. This process represents an integrated approach to risk decision making. The contextual approach taken in developing this toolbox is expected to improve initial buy-in and its long-term use. This in turn will lead to a cultural shift whereby the Coast Guard's distributed decision makers are better able to evaluate, control, and communicate risks in a more uniform and defensible manner.

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Mr. Macesker has worked at the Coast Guard R&D Center since 1990. He has been the project officer and test director for much of the new ship acquisition RDT&E carried out by the R&D Center. For several years, Mr. Macesker was the project manager for the R&D Center's Marine Safety and Naval Architecture program. He currently is the project manager and team leader for a number of Coast Guard initiatives to develop risk-based technologies for the Offices of Marine Safety and Environmental Protection and Safety and Environmental Health. These projects represent research in areas of internal Coast Guard operational risk and external risk as it relates to Coast Guard activity impacts on industry and public safety. Mr. Macesker was a research test engineer at Electric Boat Division of General Dynamics from 1985 through 1989, working on the SSN21 SEAWOLF design. He worked as a project engineer for Applied Measurement Systems, Inc. from 1989 through 1990, developing and testing new towed sonar arrays. Mr. Macesker received his B.S. degree in ocean engineering from Florida Atlantic University and his M.S. degree in engineering from the University of Connecticut.

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Mr. Myers has over 19 years of experience in health and safety. He is a graduate of the Johns Hopkins University's Whiting School of Engineering. He worked for several defense contractors in the areas of occupational and system safety, environmental compliance, and risk assessment. Mr. Myers holds a CSP in system safety aspects. He chaired the Sub-Committee of the GEIA G-48 system safety committee, which coordinated industry input to the revision of MIL-STD-882D. He is employed by the Coast Guard supporting the Prevention Through People Program. His activities concentrate on developing and expanding the use of risk-based decision making in the field of Marine Safety and Environmental Protection. He has presented at three previous International System Safety Conferences. Mr. Myers earned his masters in public health from the Johns Hopkins School of Hygiene and Public Health with a concentration in injury prevention and risk sciences.

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Before joining EQE, Mr. Schoolcraft was employed as a senior loss control consultant specializing in fire and occupational loss control. From 1991 until 1997, he served as a fire and occupational safety program manager for NASA's Goddard Space Flight Center (GSFC) in Maryland. For nearly 7 years, Mr. Schoolcraft served as a safety engineer with NASA's GSFC. He developed and implemented the chemical safety and safety verification programs for two NASA field centers. He also managed NASA's onsite emergency response team (fire, medical, HAZMAT, and technical rescue) and led mishap investigations for GSFC. Mr. Schoolcraft earned his M.B.A. from the University of Phoenix and his B.S. in chemical engineering from Texas A&M University.