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# **RISK ANALYSIS AND INTELLIGENCE COMMUNITIES COLLABORATIVE FRAMEWORK**

## **Final Report**

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# EXECUTIVE SUMMARY

## Objective and Approach

Improving and expanding the use of risk analysis within the U.S. Department of Homeland Security (DHS) has been a consistent aim among the Department's senior leadership. For example, one of the five Action Directives issued by DHS Secretary Janet Napolitano upon taking office focused on risk analysis, which she subsequently declared helps to "assure that the Department's strategies are risk-based."<sup>1</sup>

Homeland security risk assessments often depend on receiving tailored threat judgments from intelligence analysts and others with expert knowledge about terrorist threats. However, producing useful threat judgments for DHS risk assessments is complicated by basic differences in the disciplines of risk and intelligence analysis. The Homeland Security Institute (HSI) was asked by the DHS Directorate for Science & Technology (S&T) to undertake an analytic project to help improve collaboration between these two disciplines.

The project's specific purpose was to develop a framework for enabling greater collaboration between the community of risk analysts, who rely on tailored threat information for making risk assessments, and the community of intelligence analysts who provide much of this input. In developing a collaborative framework, the HSI team sought to advance basic thinking on collaboration principles and to offer practical recommendations for how DHS intelligence and risk analysts can better work together on risk assessments. This task also involved developing a tutorial to help intelligence analysts and risk analysts learn more about each other's discipline and approach.

The project was based on an analytical method to collect insights on how intelligence and risk analysts view the challenges of working together in producing the threat judgments needed for DHS risk assessments. The HSI team undertook a literature review and conducted interviews with individuals involved with DHS risk assessments, or who have been responsible for providing intelligence inputs. In addition, we organized a series of Collaboration Workshops that brought together DHS intelligence and risk analysts to identify existing challenges and potential opportunities for improving collaboration to produce reliable threat judgments. Based on their inputs, we evaluated the relative benefits and limitations of three basic types of interaction between DHS intelligence and risk analysts for generating threat judgments. The results provide the basis for our project outputs—the findings and recommendations presented below.

**Annuities**

## Major Findings and Recommendations

The HSI team identified several challenges to obtaining threat judgments for DHS risk assessments. We also offer specific recommendations on how the members of the DHS Intelligence Enterprise and the corresponding risk community can improve their

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<sup>1</sup> Testimony of Secretary Janet Napolitano before the House Committee on Homeland Security on "DHS, The Path Forward," 111<sup>th</sup> Cong., 1<sup>st</sup> sess., February 25, 2009, p. 2.

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collaboration in producing decision-quality threat inputs needed to support senior DHS decision-makers in making sound risk management choices.

### **Need for Greater Cross-Discipline Familiarity**

*Finding: Collaboration between intelligence and risk analysts is constrained by the absence of cross-discipline familiarity.* Risk analysts sometimes have unrealistic expectations concerning the ability and willingness of intelligence analysts to provide quantifiable threat inputs. Similarly, they can underestimate the amount of time and effort needed to work with intelligence analysts in producing “decision quality” threat judgments. Likewise, intelligence analysts typically expect risk assessments to account for uncertainty at levels of detail that can create unmanageable complexity for risk analysts without necessarily improving the usefulness of the results.

*Recommendation: DHS should take steps to improve cross-discipline familiarity between the risk analysis and intelligence communities.* Such steps could go a long way toward reducing unrealistic expectations on both sides and helping to avoid wasted efforts. These steps can include:

- *Cross-discipline education.* Intelligence and risk analysts could benefit from having a variant of the existing *DHS Risk Lexicon* tailored to support their joint activities. Similarly, this report has companion materials (a written tutorial and a supplementary briefing) for cross-discipline education purposes.
- *Cross-training.* DHS should provide intelligence and risk analysts with training that ranges from a standardized orientation session for all DHS risk and intelligence analysts to more in-depth training for the managers and analysts most involved in producing threat judgments.
- *Personnel exchanges.* The DHS Office of Risk Management and Analysis (RMA) should sponsor personnel exchanges with DHS intelligence and threat organizations.
- *Facilitation point of contact (POC).* The DHS Office of Intelligence and Analysis (I&A) should take the lead in establishing a “facilitation POC” for assisting risk analysts in working with the diverse components of the DHS Intelligence Enterprise.
- *Increasing transparency.* Providing intelligence analysts with access to documentation generated in the course of the DHS risk assessment process could help encourage cross-discipline familiarity and transparency.

### **Moving Beyond “Supply and Demand” to Mutually Beneficial Collaboration**

*Finding: The existing relationship between the two communities largely operates one-way: risk analysts present a “demand” for threat inputs and intelligence analysts seek to “supply” the needed inputs.* Relying on a supply and demand relationship is not well-suited for meeting the needs of DHS decision-makers for decision-quality threat inputs. Risk analysts need threat judgments from DHS intelligence analysts, but the broader benefits for intelligence analysts are less apparent. In fact, providing support for DHS risk assessments can involve added efforts for intelligence analysts in a way that



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currently competes with their time available to fulfill standing intelligence mission requirements.

*Recommendation: Steps should be taken to promote mutually beneficial collaboration between the risk analysis and intelligence communities for the purpose of ensuring high-confidence threat judgments over the longer term.* Developing an interaction process that gives both communities a mutual stake in producing the high-quality threat judgments needed for DHS risk assessments is the best basis for cross-discipline collaboration. Within this context, systematic engagement between intelligence and risk analysts throughout the risk assessment process could increase the benefits for intelligence analysts, including feedback on how their threat inputs were used and what types of questions DHS decision-makers posed concerning the risk assessments. However, added resources and dedicated time are needed for intelligence organizations that are planning to make their intelligence analysts available to provide threat judgments. Managers in the DHS risk and intelligence communities must ensure that senior decision-makers recognize the importance of receiving quality support from the DHS Intelligence Enterprise. Senior decision-makers must be willing to provide the needed guidance, task-specific training, and additional resources to allow the DHS risk analysis and intelligence communities to work together closely enough as needed to produce decision-quality threat judgments.

### **Leveraging Systematic Engagement to Achieve Better Threat Judgments**

*Finding: Many DHS risk assessments depend on risk and intelligence analysts to work together effectively to produce threat judgments. Most approaches would benefit from undertaking systematic engagement throughout the risk assessment process.* Our analysis and interviews indicate that there are significant benefits from involving intelligence analysts at an early stage in the risk assessment process. DHS risk assessments that rely on continuous (or frequent) interactions with intelligence analysts have a better chance of producing decision quality threat judgments.

*Recommendations: Managers responsible for DHS risk assessments should enhance the collaboration of risk and intelligence analysts by encouraging systematic engagement throughout the entire process.* The collaborative framework presented in this report provides guidelines that place a premium on sustained collaborative interactions throughout all three phases of each risk assessment (assuming continuous interaction between DHS intelligence and risk analysts does not already exist). The recommended interactions include:

- *Phase I: preparation and initial engagement.* Risk analysts should review available intelligence products recommended or provided by the intelligence analysts, develop a clear research design and then convey their essential approach and needs for threat judgments to their intelligence counterparts in a concise and documented manner (e.g., a terms of reference).
- *Phase II: scenario development and threat inputs.* The aim should be for intelligence and risk analysts to work together in facilitated “brainstorming” sessions to draft a set of scenarios (and/or attack paths) that both sides find useful and plausible. This changes their relationship from a supply-and-demand basis to a more productive collaboration with a better chance of producing decision-

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quality threat judgments that senior DHS decision-makers can have confidence in using to make risk management choices.

- *Phase III: follow-up activities.* Having the risk analysts reengage with intelligence analysts after the risk assessment has been completed also helps to strengthen the collaboration process over the long run by providing intelligence analysts with some useful insights resulting from their participation in the DHS risk assessment process. In addition, risk analysts could alert intelligence analysts to future needs for threat inputs.

## **Outstanding Research Issues**

*Finding: Critical questions concerning how best to obtain and incorporate terrorist threat judgments into DHS risk assessments remain to be addressed.* DHS risk assessments have greatly benefited from leveraging academic research and professional practices in many areas to develop their particular approaches. However, some questions are very specific to the nature of homeland security problem, such as generating judgments on terrorist threats, where these broader works are less helpful.

*Recommendation: DHS/S&T should encourage research efforts that address outstanding questions on threat judgments needed for DHS risk assessments.* With the intent of informing the long-term research agenda, the HSI team was asked by the study sponsor to identify important research topics that could enhance the collaboration of the intelligence and risk analysis communities in their joint effort to support DHS risk assessments. The HSI team recommends that the DHS Directorate for Science & Technology encourage research and analysis on practical improvements in how threat judgments are produced for DHS risk assessments. The following research questions deserve particular attention:

- What are realistic expectations in making threat judgments for DHS risk assessment purposes, particularly concerning quantifiable judgments?
- How should DHS risk assessments account for adaptive, intelligent terrorist adversaries?
- How should homeland security risk analysts identify and make use of the needed threat expertise that exists both within and outside of the national Intelligence Community?
- Is reliable proxy data on terrorist intent and capabilities available, and what would be the proper conditions for using it to support DHS risk assessments?

Thus, along with providing recommendations to improve how DHS intelligence and risk analysts can work together in producing threat inputs for DHS risk assessments, this report also identifies relevant issues that can inform the long-term research agenda for homeland security risk management.

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# 1. INTRODUCTION

By integrating expert analysis of homeland threats, vulnerabilities and the consequences of adverse events, risk assessments play an increasingly important role in supporting U.S. homeland security decision-making and planning. They help inform Department of Homeland Security (DHS) risk management decisions on operational priorities and resource allocations given a broad range of risks that the nation faces from terrorist threats, natural disasters, and other hazards. Such assessments often depend on receiving tailored threat judgments from intelligence analysts and others with expert knowledge about terrorist threats. However, producing useful threat judgments for DHS risk assessments is complicated by basic differences in how the risk analysis and intelligence communities approach such problems. Our report identifies ways to achieve mutually beneficial collaboration between risk and intelligence analysts who need to work together on homeland security risk assessments.

**Annuity Rates**

## **Purpose**

The Homeland Security Institute (HSI) was asked by the DHS Directorate for Science and Technology (S&T) to undertake a study project that could enhance collaboration between the DHS risk analysis and intelligence communities. The project's specific purpose was to develop a framework for fostering greater collaboration between the community of risk analysts, who rely on tailored threat information for making risk assessments, and the intelligence analysts who provide much of this input. This collaborative framework, which offers a set of principles and procedures, identifies ways of improving the process and methods for obtaining threat inputs needed for DHS risk methods and modeling purposes. In addition, we were tasked to produce a tutorial for intelligence and risk analysts involved in joint activities who want to become more knowledgeable about each others' discipline.

## ***Project objectives***

In accomplishing the project's main purpose, the HSI research team had two complementary objectives:

- *Applications*: to make certain the project's results and products offer useful inputs to ongoing DHS risk analysis activities by identifying ways of improving upon existing collaborative processes and methods, and
- *Research*: to make a broader contribution to thinking among the community of scholars and experts working to advance the state of the art concerning risk analysis principles and methods to generate expert judgments.

Thus, our project's activities and resulting products are intended both to advance basic thinking on collaboration principles and to offer practical recommendations for DHS practitioners.

**Best Life Insurance**

## ***Stakeholders***

The HSI team worked with relevant stakeholders in the DHS risk analysis and intelligence communities. The primary stakeholders for this project were the DHS

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components and directorates concerned with advancing the state of the art on risk analysis and modeling that makes use of threat judgments from intelligence analysts. On the risk analysis side, these stakeholders included the project’s sponsoring organization, the DHS/S&T Directorate, along with the National Protection and Programs Directorate’s Office of Risk Management and Analysis (RMA) and offices concerned with risk analysis in the Office of Infrastructure Protection (OIP), the Transportation Security Administration (TSA), and the U.S. Coast Guard (USCG).

On the DHS intelligence and threat analysis side, key stakeholders included the DHS Office of Intelligence and Analysis (I&A), particularly its Critical Infrastructure and Threat Analysis (CITA) Division<sup>2</sup>, along with the Homeland Infrastructure Threat and Risk Analysis Center (HITRAC) that it operates in conjunction with the Office of Infrastructure Protection.<sup>3</sup> This project’s activities also involved other intelligence organizations within the DHS Intelligence Enterprise, including TSA’s Office of Intelligence, and the USCG Intelligence Coordination Center (ICC), which are involved in supporting DHS risk assessments.<sup>4</sup>

### ***Intended Audiences***

The intended audiences for this HSI report are decision-makers, managers, and analysts in the homeland security community who have current or likely future responsibilities for producing or using DHS risk assessments. This report could be particularly useful for DHS managers who oversee joint assessment activities involving risk and intelligence analysts. Similarly, individual analysts from either discipline who might participate in soliciting or producing threat judgments for risk assessments could find this report helpful. Finally, this report has a companion tutorial (and supplemental briefing material) that covers the fundamentals of homeland security risk assessments and terrorist threat assessments. These were developed mainly for DHS risk and intelligence analysts (and their managers) who are interested in learning more about each other’s discipline.

## **Scope and Limitations**

This research project was concerned with identifying ways of ensuring mutually beneficial collaboration among the DHS risk analysis and intelligence communities—its focus is limited to their collaborative activities in supporting homeland security risk assessments. While we drew on the broader insights from the scholarly and commercial

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<sup>2</sup> More recently, the Critical Infrastructure and Threat Analysis (CITA) Division in I&A has been renamed the Domestic Threat Analysis Division.

<sup>3</sup> One of the special features of HITRAC is that it is a joint program office within DHS that brings together expertise from the Office of Infrastructure Protection and the Office of Intelligence and Analysis to create and disseminate threat- and risk-informed analytic products relevant to the nation’s infrastructure protection strategies and protective actions.

<sup>4</sup> The DHS Intelligence Enterprise brings together the various intelligence elements operating within different DHS components, including: the Office of Intelligence and Analysis; the Customs and Border Protection’s Office of Intelligence; the Immigration and Customs Enforcement Office of Intelligence and Operations Coordination; the TSA Office of Intelligence, the Office of Fraud Detection and National Security of the U.S. Citizenship and Immigration Services (USCIS), and the USCG Intelligence Coordination Center.

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literature on risk analysis, expert elicitation methods, and survey research, the aim was to identify ways of producing useful threat judgments for risk assessments within the homeland security context and not necessarily to make original contributions to the discipline of risk analysis *per se*.

Although the HSI team gained insights from the experience of varied DHS risk methods and models, this report does not offer a comprehensive review of past and ongoing efforts. Instead, we discuss some specific DHS risk assessments as a way of illustrating different types of approaches for how intelligence and risk analysts can work together to generate threat judgments. We did not investigate non-DHS risk assessments that might be undertaken by other federal agency, State and Local government entities, or private sector firms.<sup>5</sup>

Within the context of DHS risk assessments, we focused our analysis on the challenges of producing terrorist threat judgments rather than the full range of natural disasters and human accidents.<sup>6</sup> We chose this focus because offering specific judgments concerning terrorist threats is particularly challenging for intelligence analysts.

Finally, this report is purposefully written at the unclassified level to allow for unrestricted distribution within the homeland security community, within the guidance provided by the DHS project sponsor. One limitation is that the discussion of DHS risk assessment activities, and associated activities with intelligence and threat analysis organizations to generate threat inputs, is somewhat abbreviated to meet this requirement for unrestricted dissemination of this report.

## **Data Sources**

The project methodology involved a research and analysis approach that took advantage of multiple venues to obtain insights on the nature of challenges and opportunities for improving collaboration between intelligence and risk analysts.

### ***Data collection***

The HSI team reviewed literature produced by practitioners and academic researchers on techniques for generating expert judgments, especially those techniques that appear most relevant to support DHS risk assessments, such as expert elicitation. In addition, we interviewed individuals who had observed, participated in, or provided intelligence inputs to such assessments. Several of these individuals were HSI colleagues with experience in these areas.

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<sup>5</sup> Risk analysis is also being used at the regional, state and local levels of government, as well as within the private sector, to assess threat, vulnerabilities, and the consequences of possible man-made and natural events. A good example is the Terrorism Risk Assessment and Management (TRAM) toolkit, which has been developed to assist decision-makers and analysts at the Port Authority of New York/New Jersey in assessing a broad range of potential threats and hazards to help inform risk management decisions on their critical infrastructure assets.

<sup>6</sup> In some cases, the DHS risk assessment methods and models that we examined possess the ability to account for both terrorist threats and major natural disasters. See Appendix B for examples of risk assessment models that account for both types of threats or hazards.

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## ***Expertise and Feedback***

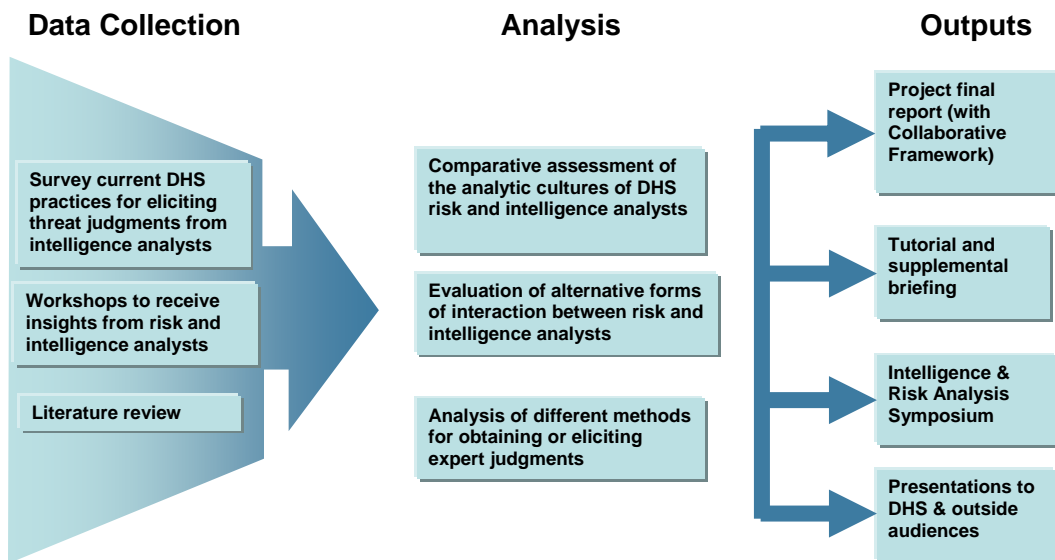
The HSI team drew on its interdisciplinary team expertise and outside consultants with extensive experience in risk analysis and/or intelligence analysis to assess ways to improve how risk and intelligence analysts can collaborate. We evaluated alternative approaches for generating threat judgments and identified opportunities for improving collaboration by developing a collaborative framework.

We gained invaluable feedback to our initial analysis and findings from the participants in a series of three “Collaboration Workshops” hosted by HSI during September to November 2008 (see Appendix A for details). The participants involved DHS risk and intelligence analysts, as well as outside academic and private sector experts in risk analysis or intelligence analysis. The workshop sessions provided an opportunity for the participants to engage in candid discussions of the challenges that intelligence and risk analysts encounter in working together to generate tailored threat judgments, as well as potential ways to improve collaboration.

## **Analytic Method**

In producing our findings and recommendations, the HSI team relied on an analytic method that gained insights in various ways from DHS intelligence and risk analysts who have experience in producing threat judgments, as well as reviewed the relevant literature produced by practitioners and scholars. As Figure 1.1 shows, the team’s analysis involved seeking to understand the distinctive analytic cultures of the DHS intelligence and risk communities, evaluating the different types of interactions that DHS risk and intelligence analysts have used in working together to generate threat inputs, and analyzing particular methods for obtaining expert judgments, such as expert elicitation.

**Figure 1.1: Project Analytic Method.**



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The insights gained from using this analytic method provided the basis for the project's findings and recommendations. These outputs took the following forms:

- *Collaborative Framework*. This report, which presents a collaborative framework that identifies principles and practices for achieving mutually beneficial collaboration between the intelligence and risk analysis communities, is the HSI project's primary output. In formulating the framework as an aid for practitioners, we recognized that any such framework required sufficient flexibility to apply to a range of interaction approaches that can be found among the different DHS risk methods and models.
- *Tutorial*. This task also involved developing a tutorial to help intelligence analysts and risk analysts better understand each other's discipline and approach. The HSI team has produced a companion document to this report that offers a combined tutorial: the target audience is risk analysts and intelligence analysts involved in requesting, producing and/or using threat inputs for DHS risk methods and models. For intelligence analysts, the tutorial presents the fundamentals of risk methods and models, and discusses why there is a need for terrorist threat inputs in a particular form. Likewise, the tutorial offers risk analysts an introduction to the fundamentals of intelligence analysis with particular attention to the analytic challenges of providing terrorist threat assessments.
- *Supplemental Briefing*. Supplementing the tutorial is a separate annotated briefing, "Enhancing Risk Analysis and Intelligence Communities Collaboration." The briefing offers the equivalent of an initial presentation in a training session aimed at facilitating how intelligence and risk analysts work together in producing threat judgments for DHS risk assessments. It provides an active teaching method that can be an effective supplement to the tutorial, assuming that those serving as the presenters possess a good grounding in the issues associated with the risk and intelligence disciplines.
- *Presentations and Stakeholder Feedback*. This project also benefited from having several opportunities to present the HSI team's preliminary findings and recommendations to broader audiences that included DHS practitioners, and in some cases, outside risk analysis and intelligence professionals. These opportunities included:
  - HSI project concepts and draft findings presentation to the Collaboration Workshop (November 18, 2008), which brought together DHS risk and intelligence analysts, and some outside experts.
  - HSI project preliminary findings presentation at the Society for Risk Analysis (SRA) Annual Conference (December 9, 2008) on a panel concerning DHS risk analysis entitled, "Homeland Security Risk Management: A Look Under the Hood."
  - HSI project preliminary findings and recommendations at the "Intelligence and Risk Analysis Symposium," (December 16, 2008), which was cosponsored by the National Center for Risk and Economic Analysis of Terrorism Events (CREATE), the Center for Peace and

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Security Studies (CPASS) at Georgetown University, and the Homeland Security Institute (HSI). The symposium brought together practitioners and scholars in the areas of risk analysis and intelligence analysis to discuss issues of mutual concern, including how intelligence and risk analysts can work better together.

- HSI presentation of project findings and recommendations at meeting (March 11, 2009) of the DHS Risk Steering Committee (Tier III), which is a cooperative body that was formed to ensure that risk management is carried out consistently and comparably throughout DHS.

Along with interviews and discussions that occurred in the project's research phase, these presentations resulted in additional useful feedback from stakeholders in the risk analysis and intelligence communities concerned with homeland security threats.

## **Report Organization**

This report is organized as follows:

- Section 1 discusses the project's purpose, scope, and approach.
- Section 2 analyzes the importance of collaboration for intelligence and risk analysts within the context of DHS risk assessments and the challenges associated with obtaining needed threat judgments.
- Section 3 discusses ways to enhance cross-discipline collaboration in a way that achieves mutually beneficial interactions between the risk analysis and intelligence communities.
- Section 4 presents the collaborative framework, which identifies practices for improving how intelligence and risk analysts work together in producing the threat judgments needed as inputs to DHS risk assessments.
- Section 5 presents the project's main findings and offers policy-relevant recommendations.

In addition, the report includes a list of acronyms prior to the appendices. The appendices provide additional information on relevant issues. In particular, Appendices C through F offer more detailed discussions of specific topics (such as the problem of representing adaptive adversaries, or the various approaches used to elicit expert judgments) that have a significant bearing on collaboration between the DHS intelligence and risk analysis communities. Also this report has companion material: a tutorial for risk and intelligence analysts, and a supplemental instruction material in the form of an annotated briefing.



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## 2. THE IMPORTANCE OF COLLABORATION BETWEEN RISK AND INTELLIGENCE ANALYSTS

Sound threat judgments are an integral element in producing risk assessments that inform DHS decision-makers' risk management decisions. Despite the premium placed on having credible risk assessments for homeland security purposes, intelligence and risk analysts can encounter impediments in working effectively together to produce the needed threat judgments. Improving how risk and intelligence analysts can collaborate is a necessary for ensuring confidence in DHS risk management decisions.

This section sets the stage by reviewing the nature of risk assessments used to support DHS risk management decisions, provides an overview of representative DHS risk assessments, discusses current approaches to producing threat judgments for these assessments, and examines the collaboration challenges associated with generating threat judgments for DHS risk assessment purposes.

### How DHS Uses Risk Assessment

Given limited resources and time, DHS decision-makers and staff need realistic assessments of the risk to the homeland from multiple threats, including terrorist attacks, natural disasters, pandemic diseases, and border issues. For DHS decision-makers, planners, and operators to have confidence in risk management decisions, they must be persuaded that the underlying risk assessments are based on well-founded judgments provided by knowledgeable individuals.

#### *Risk Assessment*

Homeland security risk analysts depend on experts from various disciplines to make judgments on threat, vulnerability and consequence issues that are integral to producing risk assessments. They depend on these subject matter experts to provide informed judgments on the following types of questions that are the basis for risk assessments:

- What can happen?
- How likely is it to happen?
- What is the severity of consequences?<sup>7</sup>

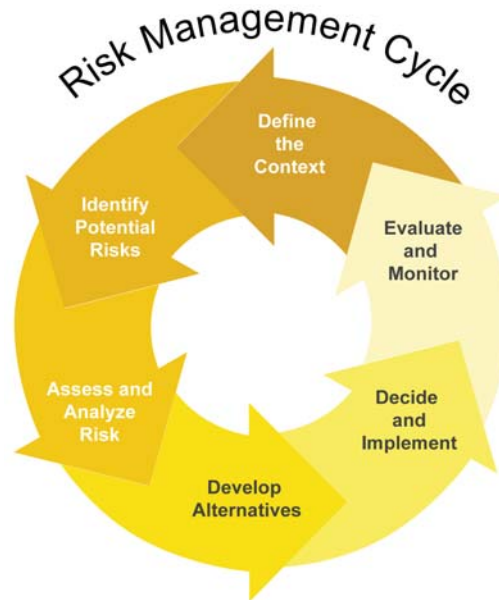
In the homeland security context, such experts are asked to provide their best judgments on the likelihood and consequences of events, such as particular types of terrorist attacks, which have previously occurred only rarely or not at all. Hence, the risk analysts must

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<sup>7</sup> Sources: Communication with Dr. William L. McGill, The College of Information Sciences and Technology, The Pennsylvania State University, 15 December 2008, and congressional testimony of Dr. Detlof von Winterfeldt, CREATE, *Terrorism Risk Assessment at the Department of Homeland Security*, hearing before the Subcommittee on Intelligence, Information Sharing, and Terrorism Risk Assessment of the House Committee on Homeland Security, 109<sup>th</sup> Cong., 1<sup>st</sup> sess. (Washington, DC: U.S. Government Printing Office, 2007), p. 19.

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account for the fact that substantial uncertainty exists in generating expert judgments on various aspects of threat, vulnerability, and consequences. As Figure 2.1 indicates, risk assessment constitutes a key step in the DHS risk management process by identifying potential homeland security risks and then assessing and analyzing risk.<sup>8</sup>



**Figure 2.1: DHS Risk Management Process.**

***Risk Management***

Risk assessment, in turn, serves as part of the broader analytic process to enable decision-makers to address the following types of questions that are central to making risk management choices:

- What can be done?
- What options are available, and what are the benefits and costs of each option?
- What impact do current options have on the future choice of options?

These core techniques associated with risk assessment and risk management build on decades of experience gained in other fields, including industrial safety, environmental protection, and business, where the use of risk analysis has taken root. However, applying such techniques to homeland security without modification is problematic. Because DHS risk assessments, which are the focus of this report, need to account for threats involving

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<sup>8</sup> Figure adapted from U.S. Department of Homeland Security (DHS), Risk Steering Committee, *Interim Integrated Risk Management Framework* (Washington, DC: DHS, January 2009), p. 8.

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an intelligent, adaptive adversary, DHS risk techniques must address an added complexity. As one expert on decision analysis has observed:

The application of risk assessment to terrorism is relatively new, providing new opportunities and challenges. Natural and engineered systems are “neutral” agents who don’t seek out our vulnerability. Terrorists, in contrast, are the adversaries who attempt to attack us where we are weak, and furthermore they adjust their actions in response to our defenses. This non-random nature of terrorism complicates risk assessment and requires the development of new tools.<sup>9</sup>

This added challenge highlights the importance of developing sound approaches for intelligence and risk analysts to work together.

## **DHS Risk Assessments**

Risk assessments are undertaken by organizations within DHS (e.g., the Office of Infrastructure Protection, the Transportation Security Administration, the U.S. Coast Guard) to address their mission-related needs for analysis of the relative risk associated with a range of threats and/or hazards. These DHS risk assessments are characterized by their diversity—they range from formal analytic methods and models or simulations to more generic applications of basic concepts of risk assessments. Some DHS risk assessments focus only on terrorist threats; other are concerned with a broader range of threats and hazards, including natural disasters, pandemics, major industrial accidents, or illegal movements of people across U.S. borders.

The following is a representative sample from the several dozen wide-ranging risk methods that were identified within DHS at the time this report was written. Some methods and models are already being used to inform decisions, while others are in various phases of evolutionary development:

- Bioterrorism Risk Assessment (BTRA) and Chemical Terrorism Risk Assessment (CTRA): Science and Technology (S&T) Directorate
- Homeland Security Grant Risk Model: Federal Emergency Management Agency (FEMA) Grants Program
- ICE Enterprise Risk Management: U.S. Immigration and Customs Enforcement (ICE)
- Maritime Security Risk Analysis Model (MSRAM): U.S. Coast Guard (USCG)
- Risk Analysis Process for Informed Decision-making (RAPID): Office of Risk Management and Analysis, National Protection and Programs Directorate (NPPD)

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<sup>9</sup> Testimony of Dr. Detlof von Winterfeldt, Director, Center for Risk and Economic Analysis of Terrorism Events (CREATE), *Terrorism Risk Assessment at the Department of Homeland Security*, pp. 17-18.

- Risk Management Analysis Process (RMAP) for Commercial Aviation Security: Transportation Security Administration (TSA)
- Risk Method for Portfolio Planning: developed for the Science and Technology Directorate by the Homeland Security Institute (HSI)
- Strategic Homeland Infrastructure Risk Assessment (SHIRA): the Homeland Infrastructure Threat and Risk Analysis Center (HITRAC).

Additional details on these methods are located in Appendix B.

Risk assessments that focus on terrorist threats usually characterize risk as a function of the following key variables:

- *Threat* – the likelihood that an attack by a terrorist group will be attempted based on assessments of the group’s intent and capabilities.<sup>10</sup>
- *Vulnerability* – the probability that an attempted terrorist attack will be successful in reaching and inflicting an expected level of damage on a target (or targets).
- *Consequences* – the likely effects of a terrorist attack against a target (or targets).



**Figure 2.2: Threat-Vulnerability-Consequences Approach.<sup>11</sup>**

<sup>10</sup> In some cases, DHS risk methods adapt this basic formulation to offer an “all hazards” approach that also accounts for the risk presented by natural disasters, such as major hurricanes and earthquakes.

<sup>11</sup> Adapted from:  
<http://www.rmia.org.au/LinkClick.aspx?fileticket=OY9nuxhET7o%3d&tabid=36&mid=633>.

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Figure 2.2 illustrates the combination of threat, vulnerability, and consequence factors that are applicable to many DHS terrorist risk assessments. The technique that risk analysts often use to obtain expert judgments on the types of threats in their area of analysis is the scenario. A scenario is a narrative and/or a basic set of assumptions that describe the attacker's aims, capabilities, and possibly an expected sequence of events.<sup>12</sup> A postulated threat is considered in the context of how it interacts with the potential vulnerabilities of a target, or set of targets. Finally, the risk analyst is interested in determining the likely consequences (e.g., casualties, economic damage, psychological impact) if the terrorist attacker successfully conducts the attack against the target (or targets) in question.

Some DHS risk assessments also require expert judgments on how existing or planned homeland security measures for prevention, protection, response and recovery might diminish the terrorist attackers' likelihood of undertaking an attack, or at least mitigate its consequences if the attack does occur.

## Threat Judgment Needs

Although assessing the nature of the threat to U.S. homeland security is a key element of the "threat-vulnerability-consequences" equation, it is also one of the most demanding aspects of producing a risk assessment. One reason is that threat is viewed as the most subjective component in the risk equation.<sup>13</sup> This means that risk analysts must count on intelligence analysts and other subject matter experts to possess the expertise and impartiality needed to provide *decision quality* threat judgments.

While DHS risk methods and models might share common principles, such as using the threat-vulnerability-consequences approach, there still can be substantial differences in the types of threat judgments that they require. Each DHS risk method or model tends to focus on a particular aspect of the potential threat to the U.S. homeland, such as those in the air or maritime domain or those associated with bioterrorism. In addition, they sometimes are concerned with different timeframes. For example, some models have a current threat focus while other are more concerned with how the intent and capability of terrorist groups are likely to evolve over the longer term.

Table 2.1 lists the types of threat judgments that risk analysts generally need for their DHS risk methods and models. As noted earlier, DHS risk methods vary in their specific requirements for threat judgments but most look for expert judgments on the estimated likelihood of different types of potential terrorist attacks against U.S. homeland targets. Risk analysts are likely to want these judgments in the current timeframe and/or might need estimates for a future timeframe if their risk assessments are focused on evaluating the relative benefits of homeland security measures that are planned or under consideration.

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<sup>12</sup> For additional discussion of how scenarios are best used in risk assessments, see the DHS Risk Management Analytical Guidelines draft paper, "Developing Scenarios."

<sup>13</sup> Testimony of Melissa Smislova, Acting Director, Homeland Infrastructure Threat and Risk Analysis Center, U.S. Department of Homeland Security, *Terrorism Risk Assessment at the Department of Homeland Security*, pp. 9-10.

Some DHS risk assessments use scenarios and postulated attack paths, which increases a need for additional judgments on the intent and capability of potential terrorist attackers. The capability of a terrorist group could be influenced by the type of terrorist attacker (e.g., transnational terrorist group, homegrown terrorist group, or a lone wolf attacker.) As a result, risk analysts may be interested in obtaining threat judgments that provide specific insights on likely U.S. target types, as well as what type of weapon and delivery system the terrorists are prone to employ against such targets.

<i>Threat Judgment Type</i>	<i>Specific Issues</i>	<i>Potential Sources for Threat Judgments</i>
Estimated likelihood of attacks	<ul style="list-style-type: none"> <li>• In the current timeframe</li> <li>• In a future timeframe (e.g., 5 years)</li> </ul>	<ul style="list-style-type: none"> <li>• Intelligence Community</li> <li>• Research centers/firms</li> <li>• Private risk assessment firms</li> </ul>
Types of terrorist attacks	<ul style="list-style-type: none"> <li>• Target type (e.g., critical infrastructure, public gathering location)</li> <li>• Weapon type (e.g., vehicle-borne explosive, biological weapon)</li> <li>• Domain (airborne, maritime, or land attack)</li> <li>• Tactics, techniques and procedures for executing the attack</li> </ul>	<ul style="list-style-type: none"> <li>• Intelligence Community</li> <li>• Technical community (e.g. national laboratories, other USG research institutes, DoD weapon firms)</li> <li>• Law enforcement and first responder communities</li> <li>• Research centers/firms</li> <li>• Open source providers</li> </ul>
Attacker types	<ul style="list-style-type: none"> <li>• By origin/structure: transnational terrorist groups, homegrown terrorists (with or without external support), lone wolf attackers</li> <li>• By ideology and objectives (e.g., radical Islamist, domestic extremists)</li> </ul>	<ul style="list-style-type: none"> <li>• Intelligence Community</li> <li>• Law enforcement community</li> <li>• Research centers/firms</li> <li>• Open source providers</li> <li>• Private risk assessment firms</li> </ul>
Estimated frequency of attacks	<ul style="list-style-type: none"> <li>• Relative to other potential types of terrorist attacks</li> <li>• Expected frequency over a given timeframe (e.g., 1, 2, 5 years)</li> </ul>	<ul style="list-style-type: none"> <li>• Intelligence Community</li> <li>• Research centers/firms</li> <li>• Private risk assessment firms</li> </ul>
Terrorist ability to acquire or adapt countermeasures against U.S. homeland security measures	<ul style="list-style-type: none"> <li>• Relative availability of countermeasures (e.g., false documentation)</li> <li>• Learning and adaptive potential of particular target groups</li> <li>• State sponsors of terrorists</li> </ul>	<ul style="list-style-type: none"> <li>• Intelligence Community</li> <li>• Research centers/firms</li> <li>• Technical community (e.g., national laboratories)</li> <li>• Operators of homeland security defense systems</li> </ul>

**Table 2.1: Types of Threat Judgments Needed for DHS Risk Assessments.**

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Finally, many DHS risk models address the terrorists' potential for adapting to U.S. and allied anti-terrorism security measures, such as no-fly lists or target protection measures. In making DHS risk management choices over time, decision-makers need a sense of the potential of terrorist attackers for acquiring or developing their own countermeasures to degrade, defeat, or circumvent U.S. homeland security measures. Thus, risk analysts often need expert judgments about adversarial behavior.

Table 2.1 also identifies the potential sources for expert judgments that are available for particular types of threat judgments. There is a broad range of sources that can serve to complement or even substitute in some cases for the Intelligence Community in providing expert judgments for homeland security risk assessments.

The choice of sources depends on what type of threat judgment is needed and the level of specific expertise that is required to address the questions posed in a particular DHS risk assessment.

Finally, it is worth noting that a useful threat judgment is defined by more than whether the expert provides needed input in quantitative or qualitative form. Rather, it is important that whatever the form of the threat judgment (e.g., estimated likelihood of a particular terrorist attack), it has certain desired attributes that increase the confidence of decision-makers and other users that the threat judgment is sound, defensible, and an accurate expression of the expert's view.<sup>14</sup>

Several factors explain why producing threat judgments for DHS risk assessments are often challenging. Our analysis, including feedback received from interviews and the Collaborative Workshops, indicates that among the most important impediments to collaboration are:

- *Distinctive disciplines.* An underlying impediment to improving how intelligence and risk analysts work together is rooted in their distinctive disciplines and the analytic cultures associated with them. What comes natural to risk analysts, who view threat judgments as one of several inputs for a risk method or model, is often viewed as an uncomfortable and counterintuitive request by intelligence analysts who have an appreciation for the dynamic and contingent nature of terrorist threats. This challenge is exacerbated by the basic lack of cross-discipline familiarity between the intelligence and risk analysis communities.<sup>15</sup>
- *Quantifying judgments* – Quantifying threat judgments for the purposes of calculating risks is a significant, often difficult and unfamiliar cultural change for many intelligence analysts. While risk analysts tend to prefer quantifiable threat inputs for their models, intelligence analysts generally prefer qualitatively based threat judgments that account for substantial uncertainty concerning the likely

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<sup>14</sup> Desirable attributes of threat judgments include the following: (1) a common understanding of the questions and answers between intelligence and risk analysts; (2) drawing the analyst's best judgment; (3) avoid conveying "false precision" to others; and (4) resulting from a transparent and traceable process. (See Appendix C for additional discussion.)

<sup>15</sup> As discussed in the next subsection, those DHS risk assessments that involve various forms of continuous interaction between DHS risk and intelligence analysts are likely to have fewer difficulties in this area.

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actions of adaptive terrorist adversaries. This intrinsic reticence is reinforced by a general reluctance to assign precise numerical values to intelligence analyst judgments within the national-level Intelligence Community that sets the overall analytical standards that also apply to the DHS Intelligence Enterprise.<sup>16</sup> Various techniques have been developed, including expert elicitation (see Appendix F) and probabilistic risk analysis that offer structured approaches to determining subjective probabilities provided by experts for likelihood of events where specifically relevant empirical data is unavailable or incomplete.<sup>17</sup>

- *Shortfalls in existing collaborative processes and elicitation methods.* One of the more demanding forms of collaboration involves periodic interactions between intelligence and risk analysts to produce threat judgments. This can involve the following types of challenges: insufficient preparatory effort, disagreements on scenarios and questions, lack of transparency or follow-up in the process, and inadequate time and resources available for joint activities. However, as discussed next, what might be a significant process challenge in the case of some risk methods could be a non-issue for other risk methods depending on their particular approaches to collaboration.

## Existing Approaches

The HSI team identified three basic approaches (Table 2.2) for how intelligence and risk analysts currently work together to produce the threat judgments needed for DHS risk assessment purposes. We evaluated their relative benefits and limitations. These approaches can be distinguished by the degree of interaction between DHS risk analysts and intelligence analysts.<sup>18</sup>

### *Continuous Interaction*

This approach can involve cross-discipline staffing (i.e., both intelligence and risk analysts) or a standing working group that allows for the analysts to work together on an ongoing basis to generate threat judgments needed for risk assessments. The best example of cross-discipline staffing is the Homeland Infrastructure Threat and Risk Analysis Center, which is an organizational approach that brings together DHS infrastructure experts and intelligence analysts to support risk assessments, such as the Strategic Homeland Infrastructure Risk Assessment.<sup>19</sup>

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<sup>16</sup> See the corresponding discussion in the companion Tutorial to this report, on page 21.

<sup>17</sup> See Vicki M. Bier and Louis Anthony Cox, Jr., “Probabilistic Risk Analysis for Engineered Systems,” in *Advances in Decision Analysis*, edited by Ward Edwards, Ralph F. Miles, Jr., and Detlof von Winterfeldt (Cambridge, UK: Cambridge University Press, 2007), pp. 279-301.

<sup>18</sup> See Appendix C for additional discussion on the characteristics and relative benefits and limitations of these various approaches used among the DHS risk methods for producing threat judgments.

<sup>19</sup> HITRAC is jointly staffed with infrastructure experts provided by the DHS Office of Infrastructure Protection in the National Protection and Programs Directorate (NPPD) and intelligence analysts provided by the DHS Office of Intelligence and Analysis (I&A). See Appendix B for additional discussion of SHIRA and HITRAC.



**Table 2.2: Alternative Approaches for Enhancing DHS Intelligence and Risk Analyst Collaboration for Obtaining Threat Judgments.**

<i>Degree of Interaction</i>	<i>Key features</i>	<i>Benefits &amp; Limitations</i>
<b>Continuous interaction</b>	<ul style="list-style-type: none"> <li>• Cross-discipline staffing: risk and intelligence analysts regularly work together within the same organization</li> <li>• Risk and intelligence analysts work together as a standing committee or group that supports the risk assessment effort</li> </ul>	<p><i>Benefits</i></p> <ul style="list-style-type: none"> <li>• Improved opportunities for communication and meeting of the minds</li> <li>• Greater incentives for developing an effective working relationship</li> </ul> <p><i>Limitations</i></p> <ul style="list-style-type: none"> <li>• Substantial investment of resources to support risk assessment process.</li> <li>• Added effort needed to overcome disparate disciplines</li> <li>• Career path uncertainties might arise</li> </ul>
<b>Periodic interaction</b>	<ul style="list-style-type: none"> <li>• Preparations include read-ahead materials and involving intelligence analysts in the process early on</li> <li>• Various elicitation methods are used for structured gathering of threat judgments from intelligence analysts</li> </ul>	<p><i>Benefits</i></p> <ul style="list-style-type: none"> <li>• Limits amount of investment in creating a dedicated staff of intelligence analysts to support the risk assessment effort</li> <li>• Flexibility to take advantage of a broad range of threat expertise within the DHS Intelligence Enterprise or outside of it</li> </ul> <p><i>Limitations</i></p> <ul style="list-style-type: none"> <li>• Requires intelligence analysts to make available time for threat elicitation activities</li> <li>• Risk analysts might not know which intelligence analysts they need for addressing particular threat issues</li> </ul>
<b>No direct interaction</b>	<ul style="list-style-type: none"> <li>• No direct contact between risk and intelligence analysts</li> <li>• Risk analysts draw on intelligence products and/or contractor staffs but no direct contact with intelligence organizations</li> </ul>	<p><i>Benefits</i></p> <ul style="list-style-type: none"> <li>• Reduces work requirements</li> <li>• Avoids coordination problems</li> </ul> <p><i>Limitations</i></p> <ul style="list-style-type: none"> <li>• IC expertise is not fully leveraged for risk analysis purposes</li> <li>• Risk analysts might draw invalid inferences from finished intelligence products</li> </ul>

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Examples of the other variant involving a standing working group are provided by the Bioterrorism Risk Assessment (BTRA) and the Risk Management Analysis Process (RMAP) for Commercial Aviation Security, which have relied on standing groups of intelligence analysts to support their needs for threat judgments.<sup>20</sup> Both types of continuous interaction allow intelligence and risk analysts more time and opportunities to better understand each others' approach to threat analysis. While not eliminating all challenges to cross-discipline collaboration, the continuous interaction approach has fundamental benefits for supporting joint activities.

### ***Periodic Interaction***

This approach typically involves risk analysts making requests for threat judgments infrequently, whether on a regular basis (e.g., on an annual or biennial cycle) or more sporadically as the need and opportunity arises.<sup>21</sup> An example of this approach involving periodic interaction on a regular basis is RAPID (Risk Analysis Process for Informed Decision-Making), which is sponsored by the Office of Risk Management and Analysis (RMA) and designed to support DHS strategic planning.<sup>22</sup> One advantage of this approach is that both sides may recognize the need to establish an effective working relationship if they want to produce useful threat inputs for the risk assessment. A more challenging case for periodic interaction exists where joint activities between risk and intelligence analysts occur only once. This has the limitation of not permitting analysts from both sides to build on their experience to improve the threat judgment process.

### ***No Direct Interaction***

This approach features no direct contact between the risk analysts and intelligence analysts in producing the threat judgments used in the risk assessment. Variations of this relationship range from no use of intelligence analysts to the use of threat experts outside of the DHS Intelligence Enterprise or reliance on finished intelligence products without additional interaction.<sup>23</sup>

## **Summary**

Although many different types of DHS risk assessments exist, most share a need for obtaining sound threat judgments that address their specific requirements. Thus, there is no "one size fits all" when it comes to producing threat judgments for DHS risk methods and models. Rather, threat judgments need to be tailored to the specific needs of particular DHS risk efforts. Generating threat judgments is challenging, particularly given the different analytic cultures that each discipline brings to thinking about threat issues and the challenges in existing organizational processes. The next section identifies ways to develop a mutually beneficial relationship between the risk analysis and intelligence communities.

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<sup>20</sup> See Appendix B for more discussion of the RMAP approach, which uses a standing committee involving a broad range of intelligence experts.

<sup>21</sup> See Appendix C for more discussion of the periodic interaction approach.

<sup>22</sup> See Appendix B for additional discussion of RAPID.

<sup>23</sup> See Appendix C for more discussion of this question.

### 3. ENHANCING CROSS-DISCIPLINE COLLABORATION

While the previous section examined the threat inputs needed for DHS risk assessments, this section addresses the broader question of why achieving mutually beneficial collaboration between the two communities is important and then identifies ways of enhancing the broader collaboration environment.

#### Why Collaboration Matters for DHS Risk Analysis

Achieving productive interactions between risk and intelligence analysts is essential for producing the sound threat judgments that are an integral element in the homeland security risk assessments being undertaken for DHS decision-makers. However, to be sustainable over time, the collaborative process must be based on providing mutual benefits.

The stakes for both communities in improving collaboration mainly hinge on enhancing each community’s organizational performance. As shown in Figure 3.1, each community manages a process—the intelligence cycle and the risk management cycle—that share the common goal of supporting decision-making on important security issues. While this graphic presents a simplified representation of much more complex processes, it aptly highlights that the two cycles are connected by actual and possible cross-links with the potential to make each community more effective in performing their respective roles in supporting senior-level decision-making.

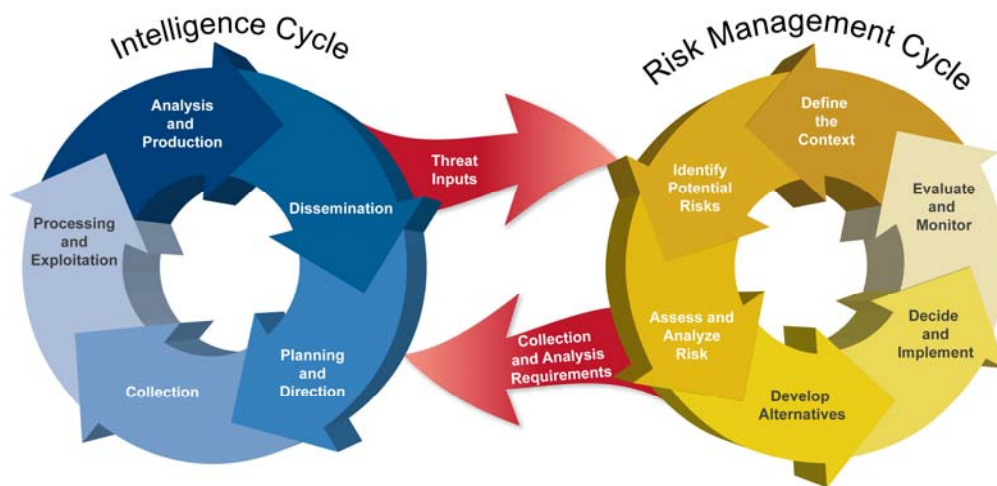


Figure 3.1: Potential Linkages in the Intelligence and Risk Management Cycles.<sup>24</sup>

<sup>24</sup> These graphical representations necessarily simplify the nature of the intelligence and risk management cycles, which can be potentially linked in numerous ways. See the following for additional discussion of various linkages: Henry H. Willis, *Using Risk Analysis to Inform Intelligence Analysis* (Santa Monica, CA: RAND Corporation, February 2007). Accessed at: [http://www.rand.org/pubs/working\\_papers/WR464/](http://www.rand.org/pubs/working_papers/WR464/).

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## ***Need for Credible Threat Judgments***

DHS decision-makers, planners, and operators need sound risk assessments to enable them to make credible risk management choices. The utility of risk assessments for homeland security purposes depends on having reliable data and expert judgments provided by knowledgeable individuals who have a good understanding of how to address issues concerning threats in the context of vulnerabilities and consequences. As discussed earlier, obtaining sound judgments on terrorist threats is one of the most challenging tasks for risk analysts.

As suggested by Figure 3.1, many DHS risk analysts look to the Intelligence Community, specifically the DHS Intelligence Enterprise, as a special source of threat inputs for identifying and characterizing terrorist threats to the U.S. homeland. This is not surprising given that intelligence analysts routinely access unique sources of information on terrorist group intentions and capabilities, and can leverage a broad range of related expertise and experience in dealing with the terrorist problem. Furthermore, DHS decision-makers are likely to attach much credibility to Intelligence Community judgments on the nature of terrorist threats, which only increases the need for risk analysts to draw upon the expertise of intelligence analysts.

Of course, intelligence analysts are not the only source of expertise concerning terrorist thinking and behavior. As discussed in Section 2, other potential sources of data and expertise exist for providing insights relevant to risk assessments. These include: the broader technical community; U.S. and foreign research centers, including research institutes and universities; open source providers of analysis and information on terrorist developments; and specialized knowledge available from the private sector.<sup>25</sup> From a decision-maker's perspective, however, these sources are likely to be viewed as valuable complementary sources of information and analysis but not an acceptable substitute for intelligence analyst judgments, which could be considered by decision-makers as the most credible (and defensible) source of threat judgments for making their risk management decisions.

## ***Growing Centrality of Risk Analysis for DHS Decision-Making***

Risk analysis is becoming a central element in how senior decision-makers view the security risk to the U.S. homeland. Certainly for homeland security decision-making, risk management has become integral to how senior DHS decision-makers view their responsibilities in allocating limited resources among nationwide vulnerabilities to potential terrorist threats and other hazards. This thinking is recognized in the following observation in the *National Strategy for Homeland Security* on what is required to ensure long-term success:

The assessment and management of risk underlies the full spectrum of our homeland security activities, including decisions about when, where, and how to invest in resources that eliminate, control, or mitigate risks. In the face of

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<sup>25</sup> An often underappreciated source of relevant expertise are those government and contract personnel who have hands-on experience in working with processes and systems used to support the homeland security missions, particularly those concerned with preventing and protecting the nation against terrorist activities.

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multiple and diverse catastrophic possibilities, we accept that risk—a function of threats, vulnerabilities, and consequences—is a permanent condition.<sup>26</sup>

Given the central role that risk analysis plays in shaping how many DHS personnel approach their homeland security responsibilities, the DHS Intelligence Enterprise has a stake in ensuring that it is well prepared to meet the continuing need for its expertise in addressing threat issues, including to support risk assessments.

There are potential benefits to the DHS Intelligence Enterprise from actively participating in risk assessment development with members of the risk analysis community. The process of clarifying threat judgments as part of the necessary interaction can help intelligence managers and analysts better understand and anticipate the concerns of senior DHS decision-makers concerning the scenarios and issues raised in the risk assessments. The questions posed by risk analysts can stimulate intelligence analysts to think of contingencies and aspects of the terrorist threat that might be worthy of additional or renewed consideration at their end. As Figure 3.1 indicates, risk analysis could help inform the intelligence community's collection and analysis efforts in ways to refine outstanding questions on the estimated risk of particular types of terrorist attacks against U.S. homeland targets.<sup>27</sup>

Intelligence managers and analysts also can take advantage of risk analysis as a tool to sharpen their judgments in identifying and categorizing scenarios and terrorist activities of potential concern. Risk analysis is an analytic method of interest to intelligence analysts and can be applied to a broad range of intelligence problems.

Thus, given the central role that risk analysis plays in shaping how senior DHS decision-makers, planners, and operators approach their homeland security responsibilities, the DHS Intelligence Enterprise has a stake in ensuring that it is well prepared to meet the continuing need for its expertise in addressing threat issues, which includes supporting homeland security risk assessments.

## **Steps for Enhancing the Collaboration Environment**

Based on our research and analysis, as well as inputs from DHS intelligence and risk analysts, the HSI team identified three categories of actions that could improve the long-term prospect for effective collaboration between risk and intelligence analysts: (1) greater cross-discipline familiarity; (2) community-to-community process improvements; and (3) increased transparency.

### ***Greater Cross-Discipline Familiarity***

One of the recurring themes that arose in the HSI research is the strong need to improve the level of cross-discipline knowledge and familiarity between the risk analysis and intelligence communities. The HSI team identified the following steps that could help increase the level of familiarity between DHS intelligence and risk analysts:

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<sup>26</sup> Homeland Security Council, *National Strategy for Homeland Security* (Washington, DC: White House, October 2007), p. 41.

<sup>27</sup> Willis, *Using Risk Analysis to Inform Intelligence Analysis*, p. 14.

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- *Cross-training.* One way to improve cross-discipline familiarity is to offer cross-training that provides a good grounding in the fundamentals of each discipline and their relevance to the joint activities of analysts in supporting DHS risk assessments. Such training might include a standardized orientation session for all DHS intelligence and risk analysts, which could be made a module or presentation in their basic orientation courses. In addition, a more in-depth course (probably running several days) could be specially developed for those risk and intelligence managers and analysts who might have continuing responsibilities for working together. Having both DHS risk and intelligence personnel attend the same session could provide the added benefit of informal learning and development of a team outlook for supporting DHS risk assessment needs.
  - *Educational material.* There is a current lack of educational materials that are specifically tailored to the needs of intelligence and risk analysts who must work together in producing threat judgments. One type of needed educational material is a lexicon to help ensure that analysts are familiar with a common terminology in working together. The existing *DHS Risk Lexicon* is a good example and could be leveraged to create an addendum or derivative product that also incorporates terms that DHS intelligence analysts are likely to use in communicating their threat judgments.<sup>28</sup> In addition, there is a need for tutorial materials that will provide both intelligence and risk analysts with a good overview of the other's discipline and basic approach to threat issues. As part of this project, the HSI team was tasked with producing a tutorial for supporting improved collaboration between risk and intelligence analysts who must work together in producing threat judgments for DHS risk assessments. We have produced a written tutorial and an annotated briefing as supplementary education material.<sup>29</sup>

The aim of cross-training and education material is not to add to the training and education burden for each community, but to provide focused materials to enhance the efforts of those individuals most likely to be involved in joint activities supporting DHS risk assessments.

### ***Community-to-Community Process Improvements***

Improving the overall processes for community-to-community interaction is another way of enhancing the collaboration environment. With the exception of risk methods and models that benefit from continuous interaction, such as HIRAC's, or those that have established standing working committees of risk and intelligence analysts, the interaction between the communities have been largely ad hoc and fragmented in supporting DHS risk assessments. Two potentially useful steps for improving the process are:

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<sup>28</sup> U.S. Department of Homeland Security, *DHS Risk Lexicon* (Washington, DC: Risk Steering Committee, U.S. Department of Homeland Security, September 2008). Available at: [http://www.dhs.gov/files/publications/gc\\_1232717001850.shtm](http://www.dhs.gov/files/publications/gc_1232717001850.shtm).

<sup>29</sup> See the tutorial and supplementary briefing materials to this report.

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- *Personnel exchanges.* Cross-discipline familiarity also is likely to be improved by sponsoring personnel exchanges. Experienced personnel from the two communities should be exchanged, either for a short period (e.g., weeks or months) or on a protracted basis (e.g., a year). The benefits of personnel exchanges would be enhanced if the individuals who are exchanged are not confined to filling an existing need in the counterpart organization but rather were provided with some expectation of gaining a broader appreciation of the other community and spending some of their time in facilitating cross-discipline collaboration. The latter role could include helping to organize and provide cross-discipline education and training.
  - *Facilitation Point of Contact (POC).* An important step is to consider establishing a facilitation point of contact or focal point within the DHS Intelligence Enterprise organization. This “facilitation POC” should advise and assist those undertaking risk assessments for DHS who have a requirement to leverage the threat expertise that might reside within the Intelligence Community—starting within the DHS Intelligence Enterprise. This POC would not serve as a “gatekeeper” but would have a working knowledge of the different areas of expertise and responsibilities within the enterprise. The POC could help risk analysts in navigating available intelligence resources (e.g., finished intelligence products) and help the risk analysts to connect with relevant organizations within the national-level Intelligence Community when such outreach is warranted by the need to address particular threat questions.

Implementing these steps could provide greater continuity and efficiency in the joint activities of the risk analysis and intelligence communities.

### ***Increased Transparency***

Another important aspect of improving the prospect for community-to-community collaboration involves increasing transparency in their interactions. Some steps in this area could enhance the overall collaboration environment:

- *Providing access to risk assessment documentation.* Permitting and encouraging access to relevant documentation on DHS risk assessments is another way to improve the level of awareness between the two communities. For the risk analysts, this means making certain that intelligence analysts have timely access to documentation of the various DHS risk methods and models that are seeking threat inputs from the intelligence analysts. This could give intelligence analysts greater confidence that their prior work in providing threat judgments for other DHS risk efforts has been reviewed and built upon before a new request for another risk assessment was generated by a different DHS risk assessment effort.
- *Generating threat updates for risk analysts.* One concern about threat judgments is that the underlying intelligence may change and raise significant implications for DHS risk assessments. A stronger community-to-community relationship should increase the likelihood of having intelligence analysts providing periodic updates on their threat assessments relevant to what they were asked to address in supporting the DHS risk assessments. Given that many risk assessments occur only on an annual or biennial basis, receiving a periodic update from intelligence

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analysts could alert risk analysts to a potentially important change in threat judgments. Although these steps are not the only ways of enhancing transparency between the two communities, they would be a good start. Along with the collaborative framework presented in the next section, these steps could have the benefit of strengthening mutually beneficial collaboration between the communities.

## **Summary**

This section has identified practical near-term and long-term steps that can be undertaken to develop a mutually beneficial collaboration between the intelligence and risk analysis communities. These steps aimed to increase cross-discipline familiarity, undertaking community-to-community process improvements, and increasing the level of transparency associated with the joint activities of intelligence and risk analysts. The next section shifts the focus from the broader environment to presenting a collaborative framework that identifies improved collaborative practices relevant to DHS risk assessments mainly involving periodic interactions.



## 4. COLLABORATIVE FRAMEWORK: GUIDELINES FOR IMPROVING RISK-INTEL COLLABORATION

This section provides a collaborative framework (Table 4.1), i.e., basic principles and practical guidelines that can be used to improve how risk analysts collaborate with intelligence analysts in developing threat judgments for DHS risk models. It builds on insights that the HSI team gained through interviews and discussions with intelligence and risk analysts involved in supporting DHS risk assessments, in addition to reviewing professional and academic literature relevant to the topic. This framework is most relevant to DHS risk methods and models that involve periodic interactions with intelligence analysts to obtain threat judgments, although the framework’s underlying principles are also relevant to situations where continuous interaction between intelligence and risk analysts occur.

Phase I	Phase II	Phase III
<p><i>Main Focus</i> Preparation and Initial Engagement</p>	<p><i>Main Focus</i> Scenario Development and Threat Inputs</p>	<p><i>Main Focus</i> Follow-up Activities</p>
<ul style="list-style-type: none"> <li>• Research design               <ul style="list-style-type: none"> <li>○ Establish realistic data collection goals</li> <li>○ Data collection approach</li> </ul> </li> <li>• Engage intelligence organizations (e.g., terms of reference)</li> <li>• Review relevant intelligence materials</li> </ul>	<ul style="list-style-type: none"> <li>• Develop draft scenarios and/or attack paths in collaboration with intelligence analysts</li> <li>• Undertake “question framing” and capture simplifying assumptions</li> <li>• Maximize question validity</li> <li>• Review threat input methods and types of input</li> <li>• Produce documentation</li> </ul>	<ul style="list-style-type: none"> <li>• Review risk model results with intelligence analysts</li> <li>• Obtain feedback on research methods</li> <li>• Present expectations on additional research</li> </ul>

**Table 4.1: Collaborative Framework Guidelines for Intelligence and Risk Analyst Interactions.**

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Without attempting to be comprehensive or exhaustive, the collaborative framework identifies guidelines for risk analysts that will help them obtain quality threat judgments while reducing misunderstandings between intelligence and risk analysts. The framework largely focuses on practices that risk analysts can use to work collaboratively with intelligence analysts. In those circumstances where continuous interaction between risk and intelligence analysts does not already exist, adhering to these recommended guidelines will likely improve the prospect of risk analysts obtaining sound threat judgments needed for making homeland security risk assessments.<sup>30</sup> Hence, the guidelines are offered from the perspective of what risk analysts can do in working with risk analysts to improve cross-discipline cooperation within the current environment.<sup>31</sup> Although the process is typically initiated by risk analysts seeking threat inputs, the responsibility for producing quality threat judgments involves both the DHS intelligence and risk communities.

The collaborative framework for collecting threat inputs for DHS risk assessments is presented in three distinct phases, although in practice these phases could overlap. We use this framework to discuss specific issues and offer recommended guidelines when intelligence and risk analysts work together, particularly on a periodic basis, to produce threat judgments needed for DHS risk assessments:

- Phase I: Preparation and Initial Engagement
- Phase II: Scenario Development and Threat Inputs
- Phase III: Follow-up Activities.

The guidelines presented in each phase are informed by feedback that the HSI team received from intelligence and risk analysts concerned with homeland security issues. They also are consistent with the standard research steps taken in many social science research and survey studies. (More detailed discussion on the underlying data collection principles are contained in Appendix F.)

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<sup>30</sup>Although the collaborative framework is focused on DHS risk assessments that involve periodic interactions between intelligence and risk analysts, the underlying principles are also relevant to those risk models and methods that benefit from continuous interaction, either by being supported by cross-discipline staffing (e.g., HITRAC) or a standing working group that includes intelligence and threat experts.

<sup>31</sup>Many variables (e.g., project resources, availability of intelligence analysts, and data collection abilities of risk analysts) affect research designs and should be taken into account when developing the research plan for inputs into risk models. The collaborative framework does not assume that each project must use the same practices and procedures; rather, basic methods identified in the framework should be tailored to the specific needs of each risk model project. We expect that practitioners will tailor these practices to meet their particular needs and that they will find ways of improving upon the recommendations put forward in this section.

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## Phase I: Preparation and Initial Engagement



Phase I in the framework provides the essential starting point for cross-discipline collaboration by starting the interactions out on a productive course. The key steps within this phase are:

- Developing the research design
- Reviewing relevant intelligence materials
- Engaging the intelligence organization

### *Research Design Development*

The first recommended guideline is for the risk analysts to have a sound research design, or at least a semi-structured approach, for how threat data will be collected and analyzed for the risk method or model. The research design will likely evolve according to the project requirements and the practical challenges of data collection. However, the risk analysts will benefit from developing a well-considered research design prior to data collection begins. This design will likely have a significant impact on the quality of the threat inputs and judgments collected from intelligence analysts.

Lacking a well-considered research design is likely to result in ad-hoc data collection and analysis as the risk analysts need to account for unexpected developments. Relying on ad-hoc research approaches for developing threat judgments from intelligence analysts also is likely to create confusion for both the intelligence analysts and the risk analysts, and diminish the prospect for establishing confidence in a collaborative process.

### **Establishing Realistic Data Collection Goals**

During our research into current approaches, some intelligence analysts observed that risk analysts do not always have realistic expectations regarding the availability and certainty of what can be provided as terrorist threat judgments. They suggested that inputs from intelligence analysts will not provide all the answers needed to the questions generated by risk analysts.

A key aspect of developing better collaborative relationships between risk and intelligence communities is reaching a common view of what are realistic expectations regarding data availability and certainty. Establishing feasible data collection goals at the outset of the risk model project will set the groundwork for enhanced collaboration throughout the study.

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## **Data Collection Methods**

The methods used to collect threat inputs will be determined mainly by “resource” variables that include:

- Type of threat inputs needed
- Research abilities and experience of the risk analysts on the project
- Funding and time resources
- Organizational constraints
- Classification levels
- Availability and willingness of intelligence analysts

One of the benefits of giving close consideration to the data collection and implementation approach prior to contacting the intelligence offices is that risk analysts can explain in practical terms what they need to accomplish in the threat input collection for the risk model. The research approach will also need to account for the availability of intelligence analysts to support the DHS risk assessment. Therefore, it will be important to gain agreement on resource needs with the intelligence organization’s management as early as possible in the process.

### ***Reviewing Available Intelligence Products***

Another guideline is for risk analysts to review existing intelligence products relevant to their work before contacting an intelligence office—particularly those developed by the intelligence organizations they are planning to contact. Previewing existing intelligence products has several potential benefits, including:

- Enabling the risk analysts to develop a better research design
- Helping the risk analysts to develop questions and scenarios to be tested by intelligence analysts
- Providing possible inputs for the risk model itself
- Allowing the risk analysts to focus their efforts more on the gaps in existing knowledge rather than asking intelligence analysts to provide judgments that are already available in documentation. This will allow the risk analysts to make the best use of the intelligence analysts’ time to meet their particular needs for threat inputs.
- Providing possible leads to other intelligence documents and organizations that also could be relevant.

One difficulty in reviewing intelligence products and data is that risk analysts might encounter impediments in accessing potentially desirable material because of classification constraints or limited access to the necessary secure information systems. However, the benefits that can be achieved in undertaking preparatory work are

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potentially significant and will help define the specific areas where intelligence analyst judgments are most needed.

### ***Engaging the Intelligence Organizations***

In engaging with the DHS Intelligence Enterprise, the more prepared the risk analysts are to clearly describe their risk effort and its objectives, their data needs, and their expectations regarding the scope and extent of collaboration desired, the better the chances are for obtaining relevant threat inputs. Key elements to be communicated are outlined below:

- The goals and objectives of the risk project.
- The type of risk modeling project and why it is important to have intelligence input into the model beyond the information provided in available intelligence products.
- The methods the risk analysts are planning to use and the amount of time they anticipate the methods involving (e.g., brainstorming session for two hours followed by a second session several weeks later).
- The classification level of the threat inputs that the risk analysts would expect from the intelligence analysts.
- Request for information on whether there are additional intelligence products the intelligence analysts recommend now that they have a better sense of areas of interest to the risk analysts. If access is available to the risk analysts, these documents can be included into their literature review and research design processes prior to initiating data collection.
- A concise written statement or memo (e.g., a terms of reference) describing the effort and providing a rough schedule for the risk assessment process, including the expected involvement of the intelligence analysts. This can be a useful way of ensuring that both parties start with common expectations on what type of collaborative assistance is being requested and the process envisioned for interactions.

Some intelligence organizations and offices have relatively extensive experience in collaborating with risk analysts. As a result, they may be able to provide quite useful information on data availability and necessary data collection methods. Other offices may have little experience (or poor experience) in collaborating with risk analysts. In such cases, more care is needed in detailing the rationale for the project and a clear approach for making good use of the intelligence analysts' time and judgments.

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## Phase II: Scenario Development and Threat Inputs



The main purpose of Phase II is to provide principles and practices for how risk and intelligence analysts can work together in producing the threat judgments for DHS risk assessment methods or models. This phase involves the following collaborative steps:

- Developing draft scenarios and/or attack paths
- Choosing the best method for collecting threat inputs
- Undertaking “question framing”

### *Developing Draft Scenarios and Attack Paths*

A key collaborative activity in risk model development is scenario development. Scenarios depict different possibilities or events that could lead to outcomes measured through risk models.<sup>32</sup> Scenarios are usually the cornerstone of risk models through which probabilities and uncertainties are constructed. Generally, a good scenario typically considers the “risk to what” and the “risk from what,” with the purpose of representing potential risks addressed within a risk assessment.<sup>33</sup>

Intelligence analysts in the DHS Office of Intelligence and Analysis, HITRAC, and the various DHS components with intelligence offices can play a critical role in helping risk analysts define which scenarios for a particular threat event are the most plausible. Likewise, when multiple scenarios are being used, the feedback from intelligence analysts on which variations should be included or excluded can be very valuable for DHS risk analysts. In addition, intelligence analysts can provide important insights into the actions and mind-sets of terrorists, including information that is not normally available to risk analysts. Such insights can play an important role in providing the risk analysts with more realistic threat assumptions. Intelligence analysts can “identify important characteristics of terrorist scenarios like background information, components of an attack, and possible methods of employment,”<sup>34</sup> as well as targets and the composition of attack paths or phases through which terrorist organizations plan attacks. Along with providing information on how the terrorists can achieve their goals,

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<sup>32</sup> It is important to note that many, but not all, DHS risk assessment methods and models make use of scenarios. Some consider attacker methods of attack without developing a full-fledge narrative or scenario; others use simulations that consider a comprehensive arrange of attack options without relying on scenario details.

<sup>33</sup> U.S. Department of Homeland Security, Office of Risk Management and Analysis, Risk Management Analytic Guidelines, “Developing Scenarios” (draft document, 2008), p.1.

<sup>34</sup> Ibid., p.1

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intelligence analysts may also have useful insight into how previous such attacks have been thwarted.

Intelligence analysts can greatly increase the quality of a scenario by ensuring that it is:

- Easily understood and internally consistent
- Documented with key assumptions explicitly detailed
- Generally specifying, at a minimum, the “risk to what” (potential target) and the “risk from what” (threat/hazard)
- At an appropriate level of depth (based on assessment requirements and the availability of information to support the scenario).<sup>35</sup>

One of the most effective method for gathering input on scenarios is through face-to-face meetings with a group of intelligence analysts. Once gathered, eliciting information can be conducted by the Delphi method, a moderator-led focus group or a brainstorming session. Analysts can also be surveyed. According to our interviews, however, most intelligence analysts agree that they prefer to provide inputs in groups as they often work together to reach consensus on the soundness of their threat judgments based on a variety of available expertise and experience.

Once scenarios have been developed, event tree or attack paths are often developed by risk analysts to provide a visualization of the threat event, although it is important to note that not all DHS risk methods or models use scenarios in the form of detailed narrative or postulated event trees.<sup>36</sup> The various branches or paths, representing the choices or courses of action an adversary might take, are enumerated and then assigned probabilities that correspond to their likelihood of occurring. Risk analysts are interested in the judgments that intelligence analysts can bring to these types of exercises.<sup>37</sup>

### ***Choosing among Available Methods for Collecting Threat Inputs***

Many different methods exist for gathering information from intelligence. The type of method that should be used depends upon the resources (e.g., time and money) available to the risk project, the amount and kind of access to intelligence analysts, and the abilities

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<sup>35</sup> The qualities that make a good scenario are identified in “Developing Scenarios,” p. 2.

<sup>36</sup> For a discussion attack paths, which can be derived from fault trees and event trees that are commonly used in risk analysis, see “Developing Scenarios,” pp. 4-6, as well as Detlof von Winterfeldt and Ward Edwards, “Defining a Decision Analytic Structure,” in *Advances in Decision Analysis*, edited by Ward Edwards, Ralph F. Miles, Jr., and Detlof von Winterfeldt (Cambridge, UK: Cambridge University Press, 2007), pp. 81-103.

<sup>37</sup> A brainstorming session also provides an opportunity to clarify expectations. For example, these sessions provide an opportunity for risk analysts who are seeking expert inputs concerning attack paths to make clear to the DHS intelligence analysts whether certain conditionalities (e.g., the presence of intelligence warning) should be considered when they provide their assessments of likelihoods or probabilities.

and experience of the risk analysts who will be conducting the threat estimate data collection with the intelligence analysts.

As Table 4.2 highlights, the methods available to risk analysts include “Brainstorming,” informal interviews, the use of Delphi methods, and even the use of highly structured methods, such as expert elicitation, or formal survey techniques. (These methods to

Method	Description
Brainstorming or focus group sessions	Using a facilitated “brainstorming” session can be helpful for both scenario development and generating threat inputs. While brainstorming sessions are generally reserved for qualitative data collection, they can also be used to generate a number of different types of threat inputs for models. Some intelligence analysts have indicated that they prefer this method for providing judgments on threat inputs. Therefore, the focus group or brainstorming sessions becomes more quantitative based on the type of questions being posed in the groups.
Delphi method	This method involves gathering judgments from experts or participants separately and later convening those interviewed to discuss the collective results of their judgments. When the experts reconvene, they are able to alter their judgments based on the discussion and inputs of other experts. The Delphi method can be used to obtain and combine the judgments of a group of individual intelligence analysts in a way that helps reduce variance in views based on misunderstanding and implicit assumptions.
Expert elicitation	Expert elicitation is a highly structured and multi-phase data collection method that offers a way to produce specific numerical probabilities from knowledgeable individuals. Expert elicitation involves conducting one-on-one interviews when expert judgments are required to compensate for the lack of firm data in providing needed judgments for a risk model purposes. This approach has been used with intelligence analysts to generate estimates of the likelihood of terrorist attacks and alternative attacks paths.
Informal interviews	Informal methods for interviews generally seek expert views in a less structured manner. These might be a wide-ranging interview with an individual intelligence analyst or even a group discussion session involving several analysts. The results may be recorded and subsequently used by risk analysts to help inform their own judgments on the plausibility of alternative terrorist threats and attack paths.
Survey instruments	Survey instruments can be very powerful tools, assuming they are correctly applied, to obtain the judgments of a number of experts in a manner that permits direct comparisons. When making use of a survey, risk analysts should involve a survey specialist who can assist with instrument and sample design and implementation. Surveys can supplement the other methods described above or can be used as a stand alone instrument for collecting data from experts.

**Table 4.2.: Overview of Methods for Obtaining Threat Judgments.**



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obtain threat judgments are discussed in greater detail in Appendix F.) However, even in the case of the seemingly familiar methods, such as informal interviews, if not enough care and preparation is taken in using these methods correctly, then problems associated with poor data quality and the nature of the collaborative relationships with intelligence analysts may result.

### ***Question Design and “Framing”***

How a threat judgment question is understood by the intelligence analysts, and how the risk analyst understands the feedback from the intelligence analysts is at the core of generating decision quality threat inputs for DHS risk assessments. One reason for giving careful consideration to the design of the questions being asked in obtaining threat judgments is that this is a relatively inexpensive means for improving the quality of threat judgments. Different structured techniques exist in the survey research world for testing the framing and structure of questions.<sup>38</sup> However, what is most important is that these concepts are being practiced in some capacity and are taken into consideration when developing the questions that will be used to obtain threat judgments. As illustrated in the inset box, there may be a lot of uncertainty on the part of the respondent in terms of

#### **Why Question Framing Matters: An Example**

The following example provides a notional illustration of how question framing and assumptions can affect the results of threat estimates. If a question in a threat assessment asks, “What is the likelihood that al-Qa’ida will conduct a large scale terrorist attack in the near future?,” then there are multiple ways the question can be understood and multiple ways the respondents can provide input on the question. Some of the respondents’ uncertainties concerning the question could include:

- What is meant by “al-Qa’ida”? Does it include any group that is inspired by al-Qa’ida, all al-Qa’ida affiliated groups (e.g., al-Qa’ida in Iraq, Islamic Maghreb, and Europe, etc.), or just al-Qa’ida groups based in Afghanistan/Pakistan region?
- What is mean by “large scale”? Is it referring to lost of lives, economic costs, political significance, etc?
- In addition, “terrorist attack”, “near future” and “likely” are all parts of the question that will need simplifying assumptions and framing in order for the respondents to provide consistent responses.

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<sup>38</sup> The phenomena of question and answer comprehension are captured through concepts such as question validity, reliability, framing, and simplifying assumptions. These concepts are theoretically distinct, but overlap in practice. A well-developed body of work is available on this topic within the social studies and survey research fields. For example, see L. M. Rea. *Designing and Conducting Survey Research: A Comprehensive Guide* (San Francisco, CA: Jossey-Bass Publishers, 1997).

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what particular question they were being asked. In addition, the interpretation of the question may vary in some potentially important ways from one intelligence analyst to another. *If the risk analyst does not explicitly state the assumptions, then the intelligence analyst will likely make implicit assumptions that may not be documented.*

Other issues that risk analysts should consider for Phase II of the process can be found in Appendix F. These issues include: terminology, concepts, training, communicating the levels of measures needed, dealing with classification levels, and addressing the need to obtain threat inputs with sufficient reliability and validity for risk assessment purposes.

### **Phase III: Follow-Up Activities**



The last phase of the collaborative framework recommends that risk analysts take steps to follow up with the intelligence analysts and their managers after the threat estimate inputs have been incorporated into the DHS risk model. The primary Phase III steps are:

- Reviewing risk assessment results with intelligence analysts
- Obtaining feedback on data collection methods and processes
- Setting expectations on additional data collection.

This list of follow-up steps is not exhaustive, but rather provides some examples based on the feedback we received from intelligence and risk analysts on what might foster an improved collaborative process.

#### ***Reviewing the Risk Assessment Results***

Renewing interaction with intelligence analysts following the data collection phase offers them an opportunity to review the preliminary results produced by the DHS risk method or model. Most intelligence analysts and managers will be interested in understanding how their threat inputs were utilized in the DHS risk assessments. They also could be interested in understanding the outputs from those models. Equally important is feedback on how decision-makers and decision-makers reacted to the risk model outputs and any insightful observations the decision-makers may have offered concerning their questions about the threat judgments and assumptions. This feedback may help give the intelligence analyst a sense of the value of decision-quality threat judgments for DHS decision-makers, thus fostering greater clarity concerning their importance in supporting the risk assessment process.

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### ***Obtaining Feedback on Research Methods***

Another way to reengage with intelligence analysts is to interview them after the fact about what worked and what did not in the collaborative process. This is particularly effective if done while the experience is still relatively fresh. Gathering this feedback, identifying lessons learned, and incorporating them into the future data collection process can be an important way to improve the effectiveness of the collaborative process for producing the needed threat judgments.

### ***Setting Expectations on Additional Data Collection***

At the end of the process, it is useful to begin setting future expectations for when the next data collection cycle is likely to start and how it will compare with the current process. This will enable intelligence partners to better plan their work requirements and schedules and to begin identifying data sources. Even at this early stage, the opportunity exists for intelligence analysts to help risk analysts determine which scenarios are more applicable to the risk analysts' future need, or to identify missing scenarios that may have become more important since the last time the model was updated. This can be particularly helpful when dealing with dynamic adversaries such as terrorist organizations.

## **Full-Process Documentation**

Throughout every phase of the collaborative process, documentation is essential for ensuring the decision quality of threat inputs. For example, it will be important for risk analysts to document the simplifying assumptions used when developing the scenarios. In addition, any of the qualifications made by the intelligence analysts when developing probabilities will be important to document. Such documentation will allow intelligence analysts to recall their decision making process and increase their confidence that their inputs are being properly captured and used. It can be also used to help bring up to speed new intelligence analysts who were not involved in the earlier process.

Documentation of the data collection process and how the risk assessments results were arrived helps to instill transparency into the collaborative process. Documentation concerns not only the procedures used to collect the data<sup>39</sup> and the data itself, but to the entire reasoning process used by intelligence analysts in providing threat judgments.

Enough documentation should be provided such that the method could be repeated if needed. Key assumptions, caveats, and insights provided by the intelligence analysts making threat judgments should be documented in a way that is readily understandable and retrievable at a later date by individuals outside of the particular risk analysis team to enhance transparency and the confidence of others in the results. Furthermore, if the same threat judgments are to be used within more than one risk model, it is critically important

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<sup>39</sup> How the intelligence analysts were selected for the study should be included, even if the selection criteria were to make use of the analysts most available during the data collection timeframe. The documentation should include why the intelligence office or the particular type of intelligence analyst was selected for the study.

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that documentation on the questions, their context, along with the results and any parameters surrounding the measurement method being used are all captured.

## **Summary**

The guidelines of the collaborative framework are aimed at helping risk analysts who work with intelligence analysts to obtain sound threat judgments. These guidelines build upon principles and practices used by practitioners and scholars involved in social science and survey research. They are also informed by insights and feedback provided by intelligence and risk analysts through the course of the HSI team's analytic effort.

The framework's core principle is to foster an interaction approach that allows for systematic engagement of intelligence and risk analysts throughout the DHS risk assessment process. For DHS risk methods and models that benefit from continuous interaction through access to mixed staffing or standing committees that bring together risk and intelligence analysts on a continuing basis, these opportunities are already present and only need to be realized in practice. For risk assessment efforts that rely on periodic interaction for annual or biennial threat inputs from intelligence analysts, then undertaking systematic engagement using the concepts and practices highlighted in the framework becomes particularly important to achieving sound threat judgments.

By taking advantage of collaborative methods, such as scenario "brainstorming" sessions that bring together risk and intelligence analysts early, the process for producing threat judgments can better evolve from a being a relatively limited "supply and demand" relationship one that is mutually beneficial for both DHS risk and intelligence analysts. The result could be a process better suited to providing the decision-quality threat judgments that DHS decision-makers need for making sound risk management decisions.

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## 5. FINDINGS AND RECOMMENDATIONS

The HSI team's research and analysis, which draws on insights provided by members of the DHS risk analysis and intelligence communities, provides the basis for several major findings. These findings are mainly concerned with defining the challenges that face intelligence and risk analysts in working together to produce threat judgments for DHS risk assessment purposes. The findings also provide a basis for identifying improvements in ways for risk and intelligence analysts to collaborate.

This section also offers recommendations to DHS decision-makers, managers, and analysts on how best to achieve mutually beneficial collaboration between the DHS risk analysis and intelligence communities. Such collaboration is essential to meeting the common goal of supporting the needs of senior decision-makers responsible for making risk management choices involving U.S. homeland security.

### Major Findings

**Collaboration between DHS intelligence and risk analysts is constrained by the absence of cross-discipline familiarity.** The observation that there is a basic lack of cross-discipline familiarity between intelligence and risk analysts was a recurring theme in HSI-sponsored workshops involving individuals from both communities. Exacerbating this situation is the differing analytic cultures of the two disciplines. Although both risk analysts and intelligence analysts are accustomed to dealing with uncertainty in approaching problems, they have distinctive perspectives. Risk analysis provides a variety of tools and techniques (e.g., probability risk assessment, expert elicitation) that help risk analysts take a structured, and often quantitative, approach to estimating the likelihood and consequences of possible events, such as attacks on the United States. In comparison, the confidence of intelligence analysts is often strongly influenced by working with limited knowledge concerning a terrorist group's specific intent and capabilities, particularly given possible changes resulting from the dynamic and adaptive nature of terrorist groups.

This difference in perspective appears to foster unrealistic expectations in several ways. In particular, risk analysts sometimes have unrealistic expectations concerning the ability and willingness of intelligence analysts to provide quantifiable threat inputs. Similarly, they can underestimate the amount of time and effort required to work with intelligence analysts in producing high-confidence threat judgments. Likewise, intelligence analysts typically expect risk assessments to account for uncertainty at levels of detail that can create unmanageable complexity for risk analysts without necessarily improving how useful the results are for decision-makers. Basic improvement in cross-discipline familiarity is needed for intelligence and risk analysts, and their managers, to reduce such mismatched expectations and to create a productive basis for their collaborative activities.

**Simply relying on a supply and demand relationship to produce the threat judgments needed for DHS risk assessments fails to give both the risk analysis and intelligence communities a strong, mutual stake for supporting this DHS decision-maker requirement.**

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Much of the current interaction between the intelligence and risk analysis communities involves a one-way “supply and demand” relationship—risk analysts present a “demand” for threat inputs and intelligence analysts “supply” them. Producing reliable threat judgments can be challenging for several reasons: (1) risk analysts need tailored threat judgments that usually are not satisfied by what is available in finished intelligence products; and (2) sometimes intelligence organizations are asked to support DHS risk assessments as an added duty to their primary mission activities. In other words, providing support for DHS risk assessments can involve extra efforts for intelligence analysts that compete with their time available to fulfill standing intelligence mission requirements.

Risk analysts need threat judgments from the DHS Intelligence Enterprise, but the benefits for intelligence analysts are less apparent. Achieving a collaborative relationship, which is more sustainable over the longer term, requires ensuring that intelligence organizations develop a greater stake in supporting the risk assessment process. Improving cross-discipline collaboration is not an end in itself—rather it is a better way for producing decision-quality threat assessments needed by DHS senior leadership for making sound risk management decisions on allocating the Department’s limited resources. Without quality threat judgments, confidence in DHS risk management choices will suffer.

**Most approaches would benefit from undertaking systematic engagement throughout the risk assessment process.** Numerous risk assessments are being undertaken by DHS components and offices, and most have distinctive needs for threat inputs. In addition, a range of different approaches exist for how intelligence and risk analysts interact in producing threat judgments. Some make use of cross-discipline staffs while others depend on periodic interactions between intelligence and risk analysts to produce tailored threat judgments. Thus, a “one size fits all” approach is unwarranted for improving how the risk and intelligence communities collaborate in supporting DHS risk assessments.

Nonetheless, for the cases where intelligence and risk analysts periodically interact to produce threat judgments, there are benefits from undertaking systematic, collaborative engagement from the start and through the completion of the risk assessment process. Our analysis and interviews indicate that there are significant benefits from involving intelligence analysts at an early stage in the risk assessment process. A major benefit is to ensure that both the intelligence and risk analysts are proceeding on common assumptions. This will help avoid misunderstandings later that cause delays and raise doubts about the value of the threat judgments being produced.

Involving intelligence analysts early in the risk assessment process also is likely to facilitate collaboration in the subsequent phase of the process that is concerned with developing scenarios and producing threat judgments. Similarly, reengaging with intelligence analysts after the risk assessment has been completed helps to strengthen the collaboration process over the long run by providing intelligence analysts with some useful insights on how better to support the DHS risk assessment process.

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**Critical questions concerning how best to obtain and incorporate terrorist threat judgments into DHS risk assessments remain to be addressed.**

The HSI team identified important research issues that could enhance the collaboration of the intelligence and risk analysis communities in their joint efforts to support DHS risk assessments (see Appendix E for details). These issues involve what are realistic expectations for generating threat judgments, how to account for terrorists as adaptive adversaries, the potential utility of proxy data, and identifying ways to leverage the full range of available threat expertise within and outside the broader Intelligence Community.

## **Recommendations**

Along with presenting major findings, the HSI team offers the following recommendations that are relevant to both the risk analysis and intelligence communities in their joint activities.

**DHS should take steps to improve cross-discipline familiarity between the risk analysis and intelligence communities.**

Along with improving how risk and intelligence analysts work together in a single risk assessment, DHS decision-makers and managers need to take some immediate steps to improve the level of cross-discipline knowledge and familiarity. Such steps could go a long way toward reducing unrealistic expectations on both sides and helping to avoid wasted efforts. The HSI team has identified several ways of enhancing the collaboration environment for risk and intelligence analysts. These include:

- *Cross-discipline education.* Providing intelligence and risk analysts with tailored education materials is essential for enhancing their cross-discipline knowledge. The *DHS Risk Lexicon* is a useful product for helping intelligence analysts and others become familiar with risk analysis. Risk and intelligence analysts could benefit from having a comparable lexicon available for understanding terms of art used by intelligence analysts. Similarly, the tutorial material provided as companion material to this report is intended as a basic educational product for helping intelligence and risk analysts better understand the basics of the other's discipline.
- *Cross-training.* A major means for increasing familiarity is to provide cross-training. DHS should provide training that ranges from a standardized orientation session for all DHS intelligence and risk analysts to a more in-depth training design for those managers and analysts who are substantially involved in working with their counterparts to produce threat judgments for DHS risk assessments. Training intelligence and risk analysts in the same sessions is likely to have beneficial effects for DHS risk assessments purposes.
- *Personnel exchanges.* Undertaking personnel exchanges is a direct method for improving cross-discipline familiarity. The DHS Office of Risk Management and Analysis (RMA) should sponsor personnel exchanges with the intelligence and threat organizations within DHS. The individuals involved in the exchanges should be assigned an explicit role in facilitating cross-discipline collaboration and should also support cross-discipline education and training activities.

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- *Facilitation point of contact (POC).* Given the likelihood that the number of DHS risk efforts will grow over time, DHS decision-makers in the Office of Intelligence and Analysis (I&A) should establish a “facilitation POC” for assisting risk analysts in working with the diverse components of the DHS Intelligence Enterprise. This facilitation POC should be available to advise and assist DHS risk assessment efforts in identifying and connecting with relevant types of intelligence expertise operating within DHS. In addition, the designated POC should be able to provide information on threat and hazard expertise found outside of DHS, either within the national Intelligence Community or available from other relevant sources besides the Intelligence Community.
  - *Increasing transparency.* Intelligence analysts who provide threat judgments are often interested in knowing how their inputs are being used in making risk assessments. Providing intelligence analysts with access to documentation generated in the course of the DHS risk assessment process is another way to encourage cross-discipline collaboration. An incidental benefit might result if intelligence analysts are encouraged to alert their risk analyst counterparts if they receive intelligence updates that could lead to a significant reconsideration of the threat judgments that they provided earlier.

Separately, and in combination, these steps could strengthen the level of collaboration between the risk analysis and intelligence communities in meeting the needs of DHS decision-makers for sound risk assessments.

**Steps should be taken to promote mutually beneficial collaboration between the DHS risk analysis and intelligence communities for the purpose of ensuring high-confidence threat judgments over the longer term.**

Developing a mutually beneficial collaborative process could provide a stronger basis for long-term collaboration between the two communities in a way that encourages producing the decision-quality threat judgments needed for DHS risk assessment purposes. A collaborative relationship is likely to be more effective in producing higher quality threat judgments and more sustainable over the long term.

As noted earlier, systematic engagement between intelligence and risk analysts throughout the risk assessment process could increase the return benefits for intelligence analysts. For example, intelligence analysts might benefit from receiving feedback on how their threat inputs were used in the risk assessments and what types of questions DHS decision-makers might have raised concerning the risk assessments. Having added insights on what types of threats (and potential scenarios) are of concern to senior decision-makers could assist intelligence analysts, and their managers, in performing their intelligence mission activities and anticipating future requests for their analyses. In the best circumstances, the intelligence organizations might also find that participating in the DHS risk assessment process helps to inform their collection and analysis efforts.<sup>40</sup> For example, the types of terrorist threat scenarios and issues presented in the risk

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<sup>40</sup> For additional discussion on the potential benefits that intelligence analysts can gain from greater involvement with risk assessments, see Henry H. Willis, *Using Risk Analysis to Inform Intelligence Analysis* (Santa Monica, CA: RAND, February 2007), p. 14.



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assessment process might move intelligence analysts to conduct additional analysis of existing intelligence or refine their requirements for collecting relevant intelligence and information.

All of these activities could increase the stake that the intelligence community has in supporting DHS risk assessments. However, added resources and dedicated time on the part of intelligence analysts are essential for realizing a process that produces decision-quality threat judgments. Managers in both the DHS risk and intelligence communities must ensure that DHS decision-makers recognize the importance of receiving DHS Intelligence Enterprise support in producing needed threat judgments and that decision-makers consider providing necessary guidance, task-specific training, and additional resources, as appropriate.

**Decision-makers and managers responsible for DHS risk assessments should enhance the collaboration of risk and intelligence analysts by encouraging their systematic engagement throughout the entire process.**

One of the most direct ways to improve how risk and intelligence analysts work together in producing threat judgments is by using the principles and practices associated with the collaborative framework outlined in Section 4. These guidelines place a premium on achieving mutual understanding of the purpose in producing threat judgments by sustained collaborative interactions throughout each DHS risk assessment. For risk methods and models that involve only periodic interaction between risk and intelligence analysts, the systematic engagement would involve the following:

- *Phase I: preparation and initial engagement.* DHS risk analysts should take various collaborative steps prior to seeking threat judgments from their intelligence counterparts. These steps should include reviewing available intelligence products to begin achieving a common understanding of threat developments, as well as taking advantage of any additional intelligence materials recommended or provided by the intelligence analysts. Another important collaborative activity is for the risk analysts to develop a clear research design and then convey their essential approach and needs for threat judgments to their intelligence counterparts in a concise and documented manner (e.g., terms of reference).
- *Phase II: scenario development and threat inputs.* In this phase, the intelligence and risk analysts should work together in facilitated “brainstorming” sessions to draft a set of scenarios (and/or attack paths) that both sides find useful and plausible. Risk analysts should leverage the knowledge of their intelligence counterparts to help frame their questions in a way that is best suited for producing the types of needed threat judgments. Special efforts should be made by the risk analysts to explain different ways of measuring expert judgments and uncertainty, as well as identifying the methods for obtaining threat judgments that best work with their intelligence counterparts (e.g., individual or group interview sessions).
- *Phase III: follow-up activities.* Continuing the collaboration after the threat judgments have been acquired is important to sustain the collaborative process between intelligence and risk analysts over the longer run. Risk analysts should

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review the results of the risk assessment with the intelligence analysts to provide them with an understanding of how their threat inputs are being used. In addition, risk analysts should make a special effort to provide their intelligence counterparts with feedback gained from DHS decision-makers concerning threat scenarios and assumptions, which intelligence analysts could see as valuable insights resulting from their participation in the risk assessment process.

For DHS risk assessments that involve continuous interactions between risk and intelligence analysts, the principles of systematic engagement during each phase of the risk assessment process remain valid even though they might be applied somewhat differently in situations where continuous interaction take place.

**DHS/S&T should encourage research efforts that address outstanding questions that concern threat judgments provided for DHS risk assessments.**

DHS risk assessments have greatly benefited from leveraging academic research and professional practices in many areas to develop their particular approaches. However, there are some questions that are very specific to the nature of homeland security problem, and where these broader works are less helpful. With the intent of informing the long-term research agenda, the HSI team recommends that the DHS Directorate for Science & Technology support research for improving how threat judgments are produced to support DHS risk assessments. The following research questions deserve particular attention:

- What are realistic expectations in making threat judgments for DHS risk assessment purposes, particularly concerning quantifiable estimates?
- How should DHS risk assessments account for adaptive, intelligent terrorist adversaries?<sup>41</sup>
- How should homeland security risk analysts identify and make use of the needed threat expertise that exists both within and outside of the national Intelligence Community?
- Is reliable proxy data on terrorist intent and capabilities available, and what might be the proper conditions for using it to support DHS risk assessments?<sup>42</sup>

In summary, both the intelligence and risk analysis communities have an important stake in strengthening the collaborative process for working together to support DHS risk assessments. Improvements can be achieved by increasing cross-discipline familiarity, encouraging systematic engagement of risk and intelligence analysts throughout the risk assessment process, and addressing outstanding research questions. Achieving mutually beneficial collaboration between the risk analysis and intelligence communities is important for supporting the long-term need of DHS decision-makers for risk assessments that incorporate the best available threat judgments.

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<sup>41</sup> See Appendix E for a discussion of some current approaches for evaluating terrorists as intelligence and adaptive adversaries.

<sup>42</sup> See Appendix D for a more detailed discussion of these research questions.

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## LIST OF ACRONYMS

BTRA – Bioterrorism Risk Assessment  
CBP – Customs and Border Protection  
CIKR – Critical infrastructure and key resources  
CIA – Central Intelligence Agency  
CITA – Critical Infrastructure Threat Assessment (Division of I&A)  
CREATE – Center for Risk and Economic Analysis of Terrorism Events (at USC)  
CRS – Congressional Research Service  
CTC – Counter Terrorism Center (within CIA/DI)  
DHS – U.S. Department of Homeland Security  
DIA – Defense Intelligence Agency  
FYHSP – Future Years Homeland Security Plan  
GAO – U.S. Government Accountability Office  
HITRAC – Homeland Infrastructure Threat and Risk Analysis Center  
HSTA – Homeland Security Threat Assessment  
HSI – Homeland Security Institute  
HSPD-10 – Homeland Security Presidential Directive Number 10  
IC – Intelligence Community  
ICC – Intelligence Coordination Center (U.S. Coast Guard)  
ICE – Immigration and Customs Enforcement  
MSRAM – Maritime Security Risk Analysis Model (USCG Risk Model)  
INR – Intelligence and Research (Bureau within State Department)  
NAR – National CIKR Protection Annual Report  
NCTC – National Counterterrorism Center  
NIPP – National Infrastructure Protection Plan  
NPPD – National Protection and Programs Directorate  
ODNI – Office of the Director of National Intelligence  
OGT – Office of Grants and Training (within DHS)  
I&A – Office of Intelligence and Analysis (within DHS)  
OIP – Office of Infrastructure Protection (within DHS)  
OMB – Office of Management and Budget  
POC – Point of contact  
PRA – Probabilistic Risk Analysis  
RAPID – Risk Analysis Process for Informed Decision-Making (RMA risk model)  
RMA – Office of Risk Management and Analysis (within DHS)  
RMAP – Risk Management Analysis Process (for Commercial Aviation Safety)  
SARMA – Security Analysis and Risk Management Association  
SHIRA – Strategic Homeland Infrastructure Risk Assessment (OIP risk method)  
SMEs – Subject Matter Experts  
SSAs – Sector Specific Agencies  
SRA – Society for Risk Analysis  
START – Study of Terrorism and Responses to Terrorism (at University of Maryland)  
S&T – Science & Technology Directorate (within DHS)  
TSA – Transportation Security Administration  
T,V,C – Threat, Vulnerability, and Consequences factors  
USCG – United States Coast Guard  
USCIS – United States Citizenship and Immigration Services  
WITS – Worldwide Incident Tracking System (NCTC database)

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## **APPENDIX A**

### **COLLABORATION WORKSHOPS**

The HSI team organized and hosted a series of what we called “Collaboration Workshop” during September to November 2008. Their purpose was to bring together members of the DHS risk analysis and intelligence communities to discuss issues of mutual interest concerning the challenges and opportunities for producing threat judgments needed for DHS risk assessments purposes. The workshops generally ran less than a full day and were hosted by the Homeland Security Institute using conference facilities of its parent organization, Analytic Services, Inc. Each workshop featured presentations by the HSI staff members and facilitated discussions of various issues related to problems associated with how intelligence and risk analysts work together, as well as potential opportunities for mitigating or overcoming these problems.

The following is a summary of the Collaboration Workshop activities, and a combined list of the various participants in the workshop activities.

#### **Collaboration Workshop #1**

The initial workshop was held September 25, 2008. It focused on identifying the main challenge to collaboration between intelligence and risk analysts in producing threat judgments for DHS risk assessments. The main result of this workshop was to identify various challenges (Table A.1) and opportunities (Table A.2) for intelligence and risk analysts working together to produce threat judgments needed for DHS risk assessments.

#### **Collaboration Workshop #2**

The next workshop was held on October 16, 2008. The focus of this workshop was to discuss the HSI team’s preliminary concepts for addressing risk analysis and intelligence communities collaboration challenges. It also featured a presentation on a visualization tool using CORE systems engineering software that could be adapted for eliciting and visualizing threat judgments in the form of attack paths. The HSI presentation focused on set of Improvised Explosive Devices (IED) related terrorist threat scenarios. One scenario, based on a postulated IED attack against U.S. urban targets was chosen to demonstrate one possible expert elicitation method and the practical application of threat information into a risk model. The postulated purpose of the elicitation was to identify the most likely attack paths a terrorist would take as an input to a DHS risk assessment.<sup>43</sup>

#### **Table A.1: Workshop Participant Feedback on Collaboration Challenges.**

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<sup>43</sup> To support this demonstration, the HSI team used the CORE™ system engineering tool for modeling relevant threat paths to different levels of detail. This analysis and visualization tool was used to build and display functional relationships, highlight choices available to threat actors, present alternative modes of attack, reveal interrelationships, and provide a built-in simulator to provide verification. (CORE™ is a Computer Aided Systems Engineering (CASE) tool that can be used manage the systems engineering process from requirements development through architecting and system design.)

<b>Challenges to Collaboration</b>	<i>Elicitation method issue</i>	<i>Organizational process issue</i>	<i>Perspectives issues</i>
<ul style="list-style-type: none"> <li>• Intelligence and Risk Analysts need to know more about each others’ fields. Participants to the workshop agreed that better mutual understanding would lead to greater collaboration.</li> <li>• Risk Analysts need to conduct more background research on products the intelligence community produces and information from other resources pertaining to the inputs needed for their models.</li> <li>• Risk community’s approach to the intelligence community is not adequately organized, creating multiple and overlapping requests to the intelligence community. There is no stability in the data requirements for the intelligence community, and no common method risk analysts use for gathering inputs from intelligence analysts.</li> <li>• Input from intelligence analysts needs to be gathered early in risk model development, particularly in the scenario stage. It becomes difficult for intelligence analysts to provide inputs on scenarios they do not analyze or are not considered realistic.</li> <li>• Scarcity of intelligence data makes it difficult to provide judgments.</li> <li>• Risk analysts are asking for quantitative measurements for inputs that are developed qualitatively or in prose.</li> <li>• Risk analysts need to understand the certainty limits inherent in many terrorist related intelligence judgments, and manage their own expectations of this data.</li> <li>• Intelligence and risk analysts have similar terms and metrics that have different meanings and methodologies.</li> <li>• The risk community is asking for input that is not traditionally produced by intelligence community, and the threat input to models is not just an intelligence community function.</li> <li>• While risk analysts could ask questions of people outside the intelligence community, sometimes they will still need to ask non-traditional questions from intelligence community members and ask for their best judgment, even though it may not be seen as a valid request by intelligence analysts.</li> <li>• Risk analysts have trouble developing relationships with intelligence offices that have high turnover rates.</li> </ul>	<p>X</p> <p>X</p> <p>X</p> <p>X</p> <p>X</p> <p>X</p> <p>X</p> <p>X</p> <p>X</p>	<p>X</p> <p>X</p> <p>X</p> <p>X</p> <p>X</p> <p>X</p> <p>X</p> <p>X</p> <p>X</p>	<p>X</p> <p>X</p> <p>X</p> <p>X</p> <p>X</p> <p>X</p> <p>X</p> <p>X</p> <p>X</p> <p>X</p> <p>X</p> <p>X</p> <p>X</p> <p>X</p> <p>X</p> <p>X</p> <p>X</p>

**Table A.2: Opportunities for Improved Collaboration.**

<b>Identified Opportunities</b>	<i>Elicitation method issue</i>	<i>Organizational process issue</i>	<i>Perspectives issues</i>
<ul style="list-style-type: none"> <li>• A long term solution is having long-run risk projects develop their own threat analysts.</li> </ul>		X	
<ul style="list-style-type: none"> <li>• Having some risk structure input for intelligence data collection and analysis requirements</li> </ul>		X	
<ul style="list-style-type: none"> <li>• Risk analysts could do more background research and read intelligence community products before eliciting judgments from the intelligence community.</li> </ul>	X	X	
<ul style="list-style-type: none"> <li>• A repository of relevant intelligence products could be developed for risk analysts as to make them more available to risk analysts.</li> </ul>		X	
<ul style="list-style-type: none"> <li>• Risk can use more open-source documents.</li> </ul>	X		
<ul style="list-style-type: none"> <li>• A tutorial could be developed to educate risk and intelligence analysts on each others' disciplines.</li> </ul>			
<ul style="list-style-type: none"> <li>• Development of “rubrics” to assist in the communication of terms between risk and intelligence analysts.</li> </ul>			X
<ul style="list-style-type: none"> <li>• Risk analysts could be more transparent when explaining the context in which the intelligence judgments will be used.</li> </ul>	X	X	X
<ul style="list-style-type: none"> <li>• Intelligence analysts could be brought in earlier to develop scenarios and help frame elicitation questions.</li> </ul>	X	X	

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### Collaboration Workshop #3

The final workshop which was held on November 18, 2008, included a facilitated discussion of whether intelligence and risk analysts share a common concept of what “threat” entails, as well as a presentation of the HSI team’s preliminary findings and recommendations. In addition, the workshop featured two presentations by outside experts on how analytic methods for dealing with the problem of intelligent, adaptive terrorist adversaries:

- Dr. Brian Jackson, Associate Director, Homeland Security Program RAND Corporation, gave a presentation on RAND analysis on thinking about adversary impacts on homeland security defensive measures from a dynamic rather than a static perspective (see Appendix E for details concerning RAND analysis on this subject).
- Dr. John Lathrop, Lawrence Livermore National Laboratory (LLNL), provided an overview of his work on Modeling the Adversary for Responsive Strategy (MARS) with particular attention to “threat shifting” and how terrorists as intelligent adversaries might respond to U.S. homeland security countermeasures to potential terrorist attacks.

Their analytical approaches are discussed in more detailed in Appendix E, “Analytic Approaches to Assess Adaptive Terrorist Adversaries.”

The following participants attended one or more of the Collaboration Workshops:

<b>Participant</b>	<b>Affiliation</b>
Christopher Abela	DHS/OIP/HITRAC
Geoffrey Abbott	HSI
Clarke Ansel	HSI
John Baker	HSI
Matthew Becker	DHS/HITRAC
Steve Bennett	DHS/S&T
John Brennan	DHS/HITRAC
Steve Chase	DHS/I&A
Ted Constantine	DHS/I&A
Kim Corthell	HSI
Andrew Cox	TSA
Robin Dillon-Merrill	Georgetown University
Gary Foster	HSI
Gordy Garrett	DHS/RMA
Steve Guerra	HSI
Phil Hammar	HSI

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Mark Hanson	HSI
Al Hickson	TSA Intelligence
Russell Ignarro	DHS/I&A (HITRAC)
Brian Jackson	RAND
Ed Jopeck	SRA Intl. & SARMA
Darryl Kramer	DHS/I&A
Bob Kolasky	DHS/RMA
Rich Kraske	TSA Intelligence
Adam Landry	CG/ICC
Skip Langbehn	HSI
Rosemary Lark	HSI
John Lathrop	Lawrence Livermore Nat. Lab.
Genevieve Lester	University of Berkeley
Evan Levine	DHS/RMA
Mark Lowenthal	Intel & Security Academy
Steve Mabeus	DHS/I&A
Audrey Mazurek	ANSER
William McGill	Penn. State University
Alex McLellan	HSI
Arthur (Butch) Miller	CG Intel (ICC)
Darrell Morgeson	IDA
Sarah Norcross	DHS/RMA
Matt Phillips	ANSER
Chad Reifer	ANSER
Bob Ross	DHS/S&T
Adrian Smith	HSI
Erik Smith	ANSER
Susan Smith	DHS/OIP/HITRAC
Jake Stenzler	DHS/RMA
Steven Streetman	DNDO
Kevin Strompf	DHS/I&A
Greg Swider	HSI
Arch Turner	DHS/S&T
Henry Willis	RAND
Meghan Wool	HSI
Alexis Zeiger	ANSER



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## **APPENDIX B**

### **BACKGROUND ON DHS RISK METHODS AND APPROACHES**

This appendix offers additional information on the several DHS risk assessment methods and models that are discussed earlier in this report. It gives particular note to the types of interaction that intelligence and risk analysts undertake in producing the need threat inputs and judgments for these methods and models.

*DHS Risk Assessments that feature Continuous Interaction*

#### **Strategic Homeland Infrastructure Risk Assessment (SHIRA)**

The Strategic Homeland Infrastructure Risk Assessment (SHIRA) process provides a snapshot of the all-hazard risks to the nation's Critical Infrastructure and Key Resources (CIKR), to include human, physical and cyber assets.<sup>44</sup> This risk method is produced for the DHS Office of Infrastructure Protection (OIP) with CIKR vulnerability and threat analyses provided by intelligence analysts and infrastructure experts in the Homeland Infrastructure Threat and Risk Analysis Center (HITRAC), drawing upon information provided by the infrastructure protection and intelligence communities.<sup>45</sup> The purpose of the SHIRA process is to provide senior policy makers with a strategic assessment of the all-hazards risks to the 18 CIKR sectors. The analysis presented in SHIRA provides risk rankings of worst, most reasonable case scenarios in each sector and provides a relative ranking of those scenarios.

#### **Description**

The SHIRA process grew from a direct request from the White House in 2003 and has evolved into an inclusive process that produces a strategic, integrated assessment of the risks to the Nation's CIKR sectors posed by all hazards.. The SHIRA process is designed to assess key risks to the Nation's CIKR sectors from a variety of hazards including terrorists and natural disasters. The process is conducted in coordination and collaboration with members of the intelligence and infrastructure protection communities. HITRAC coordinates directly with CIKR stakeholders and Intelligence Community members to obtain or generate the data used in the SHIRA. These stakeholders include the Intelligence Community for threat assessments, along with the Sector Specific Agencies and other Federal subject matter experts to assess vulnerability and consequences by sector. The SHIRA results form the basis for the National Risk Profile within the National CIKR Protection Annual Report (NAR) and individual Sector Risk

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<sup>44</sup> U.S. Department of Homeland Security, *National Infrastructure Protection Plan: Partnering to Enhance Protection and Resiliency* (Washington, DC: Department of Homeland Security, 2009), pp. 32-40. Available at: [http://www.dhs.gov/xprevprot/programs/editorial\\_0827.shtm](http://www.dhs.gov/xprevprot/programs/editorial_0827.shtm).

<sup>45</sup> *Ibid.*, p. 38.

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Profiles. It also supports the National Infrastructure Protection Plan (NIPP) in general as well as Sector Specific Plan (SSP) developments and investments to lower sector risks.<sup>46</sup>

### **Nature of Risk-Intelligence Collaboration**

Collaboration in the SHIRA process occurs on a continuous basis between the intelligence analysts and infrastructure protection analysts of the Homeland Infrastructure Threat and Risk Analysis Center. Thus, HITRAC provides the clearest example of a mixed staffing arrangement that allows for the ease of continuous interaction between intelligence and risk professionals as they work together to support products such as SHIRA. These analysts are tasked on an annual or biennial basis to provide threat inputs for SHIRA. These analysts are asked to analyze a broad range of potential terrorist attack modes across various target types within the critical infrastructure sectors and key resources. The threat inputs are informed by intelligence analysis and current information within the context of the known vulnerabilities of critical infrastructure and key resources.

### **Risk Management Analysis Process (RMAP)**

The Transportation Security Administration (TSA) created Risk Management Analysis Process (RMAP) for Commercial Aviation Security as a set of tools (modeling, simulation, and analysis) for strategic risk analysis to inform decisions on risk reduction options for the U.S. commercial aviation security system. The RMAP methodology involves assessing risk in the form of multiple attack scenarios against aviation, modeling and analysis of countermeasures against such threats, evaluating alternatives for “relative total risk reduction” in terms of their operational and economic impact on the aviation system, and focusing resources.<sup>47</sup>

#### **Description**

The RMAP toolset includes models that determine the operational and economic impacts of attacks on commercial aviation. In combination, these tools enable risk analysts to measure “relative total risk reduction” options in terms of their operational and economic impact. The RMAP Risk Calculation measures Total Risk in terms of “relative total risk reduction,” countermeasures, relative likelihood, and consequences (from the defender’s perspective).

The work is supported by USG and aviation industry experts organized in working groups, using a common terminology, and all having at least Secret-level clearances. It is

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<sup>46</sup> Brandon Wales (DHS), “The Strategic Homeland Infrastructure Risk Assessment: History, Methodology, and Process,” Briefing to HSI, February 26, 2007; Susan Smith (DHS), Briefing to Risk Steering Committee Tier III (RSC III), chaired by Tina Gabrielli, Director DHS/RMA, Featured Risk Practice Series, February 13, 2008.

<sup>47</sup> Presentation by Matthew McKean, Transportation Security Administration (TSA), on RMAP at the National Conference on Security Analysis and Risk Management, sponsored by the Security Analysis and Risk Management Association (SARMA), held at George Mason University, May 13-15, 2008.



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supported by the U.S. Commercial Aviation Partnership (USCAP) and the work of the National Information and Simulation Analysis Center (NISAC) at LLNL.

The RMAP Adversary Modeling involves a scorecard for terrorist attack options that weighs key factors, including expected deaths, economic impact, psychological impact, and the possibility of impact multiplication to account for parallel attacks. There are about 26 main scenarios involving potential damage to the U.S. commercial aviation system, including paths involving attacks on passengers, the use of aircraft as a weapon, and attacks on aviation infrastructure. One of the challenges for the RMAP involves bringing together and handling information of very different levels, ranging from classified information to unclassified but sensitive information of various types.<sup>48</sup>

### **Nature of Risk-Intelligence Collaboration**

One of the features of RMAP is that risk analyst work closely with the intelligence community to produce needed threat judgments. This requires asking intelligence analysts to think in ways that are less familiar them. The RMAP risk analysts have worked closely with the intelligence analyst counterparts and seek to use their time wisely. Sometimes the intelligence analysts must prepare specifically for the RMAP sessions; other times they need to go back and find new information on relevant questions.<sup>49</sup>

### **Maritime Security Risk Analysis Model (MSRAM)**

The Maritime Security Risk Assessment Model (MSRAM) is used by the U.S. Coast Guard (USCG) for maritime terrorism risk analysis and risk management. The USCG developed the MSRAM for use at the strategic, operational and tactical levels, and MSRAM data is used for resource prioritization by Coast Guard Headquarters as well as Coast Guard Sector officials. Threat inputs for the model are provided by the USCG Intelligence Coordination Center (ICC).

### **Description**

For the MSRAM, the Terrorism Risk = Threat x Consequences x Vulnerability.

- *Threat*: the likelihood of an attempted attack, a multiple of intent and capability.
- *Consequences*: the monetary and non-monetary, undesired outcomes, losses, and/or “costs” of an event. This could include financial, life safety, environmental, social, legal and other costs. The impacts are assessed across six different categories: Death and Injury, Direct Economic Loss, Secondary Economic Loss, Environmental, National Security, Symbolic Impact.

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<sup>48</sup> Ibid. These sensitive but unclassified information types include: Protected Critical Infrastructure Information (PCII), Sensitive Security Information (SSI), For Official Use Only (FOUO), Law Enforcement Sensitive (LES), and company proprietary information.

<sup>49</sup> Ibid.

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- *Vulnerability*: the probability of a successful attack given an attempt. This factor considers a number of sub-factors, including the innate difficulty of the attack, the ability of maritime stakeholders to intervene, and the hardness of the target.

Coast Guard leadership at the headquarters and field levels can allocate resources and plan operations based upon MSRAM analysis. MSRAM supports strategic risk management by rolling up field-level risk assessments to provide an understanding of the greatest risks throughout the U.S. maritime domain.<sup>50</sup> It supports field-level risk management by providing a consistent analytic framework for assessing the risk of different scenarios and communicating the impacts of risk mitigation strategies. MSRAM can also be used to facilitate the sharing of threat information at the local level. Because its focus is on using sensitive but unclassified information, risk assessments can be shared more readily with the private sector, local government, and local law enforcement. As Arthur “Butch” Miller notes, “the lower the overall classification, the more useful the assessment is to risk-based decision makers.”<sup>51</sup>

### **Nature of Risk-Intelligence Collaboration**

In order to develop reliable and accurate threat assessments, the MSRAM process relies upon a continuous interaction between national analysts and local stakeholders. This interaction is enhanced by locally available unclassified information. The process puts a premium upon this type of interaction and avoids reliance upon traditional Intelligence Community (IC) classified sources. The resulting assessments are much more locally driven and more easily disseminated.

The continuous interaction in the MSRAM process is highlighted in the risk assessment cycle. Because resource allocation for critical infrastructure/key resources protection typically occurs along a one to two year timeline, it is essential that threat data reflects the most realistic assessment of current and projected threats. While IC data can be an input into MSRAM analysis, the ICC has found it more reliable to use unclassified sensitive but unclassified information available from the local level stakeholders. The MSRAM relies upon the collaboration between local stakeholders and USCG analysts to accomplish this. An example of this collaboration is evident in the ICC’s Domestic Port Threat Assessments (DPTA). While the initial draft of the DPTA is written using publicly available information, any intelligence gaps are addressed by deployed ICC analysts in coordination with local stakeholders. The DPTA then becomes a living document that can be regularly updated at the local level. The overall process attempts to ensure that analysis is based on current information and assists local data collection for nationwide risk profiles such as the National Maritime Terrorism Threat Assessment.<sup>52</sup>

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<sup>50</sup> An example of a national-level assessment is the National Maritime Terrorism Threat Assessment (NMTTA). MSRAM can be used to support this type of high-level analysis as well as field-level requirements.

<sup>51</sup> Miller, “Assessing Threats to Support Risk Intelligence.”

<sup>52</sup> USCG Intelligence Coordination Center. (U) *National Maritime Terrorism Threat Assessment*. Washington, DC: USCG Intelligence Coordination Center, 07 January 2008. (Unclassified//For Official Use Only).

## **Risk Analysis Process for Informed Decision-making (RAPID)**

The Risk Analysis Process for Informed Decision-making (RAPID) is a strategic-level process for assessing DHS programs in terms of their risk reduction effects against a broad spectrum of threats and hazards to the U.S. homeland. The analytic results produced by RAPID are intended to support the risk management needs of DHS senior leaders by informing the Planning, Programming, Budgeting, and Execution (PPBE) cycle, as well as the annual DHS Future Years Homeland Security Program (FYHSP). RAPID is being developed under the sponsorship and management of the Office of Risk Management and Analysis (RMA), which is located within the DHS National Protection and Programs Directorate (NPPD).<sup>53</sup>

### **Description**

RAPID assesses the risk reduction potential of DHS programs in terms of a range of future planning scenarios involving terrorist attacks, major disasters, and large-scale emergencies. The future capabilities of existing and planned DHS programs are assessed in terms of their potential impact on the key risk elements (i.e., threat, vulnerability, consequences) associated with the different scenarios. In the case of terrorist scenarios, the risk model focuses on assumed attack paths. The RAPID analysis considers how different DHS programs could achieve risk reduction by providing capabilities for prevention, protection, response, or recovery that reduce the likelihood of a successful terrorist attack or mitigate the consequences (e.g., fatalities, economic impact) of an attack or natural disaster. A spiral development approach has been used to advance the RAPID prototype.

### **Nature of Risk-Intelligence Collaboration**

RAPID represents a DHS risk assessment model that relies on periodic interactions with intelligence analysts to obtain needed threat judgments. In the prototype development, threat judgments were obtained from intelligence analysts using expert elicitation methods. In addition, RAPID requires inputs from individual familiar with DHS capabilities.

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<sup>53</sup> *Risk Assessment Process for Informed Decision-making (RAPID): Final Report on Prototype Phase* (Arlington, VA: Homeland Security Institute, 2009). (Unclassified//For Official Use Only).

## **S&T Risk Model<sup>54</sup>**

The S&T risk model, developed by the Homeland Security Institute (HSI) to address the needs of the DHS Directorate for Science and Technology, performs risk assessments to inform S&T resource allocation decisions, thereby helping to meet the DHS mandate to incorporate risk into decision making. The model is currently the only tool that uses a common effectiveness metric (risk reduction) to compare all S&T capability gaps and programs.

The model's results may be used to develop several useful decision support products, including

- The *risk reduction potential of each capability gap*—an estimate of the amount of risk (in dollars/year) that would be reduced if a gap were filled by one or more S&T programs.
- The *risk reduced by programs*—showing the overall amount of risk reduced by each S&T program, estimated in dollars/year, assuming that the program is funded.

### **Description**

The basic design of the S&T risk model is based on three elements: attack/hazard scenarios; risk calculations; and mapping of gaps and programs to scenarios.

#### *Scenarios*

Based on the S&T Transition Managers' input, the HSI team updated and expanded the National Planning Scenarios (NPS) to meet the S&T Directorate's need for a current representation of the five-year future threat to support its investment decisions. The risk model incorporates 20 scenarios that the team derived from the NPS and further developed based on subject matter expert (SME) inputs.

#### *Risk Calculations*

The risk calculations determine threat, vulnerability and consequences differently for terrorism/criminal events and natural disasters:

- Threat is expressed as frequency of attempts per year (for terrorism/criminal events) or occurrences per year (based on historical data on natural disasters).
- Vulnerability is expressed as the likelihood of a successful event. It is assumed to be "100%" for natural disasters because they cannot be prevented. For terrorist/criminal events, each attack event is described as a series of attack-path steps, with a likelihood of terrorist success expressed as a percentage.

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<sup>54</sup> This section is adapted from Section 2.0 of HSI's *S&T Risk Model for Science and Technology Planning and Resource Allocation, Volume 1 – Final Report of 28 August 2008 (For Official Use Only)*.

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- Consequences are expressed as deaths, injuries, and economic impacts (measured in terms of dollars), for both terrorist/criminal and natural events.

These threat, vulnerability, and consequence values are multiplied together to estimate risk (in dollars at risk per year) for each event.

### *Mapping*

The team then used two types of mapping to build the detailed inputs needed to support the model's calculations:

- Mapping S&T programs to specific capability gaps—this specifies that the program would help fill one or more of the shortfalls represented by the gap. S&T provides these mapping results.
- Mapping a capability gap to an attack-path step and its associated consequence value (documented in the scenarios)—this specifies how the issue raised by the gap is associated with the estimated likelihood of completing the event and consequence value of the event.

### **Nature of Risk-Intelligence Collaboration**

Threat frequency values for terrorism were initially developed through open-source historical research and validated by threat subject matter experts (SMEs) in the Coast Guard, the Intelligence Community, and DHS S&T. Vulnerability probabilities for terrorism and criminal attack path steps were obtained from numerous SMEs affiliated with DHS S&T. These SMEs possessed detailed knowledge of relevant threat reports, the latest technology, and priorities of first responders. Very little of this threat data was acquired directly from intelligence representatives – nor were they readily available or a process in place to engage them for model inputs.

Given that this risk method is in the early stages of development, the choice not to undertake a process of obtaining threat judgments from intelligence analysts is appropriate. The S&T risk model also highlights that a broad range of sources relevant to generating threat judgments are available and can be useful for supporting the model development.



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## APPENDIX C

# DHS RISK ASSESSMENTS: ALTERNATIVE APPROACHES FOR PROVIDING THREAT INPUTS

Alternative approaches exist for producing the threat judgments needed for DHS risk assessments. Following a brief discussion on the nature of homeland security risk assessments, this appendix provides a more in-depth discussion of the desired attributes of threat judgments used in risk assessments and information on the three basic approaches for producing threat judgments for the DHS risk methods and models that we reviewed for this project.

### **Nature of Homeland Security Risk Assessments**

Senior DHS decision-makers make risk management decisions that help guide how the department plans its programs, conducts operations, and develops capabilities for fulfilling its mission requirements.<sup>55</sup> The importance of risk management to the department's mission is reflected in the fact that it is presented as one of the guiding principles in *One Team, One Mission, Securing Our Homeland: U.S. Department of Homeland Security Strategic Plan Fiscal Years 2008-2013*, which states the following:

#### **Apply Risk Management.**

The homeland security mission is complex, and resources are constrained. The Department will use qualitative and quantitative risk assessments to inform resource decisions. These resources will be targeted at the most significant threats, vulnerabilities, and potential consequences.<sup>56</sup>

#### ***Risk Assessment***

Homeland security risk analysts depend on experts from various disciplines to make judgments on threat, vulnerability and consequence issues that are integral to producing risk assessments. They depend on these subject matter experts to provide informed judgments on the following types of questions that are the basis for risk assessments:

- What can happen?
- How likely is it to happen?

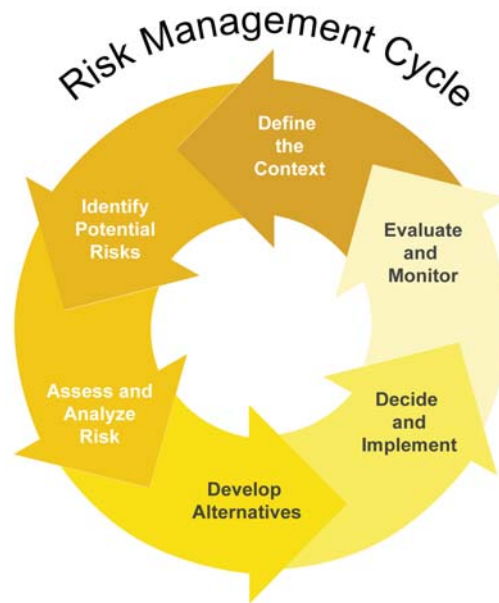
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<sup>55</sup> Bob Kolasky, Assistant Director, Risk Governance and Support, Office of Risk Management and Analysis, U.S. Department of Homeland Security, "Risk Management at DHS: Toward an Improved and Integrated Approach," Presentation to the Society of Risk Analysis, December 9<sup>th</sup>, 2008.

<sup>56</sup> *One Team, One Mission, Securing Our Homeland, U.S. Department of Homeland Security Strategic Plan, Fiscal Years 2008-2013* (Washington, DC: U.S. Department of Homeland Security, September 16, 2008), p. 4. Available at: <http://www.dhs.gov/xabout/strategicplan/>.

- What is the severity of consequences?<sup>57</sup>

In the homeland security context, such experts are asked to provide their best judgments on the likelihood and consequences of events, such as particular types of terrorist attacks, which have previously occurred only rarely or not at all. Hence, the risk analysts must account for the fact that substantial uncertainty exists in generating expert judgments on various aspects of threat, vulnerability, and consequences. As Figure C.1 indicates, risk assessment constitutes a key step in the risk management process by identifying potential homeland security risks and then assessing and analyzing risk.<sup>58</sup>



**Figure C.1: Risk Management Process.**

### ***Risk Management***

The risk assessment, in turn, serves as part of the broader analytic process to enable decision-makers to address the following types of questions that are central to making risk management choices:

- What can be done?
- What options are available, and what are the benefits and costs of each option?

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<sup>57</sup> Sources: Communication with Dr. William L. McGill, The College of Information Sciences and Technology, The Pennsylvania State University, 15 December 2008, and congressional testimony of Dr. Detlof von Winterfeldt, CREATE, *Terrorism Risk Assessment at the Department of Homeland Security*, hearing before the Subcommittee on Intelligence, Information Sharing, and Terrorism Risk Assessment of the House Committee on Homeland Security, 109<sup>th</sup> Cong., 1<sup>st</sup> sess. (Washington, DC: U.S. Government Printing Office, 2007), p. 19.

<sup>58</sup> Figure adapted from U.S. Department of Homeland Security, *Interim Integrated Risk Management Framework* (Washington, DC: Risk Steering Committee, January 2009), p. 8.



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- What impact do current options have on the future choice of options?

Decision-makers and planners within DHS already rely on risk management methodologies in several ways. These include helping them to allocate homeland security grant funding for building up national preparedness capabilities, setting priorities for infrastructure protection by comparing risks among critical infrastructure assets and sectors, and setting strategic priorities for the nation's maritime security efforts. Over the longer run, DHS is working to use integrated risk management to support risk-informed decision-making in several ways, such as playing a role in informing the DHS Planning, Programming, Budgeting and Execution (PPBE) process and supporting enterprise-level decisions, such as those involving the Integrated Planning System (IPS).<sup>59</sup>

Once the decision-makers have made choices on how to proceed, the risk management cycle continues with the process of implementing their decisions and the subsequent need to monitor and evaluate whether the planned actions are occurring as planned and having the expected effect of achieving risk reduction.

### ***Types of Threat Judgments Needed***

As noted in Section 2, risk analysts typically look to intelligence analysts to provide tailored threat inputs. Examples of the types of threat judgments needed for DHS risk assessments include:

- Estimated likelihood of attacks
- Types of terrorist attacks
- Estimated frequency of attacks
- Attacker types, targeting preferences, tactics, techniques, and procedures
- Potential of terrorist groups for adaptation against homeland security measures

Given these types of questions, it is not surprising that the Intelligence Community, which places high priority on understanding and monitoring terrorist threats, is considered an important source of threat judgments for homeland security risk assessments.

Within DHS and the broader Intelligence Community, analysts work hard to develop a deep understanding of the nature of terrorist threats to the United States, including potential terrorist attacks that could be directed at targets located in the homeland, whether such attacks are directed from abroad or originate domestically. Intelligence analysts tend to focus on understanding the intent and capability of terrorist adversaries. Assessing the *intent* of a terrorist adversary involves understanding the terrorists' goals, plans, and desires. In comparison, assessing *capability* is more concerned with determining what the terrorists are capable of accomplishing, particularly their ability to

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<sup>59</sup>Bob Kolasky, Assistant Director, Risk Governance and Support, Office of Risk Management and Analysis, U.S. Department of Homeland Security, "Risk Management at DHS: Toward an Improved and Integrated Approach," Presentation to the Society of Risk Analysis, December 9<sup>th</sup>, 2008.

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undertake effective attacks using certain types of weapons against targets located in the U.S. homeland or elsewhere. Insights on terrorist capabilities can be gained from analyzing previous terrorist attacks that occurred abroad and what is known about a terrorist group's particular recruiting and training practices.<sup>60</sup>

In providing threat judgments, intelligence analysts can rely on their own acquired expertise on terrorist intent and capability. In addition, they also can draw on the diverse expertise of colleagues and can leverage the broader and deeper knowledge that resides within the national-level Intelligence Community. For example, a DHS risk assessment could depend on understanding the relative difficulty for terrorists to acquire or develop chemical weapons on their own, as well as the operational challenges involved in delivering the chemical weapon effectively against the stadium target. For this risk assessment, a higher degree of fidelity is required. The risk analysts might need to draw on the national-level Intelligence Community's most specific knowledge of terrorist intent and capability specifically involving chemical agents and even tap into highly specialized expertise found within the technical community, such as at the national laboratories and in the private sector.

### ***Desired Attributes of Threat Judgments***

A useful threat judgment is defined by more than whether the expert provides needed input in quantitative or qualitative form. Rather, it is important that whatever the form of the threat judgment (e.g., estimated likelihood of a particular terrorist attack), it has certain desired attributes that increase the confidence of decision-makers and other users that the threat judgment is sound, defensible, and an accurate expression of the expert's view. Based on our discussions with risk and intelligence analysts, we have identified the following as desirable attributes for threat judgments used in DHS risk assessments:

- *Common understanding.* It is essential to determine that the risk and intelligence analysts involved in producing threat judgments adhere to a common understanding of the questions being asked and the answers that are received and recorded. This requires attention to differences in terminology, how questions are framed and presented to the expert, and the presence of implicit assumptions that could contribute to misunderstandings.
- *Analyst's best judgment.* A desirable threat judgment is one representing the best judgment that the analyst can provide in the face of uncertainty. In achieving a high-quality judgment, the interaction between the risk analyst and intelligence analyst should avoid conditions that lead the analyst to offer only cursory answers (i.e., in the vein of "let's get this over as soon as possible") because the

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<sup>60</sup> Testimony of Melissa Smislova, Acting Director, Homeland Infrastructure Threat and Risk Analysis Center, U.S. Department of Homeland Security, *Terrorism Risk Assessment at the Department of Homeland Security*, hearing before the Subcommittee on Intelligence, Information Sharing, and Terrorism Risk Assessment of the House Committee on Homeland Security, November 17, 2005, 109<sup>th</sup> Cong., 1<sup>st</sup> sess. (Washington, DC: U.S. Government Printing Office, 2007), pp. 9-10; and see Kim Cragin and Sara A. Daly, *The Dynamic Terrorist Threat: An Assessment of Group Motivations and Capabilities in a Changing World* (Santa Monica, CA: RAND Corporation, 2004), pp. 7-17.

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analyst feels that the scenarios or questions being asked are too unrealistic to be worthwhile. Similarly, intelligence analysts may simply hold back their best judgment and offer unduly broad estimates if they are uneasy about how the judgment might be used. Alternatively, intelligence analysts can be encouraged to offer their best threat judgments by showing them that the context and caveats associated with their threat judgments are being captured as part of the risk assessment record and, where possible, by conducting follow-up discussions that clarify any ambiguities in the judgments they provided earlier.

- *Avoids false precision.* Because risk assessments depend on quantifiable inputs, the tendency exists to seek threat judgments that may involve “false precision” when expressed in numerical form, sometimes without a sound basis for providing this level of precision. Risk analysts seeking threat judgments from intelligence analysts should avoid the false precision pitfall by using data collection methods that are not prone to this shortfall. In dealing with the intrinsically subjective nature of threat judgments, risk analysts should make clear to the users of risk assessments that seemingly precise figures for the threat judgments are largely an artifact of the modeling process and they should explain the degree of underlying uncertainty.
- *Transparent process.* A final desirable attribute for threat judgments used in DHS risk assessments is to exhibit transparency. The process for producing and use threat judgments in DHS risk assessments should be transparent and traceable enough that the both the producers and users of risk assessment can have confidence in the results by understanding how threat judgment informed the final results. The cornerstone of such transparency is having adequate documentation to allow outside observers to understand what the intelligence analyst was asked, how questions were asked and responses recorded, what assumptions were present in the discussion, and what degree of uncertainty the intelligence analyst expressed concerning the answers he or she provided.

The remainder of this appendix describes the different approaches being used within DHS to obtain the threat judgments needed for risk assessments.

### ***Challenges to Producing Collaborative Judgments***

Our analysis, including feedback received from interviews and the Collaborative Workshops, indicates that several impediments to collaboration exist: (1) distinctive disciplines for the risk and intelligence analysts, (2) challenges in quantifying threat judgments, and (3) shortfalls in the collaboration process.

**Distinctive Disciplines.** In the course of our research, we have repeatedly observed that risk and intelligence analysts often view threat issues quite differently. The discipline of risk analysis is focused on the systematic study of risks and uncertainties. Risk analysts seek to apply broadly accepted risk analysis methods in conducting risk assessments and making risk management choices related to specific problems or applications. Following the 9/11 attacks, individuals with a broad range of backgrounds became involved in

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undertaking risk assessments to address the needs of decision-makers, planners, and operators involved in making homeland security risk management choices.<sup>61</sup>

**Quantifying Judgments.** Reflecting its strong roots in engineering, business, environmental, and health applications, risk analysis has placed a premium on using quantitative methods. In cases where the relevant and reliable quantifiable data is available, then quantitative methods, including risk models, offer a powerful tool for supporting decision-making by providing a more precise way of comparing the likelihood and consequences of risks. Practical techniques (probabilistic risk assessments, events trees, expert elicitations) for applying risk analysis principles to specific problems have developed over the years. Thus, risk analysts are often interested in obtaining quantitative data or qualitative judgments in forms, such as rank order of preferences or estimated likelihoods, that can be categorized and sometimes expressed as quantifiable results.

In comparison, intelligence analysis of terrorist threats is conditioned by fundamental uncertainty that limits what intelligence analysts can assess with confidence. Two factors account for much of the uncertainty: (1) limited knowledge, and (2) the dynamic nature of terrorist threats.

First, given the range of potential terrorist threats and the active efforts of terrorists to mislead their enemies and conceal their activities, the Intelligence Community's knowledge about the specific intent and the full range of capabilities of various terrorist groups is necessarily limited. As the Director of National Intelligence has observed concerning the terrorist threat presented by al-Qa'ida:

We lack insight into specific details, timing, and intended targets of potential, current US Homeland plots, although we assess al-Qa'ida continues to pursue plans for Homeland attacks and is likely focusing on prominent political, economic, and infrastructure targets designed to produce mass casualties, visually dramatic destruction, significant economic aftershocks, and/or fear among the population.<sup>62</sup>

While the Intelligence Community might possess abundant information on terrorist activities, in some cases, the available information can consist of fragmentary details and provide more of a general sense of a terrorist group's intent and capability rather than offering specific insights on the terrorists' preferred targets and attack methods in a way that risk analysts would find useful.<sup>63</sup>

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<sup>61</sup> Edward J. Jopeck and Kerry L. Thomas, "Security Risk Management: Implementing a National Framework for Success in the Post-9/11 World," in *Critical Infrastructure Protection: Elements of Risk*. (Arlington, VA: Critical Infrastructure Protection Program, George Mason University School of Law, December 2007), p. 1.

<sup>62</sup> Dennis C. Blair, Director of National Intelligence, *Annual Threat Assessment of the Intelligence Community for the Senate Select Committee on Intelligence* (12 February 2009), p. 6. Accessed at <http://www.dni.gov/testimonies.htm>.

<sup>63</sup> James O. Ellis, III, ed., Senior Fellows Report, *Terrorism: What's Coming—The Mutating Threat* (Oklahoma City, OK: Memorial Institute for the Prevention of Terrorism, 2007), p. 26.

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Second, uncertainty also results from the dynamic and sometimes decentralized nature of terrorist threats. Some terrorist groups, particularly the most successful ones, have demonstrated the ability to evolve their capabilities and to adapt to hostile environments. This presents a major analytic challenge for intelligence analysts when asked to estimate terrorist threats in a future timeframe. The capabilities, and even the intentions, of a terrorist group can change over time, particularly if the terrorist group has demonstrated a learning potential through its own efforts or learns from the experience of other terrorists.<sup>64</sup> Moreover, many of the terrorist elements threatening the homeland are decentralized, taking inspiration and perhaps assistance from major groups or networks like al-Qa'ida but choosing their targets and tactics almost autonomously. This adds even more uncertainty to the task of assessing terrorists' likely intentions and capabilities.

Intelligence analysts are used to working with less than complete knowledge about adversaries and accounting for uncertainty in making threat judgments. Unlike for natural disasters, intelligence analysts usually lack the substantial historical data that can provide specific insights on how terrorist groups are likely to develop and their propensity for acquiring and attacking the U.S. homeland with more lethal and/or disruptive weapons, such as biological agents or radiological dispersal devices (RDD).<sup>65</sup> In most instances, providing threat judgments on the intent and capability of terrorist groups to attack new targets with new types of weapons can be challenging for intelligence analysts. It becomes even more challenging if the intelligence analysts are asked to provide threat judgments for DHS risk assessments that go well beyond current intelligence assessments by making estimates of the specific nature of terrorist threats several years from now.

What is even more problematic for intelligence analysts is to quantify their judgments about threat likelihood, even though this is what risk analysts desire for the sake of analytic rigor and consistency across a wide spectrum of threats and contingencies. Thus, what comes natural to risk analysts, who view threat judgments as one of several inputs for a risk method or model, is often viewed as an uncomfortable and counterintuitive request by intelligence analysts who have an appreciation for the dynamic and contingent nature of terrorist threats. Although some methods for generating threat judgments might be more acceptable to intelligence analysts than others, this cultural difference appears to reflect the distinctive analytic cultures of the intelligence and risk analysis disciplines, and therefore is not easily overcome.

**Process Shortfalls.** Although our sampling of DHS risk assessments indicates some common issues involving organizational processes for how risk and intelligence analysts work together, it is important to recognize that no standardized process exists within the DHS enterprise. Instead, there is a diversity of processes for how threat judgments are

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<sup>64</sup> For an analysis of how terrorists adapt to defensive measures, see Brian A. Jackson, et. al., *Breaching the Fortress Wall: Understanding Terrorist Efforts to Overcome Defensive Technologies*. (Santa Monica, CA: RAND, 2007). Accessed at: <http://www.rand.org/pubs/monographs/MG481/>.

<sup>65</sup> Government agencies and the private sector, such as the insurance industry, have compiled and analyzed data on natural disasters and major industrial incidents going back several decades. Such data and analyses provide an empirical baseline for estimating the likelihood and potential consequences of such events.

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produced as inputs to DHS risk methods and models. What might be a significant process challenge in the case of some risk methods could be a non-issue for other risk methods depending on their particular situations.<sup>66</sup> Nonetheless, our discussions with intelligence and risk analysts found that the following types of process issues are recurring:

- *Insufficient preparatory effort.* As discussed earlier, interactions between the risk analysis and intelligence communities are complicated by their distinctive analytic cultures. This places a premium on making certain that their joint activities involve a degree of preparation adequate for maximizing productivity when working together to produce threat judgments. In some cases risk analysts begin the process without much familiarity with the current terrorist threat assessments within the Intelligence Community. This can result in a missed opportunity to start their interactions with intelligence analysts based on common assumptions concerning what relevant threat assessments already exist.
- *Disagreement on scenarios and questions.* Another shortfall is that intelligence analysts are sometimes not involved in the development of threat scenarios until the time they are being asked to provide threat judgments. Intelligence analysts are more likely to doubt the credibility of particular scenarios if they are presented with scenarios without having prior discussions about the scenarios types and key assumptions. In some instances there might be a fundamental disagreement with the scenario's underlying premise; in other cases it could involve a specific scenario assumption, such as the choice of assumed target or the attack weapon. Additionally, some intelligence analysts noted that they have been asked questions that are ill-defined for obtaining their threat judgments. As discussed in Section 4, practices exist to minimize the chances of this problem occurring, mainly through early substantive engagement between the risk and intelligence analysts in brainstorming sessions.
- *No transparency or follow-up.* Another process difficulty can arise when intelligence analysts are asked to provide threat judgments but lack an appreciation for how their expert judgments feed the risk assessment results. When intelligence analysts lack the opportunity to learn about the final results of the risk assessment and the reactions of senior DHS decision-makers, then risk analysts miss the opportunity to develop greater interest within the Intelligence Community for addressing their needs for threat judgments.
- *Lack of familiarity.* Given the Intelligence Community's diversity and complexity, one of the process challenges facing risk analysts is identifying and approaching the organizations and individuals who are best suited for providing threat judgments on particular risk assessment questions. A broad range of relevant expertise and experience resides within the Intelligence Community, including among the elements of the DHS Intelligence Enterprise.<sup>67</sup> For some

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<sup>66</sup> See Appendix C for additional discussion of these underlying challenges.

<sup>67</sup> The DHS Intelligence Enterprise consists of the various intelligence organizations found within DHS and its various components: Customs and Border Protection (CBP), Immigration and

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DHS risk assessment efforts, identifying and connecting with relevant intelligence analysts is a major challenge. In addition, personnel turnover among intelligence and risk analysts add to the challenge of developing sustainable working relationships.

- *Inadequate resources.* A common theme among the process challenges is the need to allow sufficient time for risk and intelligence analysts to undertake joint activities in the most effective manner. Imposing the need to provide threat judgments as an added duty on intelligence organizations can result in unsatisfactory results and create an undue burden on the intelligence organizations, particularly if the support they provide to DHS risk assessments competes with their day-to-day responsibilities.

Our review of DHS risk assessment activities indicates that these are some of the process challenges that have arisen, although they do not apply to every risk assessment. In large part, these challenges reflect the growing pains of risk assessment activities that are mostly in the early stages of their development. Finding ways to resolve or minimize these process impediments is essential to ensuring the intelligence and risk analysts can work together to produce decision quality threat judgments as needed for DHS risk assessments.

## **Existing Approaches for Producing Threat Judgments**

The HSI team identified three basic approaches (with variations) for how intelligence and risk analysts currently work together to produce the threat judgments needed for DHS risk assessment purposes, and evaluated their relative benefits and limitations.<sup>68</sup> These approaches are: (1) continuous interaction; (2) periodical interaction; and (3) no direct interaction. Each approach for producing threat judgments has its particular benefits and limitations.

### ***Continuous Interaction***

One way to improve the prospect for intelligence and risk analysts to gain a better understanding of how each discipline approaches terrorist threat problems is through arrangements to encourage continuous interaction. Such interactions can take two forms:

- *Cross-discipline staffing.* This type of interaction can occur when intelligence and risk analysts operate as an integrated team on a continuing basis to support DHS risk assessments. The specifics of these arrangements can vary as long as the risk and intelligence analysts have opportunities for continuous or frequent interaction.
- *Standing committees that combine intelligence and risk analysts.* Another variation of continuous interaction occurs when a standing committee combines

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Customs Enforcement (ICE), Transportation Security Administration (TSA), United States Citizenship and Immigration Services (USCIS), and the U.S. Coast Guard (USCG).

<sup>68</sup> See Appendix C for additional discussion on the characteristics and relative benefits and limitations of these various approaches used among the DHS risk methods for producing threat judgments.

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intelligence and risk analysts in a way that permits regular and frequent contact. These recurring opportunities for working together could help the risk and intelligence analysts to achieve some common understanding on the nature of threats relevant to DHS risk assessments.

**Overall assessment.** The “continuous interaction” approach assumes certain benefits from having intelligence and risk analysts work together on a continuing basis. These benefits largely result from having more time and opportunities for analysts from each discipline to better understand the others’ approach to threat analysis. The commitment of risk and intelligence organizations to involve their analysts in permanent or standing interactions is another benefit because it signals a willingness of managers in both communities to support a collaborative approach to producing the threat inputs that DHS risk assessments require.

However, even with the opportunities for continuous interaction, these approaches may still encounter challenges in having intelligence and risk analysts work together. Some of the interviews conducted by the HSI team suggest that even in these close working relationships difficulties can arise that inhibit the ability of the analysts to work together in producing the needed threat judgments. Some of this difficulty arises from the lack of cross-discipline knowledge. In addition, analysts assigned to roles involving sustained interaction with individuals outside of their discipline might feel that they are taking a risk of falling behind in advancing along their chosen career path within their own discipline. Another challenge is that intelligence analysts dedicated to this task often have additional intelligence analysis responsibilities that compete for their attention. Nonetheless, despite such concerns, continuous interaction appears the most promising to support the joint work of intelligence and risk analysts.

### ***Periodic Interaction***

The potentially most challenging approach for producing threat judgments involves interactions between intelligence and risk analysts that occur infrequently or only once. These interactions can occur in different variants:

- *Periodic and recurring interactions.* For many DHS risk assessments, the need to obtain threat judgments can result in risk and intelligence analysts working together on an infrequent, but regular basis. These interactions might occur on an annual or biennial basis as the threat, vulnerability and/or consequences inputs to the DHS risk methods or models are updated.
- *Non-repeating interactions.* In some cases, the interaction between risk and intelligence analysts might occur only once. This might result from several factors, including the discontinuation of a particular DHS risk method or model, the shift in focus from using one intelligence organization to another, or a decision by the managers of an intelligence organization that it is unable to support the request from the DHS risk analysts, particularly if the intelligence managers have limited staff resources and have received requests for threat judgments from multiple DHS risk assessment efforts. This case has the potential disadvantage of not allowing managers and analysts in both types of organizations to build up their experience or “learning curve” in developing preferred methods for working in a collaborative manner.



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Such periodic interactions place a premium on the need for managers and analysts in different organizations with distinctive analytic cultures to work together. Using proven methods to obtain reliable threat judgments from the intelligence analysts is a good start. These methods can include group interview sessions, which can be informal or use structured approaches such as the Delphi method to obtain individual judgments of the experts and then conduct a group session to review their collective judgments.<sup>69</sup>

**Overall assessment.** Seeking threat inputs from intelligence organizations on a periodic basis has less advantages than a having continuous interaction. However, the main advantage of relying on periodic interaction is that it limits amount of resources that must be allocated to sustaining a staff of intelligence analysts who are largely dedicated to support the risk assessment method or model. This approach also gives the risk analysts the potential flexibility to leverage threat expertise throughout the Intelligence Community, as well as take advantage of outside sources of expertise. This could be an advantage where the DHS risk assessment tends to vary its focus on threats or hazards over time.

However, drawing on intelligence organizations on a periodic basis to support DHS risk assessments can present some significant challenges for risk analysts. First, the activities of at least two organizations with their own missions and schedules require careful coordination to be successful. This necessitates long-term planning and may require accommodating schedules for mutual benefit. Second, managers at an intelligence organization might be only willing to make available a limited amount of time for their analysts to participate in risk assessment activities, particularly if such activities are viewed as an “extra duty” competing for the analysts’ time with primary intelligence mission responsibilities.

Finally, if the risk analysts are not very knowledgeable about the nature of the intelligence organization that they are working with, then they are more likely to be unsure about identifying the particular types of expertise that is relevant to addressing their needs. Periodic interaction can result in potential continuity problems in establishing a smooth working relationship between analysts, as well as managers. While none of these challenges are insurmountable, they highlight that periodic interaction between the two communities creates a premium for making a strong effort to work collaboratively to achieve mutual benefits.

### ***No Direct Interaction***

This approach fundamentally differs from the previous two approaches because it does not involve direct interaction between risk and intelligence analysts. Instead, risk analysts find alternative methods for producing threat judgments or simply go without. Hence, this approach has several possible variants, which have important distinctions in how much they draw on intelligence expertise even if they do not involve direct interaction with intelligence analysts.

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<sup>69</sup> For a discussion of this method, see the discussion in the next section along with Mary A. Meyer and Jane M. Booker, *Eliciting and Analyzing Expert Judgment: A Practical Guide*. (London: American Statistical Association and the Society for Industrial and Applied Mathematics, 1991), pp. 103-104, and 166-168.

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- *Use of intelligence products.* One variant is that risk analysts make use of finished intelligence products produced by the Intelligence Community but forgo having direct interaction with intelligence analysts. This situation could arise if risk analysts find that these intelligence products provide sufficient information and insights to meet their threat input needs, although it seems unlikely that this would be the case unless the intelligence report was produced with the intent to meet the threat inputs needs of DHS risk assessments.
  - *Use of surrogates.* Another variant is that risk analysts could draw on experts who are knowledgeable sources for threat judgments even though they are not members of the Intelligence Community. As outlined earlier in Table 2.2, these surrogate sources of threat inputs can include: research centers and private firms specializing in intelligence and/or threat analysis; technical community sources of expertise (e.g., the national laboratories, U.S. government research institutes and Department of Defense (DoD) weapon laboratories and contractors); law enforcement agencies and first responder communities, and open source providers in the private sector or U.S. government centers.
  - *No use of intelligence analysis.* A final variant is that risk analysts might not want or need to draw on the threat expertise that intelligence analysts possess. This unusual circumstance could occur in different ways.
    - *Factoring out “Threat.”* One reason for not making use of threat inputs from is if the risk analysts simply assume the threat variable out of the “threat-vulnerability-consequences” equation. For example, a very conservative approach to producing a risk assessment would be to assume that the likelihood of a given threat is 100 percent. The result is to focus the attention of decision-makers and planners on weighing the vulnerability and consequences aspects of a given risk.
    - *Proof-of-concept development.* Another possibility involves a risk method or model that is still being developed. In this case, the risk analysts may want to hold off on approaching the intelligence community for threat judgments until a proof-of-concept has been achieved in developing the risk method or model. In such cases, the risk analysts are likely to use notional values for testing the basic soundness of the risk method or model before seeking expert inputs on threat, vulnerability, and consequences. In such circumstances, the risk analysts are likely to seek threat judgments from intelligence analysts at a later stage.

**Overall assessment.** The “no direct interaction” assumes that risk analysts do not seek direct access to the expertise possessed by intelligence analysts. In some cases, the risk analysts might draw on surrogate sources of threat expertise and in other cases they might choose to go without threat judgments or expert inputs.

The main benefit of this approach is that it reduces the amount of work involved in generating threat inputs for DHS risk assessments. Without direct interaction, there is no need for investing time in coordinating with another organization and then undertaking the data collection steps needed to work with intelligence analysts to produce threat

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judgments. For risk assessment method and models that are still in the development stage, not prematurely approaching intelligence organizations makes sense. To the extent that surrogate sources provide an adequate alternative, then this approach is sound.

However, some DHS decision-makers could doubt the soundness of risk assessment methods and models that did not leverage available Intelligence Community expertise on terrorist threat—no matter what alternative sources of expertise are used. There could be concern that the risk analysts are making use of outdated information or making assumptions about the nature of terrorist objectives and operational behavior that are questionable. Hence, forgoing direct interaction with intelligence organizations is likely to be acceptable to senior DHS decision-makers only in particular circumstances, such as during the proof-testing of a DHS risk assessment method or model.

## **Summary**

The review of different forms of interaction between intelligence and risk analysts highlights once more that any effort to enhance cross-discipline collaboration must account for the different ways that the two communities interact in producing threat judgments needed for risk assessments. While the continuous interaction approach has certain benefits in allowing for more systematic engagement of intelligence and risk analysts, the other two forms of interaction also can be used effectively in particular circumstances.



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## APPENDIX D. INFORMING THE LONG-TERM RESEARCH AGENDA

DHS risk assessments are still at an early stage of development. Despite substantial progress in specific risk assessment methods and models, there are important issues that should be addressed to ensure that risk assessments have a sound basis and are relevant to the needs of DHS decision-makers. Thus, along with developing near-term ways to enhance how the risk and intelligence communities collaborate, the HSI team was tasked by the DHS sponsor to identify research questions that could inform the long-term research agenda with particular attention to improving how threat judgments are developed and used to support DHS risk assessments.

DHS risk assessments have greatly benefited from leveraging academic research and professional practices in many areas to develop their particular approaches. However, there are some questions that are very specific to the nature of homeland security, and these broader works are less helpful. Based on our research and analysis, and drawing on inputs from risk analysts and intelligence analysts, we have identified several candidate research questions that could advance the state of thinking for homeland security risk assessments.

Our main criteria for selecting the following research questions were:

- The question is relevant to enhancing how intelligence and risk analysts collaborate to support homeland security risk assessment
- It is a definable research question that can produce practical results
- The question has potential interest and support of stakeholders in both the DHS risk analysis and intelligence communities.

The HSI team identified the following as important long-term research questions that could enhance the collaboration of the intelligence and risk analysis communities in their joint efforts to support DHS risk assessments.

***Setting realistic expectations in making threat judgments.*** Feedback from workshops and interviews conducted for this project by the HSI team indicates that risk analysts, risk managers, and senior decision-makers may have unrealistic expectations concerning the nature of threat inputs that intelligence analysts are able and willing to provide for DHS risk assessment purposes. At the same time, there are indications that some intelligence analysts are more willing to provide the quantifiable threat inputs needed by risk analysts once they gain greater familiarity with risk methodologies and objectives.

***Research question: What are plausible expectations in making threat judgments for DHS risk assessment purposes?*** This research question would analyze the relative benefits for risk analysts of obtaining quantitative and qualitative judgments of various types from threat experts. A key question is determining how to account for various types of uncertainty underlying the threat judgments provided by intelligence analysts. Another is

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assessing whether risk and intelligence analysts have a common understanding of what factors are included in threat judgments.<sup>70</sup> An equally important question is analyzing whether homeland security risk assessments can be designed from the start in a way that takes advantage of what the intelligence community is most capable of providing concerning judgments of likely terrorist intent and capability.

***Accounting for adaptive terrorist adversaries.*** Unlike risk assessments that involve unintended technical failures or natural disasters, terrorist threats involve an intelligent and adaptive adversary. The DHS risk assessments that we reviewed for this project did not seem to have clear-cut or transparent approaches to account for the possibility that terrorist adversaries might adapt their tactics and techniques with the aim of defeating or circumventing U.S. and allied homeland security defensive measures. How this question is handled is likely to affect the credibility of DHS risk assessments, particularly those seeking to estimate future risk reduction gains from deploying new or improved homeland security defensive measures.

*Research question: How should DHS risk assessments account for adaptive, intelligent terrorist adversaries?* Existing risk models generally lack the ability to account for the adaptive behavior of terrorist adversaries even though several promising analytic approaches exist.<sup>71</sup> Intelligence analysts should be able to provide important insights on how terrorist groups adapt to homeland security measures. A review is needed of potentially promising analytic approaches that can help intelligence and risk analysts identify and evaluate potential terrorist countermeasures to homeland security defenses. This review should identify existing sources of expertise on terrorist adaptive behavior that exist both within and outside of the intelligence community. In addition, this research effort should consider ongoing efforts involving threat shifting using decision analysis techniques, red teaming methods, expert assessments of terrorist learning and adaptation, analysis of potential deterrence (or deflection) effects of homeland security measures, and game theoretic approaches to understanding adversary behavior. The research aim should be to provide practical approaches for how intelligence and risk analysts can account for adaptive terrorist adversaries in supporting DHS risk assessments.

***Leveraging all relevant threat expertise.*** Identifying the relevant sources of threat expertise for DHS risk assessment can be a time-consuming effort. Risk analysts need methods and resources to help them identify relevant sources of threat expertise. Some expertise is likely found within the many layers of the intelligence community (e.g., national Intelligence Community, DHS Intelligence Enterprise, law enforcement community, others). In addition, DHS risk analysts could benefit from having a better sense of the types of expertise and experience relevant to making certain types of threat judgments that could be available from outside of the Intelligence Community.

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<sup>70</sup> For example, a question that was posed at the Collaboration Workshop #3 discussion (see Appendix A) concerned whether intelligence analysts might interpret threat based solely on assessing a terrorist adversary's intent and capability while the risk analysts are possibly interested in knowing additional threat issues, including how the adversary's propensity to undertake certain types of attacks might be influenced by the terrorists' perceptions of U.S. and allied capabilities.

<sup>71</sup> See Appendix E for a review of different analytic approaches relevant to assessing the adaptive behavior of terrorist adversaries.

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*Research question: How should homeland security risk analysts identify and make use of the needed threat expertise that exists both within and outside of the national Intelligence Community?* This research effort should assist risk analysts in identifying potential sources of threat expertise. It should help them identify particular types of expertise on terrorist threats and other potential areas of concern (e.g., border violence, pandemics) that are available within the broader intelligence community. In addition, the research effort should identify sources of relevant expertise that resides outside of the Intelligence Community, including the technical community (e.g., national laboratories and government research institutes), research centers (e.g., think tanks and universities), open source providers, and private sector experts. Criteria are needed for assessing the value-added of these outside sources of threat expertise as a supplement or substitute for Intelligence Community sources, particularly if the risk analysts are trying to avoid using classified data. In addition, guidelines should be developed for determining when and how it is most desirable to make use of subject matter expertise from outside the Intelligence Community in producing threat judgments for DHS risk assessment purposes.

***Assessing the potential utility of proxy data.*** In undertaking DHS risk assessments, reliable data on a terrorist group's intent or capabilities is not always available at the desired level of specificity or classification level. In such cases, proxy data might be used for gauging terrorist group capabilities or intentions. However, this raises the basic question of under what conditions—if any—should proxy data be used in risk assessments. Research is needed to determine whether and how best to make use of proxy data to inform threat judgments for DHS risk assessment purposes.

*Research question: Is reliable proxy data on terrorist intent and capabilities available, and under what conditions should such data be used to support DHS risk assessments?* This research effort would evaluate whether the use of proxy data provides a reliable and beneficial way to deal with data gaps in making threat judgments for DHS risk assessments purposes. It would analyze the potential utility of using proxy data in cases where Intelligence Community knowledge on the intent and capability of particular terrorist groups is very limited or highly classified. For example, acceptable proxy data for gauging terrorist group capability might involve assessing the general availability of particular weapon types and the skill levels required to operate those weapons effectively. This research effort should assess the potential benefits and limitations of using proxy data in making DHS risk assessment judgments where intelligence data is otherwise unavailable, as well as how to account for any proxy data used in risk assessments.

In various ways, these research questions address underlying issues that determine whether high-confidence threat judgments are being produced to support DHS risk assessments. Each of the research questions is relevant to improving the soundness and credibility of threat judgments used for supporting DHS risk assessments.





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## APPENDIX E. ANALYTIC APPROACHES TO ASSESS ADAPTIVE TERRORIST ADVERSARIES

This appendix offers an overview of some analytic approaches that are relevant to accounting for terrorist behavior as intelligent, adaptive adversaries. This is an important question relevant to Department of Homeland Security risk management choices because decision-makers and planners need a good understanding of whether the effectiveness of current and planned homeland security defensive measures or strategies is robust against adversary adaptation or not. Knowing which defensive measures and strategies are relatively more susceptible to being degraded or circumvented by terrorist responses will help decision-makers better gauge the relative value of different approaches and decide on the appropriate combination of capabilities and strategies.

How best to account for the possibility of terrorist adaptation has yet to be addressed in a satisfactory way for most DHS risk assessments. This partly arises from the intrinsic uncertainty of the subject and partly from the challenge of how to incorporate this consideration into risk assessment methodology without adding unmanageable complexity and adding to the need for even more detailed threat inputs. Nonetheless, there are some encouraging signs of progress within the homeland security research community on different analytic approaches that could help risk assessments account for adaptive adversary behavior in assessing terrorist threats.

This appendix discusses four approaches that are potentially relevant to DHS risk assessments and risk management strategies that must address adaptive adversary behavior:

- *Threat shifting* analysis of potential terrorist responses to homeland security measures. The appendix provides an overview of the MARS model (Modeling the Adversary for Responsive Strategy), a decision analysis approach developed by experts at the Lawrence Livermore National Laboratory (LLNL) that accounts for the choice behavior of an intelligent terrorist adversary.
- *Terrorist adaptive behavior* analysis considers the dynamic nature of the terrorist threat in responding to homeland security measures. This appendix highlights some of the in-depth analysis undertaken by RAND Corporation experts on terrorism and homeland security issues.
- *Game-theoretic approaches* to understanding problems or “games” involving intelligent adversaries or competitors. The appendix reviews some of the recent thinking within the risk analysis and larger academic community on how to apply game-theoretic approaches to terrorist threat analysis.
- *Randomization strategies* aim to confound and discourage terrorist attacks by increasing adversary uncertainty over their potential exposure to security measures.

Other analytic approaches likely also exist and may be relevant for understanding the nature of adaptive terrorist threats in a way that informs and enhances the relevance of DHS risk assessments. Hence, the few approaches described in this appendix are intended

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to show that potentially promising approaches exist for accounting for terrorists as intelligent, adaptive adversaries without suggesting that those presented here are the only promising approaches.

## **Modeling the Adversary for Responsive Strategy (MARS)<sup>72</sup>**

One promising approach for understanding how terrorist adversaries are likely to engage in “Threat Shifting” when confronted with homeland security measures is the MARS model (Modeling the Adversary for Responsive Strategy).<sup>73</sup> MARS is a risk analysis model that provides decision support for R&D and deployment of anti-terrorist countermeasures. It was developed by a team of decision analysts and counterterrorism analysts at Lawrence Livermore National Laboratory (LLNL) under the leadership of Dr. John Lathrop, a decision analysis expert. The MARS approach has been developed by leveraging counterterrorism, weapons effects, consequence modeling, and decision and risk analysis expertise available at LLNL.

MARS is a risk analysis model that incorporates a tailored software package and processes to generate risk reduction indices for terrorism countermeasures, accounting for the likely “Threat Shifting” behavior of an “Intelligent Adversary.” That is, MARS provides risk management insights including how the threat spectrum is likely to shift to alternative attack possibilities once the terrorists are presented with certain anti-terrorism countermeasures. Because MARS evaluates each countermeasure by its effect on overall risk reduction, it can compare countermeasures that work at any phase in the initiation-consequence sequence: prevention, detection, interdiction, hardening, mitigation, and physical or medical response. It puts all of those countermeasure types on a risk-reduction “common yardstick,” printing out simple bar charts that graphically compare the effectiveness of different countermeasures.

MARS is based on a formally correct risk management engine that models opposing decision trees: one for the United States and one for each of potentially several terrorist groups. The U.S. decision tree accounts for different potential combinations of homeland security countermeasures against terrorist attacks, while the adversaries’ decision trees use probabilistic adversary choice models to probabilistically predict the attacks the adversary will choose based on estimated capability, intent, values, and knowledge of targets and homeland security countermeasures. MARS uses its opposing-tree structure to account for the “Intelligent Adversary” or “Threat Shifting” mentioned earlier, estimating how the terrorist threat spectrum shifts away from one set of attacks to other sets of attacks as the first attack set becomes less attractive to terrorists when faced with a new homeland security countermeasure.

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<sup>72</sup> This description of the MARS model is based on material provided by Dr. John Lathrop at LLNL. For additional information and clarification, please contact Dr. Lathrop (lathrop3@llnl.gov).

<sup>73</sup> This work has been supported with funding from the DHS Directorate for Science and Technology, Office of Special Programs, Risk Sciences Branch.

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The centerpiece of the analysis is a matrix that matches potential targets against potential terrorist weapons and attack methods. Each column is a terrorist capability and intent in terms of attack type, with probabilities elicited from counterterrorism experts. Each row is a target type, with probabilities across targets calculated using the probabilistic adversary choice models mentioned earlier.

The impact of terrorist attacks is calculated with and without the homeland security countermeasure in question to determine the risk reduction that the countermeasure delivers. The consequences of the terrorist attack are measured in terms of casualties, economic loss and iconic impact, which are then combined through a multiattribute utility function into a single impact index. MARS requires probabilistic data on weapons effects, with and without the evaluated countermeasure. That dataset can be generated by LLNL or other modelers, by expert elicitation of expert panels, or any combination of those sources.

Within the context of the risk and intelligence collaborative framework, the MARS approach integrates the expertise of counterterrorism analysts, weapons effects analysts, consequence analysts and risk analysts, linking all those information types into a single analytic framework, i.e., network of calculations in a large Excel-Python codeset. In practice, that has amounted to a process of continuous interaction through close working arrangements between the counterterrorism, effects, consequence and risk analysts at LLNL. The nature of this work has been an iterative process, which has looped repeatedly through the four sets of analysts. One advantage of the MARS model is that its logic “forces” the four analyst types to generate the data called for with requirements across the boundaries between the communities of analysts.

Once the necessary counterterrorism analysis is performed and loaded into MARS, the MARS model process involves four basic steps: (1) the decision maker describes the countermeasure management decision to be supported (e.g., the goals, alternatives, and organizational context); (2) the decision maker describes the countermeasure(s) to be assessed, to the greatest extent feasible, characterizing the consequence reductions and/or probability reductions; (3) the LLNL weapons effects and consequence modeling teams (or others under LLNL guidance) conduct weapons effects /consequence modeling/assessment/expert elicitation as necessary to meet MARS input requirements; and (4) the LLNL staff loads and runs MARS, delivering the following outputs:

- Measures of effectiveness (MOEs) in the form of bar charts where the height of each bar represents how much the countermeasure raises the expected value of the U.S. multiattribute utility by reducing the risk (probability distributions over losses) in any of the following ways:
  - Reducing the probability of successful attack (via prevention, detection, interdiction)
  - Reducing the weapons effects of a given attack (via hardening, mitigation)
  - Reducing the consequences of a given attack (via response)

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- Contrast analyses that analyze the mechanism through which one countermeasure performs better than another, for example by parsing out the effects of reducing the likelihood versus reducing the consequences of an attack, and
  - “Tornado” diagrams that present the relative sensitivities of the output measure to uncertainties in inputs and parameters.

In sum, the MARS approach generates risk management support by integrating counterterrorism, weapons effects, consequence modeling and risk analysis into a single analytic framework. In using probabilistic adversary choice models, it accounts for Threat Shifting, i.e., how countermeasures could shift terrorist attack choices. In doing that, it creates and sustains risk and counterterrorism collaboration, all within the framework of an analytic model. Its formal methodology and structure provide decision makers with defensible metrics and a documented process for allocating effort among countermeasures.

## **Terrorist Adaptive Behavior Analysis<sup>74</sup>**

Another promising approach for understanding terrorists as adaptive adversaries is based on research and analysis that has been undertaken by analysts at the RAND Corporation. In particular, Brian A. Jackson and other RAND experts have used a case-study approach to develop a conceptual framework for analysis of terrorists’ adaptive behavior to circumvent counterterrorist defenses. Their work underscores that adversary adaptation is one of the key ways in which the risk of terrorism differs from other risks countered by homeland security measures, such as large-scale accidents and natural disasters. “When challenged by defenses that limit their operational effectiveness or threaten them, violent groups will change their behavior to reconstitute their capabilities and security,” Jackson warns, “Such adaptation represents a significant risk to the benefit stream provided by security technologies,” and it also greatly complicates efforts to measure that benefit stream.<sup>75</sup> Jackson recommends thinking about the benefits of counterterrorism defensive measures in terms of how much cost or risk they impose on terrorist adversaries, rather than how much cost they prevent terrorists from imposing on society (while acknowledging that the latter is far more important to the ultimate goals of homeland security, and the former is only a means to achieve those goals).<sup>76</sup>

To identify the specific ways in which terrorists adapt to countermeasures, Jackson and other RAND researchers examined case studies of several terrorist organizations: the Provisional Irish Republican Army (PIRA), the Liberation Tigers of Tamil Eelam (LTTE), Jemaah Islamiyah (JI) and its affiliates, and Palestinian groups attacking Israel. Jackson and his team identified four key types of counter-defensive strategies used by these groups:

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<sup>74</sup> This work has been supported with funding from the DHS Directorate for Science and Technology, Office of Special Programs, Risk Sciences Branch.

<sup>75</sup> Brian A. Jackson, “Assessing the Benefits of Homeland Security Efforts Deployed Against a Dynamic Terrorist Threat,” RAND Working Paper WR-465-DHS, (Santa Monica, CA: RAND Corporation, February 2007), p. 14.

<sup>76</sup> Jackson, “Assessing the Benefits,” p. 4.

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- **Altering operational practices:** Groups defeated or reduced the effectiveness of defensive measures by changing some operational techniques or procedures.<sup>77</sup> For example, the PIRA sought to defeat government forensic analytical techniques by choosing, laundering or destroying clothing in an effort to minimize the amount of forensic evidence left behind at attack scenes. They would also use secondary devices or “scene clean-up teams” to destroy forensic evidence.<sup>78</sup>
  - **Changing or replacing technologies used by the terrorist group:** Groups acquired new technical tools or modified existing ones to overcome the effects of defenses.<sup>79</sup> Responding to government efforts to prevent bomb detonation through the use of cell phone jammers, JI integrated redundant detonation mechanisms to provide alternatives if some detonators are jammed or circumvented.<sup>80</sup> In another example, Palestinian groups overcame Israeli security barriers by shifting to a weapon – *Qassam* rockets – capable of flying over the barriers.<sup>81</sup>
  - **Avoiding the defensive measures:** Sometimes terrorist groups respond to countermeasures by simply moving their operations to other areas or selecting different targets. Although the area or sector protected by the countermeasures may have been better secured, the overall regional or national threat level in that case would not have diminished.<sup>82</sup> In one example, JI dealt with increased scrutiny at airports by shifting to other modes of cross-border travel, such as boats, buses and trains, particularly via more obscure crossing points.<sup>83</sup> JI also responded to target hardening efforts by focusing more on soft targets (while still seeking alternative means to reach hard targets and developing more powerful explosives to defeat target hardening measures).<sup>84</sup>
  - **Attacking the defenses directly:** Finally, groups sometimes chose to defeat the defensive countermeasure by attacking it – using multiple bombs or larger explosive charges, for example, to demolish physical barriers around hard targets.<sup>85</sup> The PIRA responded to the installation of bollards and barriers by escalating the size of its truck bombs, which also produced more collateral

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<sup>77</sup> Jackson, “Assessing the Benefits,” p. 5.

<sup>78</sup> Jackson, et al., *Breaching the Fortress Wall: Understanding Terrorist Efforts to Overcome Defensive Technologies* (Santa Monica, CA: RAND Corporation, 2007), pp. 110-111.

<sup>79</sup> Jackson, “Assessing the Benefits,” p. 6.

<sup>80</sup> Jackson, et al., *Breaching the Fortress Wall*, p. 56.

<sup>81</sup> *Ibid.*, p. 36.

<sup>82</sup> *Ibid.*, pp. 116-117.

<sup>83</sup> *Ibid.*, p. 47.

<sup>84</sup> *Ibid.*, p. 53.

<sup>85</sup> Jackson, “Assessing the Benefits,” p. 6.

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damage to surrounding structures.<sup>86</sup> It also developed armor-piercing shaped charges to penetrate security forces' armored vehicles.<sup>87</sup> By contrast, the LTTE has chosen not to overcome target hardening through the use of more destructive explosives despite the availability of the necessary skills and materials. Jackson *et al.* suggest this decision is based on a desire to avoid the international outrage and loss of perceived legitimacy that would result from higher civilian and foreign national casualties.<sup>88</sup> The LTTE has used more narrowly scoped technology to defeat target hardening efforts, such as penetration rods affixed to the prows of suicide boats.<sup>89</sup>

Jackson notes that these four approaches often overlap, and sometimes groups have used a combination of them.<sup>90</sup> He also comments on the effects of these four strategies on the benefits delivered by the defensive countermeasures employed by security forces. Terrorist use of these adaptations could result in making the countermeasure obsolete with little or no cost to them;<sup>91</sup> for example, identifying and removing a government informant.

Alternatively, some terrorist adaptations to defeat countermeasures could involve some cost to the group, resulting in a reduction but not an elimination of the benefits of that countermeasure.<sup>92</sup> For example, terrorist discovery of government surveillance of cell phone use could prompt them to stop using cell phones, which means the surveillance has been discovered and “defeated” but the operational environment is also more difficult for the terrorists because they have to seek other means of communication.

In other cases, terrorists might decide to attack a target despite the installation of a protective measure, but their chosen weapon is less effective because of that countermeasure. In such a case, the terrorists reduce the effectiveness of the countermeasure because they still stage the attack on that target. But they do not eliminate the countermeasure's effectiveness because the measure still reduces the impact of the attack.<sup>93</sup>

Even if a countermeasure has forced a change in terrorist behavior and perhaps increased the operational level of difficulty for the adversary, a countermeasure could actually increase the overall terrorism risk if challenged by a particularly determined adversary. For example, if a security barrier simply prompts a group that previously used only small bombs to increase the size of its explosive charges in response, , then the threat may

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<sup>86</sup> Jackson, et al., *Breaching the Fortress Wall*, p. 100.

<sup>87</sup> *Ibid.*, p. 101.

<sup>88</sup> *Ibid.*, pp. 79-81.

<sup>89</sup> *Ibid.*, p. 80.

<sup>90</sup> Jackson, “Assessing the Benefits,” p. 6.

<sup>91</sup> *Ibid.*, p. 9.

<sup>92</sup> *Ibid.* pp. 9-10.

<sup>93</sup> *Ibid.*, p. 10.

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actually have increased rather than decreased.<sup>94</sup> Similarly, in some cases, a countermeasure can produce a net security reduction because terrorists can manipulate it to serve their purposes. Terrorists can cause false alarms that produce response costs and reduce trust in the effectiveness of detection systems, and they can call in false tips to law enforcement that are intended to put first responders in danger.<sup>95</sup>

Jackson identifies several key implications of terrorist adaptive behavior for the design and assessment of homeland security efforts. Assessments should be dynamic, not static. “If decision-makers assume that defensive measures provide a stable benefit in spite of adaptation by adversaries, we may significantly overestimate their value and the protection they provide,” Jackson writes, adding that the risk is particularly acute for systems with significant operations and maintenance costs.<sup>96</sup> When homeland security measures are developed, he recommends considering whether they can be modified in response to changes in terrorist behavior.<sup>97</sup> Jackson also urges deploying defenses in portfolios – a “defense in depth” strategy – to “provide ‘fall back’ options if an initial defense becomes obsolete.”<sup>98</sup>

## Game-theoretic Approaches

The risk from terrorist attacks differs fundamentally from the risk from acts of nature or accidents in that terrorists would probably be motivated to adapt their strategies and attacks on the basis of their estimates of the protective actions that the defense has taken or might take. Further, many counter-terrorism strategies require the cooperation of several independent parties. Game theory is a natural approach for analyzing the actions of intelligent adversaries. It has particular relevance to assessing terrorist threats (and counters to these threats) both in situations in which there is one defender and situations in which multiple defenders must cooperate to be effective.

Several game-theoretic efforts have been made over the past decade that could offer practical ways of solving such problems. Examples include an examination of algorithms for inspecting containers at ports-of-entry,<sup>99</sup> and an analysis of the relationship between a

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<sup>94</sup> Ibid., p. 8 fn.

<sup>95</sup> Ibid., pp. 10-11.

<sup>96</sup> Ibid., p. 12.

<sup>97</sup> Ibid.

<sup>98</sup> Ibid., p. 13.

<sup>99</sup> Fred Roberts, Saket Anand, David Madigan, Richard Mammone, and Saumitr Pathak, “Experimental analysis of sequential decision making algorithms for port of entry inspection procedures,” in S. Mehrotra, D. Zeng, H. Chen, B. Thuraisingham, and F. Wang (eds.), *Intelligence and Security Informatics, Proceedings of ISI-2006, Lecture Notes in Computer Science #3975*, Springer-Verlag, New York, 2006, available at <http://dimacs.rutgers.edu/People/Staff/froberts/ArticlesAuthored.html>, David Madigan, SushilMittal, Fred Roberts, “Sequential decision making algorithms for port of entry inspection: Overcoming computational challenges,” in *Intelligence and Security Informatics, Proceedings of ISI-20*, to appear, available at <http://www.usc.edu/dept/create/assets/001/50803.pdf>; and Endre Boros, Elsayed Elsayed, Paul Kantor, Fred Roberts and Minge Xie1, “Optimization problems for port-of-entry detection systems,” *Intelligence and Security Informatics: Techniques and*

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defender attempting to detect clandestine nuclear weapons in vehicles passing through a portal using radiation monitors and an attacker attempting to smuggle in such weapons.<sup>100</sup>

A recent book on game theoretic risk analysis applied to security threats, *Game Theoretic Risk Analysis of Security Threats*, which is edited by Vicki M. Bier and M. Naceur Azaiez, presents several applications of interest.<sup>101</sup> These include the following:

- “Optimizing defense strategies for Complex Multi-Stage Systems” by Gregory Levitin in this volume deals with the problem of defending “complex multi-state series-parallel systems” against intentional attacks. Many critical infrastructure systems can be characterized as the series-parallel systems he treats. Levitin uses as an example a power substation with five components connected in series-parallel. Many other authors have conducted game-theoretic analyses of series-parallel systems.
- “Making Telecommunications Networks Resilient Against Terrorist Attacks,” by Louis Anthony (Tony) Cox, Jr. summarizes techniques to protect modern communications networks from attack. The basic game that is analyzed is one in which the defender moves first, by designing the network with certain redundancies and the attacker moves second by looking for and then attacking nodes whose loss would cause the most disruption. The author concludes with several game-theoretic examples showing that network owners and users may be able to benefit from larger commitments to security than they would make if acting on their own. This suggests that regulatory intervention or some other means may be needed to overcome such adverse incentive effects.
- “Improving Reliability Through Multi-Path routing and Link Defense: An Application of Game Theory to Transport,” by Urszula Kanturska, et. al., summarizes work on the vulnerability of transportation networks to malevolent incidents. The authors apply game techniques to the “VIP Transport Vulnerability” problem, which is the problem of finding an optimum route for moving a very important person (VIP) from one location to another in a city.

In sum, game-theoretic techniques are not only a theoretically “correct” approach to designing and analyzing systems that are resilient to terrorist attack, they have also proved to be of practical utility for this purpose. Game-theoretic approaches are particularly relevant to helping us understand situations in which the interaction between attacker and defender strategies is significant in determining outcomes, as well as situations in which cooperative behavior among independent groups is required for effective counter-terrorist action to take place.

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*Applications*, H. Chen and C. C. Yang (eds), Springer, to appear, available at <http://dimacs.rutgers.edu/People/Staff/froberts/ArticlesAuthored.html>.

<sup>100</sup> Patrick G. Heasler, Tom W. Wood, *Quantification of the Deterrent Effect of Radiation Portal Monitors (RPM) Using a Decision Theory Model*, Pacific Northwest National Laboratory (May 2, 2005).

<sup>101</sup> Vicki M. Bier and M. Naceur Azaiez, eds., *Game Theoretic Risk Analysis of Security Threats* (New York: Springer Science+Business Media, 2009).



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## Randomization Strategies

Finally, some interesting work is being undertaken on increasing uncertainty for potential terrorist planners and attackers by adopting randomization strategies in employing security assets. A good example is the work undertaken at the University of Southern California (USC), associated with the National Center for Risk and Economic Analysis of Terrorism Events (CREATE). Dr. Milind Tambe led a team of USC researchers in applying game theory to randomize the placement of security teams. They have developed a computer system, called ARMOR, to implement their concepts for security forces at Los Angeles International Airport.<sup>102</sup> Key to the system is a method for solving a class of games (Bayesian Stackelberg games) developed by Praveen Paruchuri, a Ph.D. candidate at USC.<sup>103</sup>

The approach assumes that potential attackers may belong to one or more adversary “types,” for instance sophisticated terrorist cells or naive mentally unstable angry individuals. It further assumes that adversary groups can observe the behavior of the defenders, and thus estimate the probabilities that the defenders will take different courses of action (selection of places to place security teams in the ARMOR case), although the attackers will not know which set of actions is in place when the attack is undertaken. Paruchuri has developed an efficient mixed integer linear program for finding optimal solutions to these problems. Even so, finding exact solutions can be computationally demanding for large problems, so he has also developed less demanding methods that find solutions which are close to optimal.

It may be possible to adapt these techniques to other situations in which it is prudent to assume that potential attackers have been able to monitor defensive practices, including the placement and operation of screening systems.

## Selected Readings

The following are selected open source readings on issues associated with terrorist groups as intelligent and adaptive adversaries.

### Homeland Security Applications

Gerald G. Brown, W. Matthew Caryle, and R. Kevin Wood. “Optimizing Department of Homeland Security Defense Investments: Applying Defender-Attacker (-Defender) Optimization to Terrorist Risk Assessment and Mitigation,” in National Research Council, *Department of Homeland Security Bioterrorism Risk Assessment: A Call for Change* (Washington, DC: National Academy Press, 2008), pp. 90-102.

Brian A. Jackson. *Assessing the Benefits of Homeland Security Efforts Deployed Against a Dynamic Terrorist Threat*. Santa Monica, CA: RAND Corporation, February 2007. Available at: [http://www.rand.org/pubs/working\\_papers/WR465/](http://www.rand.org/pubs/working_papers/WR465/).

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<sup>102</sup> USC Viterbi School of Engineering, “Viterbi Software on the Anti-Terror Beat at LAX, Research Moves from Ph.D. Thesis to Experimental Police Tool,” news release, October 01, 2007.

<sup>103</sup> Paruchuri, Praveen, “Keep the Adversary Guessing: Agent Security by Policy Randomization,” Dissertation Presented to the Faculty of The Graduate School, University of Southern California, July 2007.

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Edward McCleskey, Diana McCord, Jennifer Leetz. *Underlying Reasons for Success and Failure of Terrorist Attacks: Selected Case Studies*. Arlington, VA: Homeland Security Institute, 4 June 2007. Available at:  
[http://www.homelandsecurity.org/hsireports/Reasons\\_for\\_Terrorist\\_Success\\_Failure.pdf](http://www.homelandsecurity.org/hsireports/Reasons_for_Terrorist_Success_Failure.pdf).

Elisabeth Pate-Cornell and Seth Guikema. "Probabilistic Modeling of Terrorist Threats: A Systems Analysis Approach to Setting Priorities Among Countermeasures," *Military Operations Research (MORS)*, Vol.7, No. 4, pp 5-20. Available at:  
<http://www.mors.org/awards/mor/2003.pdf>.

### **Analyzing Terrorist Threats: Adaptation, Innovation, and Organizational Learning**

Kim Cragin, Peter Chalk, Sara A. Daly, Brian A. Jackson. *Sharing the Dragon's Teeth: Terrorist Groups and the Exchange of New Technologies*. Santa Monica, California: RAND Corporation, 2007. Available at: <http://www.rand.org/pubs/monographs/MG485/>.

Adam Dolnik. *Understanding Terrorist Innovation: Technology, Tactics and Global Trends*. London: Routledge, 2007.

James J. F. Forest, ed. *Teaching Terror: Strategic and Tactical Learning in the Terrorist World*. Lanham, MD: Rowman & Littlefield, 2006.

Brian A. Jackson. *Aptitude for Destruction, Vol.1: Organizational Learning in Terrorist Groups and Its Implications for Combating Terrorisms*. Santa Monica, California: RAND Corporation, 2005. Available at: <http://www.rand.org/pubs/monographs/MG331/>.

Brian A. Jackson, John C. Baker, Kim Cragin, John Parachini, Horacio R. Trujillo, and Peter Chalk. *Aptitude for Destruction, Vol.2: Case Studies of Organizational Learning in Five Terrorist Groups*. Santa Monica, California: RAND Corporation, 2005. Available at: <http://www.rand.org/pubs/monographs/MG332/>.

Brian A. Jackson, Peter Chalk, Kim R. Cragin, Bruce Newsome, John V. Parachini, William Rosenau, Erin M. Simpson, Melanie Sisson, and Donald Temple. *Breaching the Fortress Wall: Understanding Terrorist Efforts to Overcome Defensive Technologies*. Santa Monica, CA: RAND, 2007. Available at:  
<http://www.rand.org/pubs/monographs/MG481/>.

Michael Kenney. *From Pablo to Osama: Trafficking and Terrorist Networks, Government Bureaucracies, and Competitive Adaptation*. University Park, PA: Penn State Univ. Press, 2007.

### **Game-Theoretic Approaches to Attacker-Defender Interactions**

Daniel G. Arce and Todd Sandler. "Counterterrorism: A Game Theoretic Analysis," *Journal of Conflict Resolution*, vol. 49 No. 2, April 2005, 183-200.

David L. Banks and Steven Anderson. "Combining Game Theory and Risk Analysis in Counterterrorism: A Smallpox Example," in *Statistical Methods in Counterterrorism: Game Theory, Modeling, Syndromic Surveillance, and Biometric Authentication*, edited by Alyson G. Wilson, Gregory D. Wilson and David H. Olwell. New York: Springer, 2006, 9-22; and reprinted in National Research Council, *Department of Homeland*

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*Security Bioterrorism Risk Assessment: A Call for Change* (Washington, DC: National Academy Press, 2008), pp. 103-110.

Vicki M. Bier and M. Naceur Azaiez, eds., *Game Theoretic Risk Analysis of Security Threats* (New York: Springer Science+Business Media, 2009).

Erim Kardes and Randolph Hall. "Survey of Literature on Strategic Decision Making In The Presence Of Adversaries," CREATE report #05-006, March 15, 2005, available at <http://www.usc.edu/dept/create/assets/001/50765.pdf>.

Praveen Paruchuri. "Keep the Adversary Guessing: Agent Security by Policy Randomization," Ph.D. Dissertation, University of Southern California, July 2007.

Robert Powell. "Defending Against Terrorist Attacks with Limited Resources. *American Political Science Review* (August 2007), Vol. 101, No. 3, 527-541.

Todd Sandler, and Daniel G. Arce. "Terrorism and Game Theory," *Simulation & Gaming*, Vol. 34 (3) September 2003, 319-337.



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## **APPENDIX F. METHODS FOR OBTAINING AND ELICITING EXPERT JUDGMENTS**

This appendix provides additional discussion on the different types of methods that are available for gathering information and judgments from intelligence analysts (and other experts) on threats for risk models. It provides additional discussion on the following topics that are essential to obtaining quality threat inputs for DHS risk assessments: (1) methods for obtaining expert judgments; (2) defining data collection objectives for threat inputs; (3) communicating levels of measurement; and (4) ways to improve the reliability and validity of the judgments provided by experts.

### **Methods for Obtaining Expert Judgments**

As noted in Section 4, there are several methods available to risk analysts for obtaining threat judgments and inputs from intelligence analysts and other threat experts. These include:

- Facilitate “brainstorming” sessions
- Individual interviews
- Delphi method
- Expert elicitation
- Survey instruments
- Cognitive interviewing.

These methods are discussed in greater detail in this appendix.

#### ***Facilitated Brainstorming Sessions***

Using a facilitated “brainstorming” session can be helpful for both scenario development and generating threat inputs. Many literature sources exist on how to conduct the most constructive and efficient brainstorming sessions. While brainstorming sessions are generally reserved for qualitative data collection, they can also be used to generate different types of threat inputs for models. DHS intelligence analysts have indicated that they prefer this method for providing judgments on threat inputs. Therefore, the focus group or brainstorming sessions becomes more quantitative, depending on the type of questions being posed in the groups. If the focus group session is used for threat input generation (beyond basic scenario development exercises that use qualitative forms of “story telling”), the risk analysts will need to communicate the type of threat inputs very clearly and make clear breaks between the different forms of information being requested.

Brainstorming sessions with DHS intelligence analysts can help to generate scenarios by identifying attack types, methods of delivery, and likely targets. This is also an important time to develop accurate assumptions and engage in question framing needed for conducting structured interviews or sessions to generate relative or probabilistic threat judgments. Intelligence analysts can also help determine which scenarios are not credible

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or reasonable, which may assist risk analysts in determining which scenarios are best used in the risk assessment.

When conducting a brainstorming session (or Delphi method below), the DHS risk analysts team should determine ahead of time if they are trying to collect a range of responses from intelligence analysts, or if they would prefer intelligence analysts to reach a consensus on the threat inputs or scenario development information that they are providing. It should be taken into consideration that intelligence analysts are accustomed to working toward consensus, and it may be advisable to work with pre-existing group dynamics within the intelligence profession as opposed to asking the DHS intelligence analysts to change their regular methods of working together.

Regardless of the outcomes the risk analysts would like the group to work toward, it is critical that the risk analyst team communicate the “rules of engagement” for the focus group or brainstorming session for the intelligence analysts. The risk management team should not assume the intelligence analysts taking part in the study know what the risk management team is looking for either in terms of data collection methods or the structure of threat input judgments.

### ***Individual Interviews***

If gathering a group of intelligence analysts is not possible, as this is the preferred method proposed by intelligence analysts, individual interviews can be a good alternative. Furthermore, individual interviews can be done with intelligence analysts separately and then the results can be discussed as a group when the intelligence analysts become available. This is also a variation of the Delphi method.

### ***Delphi Method***

The Delphi method usually entails gathering judgments from experts or participants separately and then bringing the experts together to discuss the results of their judgments. When the experts reconvene, they are able to change their judgments based on the discussion and inputs of other experts. There are multiple ways of adapting this method for threat input collection. Intelligence analysts can be interviewed separately and then brought back together in a focus group type session to discuss their results. Intelligence analysts can provide their individual judgments in a survey type form and then discuss the results of the survey in a group format. The results can be attributable to the intelligence analysts or they can be provided without attribution and discussed on their own merits. At the end of this type of session, the discussion leaders (most likely the risk analyst), can re-survey the group to find out if the results are different based on the group discussion.

### ***Expert Elicitation***

Expert elicitation is a highly structured, resource intensive, and multi-phase data collection method for generating specific numerical probabilities from people who are

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very knowledge about a substantive area relevant to the risk assessment.<sup>104</sup> Expert elicitation is best conducted when there is no data to support the inputs needed for a risk model. Applying expert elicitation to the collection of threat input from intelligence analysts is a relatively new development. Expert elicitation has been used more often in technical and natural science fields.

### **What are the Key Steps in Expert Elicitation?**

Expert elicitation is the process of generating the best “educated guess” or expert opinion possible from knowledgeable individuals for a question where there is great uncertainty and relatively limited data. This method is sometimes applied in addressing questions that are fairly complex, where data is scarce, and when “what/if” situations that have never occurred or only rarely have occurred are under consideration (e.g., major nuclear safety accident).

Although specific applications may vary, experienced practitioners of expert elicitation have identified the following steps as essential elements for properly conducting expert elicitation:

1. Identification and selection of the issues
2. Identification and selection of the experts
3. Discussion and refinement of the issues
4. Training for elicitation provided to the selected expert
5. Elicitation of the judgments or probability distributions from the experts a structured interview process (usually one respondent at a time)
6. Analysis, aggregation, and resolution of disagreements
7. Documentation and communication

The classic method envisions holding two meetings with the subject matter experts: the first at the start of the interaction process to discuss issues and conduct elicitation training, and the second following the individual elicitations to discuss methods and to present the combined results of the individual expert judgments.

[Sources: Keeney and von Winterfeldt (1991) and Hora (2007)]<sup>105</sup>

When determining whether or not use expert elicitation, the following factors can influence how best to develop an expert elicitation approach (Meyer and Booker, 2001):

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<sup>104</sup> Expert elicitation has also been referred to as expert judgment, expert opinion, subjective judgment, expert forecast, best estimate, educated guess, and most recently expert knowledge. See Meyer and Booker, *Eliciting and Analyzing Expert Judgment*, pp. 3-7.

<sup>105</sup> For a good overview of the essential steps involving in conducting expert elicitation, see Stephen C. Hora, “Eliciting Probabilities from Experts,” in *Advances in Decision Analysis: From Foundations to Applications*, edited by Ward Edwards, Ralph Miles, Jr., and Detlof von Winterfeldt (Cambridge, UK: Cambridge University Press, March 2007), pp. 129-153; and Ralph L. Keeney, and Detlof von Winterfeldt, “Eliciting Probabilities from Experts in Complex Technical Problems.” *IEEE Transactions on Engineering Management*. Vol. 38, No. 3 (August 1991), pp. 191-201.

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- the type of information the experts must provide,
  - the number of experts available, the interaction desired among experts,
  - difficulty of preparing the problems,
  - the amount of time and study the experts will need to provide the judgments,
  - the time and resources available to the study, the methodological preferences of the data gatherers, analysts, project, sponsors, and experts.

Similarly, Bilal M. Ayyub (2001) provides extensive examples of how to apply expert elicitation, which types of elicitation methods work best, and the types of analytical methods that can be used with expert elicitation.

Some important questions have been raised about the use of expert elicitation as a tool in producing threat inputs. A study sponsored by the National Research Council of the National Academies (National Research Council, 2008) has highlighted the need for developing alternative methods for producing threat judgments related to the DHS Bioterrorism Risk Assessment, as well as discussed the importance of accounting for terrorists as intelligent adversaries in making threat judgments.<sup>106</sup>

Although expert elicitation has proven effective when applied to technical problems, such as assessing nuclear reactor safety, some challenges have arisen in applying this technique to obtaining threat judgments from intelligence analysts. These challenges have included:

- Many intelligence analysts are reticent about expressing their threat judgments in quantifiable forms that are stripped of the context and caveats that usually accompany their analyses.
- Expert elicitation usually involve in-depth, one-on-one interviews, which some intelligence analysts find contrary to their analytic culture, which emphasizes group peer review and the production of intelligence judgments as an organizational—not individual—output.
- Although intelligence analysts are used to working with highly classified information, they are sometimes asked to provide their threat judgments at unclassified levels to be compatible with the accessibility needs of the particular DHS risk method or model.
- The term “elicitation” has a generally negative connotation among intelligence analysts because in their discipline it is associated with efforts of adversaries to extract useful information from individuals using subtle techniques, such as seemingly casual conversations.<sup>107</sup>

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<sup>106</sup> See National Research Council, *Department of Homeland Security Bioterrorism Risk Assessment: A Call for Change* (Washington, DC: National Academy Press, 2008).

<sup>107</sup> For example, see the security warning by the Department of Energy (DOE) Office of Counterintelligence about elicitation, <http://www.ch.doe.gov/offices/OCI/Elicitation/index.htm>



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While these issues are unique to expert elicitation and do not diminish the value of expert elicitation techniques in generating threat judgments, they provide an appropriate caution that one of the most rigorous techniques to obtain expert judgments for risk assessment purposes needs to be appropriately adapted for use with intelligence analysts and only used when sufficient time and resources are available to meet the challenges discussed earlier.

### ***Survey Instruments***

There are many different ways that surveys can be incorporated into the data collection process to obtain threat judgments from intelligence analysts. Surveys can be part of the focus group/brainstorming session (conducted pre and post group or both), interviewing, or Delphi method techniques. Likewise, a survey instrument can act as a stand alone data collection instrument.

When done correctly, survey instruments can be very powerful tools. However, they are not appropriate for all data collection environments and there are specific methods and best practices associated with developing useful surveys. If the risk analysts are considering using a survey, it is recommended that the risk analysts employ a survey specialist who can assist with instrument and sample design and implementation. In the absence of consulting a survey specialist, the risk analysts can review some basic principles surrounding survey development. Whether or not this is recommended depends upon how much weight that will be placed on the survey results.

There are some key considerations to keep in mind when developing a survey, due the nature of surveys, the longer the survey, the more likely the intelligence analysts' interest in providing diligent responses will diminish (thus affecting the results), or the results may be less likely easy to understand. Furthermore, good survey instruments are first tested through end-user focus groups. The survey would be most appropriate if the risk and intelligence analysts had the time and resources to develop the survey with the proper question framing. The result would be that fewer questions may need to be asked, particularly if same type of information is going to be requested on a regular basis. Essentially the resources required to develop a useful survey tool should justify its use as a data collection tool. It is not recommended that long surveys be used to generate a broad swath of responses. Intelligence analysts in the HSI study provided feedback that performing this type of survey results in questions and responses that are generally not well thought out by either the risk or intelligence analysts.

Surveys may be most useful for threat input collection when they are short, concise, well thought out and understood, and asking for specific information that is best answered in a survey format. Questionnaires also have been used to obtain threat inputs from intelligence analysts. However, the usefulness of questionnaire data depends on how well the survey questions are constructed and tested with respect to the individuals being interviewed to minimize the misunderstandings concerning the questions and/or the responses. In addition, there is the risk that some questionnaires can result in cursory responses because the respondents are under pressure to provide answers even though they are personally skeptical about the value of the questions being asked.

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## ***Cognitive Interviewing***

Cognitive interviewing is a standard method, most often used to evaluate survey questionnaires, to critically evaluate the transfer of information, and “study the manner in which targeted audiences understand, mentally process, and respond to the materials we present – with special emphasis on the breakdowns in this process.”<sup>108</sup> It can be used in trying to understanding the process and mental mapping behind how a target audience comprehends the questions being asked of them. Furthermore, understanding the thought process behind underlying the responses to questions helps to ensure how the question are asked and how they are being answered are basically consistent, which contributes to the confidence of risk analysts and its customers in the reliability and validity of the risk assessment results.

Cognitive interviewing is intended to help the analyst understand the mental and decision-making processes occurring as the respondent answers a question, as opposed to focusing on the response itself. Asking the respondent to think out loud or doing verbal probes that ask more about their responses and how they came to them are both cognitive interviewing methods.<sup>109</sup>

The process use during cognitive interviewing that are the most likely to be helpful when determining if questions are understood as they are intended.

Two of the most common types of actions done during a cognitive interview are:<sup>110</sup>

- Asking the respondents in their own words to say what they think the question is asking, and
- Asking the respondents to explain how they chose a particular answer over other possible answers.

There are multiple purposes for asking intelligence analysts these questions:

- Find out if the questions are consistently understood (Fowler, 2002),
- Determine if respondents have or know the information needed to answer the questions (Fowler, 2002),
- Determine if the methods being used to measure the answers are appropriate based on the question framing and available knowledge,
- Determine how much the respondent is estimating information versus recalling information,
- Determine how much of an intellectual “stretch” the respondent is making in order to help assign levels of uncertainty to response variables.

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<sup>108</sup> *Cognitive Interviewing: A Tool for Improving Questionnaire Design* by Gordon W. Willis, 2005, p.3.

<sup>109</sup> Ibid.

<sup>110</sup> *Survey Research Methods, 3<sup>rd</sup> Ed.* Floyd J. Fowler Jr. Applied Social Studies Research Methods Series Vol. 1(2001), p. 109.

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Although this list is not exhaustive, it does provide several reasons on why finding out the reason why an intelligence analyst is responding in a certain way to a question is as important—if not more important—than the substantive response itself. This is particularly true when the risk analyst is at the initial stage of developing questions that may be repeatedly used in producing threat judgments. Having a sound basis for understanding the meaning of the intelligence analysts’ responses will give risk analysts more confidence that they are receiving answers that are understandable.

## Challenges to Obtaining Threat Judgments

While risk analysts have various methods available for obtaining threat judgments from intelligence analysts, they must also deal with certain challenges: (1) dealing with classification levels; and (2) basic tendencies that lead respondents to respond to questions with less than perfect accuracy.

**Classification of threat inputs.** Classification levels of threat data can become an impediment in cases where intelligence analysts are inhibited from explaining the basis for their threat judgment because of their access to intelligence concerning terrorist intent and/or capabilities at classification levels above what the risk analysts possess. In some cases, this challenge can arise if risk analysts want to use threat inputs at the unclassified//For Official Use Only (FOUO) level to avoid complicating their work on the risk assessment. In some case, risk analysts request intelligence analysts to provide their specific judgments at the unclassified//FOUO level or Secret-level. The classification level for threat inputs to a DHS risk method or model will likely depend on the types of questions being asked and the degree of specificity that the risk analysts are seeking from the intelligence analysts.

**Respondent tendencies.** Having an appreciation for some of the basic reasons that account for non-responses or inaccurate responses is important for gathering the correct data and improving collaboration. One expert in survey research (Fowler, 2002) has identified four basic reasons why respondents report events with less than perfect accuracy<sup>111</sup>:

- *They do not understand the question:* respondents may not always tell the interviewer that they do not understand a question or that a term is unfamiliar or ambiguous to them. Therefore, in answering the question they may provide a response that does not accurately depict reality.
- *They do not know the answer:* the subject matter experts are unable to provide an answer, then the interviewer is asking the wrong type of respondents or the question is not designed correctly.
- *They cannot recall an answer even though they claim to know it:* You can have the respondents follow-up, or provide their best estimates in a subsequent interchange. In some cases, intelligence analysts are likely to be reluctant to provide a firm judgment without checking their classified data sources and conferring with other intelligence experts who possess more knowledge or

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<sup>111</sup> Ibid., p. 95.

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experience in dealing with certain subjects. In such cases, the interviewer needs to note that any threat input is tentative and requires additional effort or outreach by the intelligence analyst.

- *They do not want to report the answer in the interview context:* The interviewer can try to find out why the respondent is reluctant to respond. It could be because the information is classified at levels above the interview discussion or because the intelligence analyst is simply unclear or uncomfortable with how the risk analysts might be using the information. It is important that any such reservations be captured in a way to help the risk analyst team to design their data collection in a way that reduces such impediments.

In some cases, the risk analysts might want to consider using one of the other methods for obtaining the desired threat inputs if these impediments are significant. For instance, in cases where one-on-one interviews are encountering major difficulties, then shifting to group discussions and interviews with intelligence analysts might provide helpful to determine whether the problem is rooted in the venue or in the data collection design.

## **Defining Data Collection Objectives for Threat Inputs**

There are two main elements of research design: (1) pre-collection thinking and (2) the data collection and implementation approach.

### ***Pre-Collection Thinking***

Giving serious thought to data collection goals, objectives, and how they tie together prior to starting any data collection activities will likely improve the quality of the resulting data collected, and ultimately the ability to use the data collected in a risk model.<sup>112</sup> It can be easy to start collecting what seems to be “obviously” important information, then later determine when trying to use the information that it is not as related to your initial data collection goal as it initially seemed. While some of this is natural in the course of any research, much of it can be resolved by doing pre-collection thinking. Risk assessments that are still being developed are particularly susceptible to having a mismatch between the data collected and the data most needed.

This pre-collection thinking aims at determining what information most relates to the goal of the risk model and how that information needs to be framed in order to support the goals of the risk model. Some of the questions the risk analysts should ask regarding the possible data to be collected are:

What implications would the data have for my understanding of how to solve this problem? Compared to my best guess about how the data will look once I've got them, how different might they look if I actually took the trouble to get them? How much is it worth to me to confirm the actual difference

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<sup>112</sup> “Pre-Collection Thinking” is a word borrowed from Eugene Bardach, *A Practical Guide for Policy Analysis: The Eightfold Path to More Effective Problem Solving*, 2<sup>nd</sup> Ed. (Washington, DC: CQ Press, 2005).

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between what I can guess and what I can learn about the world by really getting the data?<sup>113</sup>

Sensitivity analysis offers a good technique for helping with pre-collection thinking about desirable threat inputs. Undertaking sensitivity analysis with mock data prior to data collection could refine the planned questions and help ensure question framing and scaling are appropriate for the needs of the risk model.

While objectives may change throughout the study based on the availability of data and realities of data collection, starting out with specific data collection objectives is fundamental to having focused research. By carefully considering in advance how the threat inputs collected will be utilized in the risk assessment, the risk analysts can clarify and prioritize their data collection objectives for working with the intelligence analysts.<sup>114</sup>

These two steps (pre-collection thinking and developing the data collection approach) should be approached using a continuous feedback process. The data input needs for a risk model and the realistic ability to collect that information are inseparable in practical terms.

Engaging in this type of pre-collection thinking and developing a data collection approach before contacting an organization can have several benefits:

- Provide the intelligence analysts and managers with confidence that best use of their analysts' time is being made by the risk analysts;
- Allow the risk analysts ask more relevant and productive questions;
- Help the team of risk analysts to develop a more consistent understanding of the desired data collection methods for obtaining threat judgments as each risk analyst gains a deeper appreciation of how the interview methods will support meeting the data collection objectives;
- Increase the utility of the data being collected by providing the risk analysts and their customers with greater confidence that a sound process was used.

## **Communicating Levels of Measurement**

Regardless of the type of methods used to collect threat judgments from intelligence analysts, communicating the level of measurement needed by risk analysts for their risk method or model is an important issue for ensuring that useful threat judgment inputs are

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<sup>113</sup> Ibid., p. 12.

<sup>114</sup> Relevant to this question, one survey research specialist has observed that having research objectives is key as “researchers are often tempted to add related questions that do not contribute to achieving the project’s goals,” and that by developing a list of categories and their parameters will assist in maintaining the focus of data collection, “a check against such temptations is to have a good statement of purposes, against which inclusion of a particular area of inquiry can be measured.” Floyd J. Fowler Jr., *Survey Research Methods, 3<sup>rd</sup> Ed.*. Applied Social Studies Research Methods Series Vol. 1 (Ten Thousand Oaks, CA: SAGE Publication, Inc., 2001) p. 105.

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obtained. Measurement levels refer to the collection of nominal, ordinal, interval, or ratio data (see inset box for specific definitions and distinctions).

### **Measurement Level Application Scales**

Risk analysts can make use of different measurement levels exist for expressing knowledge from subject matter experts about the state or value for a particular variable. These measurements range from the qualitative measures (e.g., nominal) to very quantitative measures (e.g., ratio scales). The following is a brief definition of these measurement levels or scales:

- *Nominal scales* simply attach a name to the value of a variable. Typically, nominal scales are used exclusively for unordered categorization or classification.
- *Ordinal scales* are used to place certain quantities in order based on relative magnitude (e.g., best to worst, least likely to most likely). The distance between two positions on an ordinal scale, however, has no practical meaning other than one is less than (more than) the other.
- *Interval scales* are used when the distance between two subsequent values on the scale matter, but are not pegged to a fixed reference point. While distance has meaning, the ratio of one value to another does not. For example, temperature expressed in degrees Fahrenheit is on an interval scale – the difference between 32 and 31 degrees is the same as the distance between 96 and 95. However, because interval scales lack a zero reference point, one cannot say that 96-F is three times hotter than 32-F.
- *Ratio scales* are used when both the distance and ratios between two scale values matter. Time expressed in any clock-unit is on a ratio scale, as is age, since in both cases zero is a reference point.

[Sources: Edward Jopeck and William McGill, risk-intelligence tutorial supplementary instructional briefing for this project is a companion piece to this report.]

There are two parts to the process of determining measurement levels. The first is making certain that risk analysts know precisely what they need, and the second is communicating that information to the intelligence analysts. The risk analyst team would have determined during the research design process which inputs and what measurement levels are desired to support their risk method or model. The risk analyst must ask questions of the intelligence analysts that are structured to provide the desired types of measurements. If the intelligence analysts are not willing or able to provide their responses in the desired type of measurement level (e.g., probabilities), then it is up to the risk analysts to work with intelligence analysts to determine what is possible or whether initial expectations must be revisited and modifications made to the risk approach.

It is generally recommended that the risk analysts avoid using the terms nominal, ordinal, interval, or ratio with the intelligence analysts, unless they are able to provide pre-interview orientation and training, which is the expectation in using the expert elicitation method. Instead, the risk analysts can use different examples to explain what types of information they are requesting. The inset box provides some examples of explanation

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that can help intelligence and risk analysts make certain that they are communicating accurately.

The range starts from having the respondent providing basic prose descriptions (words or purely qualitative) in the form of nominal scales to measurements. It continues with having risk analysts offer their judgments as to the relative magnitude or likelihood of one events compared to another. Finally, the range ends with using expert elicitation methods to translate the intelligence analysts' threat judgments into purely numerical terms that provide the basis for probabilistic inputs to risk assessments.<sup>115</sup>

One of the challenges of obtaining threat judgments from intelligence analysts and other threat experts is that their threat estimates are inherently subjective—there is no way to compare the information being provided against other facts or feedback to ensure the accuracy of the response by the intelligence analyst. This is frequently the case when using ordinal scales that ask a threat analyst about how likely it is that a certain event will occur. This condition reinforces the importance of pre-testing questions (wording and scaling) because there is no other good way of making certain the information being provided has the validity needed for risk assessment purposes.

## **Improving the Reliability and Validity of Expert Judgments**

Methods for improving and checking reliability and validity can be done before data collection, during the early phases as part of the data collection, and after the data has been collected. However, checking for reliability and validity after the data has been collected does not help improve the quality of the data collected even though it does help improve future data collection and inform the risk analysts (and their customers) of limitations in the existing data and results.

### ***Reliability and Validity***

As noted by a leading expert on survey research methods:

Good questions are reliable (providing consistent measures in comparable situations) and valid (answers correspond to what they are intended to measure).<sup>116</sup>

**Measurement reliability.** A good threat estimate question needs to be understood the same way by two or more intelligence analysts, thus making the question a reliable instrument for obtaining answers that can be compared. Measurement error is produced when respondents understand and respond to questions differently in ways that are unintended, thus making the values generated through the data collection process less accurate or precise.

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<sup>115</sup> For a useful comparison of qualitative, semi-quantitative, and quantitative approaches to designing a risk analysis approach, see DHS Office of Risk Management and Analysis, "Risk Management Analytic Guidelines, "Designing Risk Analysis Approaches," (draft document, 2009), pp. 5-7.

<sup>116</sup> Fowler Jr., *Survey Research Methods*, p.76.

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**Validity.** In this context, validity refers to measuring what is intended to be measured. It involves mutually understood communication between risk and intelligence analysts concerning the questions being asked and the responses being gathered. If there are misunderstandings arising or undocumented assumptions being made between the risk and intelligence analysts during the data collection of threat judgments, then measurement error is being introduced to the study. While some degree of measurement error is inevitable, a substantial problem will raise questions about the validity of the data collection results.

In designing their data collection instruments and questions, risk analysts can benefit from drawing on the well-developed expertise and experience available in the fields of survey and applied social studies research. Risk analysts who are likely to be deeply involved in data collection activities on a recurring basis especially should become more familiar with survey and applied social studies research methods and/or draw on specialists with these skill-sets.

### ***Methods Available for Improving Reliability and Validity***

The following are some methods available to risk analysts for improving the reliability and validity of the threat inputs used for DHS risk assessment purposes:

- *Pre-testing the questions and data collection methods.* The best way to prevent or minimize measurement error is to pre-test the questions before they are used with the intelligence analysts to collect threat judgments. The risk analysts can use mock-respondents to pre-test the questions and methods that they plan to use during threat judgment collection with the intelligence analysts. It is recommended that the mock-respondents not be people on the same risk management team, and preferably people who are not familiar with risk analysis. This will help the risk team catch if they are using language or wording that is only meaningful to other risk analysts. However, ideally they would be able to pre-test the data collection questions with intelligence analysts, particularly those who are collaborating with to arrange the data collection interviews. If multiple interactions between the risk and intelligence analysts occur during Phase II of the collaboration process, then one of the iterations might be used to conduct a brainstorming session where the intelligence analysts help the risk analysts develop and frame questions in a way that is most appropriate for obtaining quality threat judgments.
- *Using trained discussion facilitators and interviewers.* Having well trained interviewers and discussion leaders involved in the data collection process will help reduce measurement errors that could be a result of reliability or validity issues. The discussion facilitator or interviewer has the ability to introduce a tremendous amount of error. He or she will need to make certain that questions are being asked in a consistent manner and be alert for any cues that the intelligence analysts are not clearly understanding the questions. Documentation of questions (developing good written directions and questions for the moderator or interviewer) and intense note-taking during sessions can help reduce the chance of reliability and validity related error.



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- *Adapting to prompt feedback.* Another method available to risk analysts is to incorporate the feedback from intelligence analysts (particularly if there is a group session) at the time the questions are being asked. Then again ask for the probabilities or other value judgments after the intelligence and risk analysts have agreed on any new question framing and simplifying assumptions. Of course, the discussion leader for this session would need to be well-versed in what is acceptable in changing the data collection methods or objectives while still basically meeting the needs of the risk model or method.
  - *Building on consecutive interviews.* If the threat judgments are being conducted in the form of consecutive individual interviews, then the initial interviews could be used to help frame the questions and clarifying the underlying assumptions, while the consecutive interviews would build on the question framing from the these early interviews. However, the risk team would have to be careful to document the subsequent changes and then go back and re-ask certain questions to the first one or two intelligence analysts interviewed if the risk team wants to incorporate the threat value input from those analysts in a compatible manner.
  - *“Reading” the interviewees.* During the interviews or focus groups sessions, the risk analysts should be sensitive to the verbal and non-verbal cues provided by the intelligence analysts concerning whether or not they understand or are willing to answer questions, particularly if the questions seem to be answered in very different manners by various intelligence analysts. As noted earlier, the risk analysts might observe certain verbal and non-verbal cues that indicate that the interviewee is having difficulty understanding the questions being asked, or simply are uncomfortable with a line of questioning. In some cases, the risk analysts might then try informal methods (e.g., time-out), discussions with intelligence analysts who are arranging the interviews, and/or follow-up discussions on the data collection methods to better assess variations in intelligence analyst responses that go beyond understandable substantive differences.
  - *Using cognitive interviewing.* As discussed earlier, cognitive interviewing is a method that risk analysts can use to better understand if an intelligence analyst understands the question the same way the risk analyst intends, or is using assumptions not explicitly stated that significantly differ from of the risk analyst. Such cognitive interviewing techniques are more interested in understanding how a respondent arrived at an answer, the mental thought process and assumptions, than with the answer to the question itself. This type of method might be used, with permission of the interviewee, in developing the question framing or in assessing a problem that has arisen during the Phase II data collection that raises significant concerns over the reliability or validity of the threat judgments being obtained.
  - *Conducting exit interviews.* Conducting a type of “exit interview” after the brainstorming or interview sessions where threat inputs were collected is useful to determine if participants understood the questions they way they were intended. However, given this is after-the-fact information, it does not change the data that was collected. Nevertheless, it will alert the risk analysts that there could be a problem with the data and the data collection certain timely

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adjustments in the data collection approach or question framing might be desirable.

- *Assessing the data collection results for process insights.* The risk management team can also check for reliability and validity issues in the data after it has been collected. Although the results are unlikely to affect the existing data, they could alert the risk analyst to any issues that require improvements in their data collection methods in the future. The risk team can do this by comparing the data across intelligence analysts (if individual interviews or separate focus groups have been conducted) to determine if the results vary in ways that are fundamentally unexpected and difficult to understand from a substantive perspective. Where there are such differences, the risk analysts can try to look deeper to determine whether a possible source of highly divergent responses was a very different understandings of the questions being asked of the intelligence analysts, or unintended variations in how the data collection interviews were conducted. This can only be done if good documentation of the questions and procedures used in data collection process is available.

In summary, risk analyst have available a variety of methods for obtaining threat judgments and inputs from intelligence analysts. This appendix provides an overview of alternative methods and highlights some of the challenges in achieving reliability and validity in the data collections, as well as some collaborative practices for improving the prospect of producing useful threat inputs for DHS risk assessment purposes.