Executive Summary

HAZMAT SAFETY & SECURITY

FIELD OPERATIONAL TEST

TASK 1:

RISK/THREAT ASSESSMENT

To

Federal Motor Carrier Safety

Administration

U.S. Department of Transportation

Washington, DC 20590

In association with Total Security Services

International, Inc.

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Executive Summary

Introduction

Following the September 11, 2001 terrorist attacks on the U.S., the Department of Transportation was asked to identify areas within the transportation system that were vulnerable to terrorist attack. One major area of concern identified was the transportation of hazardous materials (hazmat). The Federal Motor Carrier Safety Administration is conducting a field operational test (FOT) to quantify the security costs and benefits of an operational concept that applies technology and improved enforcement procedures to hazmat transportation. The FOT will demonstrate an approach that enhances the safety and security of hazmat shipments from origin to destination.

As part of the Hazmat FOT, a risk/threat assessment (Task 1) was conducted to organize the safety and security risks and threats in the highway transportation of hazardous materials. This report documents that assessment. It frames the safety and security risks being addressed by the FOT and is the basis for developing the Concept of Operations (Task 2). This assessment categorizes the threats and leads to the prioritization of potential countermeasures.

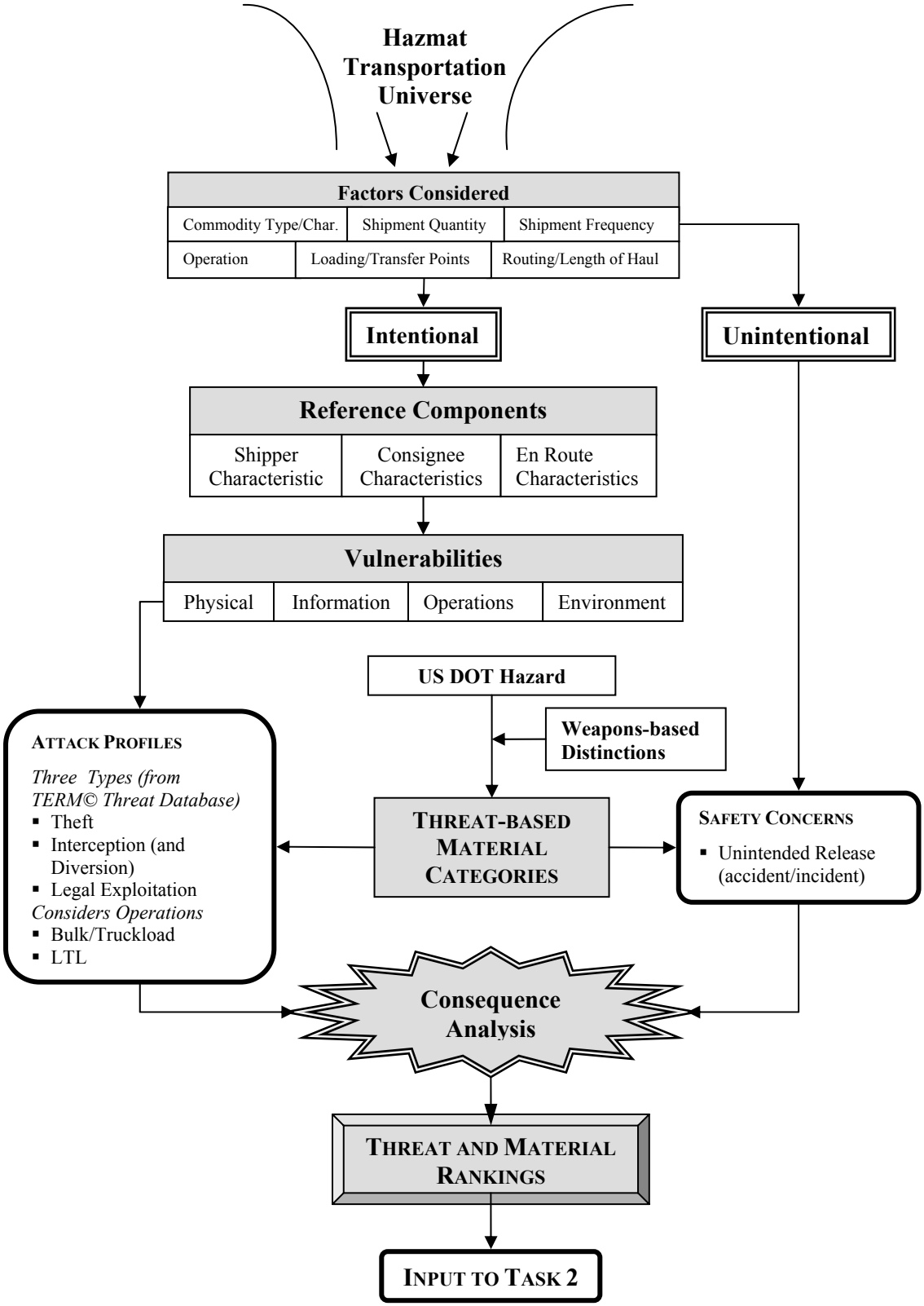
Assessment Process

Figure 1 illustrates the assessment process developed to conduct this task. The assessment begins with a look at the broad universe of hazmat transportation. This universe is extremely varied, encompassing a diverse set of factors that need to be considered in conducting a risk/threat assessment, including:

- Type and characteristics of commodity;
- Quantity of hazmat in individual shipments;
- Frequency of hazmat shipments;
- Type of operation (e.g., bulk and non-bulk, private and for-hire);
- Routing and length of haul; and
- Commodity loading and transfer points.

These factors are then considered from two very different perspectives: intentional vs. unintentional releases. Because the scope of work for the Hazmat FOT includes consideration of both security and safety, both intentional (i.e., terrorist threat) and unintentional (i.e., accidents and incidents) releases are addressed. As shown in Figure 1, a greater portion of this effort was focused on terrorist-based intentional releases, but safety-related unintentional releases were considered as well.

Figure 1 - Assessment Process Flow



To address intentional releases, general categorizations (called *reference components*) for shippers, carriers, consignees, and en route conditions were defined. The definitions for specific reference components included typical operations and characteristics. Carrier and en route conditions were grouped together. The reference components used are:

Shipper: warehouse/reseller, hazmat manufacturer, academic/research facility, and hazmat waste generator

Consignee: residential consumer, warehouse/reseller, industrial consumer, construction or mining consumer, academic/research facility, and waste disposal facility

En Route: rural Interstate, urban Interstate, rural arterial or two-lane highway, urban arterial, truck stop, rest stop or parking area, weigh station and border crossing, carrier terminal, and transfer terminal

The primary purpose for defining reference components was to organize, identify, and represent typical vulnerabilities. Each reference component was defined not to represent industry best practices related to security but to reflect the combination of vulnerabilities that can be readily found throughout industry. A reference component cannot be deemed typical in aggregate, but individual characteristics are taken from typical cases. The reference components were developed from industry knowledge and were confirmed and augmented by visiting facilities and/or conducting interviews with persons responsible for the transportation of hazmat.

As Figure 1 shows, the next step in the assessment process was to identify vulnerabilities for each reference component. The vulnerabilities were then categorized according to physical security, information integrity, operations, or environment.

Completing the development process for addressing intentional releases is the definition of terrorist tactics that would be effective against hazmat transportation. These tactics are also called attack profiles (see left side of the flowchart in Figure 1). In this study, a comprehensive database of threats developed by a member of the Battelle team, Total Security Services International, Inc. (TSSI), was examined for those threats relevant to the transportation of hazmat and specifically to the vulnerabilities identified for the reference components. Three key threats were identified: theft, interception (including diversion), and legal exploitation. For simplicity, diversion is considered a special case of interception and these two are combined and treated as a single threat. A simple definition of these threats follows.

Theft – to take control by stealth, deception, or force;

Interception – to release, detonate, or ignite while at or near a target; and

Legal exploitation – to exploit the system in a "legal" way so as not to arouse suspicion, for example, to acquire hazmat by commercial transaction or diversion using "insiders."

In addition, the two major types of transportation operations, bulk/truckload and less-than-truckload (LTL) shipments, are considered in developing attack profiles. The three threat types are then applied against each of the two operational types to develop six different attack profiles that address the intentional use of hazmat as a weapon.

Safety concerns are also addressed at this stage by consideration of unintentional releases from accidents or incidents (see the right side of the flowchart in Figure 1). Considerable prior work has addressed this issue from a purely risk perspective and the results from the most recent study for the FMCSA were included.

The attack profiles are then considered for different types of hazardous materials. The DOT hazard classifications were reviewed from a "weapons-based" perspective and new threat-based material categories were developed (see middle of Figure 1). When considering the use of hazmat as a weapon, additional distinctions are made between materials in the same USDOT hazard class. For example, gases with a toxic-by-inhalation (TIH) hazard are all in a single USDOT hazard class. These TIH materials include those that are heavier than air (HTA) and those that are lighter than air (LTA). To a terrorist, these materials are distinctly different in their weapons potential and in how they would be used against a target (i.e., the tactics that would be used). An HTA TIH gas might be directed into an enclosed underground area such as a subway station; whereas, an LTA TIH gas might best be released over a larger, heavily populated area or into a building's air intake. From these considerations, a slightly revised categorization of hazmat was developed that considered weapons-based distinctions.

Consequence Analysis

A typical security-based vulnerability analysis involves development of exposure values based on specific weapons and tactics. This study assumes worst-case outcomes for materials, defines reference components with specific vulnerabilities that can be exploited, and constructs attack profiles that can be used as the basis for defining test scenarios.

Further adaptation was necessary to address targets, which are ordinarily the focus of the analysis (such as critical facilities, sporting events, or monuments). To address the general use of hazmat as a weapon, it was necessary to conceptualize an ideal target for each material for each defined attack profile, much as a terrorist would. These idealized targets are not described in this report, as the information would provide a detailed blueprint for target identification, evaluation, and exploitation.

For the intentional release-based attack profiles, two sets of worst-case, material-specific consequence estimates were developed, one for bulk/truckload and one for LTL, primarily based on the different material quantities associated with each of these two operational types. It is assumed that the release of the material being transported will result in worst-case consequences, which are not dependent on which specific tactic is used. The only exception to this is for interception, in which the terrorist cannot precisely place the hazmat prior to release, detonation, or ignition; therefore, consequences for these attacks would typically be lower than for theft or legal exploitation. Consequences estimates include deaths, injuries, and property damage and were developed from accident scenarios and expert judgment. They are designed to be order-of-magnitude estimates and to be relative rather than absolute.

For the unintentional releases, the results of the FMCSA study[1] were applied to an abbreviated list of the threat-based material classifications to allow comparisons. These consequences were expressed on an expected annual basis rather than on a single-incident, worst-case basis to reflect the nature of the risk assessment used to determine them. The consequences for unintentional releases also include other costs such as delay and evacuation costs.

The consequence values for both intentional and unintentional releases include a cost-equivalent for fatalities and injuries of $3,000,000 and $215,000, respectively. These values were selected based on previous USDOT hazmat impact studies. Rankings are sensitive to the total economic impact value of which these are a component in the calculations. These costs represent those that are recognized by the USDOT for the purpose of analytical studies such as this one. A series of tables are presented with estimated consequences resulting from each combination of attack profiles (e.g., theft involving bulk/truckload operations) and each of the 18 threat-based material categories.

Result of Risk/Threat Assessment Task: Threat and Material Rankings

The final step in the assessment process is to use the consequence estimates to develop a ranking of threat and material categories. In order to rank the various threat-based attack profiles against each other, two different sets of weights are applied to the consequence estimates. These weights are designed to reflect the attractiveness to a terrorist of (a) a specific attack profile relative to others and (b) a specific material for a specific attack profile. These weights take into account two sets of criteria: (1) the FBI criteria, which are focused on the attractiveness of a target and include the potential for mass casualties, significant economic damage, extensive psychological trauma, and high symbolic value; and (2) TSSI-developed criteria, which are focused on the attractiveness of the set of operations that a terrorist would need to employ to mount a successfully attack. The ranking provides an understanding of how the different attack profiles relate to each other and make it possible to prioritize efforts to address the specific vulnerabilities that would allow terrorists to effectively carry them out.

In addition to ranking the attack profiles themselves, it is possible to rank the threat-based material categories across all attack profiles based on their estimated consequences and weightings. The material category ranking could be used to apply specific countermeasures to the top-ranked categories.

It is these rankings (and the specific vulnerabilities that were identified for each reference component) that are provided as input to Task 2, the Concept of Operations. This will become an important consideration in defining operational scenarios and associated countermeasures that will be selected for testing during the field operational test. This development of test scenarios will be done during Task 2.

Without a sufficiently large historical record of terrorist events exploiting hazmat, it is impossible to predict the likelihood of any specific type of incident. It is instructive,

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[1] *Comparative Risks of Hazardous Materials and Non-hazardous Materials Truck Shipment Accidents/Incidents: Final Report*, March 2001, prepared for FMCSA by Battelle

however, to compare the expected annual consequences of unintentional releases to the relatively large theoretical consequences of just one terrorist incident.

The overall FOT, and the companion cost-benefit analysis, will address security, safety, and efficiency within the same context. It is likely that some protective measures applied to security vulnerabilities will provide benefits in safety and efficiency and these additional benefits will facilitate the adoption of these protective measures by industry.