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FIRST-RESPONDER RISK ASSESSMENT METHODOLOGY:
THE BRUNO METHOD

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FIRST-RESPONDER RISK ASSESSMENT METHODOLOGY:
THE BRUNO METHOD

A Master Thesis
Submitted to the Faculty
of
American Public University
by
Patricia Joan Bruno
In Partial Fulfillment of the
Requirements for the Degree
of
Master of Arts
August 2016
American Public University
Charles Town, WV
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DEDICATION

For my late, first best-friend – My In dedication of every little girl that set her eyes on the prize and the parents that encouraged her to reach it. My journey would not be possible without my own parents. Mom, Dad, Sissy, Drew, CJ, Ev, Aunt Pam, Theni, and Reily - thank you. For every coffee with extra cream, for every kind word, for every push to keep going.

For my late grandfather, Laszlo, whose absence is a thread stitched into everything I do.

Wherever the road leads, thank you all for everything.
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ABSTRACT OF THE THESIS

FIRST-RESPONDER RISK ASSESSMENT METHODOLOGY

by

Patricia Joan Bruno

American Public University System, August 15, 2016

Charles Town, West Virginia

Dr. Kathryn Lambert, Thesis Professor

The CARVER matrix, MSRAM, and ORM contribute accurate risk assessments; however, the current risk methodologies are not readily replicated for use by the first-responders responsible to react to mass casualty events. The intention of this work is to contribute a singular risk assessment methodology to be utilized by first-responders prior to and during a potential mass casualty event that may be replicated with uniformity across the nation. First-responders will be interviewed to ascertain levels of risk perception and previous research will be analyzed in order to form the hybrid-risk assessment for first-responders. The end result is the Bruno Method, a First-Responder Risk Assessment.
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Chapter I

Introduction

The establishment of the Department of Homeland Security following the events of September 11, 2001 is one of the most significant efforts made by the United States to effectively and securely manage risk should another mass casualty event such as a terrorist attack occur. The development of new tools, models, and strategies to assist decision-makers in understanding the vulnerabilities and threats involved in managing risk have been heavily relied upon in the past decade. To make matters more complex, limited financial resource allocation is a major limitation imposed upon development of risk methodology. Without such funding for research to provide new models, data, and further analysis, individuals tasked with making critical risk management decisions are left without much education on the matter. While the idea of risk analysis is not new, the concept of managing risk as a means of providing national security is a developing field (Ezell, 2010). As such, research into the subject stipulates that one, singular risk assessment method does not currently meet the challenges raised in potential mass casualty events such as a terrorist attack or natural disaster.

A procedure or model that includes clear and concise steps is defined as a risk methodology. Unfortunately, research stipulates that the most prominent risk assessment methods require specific security clearances and training in order to properly assess risk (Sage, 2015). The training and clearances required for such risk assessment
methodologies disproportionately affect the readiness with which first-responders are able to assist in risk mitigation and/or recovery and resiliency efforts. It is the intention of the author to contribute a singular risk assessment methodology to be utilized by first-responders prior to and during a potential mass casualty event. The author will dissect and analyze the individuals steps involved in the workings of the most prominent risk assessment methods: Maritime Security Risk Analysis Model (MSRAM), the CARVER matrix, and Operational Risk Management (ORM) in order to isolate the most relevant steps of each risk methodology to be subsequently presented as the hybrid risk matrix.

Background

The research topic for this work is derived from the information gap left between elite decision-makers and lay-person actors. In the fields of Homeland Security and Emergency Management, three prominent risk assessment methodologies are used: Maritime Security Risk Analysis Model (MSRAM), the CARVER matrix, and Operational Risk Management (ORM).

All risk assessment methodologies are assembled with clear, concise steps that function as the basis for training in the models. The research presented in the work will identify the most relevant and most viable steps of the respective risk assessments in order to create a hybrid-matrix that is designed to assess the risks and hazards first-responders encounter during times of mass disaster. The suggested risk assessment model will be consistent with the Government Accountability Office (GAO) and the
National Infrastructure Protection Plan (NIPP) risk frameworks, as well as meet risk management criteria and evaluation standards put forth by the Homeland Security Risk Management Doctrine (Risk = Threat * Vulnerability *Consequence).

The CARVER Matrix owes its existence to the Second World War; however, the risk model has maintained notoriety by evolving over the years. Operational Risk Management (ORM) also has a history of adaptation and use by government officials. ORM appears to be, by far, the simplest for a lay person, such as a first-responder, to operate of the methodologies studied in this paper. Of the three risk management methodologies focused on, MSRAM is the documented favorite of the Homeland Security community. MSRAM has been revised several times since its inception, most notably in the days following September 11, 2001 (Adler, 2005). Of all the risk methodologies, experts in the field regard MSRAM as having the most potential to be adapted and applied to scenarios outside the maritime. The United States Government Accountability Office testified that the United States' United States' Coast Guard, "Security Risk Model Meets DHS Criteria, but More Training Could Enhance Its Use for Managing Programs and Operations" in 2011. Overall, MSRAM generally meets DHS criteria for being complete, reproducible, documented, and defensible. Further, the United States' Coast Guard has taken actions to improve the quality of MSRAM data and to make them more complete and reproducible, including providing training and tools for staff entering data into the model" (GAO, 2011). As demonstrated, the praise given to
MSRAM by the GAO is quickly followed by the discovery that without proper training, the model is useless and unable to be replicated. Due to the security clearance required to actively utilized MSRAM, not all United States’ Coast Guard personnel are educated on the model (Belluz, 2010).

Similarly, over the course of study, research such as those documented have led to the conclusion that those first to respond in events of crisis are largely untrained in risk management methodologies (Power, 2008). While these three risk assessment methodologies contribute accurate risk assessments, the current risk methodologies are not readily replicated for use by the first-responders responsible to react to mass casualty events. As such, this work will identify the most relevant contributions made by each of the respective models and introduce a hybrid-matrix to be utilized on a reproducible, trainable level for first-responders in times of potential mass causality resulting in an effective security investment. Once the most relevant steps are identified, this work will present a hybrid risk assessment matrix for use by first-responders during and before times of potential mass casualty scenarios.

**Purpose of the Work**

The purpose of this work is to present a first-responder risk assessment based upon first-responder risk perception. Risks can be transferred, controlled, accepted, or avoided. Due to demonstrated success, risk modeling has become prevalent in the fields of homeland security and emergency management. Critical infrastructure targets are able
to obtain the utmost sustainability and recoverability with proper risk management methods. This is a methodology that should be available to first-responders to ensure minimal loss of life during high risk events. Every risk is unique, as such, multiple methods have been devised over the course of several years (WHO, 2010). The current methodologies are a composite lesson based upon past events, scenario planning, field trials, and government protocols. While it is stipulated that all risks are distinct, it is also maintained that realistic expectations of funding are necessary to carry out training and scenario development leading to effective security investments.

The ideal risk methodology would be adaptable to various scenarios requiring the reaction of first-responders while necessitating little to no-cost in training personnel (Orsz, 2009). The risk methodology to be proposed by the author will assist in providing a more cohesive mitigation and response matrix for first-responders in an effort to maximize effective security investments while simultaneously managing financial limitations imposed by restricted resources. As first-responders, these individuals understand best what is required during times of emergency. The overall gap that is between high-level government emergency management officials and the first-responders that are expected to be the first on scene at a mass casualty event is an unacceptable disservice to the citizens of the United States and the World (McEntire, 2015). The recommended hybrid-matrix will serve as a means of assisting first-responders in the mitigation of and/or recovery and resiliency aspects of potential mass casualty disasters.
Chapter II

Literature Review

For the purposes of this paper, several themes in previous literature will be presented. The themes include: risk assessment methodology development prior to the events of 9/11, risk assessment response following the events of 9/11, the three dominant methods of risk assessment used in federal government, first-responder risk perception/assessment, previous research denoting the importance of protecting the mental health of first-responders, and previous research detailing risk assessment adaptability. While previous research contributes to the field of risk assessment knowledge, none have recommended a hybrid risk model to be nationally adapted and implemented by first-responders. It is the intention of this work to recommend a first-responder risk perception based risk assessment matrix to be utilized uniformly across the nation.

Risk assessment methodology prior to 9/11. Risk assessment methodology development did not begin after the events of 9/11. Several pieces of previous risk assessment literature date back prior to 9/11. In the 1996 work authored by Robin Cantor, “The Process of Risk Management: Rethinking Risk Management in the Federal Government,” the doctrine of risk management and the application of risk modeling in order to manage risk at the federal level is discussed (Cantor, 1996). The article focuses on the federal government’s risk management decision modeling and the application of
varying risk perspectives in order to effectively mitigate or avoid risk. The article greatly contributes to the study of this work as the article highlights both scientific and human behavioral components that have led to congressional efforts to analyze and improve risk management policy and modeling at the federal level. The article considers all of the shifts in intellectual thinking that have brought forth competing models of risk management. Additionally, The National Research Council Staff released the article “Understanding Risk: Informing Decisions in a Democratic Society” to highlight areas of concern in risk based decision-making (NRCS, 1996). The article stipulates that far too often designated decision-makers are not the individuals responsible for carrying out the response protocols or those living with the decisions made during a time of disaster response, such as first-responders. The article was written prior to the events of September 11, 2001 and supports the pre-911 development of risk assessment protocols.

**Risk assessment response following the events of 9/11.** Following the events of 9/11, risk management and risk modeling efforts were thrown into overdrive. The United States Library of Congress sponsored John Moteff’s authoring of “Risk Management and Critical Infrastructure Protection: Assessing, Integrating, and Managing Threats, Vulnerabilities and Consequences” in 2005 (USLC, 2005). The report focused on the findings of the 9/11 Commissions while denoting the various forms of federal assistance provided to states and communities during times of disaster. The work discusses existing federal policies such as the Homeland Security Act of 2002. The report is one of the first
to be issued at the federal level following the events of September 11, 2001. The article discusses the importance of risk assessment and the models and methodologies which address all threats vulnerabilities, and cost-effectiveness of implemented strategies.

The National Infrastructure Advisory Council (NIAC) conducted a study and issued a subsequent report with recommendations regarding impacts of risk on responders (NIAC, 2008). This report recommends that impact containment, recovery, and restoration are essential to effective risk response and strategy implementation. This report supports the recommendation of a uniform first-responder risk assessment in order to adequately address containment, recovery, and restoration. Other articles also contributed to this section of knowledge following the events of 9/11 such as the article “Probabilistic Risk Analysis and Terrorism Risk” authored by Ezell, Bennett, Von Winterfeldt, Sokolowski, and Collins. The article discusses the strides made by the federal government in the post-September 11th world of risk assessment (Ezell, 2010). The article contributes to the discussion of how the United States government has responded to risk estimations and security policy effectiveness. The fields of homeland security and emergency management have shifted financial focus into developing risk models and strategies based on the various means of risk perception as defined by decision-makers. The article solidly contributes to the research subject by discussing decision-makers reliance on risk modeling, scenario development, and various other
forms of decision support. The article highlights several risk management approaches utilized by the Department of Homeland Security and critiqued by National Academies.

“Organized Uncertainty: Designing a World of Risk Management” authored in 2008 by Power, discussed the development and expansions that the risk management community has undergone over a period of 15 years (Power, 2008). The book highlights that risk management policies, strategies, and models have now become designated risk assessment “blueprints” that have guided additional developments of risk policy and modeling. Unfortunately, federal regulations on risk management have also led to constricted levels of control and a lapse in risk perception from various levels of response, such as the first-responder. The book supports the argument that by neglecting various levels of risk perception, it demonstrates that much ground needs to be covered in risk assessment.

The three dominant methods. There are three dominant risk assessment models utilized in the federal government. U.S. Department of Homeland Security’s Risk Management Fundamentals published in April 2011 details the federal criteria for risk assessments such as ORM, CARVER matrix, and MSRAM (USDHS, 2011). The Federation of American Scientists defined the steps of the CARVER risk matrix in Appendix D Target Analysis Process (FAS, 2010). The Federation of American Scientists have contributed to the prior research into the field of risk modeling by clearly identifying and developing on the risk assessment steps in the CARVER matrix. The
stipulations defined by the Federation of American Scientists is utilized as the groundwork for developing the hybrid risk assessment that is the intention of this designated work.

The United States Government Accountability Office has routinely critiqued the risk assessment model known as MSRAM (GAO, 2011). MSRAM calculates maritime risk in regards of threats, vulnerabilities, and consequences of risk. This particular article is important to the development of a first-responder risk perception based model as the article highlights the security clearances needed to be properly trained and briefed in using MSRAM. The fact that the majority of first-responders to terrorist events are not able to be trained properly in MSRAM due to lack of a security clearance is a vulnerability to national security. This vulnerability of MSRAM utilization makes the risk model harder to use on a broad spectrum. As such, a hybrid risk assessment model using steps of the risk assessment model that can be broadly used across the field of homeland security at the first-responder level is necessary.

In the article entitled “Operational Risk Management” authored by Belluz, Fraser, and Simkins in 2010, the risk management model of Operational Risk Management (ORM) is discussed (Bellus, 2010). The risk model is presented in a series of risk assessment steps as to identify and clarify the model. The article contributes to the study of risk management models as risk tolerance and aligned decision making are discussed at length in the article. The article also lays the groundwork for methods to encourage
effective utilization of risk modeling, such as ORM. The article states that enterprise risk management can be influenced by the ORM risk assessment model. In this fashion, the article contributes to the discussion of utilizing current risk assessment models in order to shape future models that are applicable to a variety of risk situations. The article is joined by a few others in discussing the role of ORM in risk assessment. Robertson also authored a similar article regarding Operational Risk Management Practices in 2016 (Robertson, 2016). The United States’ United States’ Coast Guard also addressed "Operational Risk Management" by identifying and clarifying each step of the risk assessment (USCG, 2009).

**Previous adaptation of risk analysis methods.** In addition, there has been previous research into adapting and analyzing various risk assessments. The article authored by Adler and Fuller entitled “An Integrated Framework for Assessing and Mitigating Risk to Maritime Critical Infrastructure” focuses on maritime security risks and assessment (Adler, 2007). Potential hard and soft critical infrastructure targets that sprawl along the United States coastline and waterways provide thousands of potential risks to be mitigated or avoided. The article specifically presents and describes an assimilated approach to uniformly assess risks. In addition, the article details strategic risk mitigation scenarios and strategies. The authors highlight the maritime security risk analysis model (MSRAM) which assesses risks pertaining to maritime infrastructures. Similarly, to the intention of this work, the article applies aspects of human behavior into
the MSRAM risk assessment model. The article does claim that the human behavior aspect presented into the MSRAM model can be applied to various other risk areas in the field of homeland security apart from maritime. However, the article presents no examples of such application into other areas. The singular focus on maritime risk assessment distinguishes the articles contributions as separate from this one.

Furthermore, in the article authored by Orosz, Southwell, Chen, Barrett, Bakir, and Maya entitled “Port Security Risk Management and Resource Allocation System,” the importance of ports to the United States economy is addressed (Orosz, 2009). This article further supports that risk assessments have been adapted and standardized for maritime critical infrastructure dealings. As such, it is possible that other risk assessment matrixes may be designed and applied on a uniform level for land targets and vulnerabilities as well from the first-responder risk perception level. The article addressed the developments and strides the risk management community has made in the past 15 years following the event of September 11th, 2001.

In the published article “Risk, Security, and Disaster Management” written by Comfort for the Political Science Review, the author analyses existing risk policies and strategies that address emergency management and effective risk management resulting in solid security investments (Comfort, 2006). The author contributes to the study of this work as it recognizes that risk perception varies among communities and public agencies that require vastly different strategies to managing risk. The author discusses the division
between strategies required to address risk management of natural disasters and those required to address terrorist activity. Similarly to the intended contributions of this work, the author’s findings stipulate that the process of risk management must operate under continually changing and developing risk management strategies.

The James Fanto article entitled, “Anticipating the Unthinkable: The Adequacy of Risk Management in Finance and Environmental Studies,” was published in 2009 in the Wake Forest Law Review. The article analyzes the economic collapse of the 2000s and the role of risk management (Fanto, 2009). The perspective is intriguing as financial support is necessary in order to fully implement any type of standardization of risk modeling due to training protocols. The article contributes further to the research of the work by analyzing personal, public, and societal risks and subsequent risk modeling to address said risks.

**First-responder risk perception.** First-responder risk has been addressed in a variety of articles; however, there is no singular adaptably risk assessment for first-responders. Several previously authored articles address first-responder risk perception and have contributed to the outline of first-responder risk assessment needs. In 2015 McEntire authored “An Evaluation of Risk Management and Emergency Management: Relying on the Concept of Comprehensive Vulnerability Management for and Integrated Perspective” which addresses the subject of first-responders often being inhibited by outdated policies and a lack of accurate risk perception. The article argues preparedness
and response have been traditionally focused upon and such singular focus neglects the actual impact of the disasters on those charged with response. The article contributes to the development of risk assessment by addressing the areas of proactive and reactive risk response. The article highlights the differences between scholarly and responder risk perception.

In addition, “Infectious Diseases of Severe Weather-Related and Flood Related Natural Disasters” written by Ivers and Ryan, the infectious disease consequences that could affect communities and first-responders during times of severe weather disasters (Ivers, 2006). The research is important as it establishes the need for a designated risk assessment that is standardized to address risk levels encountered by first-responders when responding to natural, or terrorist, disaster events. The article stipulates that such disasters are connected to increased health proponent risk levels of first-responders. While the article address that personal protective equipment is often provided, during mass crisis, there is currently no standardized model with which to calculate or estimate such risks.

In the article entitled “Risk Perception and Terrorism: Applying the Psychometric Paradigm”, the author denotes that risk analysis experts rely on fixed calculations regarding the likelihood of attack and the damage to be sustained while the public has a much more generalized and qualitative approach. The article contributes to the body of
knowledge with the assertion that it is necessary to formulate studies to derive how the public assesses and perceives risk (Jenkins, 2006).

In another article, “Applying Risk Perception Theory to Public Health Workforce Preparedness Training”, it is stated that the fields of public health and homeland security have shifted towards a “24/7 emergency response organizational model” following the events of September 11th (Barnett, 2005). The article contributes to the goal of this work as the author identifies new expectations of first-responders following the events of 9/11. The first expectation is the willingness and ability to respond to the emergency. The second is the first-responder ability to communicate with the public so that the risk is properly understood. Strikingly, the work also supports the notion that little to no studying of first-responder risk perception has been done. This is an area that this current work attempts to partially address. It is important to understand first-responder risk perception as it relays to the level of consequence and threat.

Additionally, in the work authored by Perry regarding the Department of Homeland’s Risk Assessment Criteria, the “Preparedness for Emergency Response: Guidelines for the Emergency Planning Process.” is thoroughly discussed. Current risk assessments sponsored by the Department of Homeland Security revolve around the same risk assessment scenario of Risk \( R = \text{Threat}(T) \times \text{Vulnerability}(V) \times \text{Consequence}(C) \). While the scenario development appears to speak to the risk perception of all levels, it does not. The \( \text{Threat}(T) \times \text{Vulnerability}(V) \times \text{Consequence}(C) \) portion is further divided
into areas of Population Index, Economic Index, National Infrastructure Index, and National Security Index. The risk equation is also misleading to the average reader due to the inequity of values to be multiplied to substantiate risk. The Threat level perceived only equates to twenty (20) percent of the risk assessment equation compared to the eighty (80) percent held by both Vulnerability and Consequence variables. While all of the aforementioned variables are important to high level decision-makers, by job description the first-responder is most concerned with loss of life as opposed to such things as economic stability.

**Importance of first-responder mental health access.** Finally, the Rutkow, Gable, and Links article entitled “Emergency Legal Preparedness and the Public’s Health: Protecting the Mental Health of First-responders: Legal and Ethical Considerations” stipulates that first-responders play the most crucial and important initial response to man-made or natural disaster events (Rutkow, 2011). The physical and mental demands placed on first-responders during this response frame often result in various physical and emotional injuries in direct correlation to the job. The article continues to dissect three key issue areas: mental health screening, mental health provider availability, and workers’ compensation due to physical and mental injuries sustained. This article will serve as additional support in the development of the first-responder hybrid risk assessment matrix when the physical and mental risks of first-responders are taken into consideration during the response.
Protecting the mental health of first-responders is often a subject forgotten in the chaos of a mass casualty event. However, this does not make the area any less important. The stigma surrounding mental health is not one to be denied, even for the role of first-responder. In an article written by Royle entitled, “Issues of Stigma for First-Responders: Accessing Support for Post Traumatic Stress,” addresses the stigma that persons with diagnosed mental health conditions are often exposed to ridicule, job loss, and lack of needed support following a traumatic event. This article contributes to the idea that a successful first-responder risk assessment will include a section for debriefing in which mental health access is discussed without penalty to the seeker (Royle, 2008).

In another article written by Kronenberg, the traumatic stress suffered by first-responders during Hurricane Katrina is discussed. The literature is entitled, “First-Responder Culture: Implications for Mental Health Professionals Providing Services Following a Natural Disaster” and was published in a psychologically focused journal. Many first-responders in the region also served in Vietnam and Iraq war campaigns. Disturbingly, these same first-responders that had served in the military stated that the psychological damage sustained during the recovery efforts of Hurricane Katrina weighed far more heavily on the psyche (Kronenberg, 2008).

The importance of proper access to mental health facilities and professionals is further discussed in a work authored by Glass involving first-responder risk communication (Glass, 2004). In the work titled “Bioterrorism and the People: how to
Vaccinate a City Against Panic,” one of the most essential pieces is that first-responders are to remain calm and stoic in the face of disaster and loss of life as to not cause the victims panic. This expectation of stoicism goes directly against human instincts of fight or flight. The works in this section will offer support of a mandated mental health debriefing for first-responders in the proposed risk assessment.

While all of the previous research presents risk management as a necessity, no risk management model or methodology has been presented as a viable and replicable solution to perceptions of risk by the first-responder. This work intends to recommend a hybrid risk assessment matrix from the first-responder perspective that can be replicated and adapted with the ease of fluidity which first-responder event scenarios demand.
Chapter III

Theoretical Framework

In the fields of Homeland Security and Emergency Management, three prominent risk assessment methodologies are used: Maritime Security Risk Analysis Model (MSRAM), the CARVER matrix, and Operational Risk Management (ORM). All risk assessment methodologies are assembled with clear, concise steps. While all of the previous research presents risk management as a necessity, no risk management model or methodology has been presented as a viable and replicable solution to perceptions of risk by the first-responder. This work intends to recommend a hybrid risk assessment matrix from the first-responder perspective that has been neglected.

First-responders are identified as persons most likely to respond to matters requiring emergency personnel; most commonly such persons include police, emergency medical technicians, firefighters, and paramedics. For the purposes of this work, nurses will also be included under the first-responder category as during times of mass crisis or casualty, nurses are often responsible for mass triage events. The research presented in the work will identify the most relevant and most viable steps of the respective risk assessments in order to create a hybrid-matrix that is designed to assess the risks and hazards first-responders encounter during times of mass disaster.

The suggested risk assessment model will be consistent with the Government Accountability Office (GAO) and the National Infrastructure Protection Plan (NIPP) risk
frameworks, as well as meet risk management criteria and evaluation standards put forth by the Homeland Security Risk Management Doctrine by virtue of being a composite of already sanctioned Department of Homeland Security Risk Assessments. The Maritime Security Risk Analysis Model (MSRAM), the CARVER matrix, and Operational Risk Management (ORM) will be studied due to the frequency with which each risk methodology is used in the emergency management community (USLC, 2005). The Government Accountability Office (GAO) and the National Infrastructure Protection Plan (NIPP) risk frameworks detailed in Appendix I, as well as the aforementioned risk-assessment methodologies, will be analyzed and applied to form the structure of the proposed hybrid-risk assessment. The recommended model will then draw upon the risk assessment contribution level needed for those responding to potential mass causality disasters. Overlapping steps within the identified risk models will be combined as to provide consistency in risk assessment step order profiling. The interview research will focus on the police department in the City of Easton, Pennsylvania. The interview processes to be utilized will be of the specialized form. The interviews will be conducted to substantiate the claim that high-ranking officials have a varying perception of acceptable risk than the specialized actors involved in the initial response. The interviewing of local police officers, as well as previously documented research detailing first-responder risk perception, will assist in ascertaining which current risk assessment steps are of highest importance to first-responders’ job duties during times of anticipated
mass casualty. The proposed hybrid-matrix will be in accordance with DHS expectations and stipulated guidelines to be further discussed in the work.

Risk based assessments and analysis are inextricably linked to the critical infrastructures the methods are used to protect. The neutralization and “buying down” of risk is accomplished by the documentation of far-reaching vulnerabilities and threats posed on the infrastructure by recognized risk assessment methodologies. By definition, risk procedures or models are used to ascertain levels of perceived risk. For the purposes of this work, the three most prominently utilized risk analysis models sanctioned by the Department of Homeland Security are analyzed in applicability to the risk perception of the first-responder job role in contrast to that of a critical infrastructure. The methods/matrixes are: Maritime Security Risk Analysis Model (MSRAM), the CARVER matrix, and Operational Risk Management (ORM). Each risk assessment methodology is dissected and analyzed in order to identify the steps of each methodology that most closely identify with the perceived risk of first-responders. In order to understand the proposed hybrid, the previously mentioned three established risk assessment methodologies will be presented in the following paragraphs.

**CARVER Matrix.** The Second World War and the need to isolate targeted vulnerabilities in critical infrastructures gave rise to what is currently known as the CARVER Matrix. The matrix was previously known as the “CARVE Matrix” with the “R” not being documented until a period following the 1970s after several revisions.
Through revision and adaptations, the matrix continues to prove useful in both defensive and offensive war strategies. The matrix’s allowance for adaptation and revision has solidified its prominence and utilization as a risk assessment methodology within the Department of Homeland Security as well as the Department of Defense. The CARVER matrix is most noted for its usage of a 1-10 analytical scale that denotes the perceived risk in six (6) defined areas. The defined areas of analysis are: Criticality, Accessibility, Recoverability, Vulnerability, Effect OR Effect on Populace, and Recognizability. These defined areas frame the explicit steps in the CARVER matrix, and the pneumonic formulated from the initial letters is how the matrix derived its name. The 1-10 scale assesses whether risk is perceived as minimal to no risk (1) or whether the impending damage would be detrimental to the critical infrastructure (10). The details of the CARVER matrix are simplified below in TABLE 1 (Bruno, 2014).

TABLE 1:

<table>
<thead>
<tr>
<th>VALUE</th>
<th>Criticality</th>
<th>Accessibility</th>
<th>Recoverability</th>
<th>Vulnerability</th>
<th>Effect</th>
<th>Recognizability</th>
</tr>
</thead>
<tbody>
<tr>
<td>9-10</td>
<td>Dramatic Impact</td>
<td>Easily Accessible</td>
<td>Extreme cost/time required to recover</td>
<td>Extremely</td>
<td>Cataclysmic</td>
<td>Obvious</td>
</tr>
<tr>
<td>7-8</td>
<td>Significant Impact</td>
<td>Accessible</td>
<td>Significant Recovery Needed</td>
<td>Very Vulnerable</td>
<td>Dangerous</td>
<td>Well Understood</td>
</tr>
<tr>
<td>5-6</td>
<td>Normal Impact</td>
<td>Minimally Controlled</td>
<td>Normal Recovery</td>
<td>Vulnerable</td>
<td>Serious</td>
<td>Visible</td>
</tr>
</tbody>
</table>
Each step of the CARVER Matrix is explicitly defined. The points of failure and importance of the critical infrastructure are classified as Criticality. Accessibility assesses the ability of enemies to “access” the critical infrastructure. The required effort and time that will be necessary in order to resume full operation of the critical infrastructure is highlighted as Recoverability. The Vulnerability step of the CARVER matrix details the exposure level magnified by the adversary’s ability to act on the target. The anticipated consequences of attack are defined as the Effect or Effect on Populace. Finally, the step of Recognizability begs the question of whether or not enemies will foresee the intended target as one of attack worthiness (Bruno, 2014). It is imperative to note that unlike the first-responders targeted for this work’s presented hybrid-risk assessment, the targeting audience and decision actors that utilize the CARVER matrix have security clearances above the Public Trust level and are specifically trained in the usage of the matrix. Despite this discrepancy, the CARVER matrix has been taken in parts to formulate other risk assessments used outside of the realm of critical infrastructure for such areas as agriculture threat assessment. The ability of the
CARVER matrix to be reconstructed and applied across a variety of fields has a contributory effect on this work. In addition, the defensive aspect of the CARVER matrix can be applied to both man-made and natural events that may cause mass casualty by indicating levels of risk and the subsequent resource allocations needed to prevent or mitigate the risk. What the aforementioned research and applications do not develop upon is the first-responder risk perception as it pertains to loss of life. While the CARVER matrix is primarily focused on the risk to critical infrastructure or agricultural system, it does not focus on individual lives. The recommended hybrid-risk assessment intends to bridge this gap.

**MSRAM.** The United States’ United States’ Coast Guard employs the Maritime Security Risk Analysis Model (MSRAM) in order to allocate resources to defend critical infrastructures identified as targets. MSRAM is approved by the Department of Homeland Security (DHS) as a risk assessment method because it directly follows the DHS risk assessment formula of: Risk = Threat*Vulnerability*Consequence (Bruno, 2014). While MSRAM is identified as the predominant risk assessment method utilized by the United States’ United States’ Coast Guard, it requires resources, security clearances, and training in order to accurately utilize the tool. First-responders, the individuals first to respond to act of terror and natural disasters, do not often have the security clearances or training required to conduct proper risk assessment.
Despite this fact, MSRAM is adaptable to first-responder risk perception because the risk method focuses on risk management scenarios that can be assessed and defined. This copiously documented risk assessment method serves as the United States’ Coast Guard’s principal tool for managing maritime security risk, however, it is also widely understood that underfunded resources and lack of training has prevented the full utilization of the tool across the Department of Homeland Security board. The MSRAM models consist of four groups, leveling from the highest risk to “acceptable” risk. The model is important to the development of a first-responder risk assessment because MSRAM highlights risk reduction scenarios which can be transferred into role playing exercises and training for first-responders in order to prepare for the event of an attack or natural disaster. The security costs are weighed to estimate whether the level of risk is worth the price of action or whether the risk is acceptable. Similarly to the proposed first-responder risk assessment method detailed in this work, the MSRAM model is adaptable to the variety of judgement calls that the United States’ United States’ Coast Guard has to make depending on the fluctuating levels of risk.
As the reader looks above to Figure 1, MSRAM utilizes the scatter plot lines to ascertain whether or not the decision maker can solidly identify the Threat to Vulnerability to Consequence ratio (GAO, 2011). The decision maker is then charged with determining whether the level of risk is to be reduced, accepted, transferred, or mitigated entirely. For the purposes of the first-responder interview, MSRAM methodology steps were classified in accordance with the Department of Homeland Security’s outline of the model. MSRAM focuses on: Response, Preparedness, Recovery Capabilities, Protection Measures, and Prevention Measures (Bruno, 2014). Again, the
MSRAM risk assessment method focuses on critical infrastructures as opposed to threats to life which is the dominating factor for first-responders. There are documented cons to the MSRAM model, as adequate training is severely lacking and only given to a trivial amount of security cleared staff which makes lay person utilization of the model nearly impossible.

**ORM.** As all the aforementioned models, Operational Risk Management is primarily utilized by the United States’ United States’ Coast Guard and other military defenses. Operational Risk Management (ORM) is defined by the United States’ United States’ Coast Guard as: "A continuous, systematic process of identifying and controlling risks in all activities according to a set of preconceived parameters by applying appropriate management policies and procedures. This process includes detecting hazards, assessing risks, and implementing and monitoring risk controls to support effective, risk-based decision-making" (USCG, 1999). The deliberate level of ORM, employed by the Department of Defense, details five (5) risk assessment steps: Identify hazards, Assess hazards, Make risk decisions, Implement controls, and Supervise (Bruno, 2014). ORM proves functional in all facets of society, and various disasters of the man-made and natural kind. Of all the risk assessment methods presented in this work, ORM is the most easily trainable and adaptable to the first-responder risk perception as detailed in the previously documented researched and published literature on the subject.
While the CARVER matrix, MSRAM, and ORM risk assessment methodologies primarily focus on critical infrastructure targets, a first-responder risk assessment would focus on minimizing loss of life in the community. A risk assessment for first-responders is of increasing importance as first-responders are the initial persons on scene during potential mass causality events. These first-responders are the individuals that set the tone for event and whether calm or chaos will ensue. The hybrid-risk assessment methodology detailed in this work will address the gaps these risk assessments have left in the field of first-responder risk perception and assessment.
Chapter IV

Research Design/Methodology

Mass disaster response stems from the bottom up. This disaster response phenomenon is evidenced by the events of September 11, 2001 in which local first-responders reported to the scene of terrorist activity hours before any federal response was issued. This work flow stipulates that first-responders are the individuals that respond first to disastrous events. As such, it is important for first-responders to have a standardized risk matrix tailored to first-responder based perception and acceptance of levels of risk.

In order to create the hybrid-risk assessment method, City of Easton, Pennsylvania Police Officers were interviewed to assess level of first-responder risk perception. In addition, previously detailed research into first-responders are left untrained to assess the risk to which they are responding. This work has identified the most relevant contributions made by the
CARVER Matrix, MSRAM, and ORM in order to produce a hybrid-risk assessment model to be utilized by first-responders in times of potential mass casualty. The gap between elite leaders and decision making for first-responder actors will be bridged with the introduction and training of risk assessment methodology geared toward first-responder risk perception.

**Interview Study of Police Officers.** The in-person interview process proposal (study) received *American Public University Internal Review Board* approval on May 20, 2016 as seen in Appendix II. The original proposal stated that Easton, Pennsylvania Police and Fire Chiefs, Easton Police inspectors and varying levels of patrol officers, Easton firefighters, Easton Emergency Technicians in the Fire Department’s employ, and the Director of the local Adult Trauma Level 1 Center would create the subject base with ages ranging from 18-65. The proposal denoted a maximum of 10 police, 10 firefighters, and the Director of the local Adult Trauma Level 1 Trauma Center to be interviewed. In order for the subject to be included in the study, participants were required to be active first-responder employees of either the City of Easton, Pennsylvania’s Fire or Police departments. For perspective, the City of Easton has a history spanning 250 years and is home to an estimated 6,581.5 member population per square mile (COE, 2015). The city’s history and economic shaping has been fashioned by the city’s location in the Lehigh Valley, next to the Delaware River.
In addition, an elite interview was to take place with the Director of the local Adult Level 1 Trauma Center that is designated as the city of Easton’s first-responder triage drop off point in times of mass disaster as ease in the transfer of care is an essential point of a risk assessment model. Due to time constraints and retirements, only the Easton, Pennsylvania Police Department was interviewed with a total of eight (8) collectively pooled officers. The recruitment for the study was done via e-mail. The contact information for the first-responders was obtained via the City of Easton, Pennsylvania’s official website: http://www.easton-pa.com/. As per the IRB’s approval, there were no direct or foreseen consequences. The most notable societal benefit was contribution of first-responder based knowledge in the development and implementation of a standardized first-responder hazard assessment for national use.

The interview study was scripted to ensure consistency in qualitative analysis. The subjects were welcomed to "First-responder Risk Perception," an interview that asks a series of questions to ascertain which risk assessment methodology steps are necessary to perform the job of first-responder. Before taking part in the study, the subjects were asked to read the information provided in the consent form and sign at the bottom of the page that the subjects understood the statements and freely consented to participate in the study. The consent form, and the following wording, may bare resemblance to other generic consent forms provided by the American Public University System’s Internal Review Board. The APUS IRB approval letter can be found in Appendix II. This study
involved a series of interview questions designed to understand how first-responders think when responding to a crisis. The subjects were informed that the study was being conducted by the author, Patricia “Patti” Bruno, and overseen by Faculty Advisor, Dr. Kathryn Lambert, and it had been approved by APUS Institutional Review Board. No deception was involved, and the study involved no more than minimal risk to participants (i.e., the level of risk encountered in daily life).

Participation in the study typically took 30 minutes. Participants were briefed on the three current risk assessment methodologies discussed in this work with the assistance of a risk assessment handout. A copy of the risk assessment handout provided to first-responders during the interview process can be found in Appendix V. The risk assessment handout pulls directly from previously authored research by Patricia Bruno (Bruno, 2015). The participants were then asked a series of interview questions regarding the steps incorporated into each risk assessment methodology.

The participants were asked to verbally respond to each risk assessment step with the phrases “Critical, Somewhat Necessary, or Rarely Necessary” as it pertains to first-responder risk perception. If the participant elected to not answer the interview question, the participant could answer “Pass” and move on to the next question. The participants were also interviewed to provide personal insight as to whether current risk assessments provide first-responders with necessary tools to perform the job of first-responder. If the subject responded that the risk assessments do not, the participant was asked to identify
what the subject views as lacking from the assessments. This concluded the interview. A copy of the interview script can be found in Appendix IV.

If consented to, the participant’s first name and title will be utilized in this work as a response identifier. If a participant withheld consent of name and title use, the results will now be presented by a neutral identifier ONLY (such as: Respondent 1). All participant interview responses have been collectively pooled in order to establish a first-responder risk perception pattern to assist in the development of a first-responder risk assessment model. Participants were asked to consent to audio recording of the interview, but it was not mandatory. As per the consent form for the APUS IRB, participants were made aware that the audio recordings would not be kept on a "secure" https server of the kind typically used to handle credit card transactions, so there was a small possibility that responses could be viewed by unauthorized third parties (Appendix III).

All interviews were completed individually so that participation was voluntary and refusal to take part in the study involved no penalty or loss of benefits to which participants are/were otherwise entitled. Participants were informed that the subject could withdraw from the interview study at any time without penalty. At the urging of the APUS IRB, participants were repeatedly informed that the subject could skip any questions during the interview that the subject did not feel comfortable answering by stating “pass”. If the subject had further questions or concerns about rights as a
participant in the study, the subjects were given the following contact information: American Public University System, IRB Chair at apus-IRB@apus.edu. A copy of the consent form is found in Appendix III. Due to the inability to interview additional first-responders, previous research on first-responder risk perception and the mental health of first-responders was added to the research design of the hybrid-risk assessment matrix proposed in this work.

**Previous literature detailing first responder risk perception.** First-responder risk perception revolves around neutralizing threats to loss of life in the community that the first-responders serve. Previous literature denotes that risk analysis experts rely on fixed calculations regarding the likelihood of attack and the damage to be sustained while the public, and first-responders, have a much more generalized and qualitative approach. The article contributes to the body of knowledge with the assertion that it is necessary to formulate studies, such as the one detailed above, to derive how first-responders perceive risk (Jenkins, 2006).

In various other articles such as those authored by Barnett, Rutkow, and Perry, the risk perception of first-responders is directly linked to the anticipated loss of life. Previous literature detailing the stigma of seeking assistance for mental health by first-responders is of great volume. As stated previously, the protection of the mental health of first-responders is often a subject forgotten in the chaos of a mass casualty event. Literature in the area denotes that persons with diagnosed mental health conditions are
often exposed to ridicule, job loss, and lack of needed support following a traumatic event (Royle, 2008). This article contributes to the idea that a successful first-responder risk assessment will include a section for debriefing in which mental health access is discussed without penalty to the seeker.

In another article, the traumatic stress suffered by first-responders with prior military experience is compared and contrasted with the traumatic stress of responding to a natural disaster. These first-responders that had served in “war zones” stated that the psychological damage sustained during the recovery efforts of Hurricane Katrina weighed far more heavily on the psyche (Kronenberg, 2008). This research also supports the requirement of a psychologically debriefing and follow-up process for first-responders. The importance of proper access to mental health facilities and professionals is further discussed in a work authored by Glass involving first-responder risk communication (Glass, 2004). In the work, one of the most essential pieces is that first-responders are to remain calm and stoic in the face of disaster and loss of life as to not cause the victims panic. As stated previously in the work, this expectation of stoicism goes directly against human instincts of fight or flight. The previous research in the area of the mental health of first-responders stipulates that the job role subjects the individuals performing duties to incur high levels of stress. In summation of the above information, a hybrid-risk assessment method for first-responder use will be detailed in this work.
**Previous analysis of risk assessment.** The following analysis of risk assessment methodology has been submitted as prior research findings by the author of this work. In accordance with American Public University System policy, it is stipulated that the information presented below is directly taken from the work “Risk Assessment Methodologies” authored by Patricia Bruno in November of 2014 (Bruno, 2014). The authored risk assessment methodology analysis supports the finding that the three risk assessment models presented are basis for a hybrid-risk assessment matrix in this work can be adapted for utilization by first-responders.

As noted previously in TABLE 1, the CARVER matrix's approach to aggregating threat, vulnerability and consequence into a risk assessment is a broad encompassment. In using the CARVER matrix to assess man-made versus natural hazards, the CARVER matrix was designed for the military but it can be applied to most anything as long as a goal is in place. These goals include the neutralization of mass casualty events such as concern first-responders. For example, presented below is Table 2 previously developed by the author to demonstrate the cumulative risk analysis of the CARVER matrix applied to a small town bracing for a Category 4 Hurricane such as that of Easton, Pennsylvania. The example supports the current methodology as the City of Easton’s first-responders would be likely to need the risk assessment for such an impactful storm. The CARVER matrix aspect of "Recognizability" would have to be muted all together or adapted to reflect the path of the Hurricane. For the purposes of Table 2, it will be understood that
the bridge is in the direct path of the Hurricane. Figure 2 shows that the Joint Toll Bridge stands at the highest risk, at 45 points, and will be in need of extra measures in order to lessen impact. It would be the operator's decision whether the time and cost placed into securing the Joint Toll Bridge would be cost and time effective. Please note that the values assigned in the 1-10 scale provided in Table 2 is for example purposes only.

**TABLE 2:**

<table>
<thead>
<tr>
<th>TARGET SYSTEM</th>
<th>Criticality</th>
<th>Accessibility</th>
<th>Recoverability</th>
<th>Vulnerability</th>
<th>Effect</th>
<th>Recognizability</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Joint Toll Bridge</td>
<td>6</td>
<td>10</td>
<td>5</td>
<td>7</td>
<td>7</td>
<td>10</td>
<td>45</td>
</tr>
<tr>
<td>Electric Power</td>
<td>5</td>
<td>3</td>
<td>6</td>
<td>4</td>
<td>2</td>
<td>3</td>
<td>23</td>
</tr>
<tr>
<td>Water Supply</td>
<td>9</td>
<td>2</td>
<td>9</td>
<td>5</td>
<td>4</td>
<td>2</td>
<td>31</td>
</tr>
<tr>
<td>Rail Transport</td>
<td>2</td>
<td>1</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>17</td>
</tr>
<tr>
<td>Air Transport</td>
<td>3</td>
<td>4</td>
<td>6</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>23</td>
</tr>
<tr>
<td>Road Networks</td>
<td>5</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>9</td>
<td>3</td>
<td>27</td>
</tr>
</tbody>
</table>

It is important to note that the risk decision made by the operator would affect first-responder preparations, but not actual response. If the operator chose to not secure the bridge prior to impact, the first-responders would have less time to prepare efficiently for the impact of the storm. However, once the hurricane hits the bridge, first-responders must react to the catastrophe whether or not the first-responders were allotted time to prepare prior to the event. Additionally, one of the only visible cons of the CARVER matrix is that if too many target systems are presented under one model run and multiple...
target systems rank "high risk" that the matrix will have done very little to assist those in
deciding which systems will require the majority or addition of available security assets
(Bruno, 2014). Notably, first-responders do not base decisions on target impact as much
as the effect on population and loss of life. Due to that stipulation, the first-responders
will always direct response to the most life-critical target.

In regards to prior MSRAM analysis by the author, MSRAM is noted as the Coast
Guard’s principal tool for managing the risks associated with maritime security.
However, the underfunding and lack of resources and training leaves the program lacking
in ability to be utilized elsewhere apart from tactile missions without the proper training.
Training is seen as one of the most lacking factors when reviewing the MSRAM model
as it is documented that the United States' Coast Guard has generally provided MSRAM
training only to a small number of sector staff which makes the model hard for the
average person to utilize (Bruno, 2014). This lack of training, funding, and proper
education would have to be addressed in any risk-assessment methodology. It is
especially important with first-responder risk assessment scenarios as the potential for
loss of life based on uneducated triage decisions or evaluation of risk criteria is high. In
addition, without the adequate training, it is impossible for proper adaptations of the
model to be complete.

In reference to previous analysis of ORM as an adaptable risk assessment, it is
stipulated by the United States’ Department of Defense that four main principal
classifications of risk are designated to be assessed by levels of ORM. ORM functions best when utilized to assess the cost of action versus inaction. When benefits of action are outweighed by the cost of accepting the risk, ORM is able to be applied. In this scenario, first-responder risk assessment methodology would be of great use as adapted from ORM. ORM also contributes to first-responder risk assessment by the planning, anticipation, mitigation, and delegation of risk decisions. These facts are to state that first-responders must prepare and plan response. The first-responder risk assessment would also require the anticipation of a potential mass casualty event and define a line of authorized protocol in order to keep chaos at bay. At no point in a first-responder risk assessment would first-responders unnecessarily accept loss of life over economic stability or the ability for a facility to resume operation. In this defined difference, a first-responder risk assessment method would be the only kind to focus on the value of life over the criticality of an infrastructure.
Chapter V

Findings, Recommendations, and Discussion:

While the CARVER matrix, MSRAM, and ORM risk assessment methodologies contribute accurate risk assessments, the current risk methodologies are not readily replicated for use by the first-responders responsible to react to mass casualty events. During the interview study, eight police officers of varying ages and titles were interviewed and collectively pooled. In accordance with first-responder interviews, the dissection and analyzation of the individuals steps involved in the workings of the most prominent risk assessment methods: Maritime Security Risk Analysis Model (MSRAM), the CARVER matrix, and Operational Risk Management (ORM) have been isolated to identify the first-responder job related steps of each risk methodology.

During the interview study the subjects were asked what current risk assessment methods are utilized by themselves and other first-responders. The responses from each of the eight officers reflected varying levels of “Standard Operating Procedures” (SOPs) such as those used during Active Shooter scenarios or Drug Raids. While the SOPs utilized by the Easton Police Department are fluid to situations officers are expected to react to, the SOPs are much more reactive as opposed to proactive. This fact is to stipulate that the job of first-responders is to respond to an actual event more than prepare for an event that may never happen. When asked if the current risk assessment methods fit the needs of the department, three officers stated that more risk assessment training
would benefit the job role. Five out the eight officers pooled stated that no formal risk assessment method training is provided. One officer felt that the SOPs provided as training fit all the needs of the department. One officer noted that the personal protection equipment required for utilization in some risk response scenarios is in need of renew.

Responder 1 stated that the majority of risk assessment protocols or demand for training was “above” the individuals pay grade. This sentiment was echoed in Responder 2’s statement that the individual is “not briefed” on formal risk assessment methods before being asked to perform. The responses were noted as the answers support the demonstrated gap between higher level management and the first-responder actor risk perception and assessment.

The most critical aspect of risk assessment to the job role of first-responder was identified as loss of life, the security of, and/or protection of the victim(s) by seven out of eight responders. One responder identified the most important aspect as the training provided for such events. The responses to the question demonstrated that previous research into first-responder risk perception is accurate to state that loss of life is of the highest importance to the job role of first-responder. In line with previous research, first-responders were concerned with “loss of life” as opposed to steps concerned with protection of a critical infrastructure.

It was then stipulated that responding to a mass casualty event is highly psychologically and physically stressful. Given this stipulation, and the subject’s
expertise as a first-responder, the responder was asked if a proper first-responder risk assessment matrix would include a step mandating ease of access to mental health services following the event of mass casualty. Eight out of eight officers responded that a step mandating a mental health and situational debriefing is a necessity when operating from the first-responder perspective. All the officers studied stated that the department not only provides initial situational and mental health debriefing, but also conducts a follow-up after a few days have passed. The information was noted and applied to the proposed risk assessment method.

For the next portion of the interview study, the risk assessment methodology handout as detailed in Appendix V was discussed with the first-responders. As a participant, the first-responders were asked to rate whether the respective steps incorporated into each risk assessment methodology are Critical “C”, Somewhat Necessary “S”, or Rarely Necessary “R” to the job role of first-responder. No responder elected to not answer the question or “Pass” to move on to the next question. The following are the results of each of the respective risk assessment methodology steps.

**Results of Interview Study.** CARVER MATRIX Steps: Criticality received two (2) Cs and six (6) Ss, (2) Accessibility received eight (8) Cs, (3) Recoverability received four (4) Cs, two (2) Ss, and two (2) Rs, (4) Vulnerability received seven (7) Cs and one (1) S, (5) Effect OR Effect on Populace received six (6) Cs and two (2) Ss, and (6)
Recognizability received six (6) Cs, one (1) S, and one (1) R. This data is simplified in the graphic below labelled as Figure 2.

**FIGURE 2: CAVER Matrix Interview Results**

As displayed in the above graphic, Accessibility is the only documented CARVER matrix step to have received a 100 percent interview response score. Vulnerability scored a remarkable 87% Critical response with the interviewed first-
responders. The steps of Effect and Recognizability followed with a sharp 75 percentage interview score. Upon further investigation, these responses can be predicted based upon the job description of the first-responder. The response percentages lend evidentiary support to the assertion that first-responders are most concerned with loss of life. The accessibility of a targeted attack that may result in mass causalities is of the highest priority of first-responders as all interviewed collectively grouped the accessibility of the target to the vulnerability of the population and subsequent loss of life. Notably, the criticality of the importance of the infrastructure on netted a 75% Somewhat Necessary percentage. These facts assert that the hybrid-risk assessment matrix must identify the neutralization of loss of life as the primary intent of the model.

Secondly came the MSRAM risk assessment methodology Steps: (1) Response received eight (8) Cs, (2) Preparedness received six (6) Cs and two (2) Ss, (3) Recovery Capabilities received two (2) Cs, five (5) Ss, and one (1) R, (4) Protection Measures received seven (7) Cs and one (1) S, and (5) Prevention Measures received six (6) Cs and two (2) Ss. The results from the MSRAM risk perception interview are displayed below in Figure 3.
FIGURE 3:

Response: 100% Critical

Preparedness: 25% Critical, 75% Somewhat

Recovery: 13% Critical, 25% Somewhat, 62% Rarely

Protection Measures: 25% Critical, 75% Somewhat

Prevention Measures: 25% Critical, 75% Somewhat
As displayed in FIGURE 3, MSRAM demonstrates itself as the most able to be adapted with four (4) out of five (5) steps of its risk methodology receiving over 75% of a Critical score for first-responders. Yet again, the only step of the risk assessment methodology to not receive over a 75% Critical score to first-responder risk perception is that of the recoverability of an infrastructure. The interview results again provide evidentiary support that first-responders are most concerned with the effect on the community and the anticipated loss of life. The unanimously critical step of the MSRAM model is that of Response. Ironically, “response” is directly addressed in the job description of a first-responder. The preparedness, protection, and prevention measures that surround a potentially catastrophic targeted attack or natural disaster received a 75% Critical rating from first-responders interviewed. Therefore, the proposed hybrid-risk assessment matrix addresses the training and protection measures involved in the minimizing loss of life.

Finally, the ORM Steps Deliberate Level were as follows: (1) Identify hazards received eight (8) Cs, (2) Assess hazards three (3) Cs, five (5) Ss, (3) Make risk decisions two (2) Cs, six (6) Ss, (4) Implement controls received two (2) Cs, five (5) Ss, and one (1) R, and (5) Supervise received five (5) Cs, two (2) Ss, and one (1) R. Figure 4 demonstrates the first-responder interview responses in percentage format.
In contrast with prior analysis and assessment, first-responders least identify with the ORM methodology of risk assessment with only one step scoring over 75% of the first-responders interviewed. The ORM, as previously detailed and described, is the most simple methodology utilized throughout daily life. However, when educated and informed about the method, first-responders were least to actually identify with the ORM methodology. As such, these findings were absolutely unexpected given the
methodologies ability to be utilized in daily life. In reference to the ORM model, the only risk-assessment methodology step to receive an over 75% percentage scoring was that of identification of the hazard. Upon further investigation, first-responders correlated potential loss of life with the initial identification of a hazard or risk. Due to this stipulation in the interview study of first-responders, the hybrid risk assessment method recommends the identification of actual hazards as the first step.

First-responder perspective based risk assessment. As displayed in the below figure, the most weight was given to Critical identification, followed by Somewhat Necessary, and ending with those identified as Rarely Necessary to the job role of first-responder. The only steps to be unanimously identified as critical to the job role of first-responder were: Accessibility, Response, and Identification of Hazards. As such, these steps were pulled from their respective risk assessment methodologies in order to assist in the hybrid-risk assessment method for first-responder use. The areas highlighting loss of life (threat to life) and steps involving a situational and mental health access debriefing were also included based on the interview study and previous research in the area as notated in the work. First-responders identified accessibility as the accessibility of the population to attack or damage, as such accessibility coincides with the step entitled “Threat to Life.” The Bruno Method satisfies the Department of Homeland Security risk assessment guidelines of Risk equates to Threat X Vulnerability X the Consequence. The developed risk assessment methodology takes the Government Accountability
Office’s framework into consideration. The method also draws directly on the measuring of effectiveness as a defined step in the framework of the National Infrastructure Protection Plan. In light of the interview study and previously documented research in first-responder risk perception and mental health, this work recommends a hybrid-risk assessment method for use by first-responders during and before times of potential mass casualty scenarios.

**The Bruno Method risk assessment.** The Bruno Method lists the following risk assessment steps as part of the working methodology model: (1) Identification of Hazards, (2) Threat to Life, (3) Preparedness, (4) Response, (5) Debriefing, and (6) Follow-up. Identification of hazards is seen as a critical step in the functionality of a first-responder and risk perception. The threat to life, loss of life, and accessibility of victims to adversaries and natural disasters is of high concern to first-responders. As such, accessibility of the target (people) has been transferred into the “Threat to Life” risk assessment step in the model. Preparedness encompasses the scenario development, standard operating procedure training, personal protective equipment, and additional trainings necessary to fulfill the job role of first-responder while minimizing the first-responders own level of risk. The response step of the model is straightforward and is commensurate with the level of risk perceived and identified in the previous three steps of the model. For example, at the response step of the Bruno Method, a smaller threat is given a smaller allocating of resource response in comparison to a larger perceived threat.
The debriefing step of the method is unique to this risk assessment model. Not only is the debriefing step of the method the time in which first-responders reflect and revisit what went right and wrong in the first four steps of the method, but mental health accessibility debriefing is included. The final step mandates follow-up and follow-through on areas in need of address and modification based upon the level of perceived risk and execution of past events. The model is the only first-responder risk perception based risk assessment methodology to mandate higher level management follow-up on the mental health access and suggestions as input by the actual first-responder actors in the assessment. The follow-up step of the method allows for the continually betterment and development of the method in future use.

The risk assessment steps of the hybrid-risk assessment method, First-Responder Risk Assessment: The Bruno Method, is demonstrated below in Figure 5.
The Bruno Method begins with the step of Identification of the Hazard in question. The reasoning behind the initial step is that first-responders interviewed states that proper response to the situation in question was directly linked with the ability to find the hazard. The next step is the level of threat to life. The reasoning behind the second step is that in each risk assessment methodology, the loss of life took precedence over any economic stability or critical infrastructure. The third step of preparedness relates to the “reactive” versus “proactive” methods of current risk assessment methodologies. Preparedness includes the training, funding, and personal protective
equipment necessitated by the anticipated response. The fourth step entitled “Response” is self-explanatory. The fourth step builds upon the preparation and risk level acknowledgments as defined by the prior steps.

The fourth step, “Debriefing,” is unique to the Bruno Method of first-responder risk assessment in that it is the only risk assessment methodology to mandate a mental health debriefing in addition to subsequent action reports. As noted in the previously researched work, response to traumatic events by other human beings leaves those responding to the tragedy with a higher likelihood of post-traumatic stress or the need for some type of counseling. Finally, the follow-up step of the Bruno Method guarantees first-responders with the freedom to vocalize what is not working in the department or local floors.

The next paragraph will detail the workings of the Bruno Method in response to a Category 4 Hurricane positioned to make landfall near the city of Easton, Pennsylvania. For the purposes of this scenario, the hurricane will be named Apple. In the average event requiring first-responder reaction, the Bruno Method begins with the step of Identification of the Hazard. In this scenario, the hazard to be identified is the Category 4 Hurricane Apple. The next step first-responders would assess would be Hurricane Apple’s Threat to Life in the community. If the assessed risk is high enough to warrant first-response action, then the next step of the Bruno Method requires first-responders to Prepare for the event. In order to prepare for Hurricane Apple’s landfall, the police, fire,
and emergency medical service departments within the city must ensure proper training to respond to mass triage. In addition, first-responders must establish chains of command and communication with the public as a means of maintaining safety. The next step of the method is the Response to the event. In this case, once Hurricane Apple has made landfall, the Preparedness step in the response method is put into action. Following the response, the Debriefing and Follow-up steps of the Bruno Method are enacted upon. The debriefing will address any successes, failings, and cover adequate access to mental health services following the traumatic events for the first-responders. For example, a recommendation to come out of the debriefing may be that the police and fire departments must have a mobile headquarters in the event stations flood.

**Evidentiary support for new findings.** The Rutkow article entitled “Emergency Legal Preparedness and the Public’s Health: Protecting the Mental Health of First-responders: Legal and Ethical Considerations” supports the risk methodology’s Debriefing and Follow-Up steps for the protection of mental health of the first-responders by stipulating that first-responders play a critical role in the initial disaster response (Rutkow, 2011). Due to the physical and mental demands positioned upon the shoulders of first-responders during the catastrophic event response, far too often the traumatic stress results in various physical and emotional injuries in direct correlation to the job. As such, and in accordance with additional information detailed in the interview process, the recommendation for Debriefing and Follow-up is made in the Bruno Method.
Additionally, the CARVER matrix is most noted for its usage of a 1-10 analytical scale that denotes the perceived risk in six (6) defined areas of: Criticality, Accessibility, Recoverability, Vulnerability, Effect OR Effect on Populace, and Recognizability. The 1-10 scale is far too subjective for first-responder risk assessment. For instance, two victims could have sustained identical injuries during a traumatic event. However, given individual pain tolerance levels, one victim may state that the injuries are a ten (10) out of ten (10) while the other victim may verbalize a lower number on the pain scale. For this reason, the Bruno Method steers away from a sliding number scale.

**Proposed and current thesis differences.** The original thesis proposal stated that the Government Accountability Office (GAO) and the National Infrastructure Protection Plan (NIPP) risk frameworks would be compared and contrasted in order to ascertain which framework, if either, was best suited in the foundation of the newly proposed risk methodology. However, upon further research and the interview study, it appears to be of little consequence which framework is utilized as long as a follow-up step as included in the National Infrastructure Protection Plan takes place in the method. The Maritime Security Risk Analysis Model (MSRAM), the CARVER matrix, and Operational Risk Management (ORM) were studied due to the frequency with which each risk methodology is used in the emergency management community (USLC, 2005). As detailed above, research was collected and presented in regards to the existing three the most prominent methodologies. The recommended model drew upon the risk
assessment contribution level needed for those responding to potential mass causality disasters. Overlapping steps within the identified risk models were combined as to provide consistency in risk assessment step order profiling. As noted above, the interview study focused on the City of Easton, Pennsylvania’s Police Department.

**Future research components.** Future research would focus on continual development of the Bruno Method and possible implementation on a small scale for a trial base. The author would also attempt to utilize a larger time frame in which to collect interviews with first-responders as three-weeks was not enough to collect all of the needed interviews desired. Additionally, during the interview Responder 3 stated that concern for mental health of first-responders is at the forefront of minds when mass casualty events occur, but not in other day-to-day, smaller traumatic events. The statement was striking; it is of interest for further research as it pertains to risk perception and first-responders. The focus on the police aspect of first-responder risk perception was inadvertently interesting. Future research could be done into varying city police department standard operating procedures for a deeper insight as to the level of perceived risk.

**Limitations of the interview study.** Limitations of the study revolve around the subject base of the first-responder interview. Due to time constraints, the author was unable to interview as many first-responders as initially intended which required the author to pull from previous first-responder risk perception research. The first-
responders interviewed were all from the Easton Police Department, which creates not
contrast in risk perception from other first-responders such as EMS or Firefighters. The
foreseen limitation that first-responders in FEMA Region II are more prone to water
based natural disasters and high-profile city terrorist attacks than that of such a disaster as
an earthquake is still seen. In addition, the Director of the local Trauma Adult Level I
Center retired effective May 30th of 2016 and has yet to be replaced in official title which
prevented the elite interview in its entirety. Another limitation to the study is that the
first-responders interviewed were largely unfamiliar with the methodologies of the
CARVER matrix, MSRAM, and ORM risk assessments.

In a way, this lack of familiarity with risk assessment methods also speaks to the
need for a risk assessment directed for first-responder use. In the future, more time
would be needed to collect a more encompassing composite of first-responder risk
perception interview responses as well as potentially gain interviews from service men
and women that have had the opportunity to utilized the risk assessments of the
CARVER matrix, MSRAM, and ORM as those individuals are best equipped to address
questions of risk assessment adaptability to scenario development.

Time and time again it is discovered that resource allocation and funding are
always of the highest priority. Generally, agencies and other organizations are looking to
progress but at minimal cost. The degree to which limited financial resource allocation is
provided to local agencies is a major limitation imposed upon development of risk
methodology. As stipulated previously in the work, without such funding to research and provide new models, data, and further analysis, individuals tasked with making critical risk management decisions are left without much education on the matter. The idea of risk analysis is not new; however, the concept of managing risk as a means of providing national security is a developing field. The development of any field requires adequate financing and time to conduct proper research.
Chapter VI

Conclusion

In summation of this work, while the CARVER matrix, MSRAM, and ORM contribute accurate risk assessments, the current risk methodologies are not readily replicated for use by the first-responders responsible to react to mass casualty events. The intention of this work is to contribute a singular risk assessment methodology to be utilized by first-responders prior to and during a potential mass casualty event that may be replicated with uniformity across the nation. The result is the First-Responder Risk Assessment: The Bruno Method which is a hybrid-risk assessment method designed from the first-responder perspective. The Bruno Method utilizes six (6) step method risk assessment model. The six (6) steps of the method are: Identification of Hazards, Threat to Life, Preparedness, Response, Debriefing, and Follow-up. The method puts forth a uniquely identifying step of mental health debriefing and follow-up that are not mandated by any other model.
References


*OUP Catalogue.*
National Infrastructure Advisory Council, (2008), Chemical, Biological and Radiological Events and The Critical Infrastructure work force Final Report,

<http://www.dhs.gov/xlibrary/assets/niac/niac_CBR_FINAL_REPORT.pdf>


Appendix I

Definitions:

Acceptable risk: The level of risk that is attained when no action is considered warranted as a reaction to purported threat or vulnerability levels.

Decision-makers: Authoritative figures viewed as experts in any chosen field for which the figure is held accountable for all conclusions reached based upon risk methodologies provided.

Effective Security Investment: Venture that results in risk reduction and/or increased operational resiliency; all matters of cost efficiency are in the scope of the decision maker.


Risk Assessment: The documentation, appraisal, and approximation of situational risk level as contextually compared to current standards of security ultimately leading to a defined level of acceptable risk.
Appendix II

Institutional Review Board (IRB)

Application Number: 5-2016-45
Application Title: First-Responder Perspective of Hazard Assessment Methods

May 20, 2016

Dear Patricia Bruno,

The APUS IRB has reviewed and approved the above application.

Date of IRB approval: 5/20/2016
Date of IRB approval expiration: 5/19/2017

The approval is valid for one calendar year from the date of approval. Should your research using human subjects extend beyond the time covered by this approval, you will need to submit an extension request form to the IRB.

Changes in the research (e.g., recruitment process, advertisements) or informed consent process must be approved by the IRB before they are implemented. Please submit a
Appendix III

Consent Form: First-Responder Risk Perception

Welcome to "First-responder Risk Perception" an interview that asks a series of questions to ascertain which risk assessment methodology steps are necessary to perform the job of first-responder. Before taking part in this study, please read the information below and sign at the bottom of the page that you understand the statements and freely consent to participate in the study.

This study involves a series of interview questions designed to understand how first-responders think when responding to a crisis. The study is being conducted by Patricia “Patti” Bruno and overseen by Faculty Advisor, Dr. Kathryn Lambert, and it has been approved by APUS Institutional Review Board. No deception is involved, and the study involves no more than minimal risk to participants (i.e., the level of risk encountered in daily life).

Participation in the study typically takes 60 minutes. Participants will be briefed on the three current risk assessment methodologies. The participants will be asked a series of interview questions regarding the steps incorporated into each risk assessment methodology. The participants will be asked to verbally respond to each risk assessment step with the phrases “Critical, Somewhat Necessary, or Rarely Necessary” as it pertains to first-responder risk perception. If the participant elects to not answer the interview
question, the participant may answer “Pass” and move on to the next question. The participants will also be interviewed to provide personal insight as to whether current risk assessments provide first-responders with necessary tools to perform the job of first-responder. If the risk assessments do not, the participant will be asked to identify what the subject views as lacking from the assessments. This will conclude the interview.

The participant’s first name and title will be utilized in the work as a response identifier, if consented to below. **If a participant withholds consent of name and title use, the results will be presented by a neutral identifier ONLY (such as: Respondent 1).** All participant interview responses will be collective pooled in order to establish a first-responder risk perception pattern to be used as the basis of a first-responder risk assessment model. Participants are asked to consent to audio recording of the interview. Participants should be aware that the audio recordings will not be kept on a "secure" https server of the kind typically used to handle credit card transactions, so there is a small possibility that responses could be viewed by unauthorized third parties (e.g., hackers).

Participation is voluntary, refusal to take part in the study involves no penalty or loss of benefits to which participants are otherwise entitled, and participants may withdraw from the interview study at any time without penalty or loss of benefits to which they are otherwise entitled. Participants may skip any questions during the interview they do not feel comfortable answering by stating “pass”.
If you have further questions or concerns about your rights as a participant in this study, contact the American Public University System, IRB Chair at apus-IRB@apus.edu.

_____ I consent to participate in this study.
_____ I consent to be audio-recorded.
_____ I DO NOT consent to be audio-recorded.
_____ I consent to my first name and title to be utilized in the written work as a response identifier.
_____ I DO NOT consent to my first name and title to be utilized in the written work; I ONLY wish to be identified by a neutral identifier such as Responder 1.

By signing below I consent to participate in the study, verify that I am 18 years of age or older, and fully understand the statements above.

______________________________  ______________________
Signature                      Date
Appendix IV

Interview Script

Welcome to "First-responder Risk Perception" an interview that asks a series of questions to ascertain which risk assessment methodology steps are necessary to perform the job of first-responder. Thank you for agreeing to take part in this interview. As stipulated in the consent form, the interview can be terminated at any time without penalty. No deception is involved, and the study involves no more than minimal risk to participants (i.e., the level of risk encountered in daily life).

It is my intention to contribute a singular risk assessment methodology to be utilized by first-responders prior to and during a potential mass casualty event that may be replicated with uniformity across the nation. In accordance with first-responder interviews, I will dissect and analyze the individuals steps involved in the workings of the most prominent risk assessment methods: Maritime Security Risk Analysis Model (MSRAM), the CARVER matrix, and Operational Risk Management (ORM) in order to isolate the most essential steps of each risk methodology. The result will be a hybrid risk assessment matrix designed from the first-responder perspective.

Questions:
What current risk assessment methods are utilized by yourself and fellow first-responders in the preparation or event of a mass casualty event (i.e. terrorist activity, natural disaster)?

Do the current risk assessments fit all the needs of the department? If not, what is lacking?

What aspect of risk assessment is most critical to you as a first-responder?

It is stipulated that responding to a mass casualty event is highly psychologically and physically stressful. Given this stipulation, and your expertise as a first-responder, do you believe a proper first-responder risk assessment matrix would include a step mandating ease of access to mental health services following the event of mass casualty?

For the next portion, I will briefly go over the outline handout provided to you detailing the three risk assessments and respective steps. As a participant, you will be asked to rate whether the respective steps incorporated into each risk assessment methodology are Critical, Somewhat Necessary, or Rarely Necessary. If you elect to not answer the question, you may answer “Pass” and move on to the next question.
CARVER MATRIX Steps:
(1) Criticality, (2) Accessibility, (3) Recoverability, (4) Vulnerability, (5) Effect OR Effect on Populace, and (6) Recognizability.

MSRAM Steps:

ORM Steps Deliberate Level:
(1) Identify hazards, (2) Assess hazards, (3) Make risk decisions, (4) Implement controls, and (5) Supervise.

Debriefing: Do you have any questions for me?

Thank you for your time.
Appendix V

Risk Assessment Handout (Interview)

In the fields of Homeland Security and Emergency Management, three prominent risk assessment methodologies are used: Maritime Security Risk Analysis Model (MSRAM), the CARVER matrix, and Operational Risk Management (ORM). All risk assessment methodologies are assembled with clear, concise steps. The research presented in the work will identify the most relevant and most viable steps of the respective risk assessments in order to create a hybrid-matrix that is designed to assess the risks and hazards first-responders encounter during times of mass disaster. The suggested risk assessment model will be consistent with the Government Accountability Office (GAO) and the National Infrastructure Protection Plan (NIPP) risk frameworks, as well as meet risk management criteria and evaluation standards put forth by the Homeland Security Risk Management Doctrine.

FRAMEWORKS:


*2013 National Infrastructure Protection Plan (NIPP) Risk Framework: One/More of Three Elements (physical, cyber, human) / Set Goals and Objectives / Identify*
THE BRUNO METHOD

Infrastructure / Assess and Analyze Risk / Implement Risk Management Activities / Measure Effectiveness (NIAC, 2008).

RISK METHODS:

**CARVER Matrix**

CARVER is a mnemonic for the following main elements and attributes:

Criticality, Accessibility, Recoverability, Vulnerability, Effect OR Effect on Populace, and Recognizability. Criticality focuses on the points of failure and the degree of importance to the infrastructure. Accessibility then focuses on the ease of access to the named critical asset. Recoverability highlights the time and effort to recover or resume operation of the infrastructure. Vulnerability documents the level of exposure to an adverse event based on adversary capability. Effect OR Effect on Populace focuses on impact and the magnitude of the consequences from an adversary attack. Recognizability, which highlights the likelihood that adversaries would recognize that an asset was critical. The characterization of the CARVER matrix's quantification scheme identifies the most attractive area/infrastructure to attack by an adversary based upon six (6) essential factors utilizing a sliding linear scale from 1-10. 1 on the linear scale corresponds with no risk assessed to operations to 10 being detrimental damage or the ceasing of known operations as a result of an adverse event as demonstrated below.
As noted above in FIGURE 1, the CARVER matrix's approach to aggregating threat, vulnerability and consequence into "risk" is all encompassing. In using the CARVER matrix to assess man-mad versus natural hazards, while the CARVER matrix was designed for the military it can be applied to most anything as long as a goal is in place.

**Maritime Security Risk Analysis Method:**

MSRAMs history begins as a singular United States’ Coast Guard tool after the events of September 11, 2001. Since that time, it has undergone several revisions to where it currently stands as a tool utilized throughout maritime areas concerned with the Department of Homeland Security.
As the observer can see, the location of the data points on the MSRAM's scatter plot determine whether or not a decision maker a manager can coherently decide what initiates the majority of the risk factor and whether it is attributed to Threat and Vulnerability or simply the Consequence. The decision is then whether to transfer, reduce, mitigate, or accept the risk. MSRAM identifies its risk management methods with the following: Response/Preparedness/Recovery Capabilities (which mitigate consequence), Protection Measures (system security or the hardness of a target directly reduces the vulnerability and attractiveness of a target which in turn drops the probability
the target will be attacked), and Prevention Measures (mitigate and/or reduce all factors related to the risk formula.

**Operation Risk Management**

Similarly to the MSRAM method, Operation Risk Management (ORM) is also heavily and primarily utilized in the United States’ United States’ Coast Guard. Operational Risk Management (ORM) has been in existence for some time. ORM also appears to be, by far, the most simple for a lay person to operate of the methodologies studied in this paper. Operational Risk Management is defined by the United States' United States’ Coast Guard as: "A continuous, systematic process of identifying and controlling risks in all activities according to a set of preconceived parameters by applying appropriate management policies and procedures. This process includes detecting hazards, assessing risks, and implementing and monitoring risk controls to support effective, risk-based decision-making" (USCG, 1999). In the context of this assignment, the U.S. Department of Defense has publicly designated four (4) primary principals for which ORM is designed to function: accept risk when benefits outweigh the cost, accept no unnecessary risk, anticipate and manage risk by planning, and to make risk decisions at the right level. There are three (3) common levels of ORM: In Depth, Deliberate, and Time Critical. In depth risk management is intensively preparatory in nature. Examples of in depth risk management would be training staff or constant redrafting instructions to
a designated project. The deliberate level of ORM functions primarily as do service check on a car, that is to say some of the following are examples of deliberate ORM: quality assurance, and extensive performance assessments. Time Critical risk management is by far the most complex level, of which risk management is in use throughout the operation. For the purposes of this exercise, the deliberate level is what the Department of Defense, as well as the United States’ United States’ Coast Guard focus on. The deliberate level as pertaining to homeland security facets engages a set of five (5) key steps: (1) Identify hazards, (2) Assess hazards, (3) Make risk decisions, (4) Implement controls, and (5) Supervise (and watch for changes). The United States Navy focuses on the time critical level, producing a four (4) step model that also includes: assessing situations, balancing resources, communication of risks, and to take action against the risk.

**Referenced:**


GAO. "United States’ Coast Guard: Security Risk Model Meets DHS Criteria, but More
Training Could Enhance Its Use for Managing Programs and Operations." United


National Infrastructure Advisory Council, (2008), Chemical, Biological and Radiological
Events and The Critical Infrastructure work force Final Report,

<http://www.dhs.gov/xlibrary/assets/niac/niac_CBR_FINAL_REPORT.pdf>