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TECHNICAL
REPORT

Reducing Terrorism Risk at Shopping Centers

An Analysis of Potential Security Options

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Homeland Security

A RAND INFRASTRUCTURE, SAFETY, AND ENVIRONMENT PROGRAM

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Preface

Rising concern over the threat of terrorist attacks at private-sector targets has prompted commercial industries to consider ways to reduce the risk of terrorism. Shopping centers are particularly vulnerable to terrorist attacks because of their easy access and dense concentrations of people. This vulnerability has resulted in a relatively high risk of attacks: Since 1998, over 60 terrorist attacks at shopping centers have occurred throughout the world.

In response to heightened concerns about terrorism, a commercial property owner-operator asked the RAND Corporation to examine physical security approaches for reducing the risk of terrorist attacks at commercial shopping centers. The study used a modeling approach to identify and prioritize 39 potential security options in terms of their effectiveness at reducing the risk posed by 17 terrorist attack scenarios and their associated costs. The prioritization explicitly accounts for the wide variation in the relative risk (in terms of relative likelihood and consequences) among the scenarios. While the analysis is developed from case studies of three specific shopping centers, the method and findings are generally applicable to commercial shopping centers with a common corridor connecting tenants.

The results of this study, presented in this report, are intended to help guide shopping centers and possibly other private-sector industries in the design and implementation of security strategies aimed at minimizing the risks of terrorism. The report may also be useful in assisting with the design of incentives, standards, or other policy tools aimed at increasing private-sector involvement in homeland security. Finally, it is hoped that the analytical approach developed in this study will be a useful step toward a rational and defensible methodology for designing and evaluating security strategies.

The RAND Homeland Security Program

This research was conducted under the auspices of the Homeland Security Program within RAND Infrastructure, Safety, and Environment (ISE). The mission of RAND Infrastructure, Safety, and Environment is to improve the development, operation, use, and protection of society's essential physical assets and natural resources and to enhance the related social assets of safety and security of individuals in transit and in their workplaces and communities. Homeland Security Program research supports the Department of Homeland Security and other agencies charged with preventing and mitigating the effects of terrorist activity within

U.S. borders. Projects address critical infrastructure protection, emergency management, terrorism risk management, border control, first responders and preparedness, domestic threat assessments, domestic intelligence, and workforce and training.

Questions or comments about this report should be sent to the project leader, Tom LaTourrette (Tom_Latourrette@rand.org). Information about the Homeland Security Program is available online (http://www.rand.org/ise/security/). Inquiries about homeland security research projects should be sent to the following address:

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Summary

The threat of terrorism at commercial shopping centers is a prominent concern, with over 60 terrorist attacks against shopping centers in 21 countries since 1998. Because of this threat, shopping center operators are beginning to explore and implement increased security efforts specifically designed to combat terrorism. In order to help understand methods for reducing the risk of terrorist attacks in shopping centers, we have used a modeling approach to help shopping center operators evaluate candidate security options in terms of their effectiveness at reducing terrorism risk.

The basic modeling approach involves incrementally reducing the risk from terrorism by sequentially implementing security options. Security options are selected by weighing the effectiveness of specific options in reducing the risk of particular terrorist attack scenarios against the costs of implementing those options. Model inputs are derived from multiple sources, including statistical analyses of historical trends in terrorism, case studies of individual shopping centers, and review of security and crime deterrence literature. The model output is a prioritized list of security options and an estimate of the cumulative reduction in terrorism risk associated with the addition of each option.

The modeling results for the three centers examined share several common characteristics that reflect some important general conclusions about terrorism security at commercial shopping centers that can be drawn from our analysis:

- Based on our model and assumptions, implementing security options can substantially decrease the terrorism risk at a shopping center: We find that, if all the security options considered in this study were implemented, the risk of terrorism could be reduced by a factor of 20.
- The prioritization of security options is similar for the different centers examined. Eight of the top 10 options for each of the three centers are the same, and few options are shifted by more than two positions among the three centers.
- The prioritization of security options is strongly driven by the risk of bomb attacks. Because the overall terrorism risk is dominated by bomb attacks, the model selectively chooses options that address bomb attacks.
- Most of the risk reduction occurs with the highest-priority options. The cumulative risk drops steeply with the initial options, then decreases more gradually as additional options

are added. We find that 95 percent of the total reduction achievable with all options is provided by the first 6–10 options (the "high-priority set").
- Most risk reduction occurs with less expensive options; the average cost of each of the options in the high-priority set is 20–35 percent of the average cost of all the options.
- The overall annual cost of the high-priority set of options ranges from $0.4 million to $2.0 million at the three centers examined.
- The high-priority set of security options spans a diverse range of approaches, including communication and education, emergency response, customer entrance management, vehicle management, and building management.

In conjunction with the quantitative model, we also include qualitative estimates of the collateral benefits and detriments of each security option. We also examine some security issues outside the model framework, such as structural hardening considerations and "standby" postures to facilitate the rapid implementation of security options.

Our analysis has some important implications for terrorism security at commercial shopping centers. First, a strategy to reduce the risk of terrorism will be similar for most shopping centers. Our analysis indicates that the principal risk-reducing security options do not differ dramatically across the three types of centers examined in this study.

Second, disaster preparedness plans and exercises that focus primarily on emergency response do little to reduce terrorism risk. The vast majority of terrorism risk derives from attacks using explosives, for which the effects are immediate and the hazard abates very quickly. As a result, little can be done to reduce consequences (casualties or property damage) of a terrorist attack once it has occurred.

Third, centers that move to implement terrorism security options early may experience both challenges and advantages. Some of the high-priority security options identified in the analysis are expected to have negative collateral effects that, if great enough, may cause some shoppers to shop elsewhere. On the other hand, were the threat from terrorism to be perceived as increasing, the psychology may be reversed and customers may feel safer in centers with increased security. As terrorism security is increased in the United States and elsewhere, it would be instructive to examine the customer responses to increasing terrorism security.

Fourth, a tiered implementation may be the best strategy. One way to approach the problem of reducing the risk of terrorist attack is to implement a set of security options that are most appropriate for today's environment and develop plans today for further measures to take if the environment changes for the worse. Those plans could address precontracting for equipment and services, collecting data needed to implement options efficiently, educating staff on the measures, and planning public relations efforts. Such efforts would reduce the time and disruption involved in implementing future measures.

Finally, decisions about when to implement security options will depend on perceptions of the absolute risk of terrorism. This analysis provides useful guidance about prioritizing security options to reduce terrorism risk, but it does not address the risk of terrorism overall or when to begin implementing terrorism security options. Despite the best analytical efforts, the evolution of this perception is likely to be guided by indirect indicators, such as government actions and guidance, political changes, press coverage, or industry trends.

Acknowledgments

We thank Michael Thompson of RAND for helping to define the initial research problem and for guidance throughout the project. The modeling approach used in this study grew out of prior modeling work at RAND by Richard Hillestad and Paul Dreyer, and we benefited from their suggestions and guidance. We also thank Paul Dreyer for writing the computer program for the model and Kimberly Curry for research assistance. We gratefully acknowledge Ami Pedahzur (University of Texas, Austin) and Sara Daly and Brian Jackson (RAND) for helpful peer reviews that strengthened the report.

Abbreviations

ISE	Infrastructure, Safety, and Environment
MIPT	National Memorial Institute for the Prevention of Terrorism

CHAPTER ONE

Introduction

Terrorism and the Private Sector

The threat of terrorist attacks in the United States is highly uncertain, but, since September 2001, there has been a heightened awareness of a greater potential for attacks across the nation. Although there have been no large terrorist attacks in the United States since September 11, 2001, subsequent attacks elsewhere, such as those in Bali in 2002, Madrid in 2004, and London in 2005, suggest that the risk of terrorism has increased internationally and that it remains a serious concern. The public sector has taken on the primary response to this increased risk of terrorism. The U.S. Department of Homeland Security and associated federal, state, and local government efforts have focused on critical counterterrorism strategies such as increasing border security, strengthening intelligence operations, and improving emergency response (e.g., Riley et al., 2005; LaTourrette et al., 2006).

Complementing these public sector efforts, the private sector is exploring potential steps that may be appropriate for it to take to further address the threat of terrorism. Facilities in which large numbers of people are present in high concentrations, such as office buildings, auditoriums, and shopping centers, are attractive targets for terrorists. Owners and operators of such facilities are therefore becoming increasingly concerned about their exposure to terrorist attacks and how they may reduce their risk.

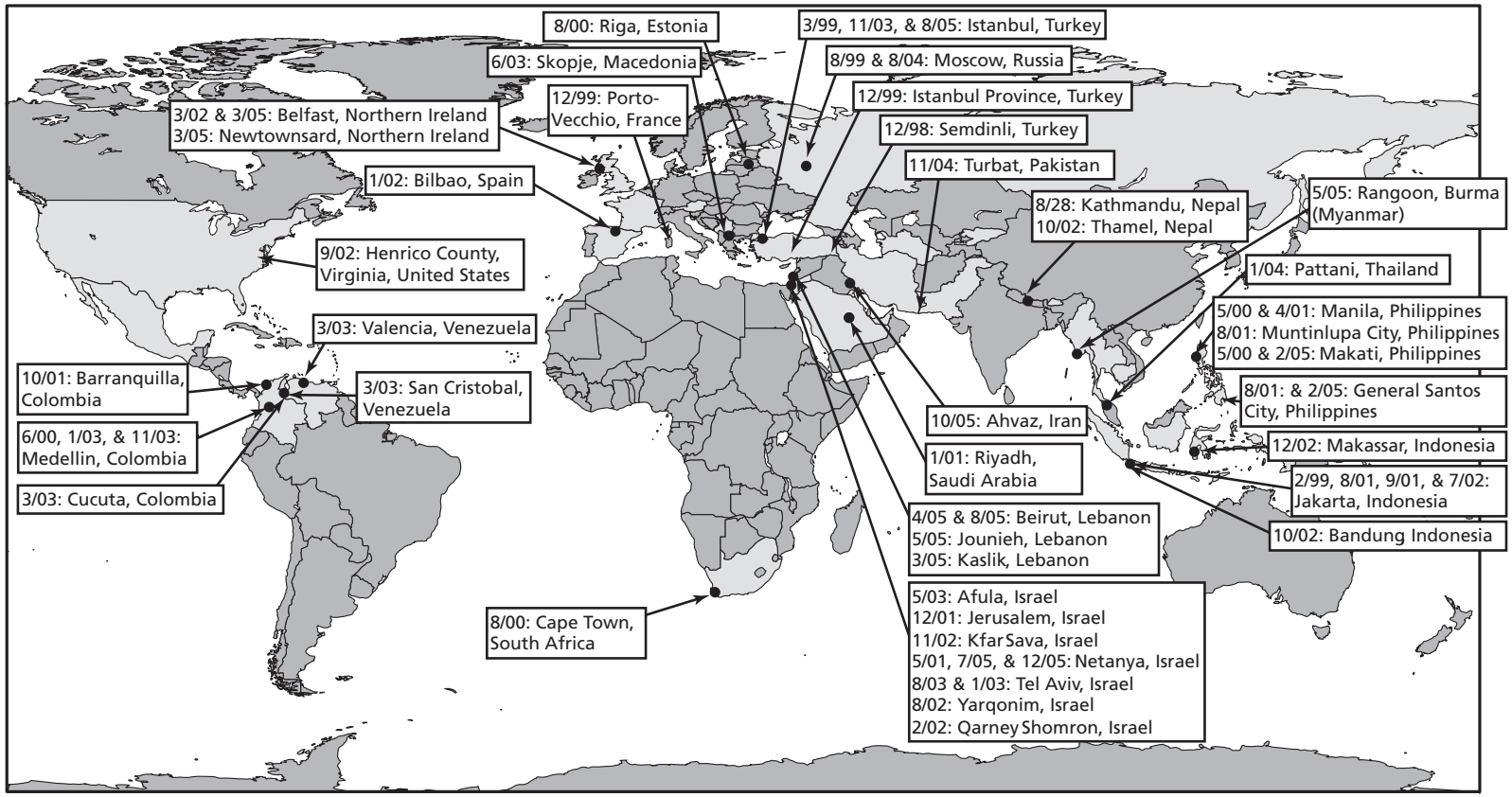
While some research has begun to examine private-sector efforts to reduce their risk from terrorism (e.g., Briggs, 2002; The Bellwether Group, Inc., 2005) and how government policy might be used to increase the level of terrorism security in the private sector (e.g., Dixon et al., 2004; Carroll et al., 2005; Farmer, 2004), the options and appropriate role of the private sector in contributing to terrorism security efforts merit further attention.

Shopping Centers as Terrorist Targets

Terrorists have repeatedly targeted shopping centers in particular. Since 1998, over 60 terrorist attacks at shopping centers have occurred throughout the world (Figure 1.1). A statistical analysis of important characteristics of these attacks is presented in Chapter Two. It is noteworthy that attacks have occurred at shopping centers in 21 countries, including those in Western Europe and North and South America.

Within the United States, shopping centers have been identified as potential terrorist targets, with specific warnings about attack threats at shopping centers in West Los Angeles in April 2004 and again in Columbus, Ohio, in June 2004. While no actual attacks occurred

Figure 1.1
Terrorist Attacks at Shopping Centers, 1998–2005



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in either case, the Los Angeles warning prompted the deployment of over 100 local and federal law enforcement officials to local shopping centers, leading to widespread panic and disruption (Yang, 2004).

In terms of their potential role as terrorist targets, shopping centers present numerous challenges for security. Shopping centers are distributed throughout the United States, both in areas that are considered high risk for terrorist attack (e.g., prominent cities or areas with iconic targets) and in areas that are not (e.g., rural or suburban areas).[1] This wide distribution makes prioritizing security efforts difficult. Shopping centers also allow unimpeded access to the public and attract a wide cross-section of the nation's population. In addition, most people have access to alternative venues for their shopping needs and can therefore avoid shopping centers without suffering undue hardship. Shopping centers therefore differ markedly from facilities like airports, which provide an essential service with few alternatives. For this reason, shopping center customers and tenants may not tolerate the expense and inconvenience of increased security. In addition, shopping center operations are governed by a complicated ownership and decisionmaking structure consisting of, among others, property owners and managers, tenant retailers, on-site employees, contract security, and customers. This multistakeholder structure increases the difficulties of implementing security and other risk-reduction measures. Finally, as with any competitive private-sector business, shopping centers may have a difficult time justifying investment in reducing the seemingly remote risk of terrorism.

Because shopping centers remain attractive targets for terrorists, stakeholders are beginning to consider increased security measures. In light of the security challenges discussed above, understanding methods for reducing the risk of terrorist attacks in shopping centers is therefore an important topic for public policy analysis.

Study Motivation and Objective

In light of continuing concerns about the risk of terrorist attacks at shopping centers and the uncertainties and complexities involved in reducing that risk, the RAND Corporation undertook a study to examine vulnerabilities to terrorist threats at shopping centers and to assess security options that could be implemented to reduce these vulnerabilities.

The primary objective of the study was to identify and prioritize security options that could help reduce the risk of terrorist attack losses at commercial shopping centers. The intention is not to recommend which specific security options should be implemented immediately, but rather which security options make the most sense in terms of cost and effectiveness against particular threats. Decisions about which options to implement and when to implement them will depend on how perceptions about the absolute risk of terrorist attacks at shopping centers evolve in a changing threat environment over time. Some stakeholders could choose to implement some of the security options analyzed in this report immediately, but many of the options may not be feasible or appropriate under current conditions. If the terrorist threat in the United

[1] In fact, one could argue that their suburban origins may make shopping centers icons of nonurban America and draw the threat outside nominally high-risk urban areas.

States increases over time, then the security options and priorities identified in this report provide a basis upon which to plan for increasing security as the risks increase.

Study Approach

Our analysis is built largely around a modeling approach in which the estimated effectiveness of specific security options in reducing the risk of particular terrorist attack scenarios is weighed against the costs of implementing those options. The basic elements of the model are a set of attack scenarios, estimates of the relative likelihoods and the consequences of each scenario, a set of potential security options, the cost of each option, and the likely effectiveness of each option in each scenario. These inputs are drawn from multiple sources, including a survey of terrorist attack statistics in shopping centers and in general throughout the world. For a given risk outlook, the model provides a prioritized list of security options and the cumulative decrease in relative risk and the cumulative cost as each option is implemented.

We also examine some security issues outside the model framework. These include preparing "standby" postures that facilitate the rapid implementation of security options, some aspects of structural design criteria, considerations for special events, and the importance of addressing terrorism both at the facility level and at the company or industry level.

Study Scope

Although we use the general term *shopping center*, our analysis is restricted to centers with a common corridor connecting tenants (*malls* in the terminology of DeLisle, 2005). We do not consider centers in which most tenants are accessed directly from a parking lot or street (*open-air centers*), although we do consider outdoor *malls*. We apply our model of terrorist scenarios and security options to three specific shopping centers: an outdoor shopping center with underground parking (Center A), a large indoor center surrounded by surface parking (Center B), and an urban center at which many customers enter from the street and from public transportation (Center C). The specific centers span a range of important shopping center characteristics, such as size, parking arrangements, indoor versus outdoor, and urban versus suburban. This set of centers was chosen to help understand the extent to which different access and design characteristics influence the prioritization of security options and to provide a more generalizable test of the risk-reducing effects of security options in shopping centers.

In addition, our analysis considers individual center-level security options only—it does not cover company- or industry-wide steps.[2] While we do consider differences in the physical design characteristics of the three centers, we do not consider any variations in the exogenous threat of terrorism that may exist among the centers (e.g., from being located in higher-risk cities). Finally, we consider the threat from terrorism only and do not consider benefits to nonterrorism security concerns or indirect negative implications of security options (e.g., customer

[2] Because of so-called target shifting, or displacement (i.e., terrorists deterred from one target may choose an alternate target), site-specific security measures are likely to reduce the risk to society as a whole less than they do at the individual site of interest. This possibility could have implications for how security measures are implemented (e.g., Lakdawalla and Zanjani, 2004).

resistance). We do provide a qualitative estimate of these implications, some of which may have an important influence on decisionmaking.

About This Report

Chapter Two presents a summary of statistics on terrorist attacks at shopping centers that are used to help us estimate the relative likelihoods and consequences of different attack scenarios. Chapter Three presents our security options model and a discussion of the findings, which include prioritized lists of security options. We also examine how the findings change under different assumptions about the threat conditions and other variables. Chapter Four discusses additional issues relevant to terrorism security at shopping centers. The report concludes in Chapter Five with a discussion of some general implications of our analysis regarding reducing the risk of terrorism in commercial shopping centers.

CHAPTER TWO

Historical Trends in Terrorism

Predicting Terrorism Risk from Historical Trends

In this chapter, we summarize recent (1998–2005) historical trends in terrorism. In particular, we characterize the relative frequency of different types of terrorist attacks and the consequences of those different types of attacks. Our analysis examines both terrorist incidents in general and terrorist incidents specifically targeting shopping centers. The objective is to inform estimates of the relative likelihoods and consequences of the terrorist attack scenarios we examine in our risk modeling.

Making assessments about future likelihood or consequences of particular terrorist attacks is an elusive undertaking. One approach is to examine recent historical evidence of what types of attacks terrorists have been conducted and what the consequences of those attacks have been. There is considerable debate about the extent to which historical trends in terrorism can be used to predict terrorism risk in the future (e.g., Willis et al., 2005; Grossi and Kunreuther, 2005; Sauter and Carafano, 2005; Haimes, 2004). Compared with other risks (e.g., automobile accidents), there are limited statistical data about terrorist attacks from which to parameterize terrorism risk rigorously in terms of relevant variables such as target type, weapon type, and geographic location.

Extrapolation from historical trends is also difficult because terrorist organizations are known to evolve and adapt as security and counterterrorism efforts are implemented (e.g., Jackson et al., 2005a, 2005b). A related uncertainty is the difficulty in predicting how terrorism, which so far has occurred largely outside the United States, will evolve if it becomes a more common threat in the United States.

In short, no golden rule says that terrorists will continue to choose targets or carry out attacks in a similar manner as they have in the recent past. However, we must begin by characterizing data from recent incidents and then determine which, if any, of the parameters estimated are likely to be different today and in the future.

Data

We used data from the RAND–National Memorial Institute for the Prevention of Terrorism (MIPT) Terrorism Incident Database.[1] Observations were restricted to those that occurred between January 1, 1998, and December 31, 2005, because we are interested in assessing more-recent consequences of terrorist incidents. We eliminated observations in which an attack was interrupted or aborted. We also eliminated attacks that occurred in Iraq after March 2003. While attacks in Iraq might be considered acts of terrorism, we do not think that they appropriately characterize the risk facing potential targets outside Iraq.

This analysis included a total of 12,831 observations. Some of the observations do not report data for specific parameters. For example, for analyzing the average number of fatalities by weapon type, only 9,614 observations report the number of fatalities. That analysis excluded observations with missing data.

The RAND-MIPT Terrorism Incident Database does not specify car or truck bomb as a weapon type. The weapon field for attacks using car or truck bombs is categorized simply as explosives. For our purposes, we believed that it was useful to analyze car bomb incidents as a specific weapon type. Car bombs have the potential to deliver a much higher explosive yield than, say, a backpack, package, or pedestrian suicide bomb, and security measures relevant to them are very different. Therefore, we used the description field to identify incidents that involved a car or truck bomb. When it was concluded from the terrorist incident description that a car or truck bomb was clearly used, we classified the weapon type as a car or truck bomb. It is important to note that this process may not result in the identification of every car and truck bomb incident. For example, a car bomb incident may appear in the database that does not include the phrase "car bomb" in the description field. However, this process does pull out instances in which it is clear from the description that a car or truck bomb was used.

Additionally, we compared the differences between terrorist incidents against any target with those against shopping centers. To do this, we first separated incidents that had occurrences of the words "mall" or "shopping center" in the description field. Then we examined the descriptions to ensure that the incident did target a shopping center or mall (e.g., some descriptions made reference to a previous attack by the same group that targeted a mall; such incidents are not be included here). Between 1998 and 2005, 62 incidents met the previously discussed inclusion criteria and clearly targeted a shopping center based on the description. Short descriptions and other data fields from the shopping center attacks are listed in Appendix A.

Weapon Types Used in Terrorist Attacks

A key consideration in prioritizing efforts to address the risk of terrorism is understanding the relative frequency of different weapons used by terrorists. Different security measures address

[1] RAND has maintained the RAND Terrorism Chronology, a database of international terrorism incidents, since 1972. More recently, RAND database efforts have been supported under contract with MIPT. The newer data set, called the RAND-MIPT Terrorism Incident Database, includes all terrorist incidents worldwide—international and domestic—since 1998. For the combined databases, see MIPT (undated).

different weapon and attack types, and an overall security approach needs to be based on an expectation about what sorts of incidents are most likely. In this section, we first examine data for all incidents that meet the inclusion criteria described previously to understand the relative frequencies with which different weapons are used. We then compare the results for all incidents with those targeting shopping centers to determine whether there are differences in the weapons terrorists use when attacking malls or shopping centers. The objective is to provide a basis for estimating likelihoods for different attack scenarios modeled in Chapter Three.

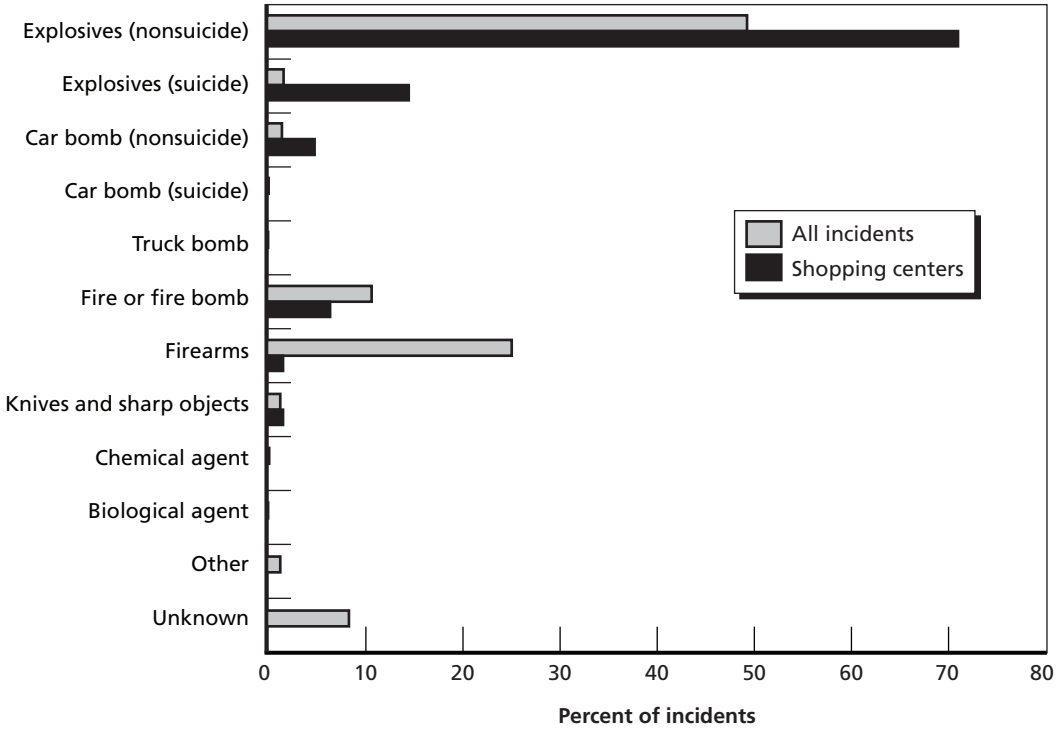
Table 2.1 and Figure 2.1 summarize the frequency of incidents by the type of weapons used for all incidents and for shopping center attacks. The first column of each sample group in Table 2.1 shows the number of incidents that occurred for each weapon type, and the second column shows the percent of incidents for each weapon type.

The results for all incidents show that terrorist attacks are dominated by nonsuicide explosives (i.e., placed bombs), which make up nearly 50 percent of all terrorist attacks in our sample. Nonsuicide explosives are a factor of 2 more common than firearms, the next most common weapon. Together, nonsuicide explosives and firearms constitute about 75 percent of the attacks, with the remaining weapon types combining to make up the remaining 25 percent. Note that fewer than 0.5 percent of the attacks used chemical or biological weapons.

Table 2.1
Frequency by Weapon Type of Terrorist Attacks, 1998–2005

	All Incidents		Shopping Centers	
Weapon Type	**Number**	**Percent of Total**	**Number**	**Percent of Total**
Explosives (nonsuicide)	6,323	49.3	44	71.0
Explosives (suicide)	215	1.7	9	14.5
Car bomb (nonsuicide)	192	1.5	3	4.8
Car bomb (suicide)	18	0.1	0	0.0
Truck bomb	11	0.1	0	0.0
Fire or fire bomb	1,378	10.7	4	6.5
Firearms	3,222	25.1	1	1.6
Knives and sharp objects	175	1.4	1	1.6
Chemical agent	26	0.2	0	0.0
Biological agent	15	0.1	0	0.0
Other	177	1.4	0	0.0
Unknown	1,079	8.4	0	0.0

Figure 2.1
Distribution of Terrorist Attacks by Weapon Type, 1998–2005



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When looking at the subset of incidents targeting shopping centers, we find that the results are even more strongly dominated by nonsuicide explosives, which make up 71 percent of the attacks. In fact, every weapon type that involves explosives (i.e., nonsuicide explosives, suicide explosives, and car bombs) represents a larger fraction of incidents at shopping centers than of terrorist attacks in general. As a result, over 90 percent of terrorist attacks at shopping centers are conducted with explosives. A consequence of this bias toward explosives is that the second most common attack type at shopping centers is suicide bombings, making up 15 percent of attacks. This contrasts with the results for all incidents, where suicide bombings are the sixth most common attack type, at 1.7 percent. Attacks with firearms, on the other hand, are negligible at shopping centers compared to attacks in general.

In summary, this analysis indicates that explosives are far and away the most common weapon used by terrorists from 1998 to 2005 and that this preference is particularly strong when targeting shopping centers. Compared with attacks overall, attackers targeting shopping centers are far less likely to use firearms and far more likely to use suicide bombs. The lower incidence of firearms attacks at shopping centers can readily be understood when considering how firearms are used in terrorist attacks. Inspection of the description field for firearms attacks in the database indicates that the majority of such incidents involve targeted political assassinations, roadside ambushes, or sieges on small villages. In this light, firearms attacks in indoor facilities such as commercial businesses or government offices are expected to be rare.

The reason for the higher incidence of suicide bombings in shopping centers is less clear, but probably reflects the bias of such attacks toward targets that allow unimpeded access and have high population densities.

If recent historical trends are a good predictor of terrorist weapon choices, these data provide us with an estimate of the relative likelihood of various weapon types that might be used against malls or shopping centers. We use this evidence to guide our estimates of likelihood of the various scenarios we include in our model.

Consequences of Terrorist Incidents

In addition to the likelihoods of different attack types, understanding the consequences of terrorist incidents is important for assessing risk and allocating resources to reduce this risk. The primary consequences of terrorist attacks are casualties and property damage. Other important consequences include business interruption, liability, and indirect economic impacts. While all of these consequences can be substantial, most are rarely documented and are difficult to estimate. The RAND-MIPT Terrorism Incident Database records consequences in terms of injuries and fatalities. Although casualties reflect only part of the total consequences, they are arguably the single metric of greatest concern. To characterize the consequences of past terrorist attacks, we examined the number of fatalities produced by incidents as a function of weapon type used.

Our analysis indicates that casualty numbers from terrorist attacks span a substantial range but are heavily skewed toward low values. Figure 2.2 shows the distribution of fatalities from attacks using all types of explosives. This distribution indicates that, while bombs can cause large numbers of fatalities, such incidents are exceedingly rare. Out of 4,800 records, only 24 (0.5 percent) had more than 30 fatalities. Ninety percent of the attacks resulted in two or fewer fatalities, and 75 percent resulted in no fatalities. The data indicate that, on average, terrorist bombings yield 1.2 casualties. Distributions for other attack types show similar strong skewing toward low fatalities.

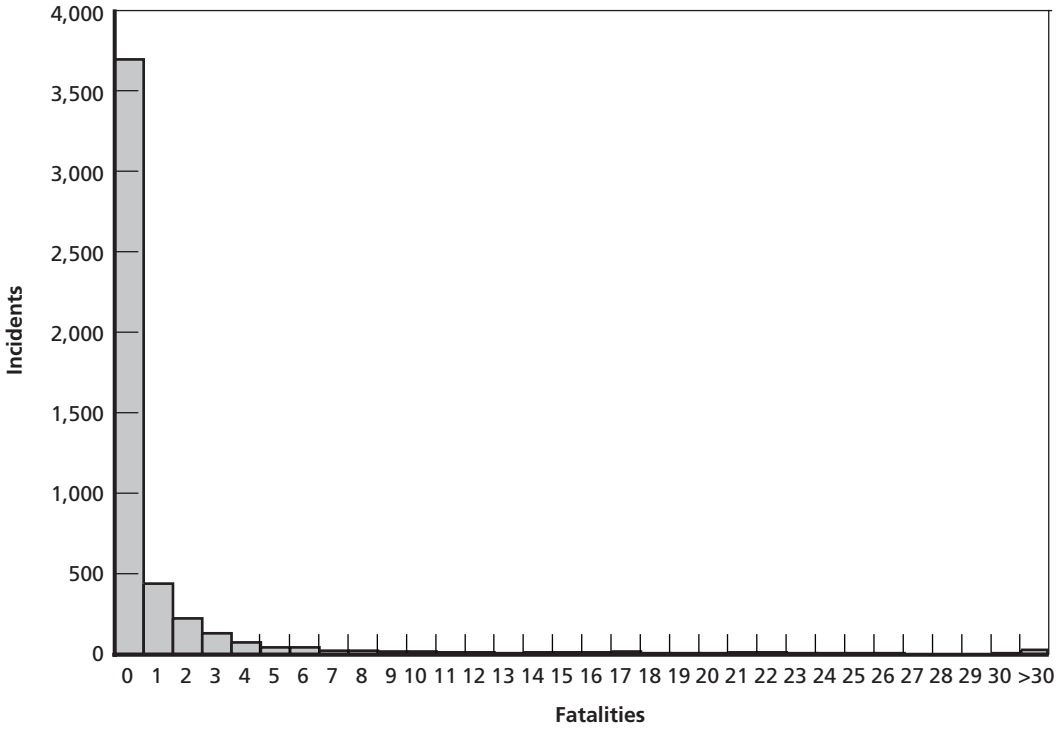
Given the very wide range in the number of fatalities that can occur from a given attack type, it is difficult to characterize fully the results with a single statistic such as the average. For our risk modeling, however, we are interested in estimating the most likely casualty outcomes of different attack types and in distinguishing the likely outcomes of different attack types. For this purpose, the average number of fatalities is an appropriate measure.

Table 2.2 shows the number of records,[2] the average fatalities, and the uncertainty on that average[3] for all terrorist attacks and attacks at shopping centers from 1998 to 2005. An important finding from this analysis is that suicide attacks are significantly more lethal than nonsuicide attacks. The mean number of fatalities for suicide explosive attacks (i.e., pedestrian

[2] Some of the incidents do not report data for specific parameters; observations with insufficient data are excluded from the analysis, leaving 9,614 valid records.

[3] The uncertainty on the average, sometimes referred to as the standard error of the mean, is used to characterize the uncertainty of differences in the average values of populations.

Figure 2.2
Distribution of Fatalities from Terrorist Bombings, 1998–2005



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suicide bombers) is more than seven times greater than that for attacks using nonsuicide explosives (i.e., placed bombs). The difference for car bombs is even more pronounced, with suicide car bombs being more than a factor of 10 more lethal than nonsuicide car bombs, although the distribution for suicide car bombs is much more dispersed. This difference in lethality between suicide and nonsuicide bombs probably reflects two distinguishing features. The first is that, compared with placed bombs, suicide bombers are better able to choose the best location and time to detonate to maximize the casualties. The second is that suicide bombers generally intend to kill victims, while nonsuicide bombers sometimes target property only and purposely avoid victims.

Table 2.2 also shows that shopping center attacks consistently result in greater numbers of fatalities than for all incidents. The most notable difference appears to be for attacks using nonsuicide explosives, where the average number of fatalities for attacks against shopping centers is double that for all incidents. However, this is driven by a single incident that had 28 fatalities. If we exclude this observation, the average fatality number drops to 1.2 with a standard error of 0.4. Suicide attacks at shopping centers are significantly more lethal than nonsuicide attacks, analogous to the case for all incidents.

Table 2.2
Average Fatalities for Different Attack Types, 1998–2005

	All Incidents			Shopping Centers		
Weapon Type	Number	Average Fatalities	Std Error of Mean	Number	Average Fatalities	Std Error of Mean
Explosives (nonsuicide)	4,594	1.0	0.1	33	2.0	0.9
Explosives (suicide)	211	7.4	0.8	9	8.3	2.4
Truck bomb	5	17.0	9.4	0		
Car bomb (nonsuicide)	131	3.2	0.6	1	5.0	0.0
Car bomb (suicide)	18	36.4	18.5	0		
Fire or fire bomb	857	0.4	0.3	4	3.3	3.3
Firearms	2,705	1.8	0.2	1	2.0	0.0
Knives and sharp objects	161	1.5	0.2	1	0.0	0.0
Chemical agent	17	0.3	0.2	0		
Biological agent	6	1.0	0.3	0		
Other[a]	132	1.2	0.4	0		
Unknown	774	1.9	0.1	0		

[a] Excludes September 11, 2001, attacks.

CHAPTER THREE

Modeling the Effect of Security Options on Terrorism Risk

We used a quantitative modeling approach to help identify and prioritize potential security options that a shopping center could implement to reduce the risk of terrorism losses. A systematic modeling approach was chosen to help contend with the great uncertainty and complexity inherent in addressing terrorism risk. Estimates of the level of terrorism risk and the effectiveness of various security options in reducing that risk are subjective and sensitive to the assumptions built into the model. In addition, the large number of potential attack scenarios and security options that must be considered make it difficult to keep track of cumulative effects, interdependencies, and mutual exclusivities. A modeling approach has the advantage of applying consistent rules and treating input parameters systematically. This generates results that are internally consistent, can be linked to specific parameters, and can be tested for their sensitivity to particular assumptions.

In our analysis, we borrow from the theoretical logic of rational-choice models of offending and situational crime prevention strategies (Clarke, 1983). This theoretical model applied to terrorism assumes that the decisionmaking process is rational and that terrorists considering an attack on a shopping mall consider the risks of their actions. We assume that terrorists are rational actors and consider the risks and rewards of their actions. These risks are assumed to flow from a consideration of the likelihood that terrorists think they can be successful in their planned attack and the consequences of their attack (e.g., number of people killed). Therefore, efforts to minimize the likelihood of a terrorist attack on a mall should focus on options that reduce the opportunities for terrorism. This study focuses on specific terrorist event scenarios and how the risk of these events can be "manipulated" through variations in the management of security and design characteristics of shopping centers that limit their attractiveness as terrorist targets.

Modeling Approach

The overall modeling approach involves incrementally reducing the risk from terrorism by sequentially implementing security options. The overall terrorism risk is the sum of the individual risks of different attack types that are intended to span the range of attacks that may occur at a shopping center. Different attack types are characterized in terms of 17 specific terrorism scenarios. The model selects security options according to their effectiveness at reduc-

ing risk and their cost and estimates the reduction in overall risk with each option. Figure 3.1 summarizes the modeling approach.

Modeling Risk

Risk is a measure of expected losses, and the risk of an attack can be expressed in terms of the likelihood of a successful attack occurring and the consequences of that attack. Risk is thus dependent on the expected frequency of an event and on how damaging that event is. Terrorism risk is reduced by implementing security options that reduce attack likelihoods, consequences, or both. We express the effectiveness of each option in terms of its ability to deter, deny, and mitigate attacks in each scenario; deterrence and denial reduce the likelihoods, and mitigation reduces the consequences. In detail, likelihood is a function of the threat from a terrorist group and the vulnerability of a target. Security options considered in this report have little influence on threat and affect likelihoods primarily by reducing vulnerabilities. Option effectiveness values are expressed on a 0–1 scale: A value of 0 has no effect on risk and a value of 1 in any one of the three categories reduces the risk to zero. For the 17 scenarios considered in our model, each option has 51 effectiveness values (deter, deny, and mitigate in each scenario) associated with it.

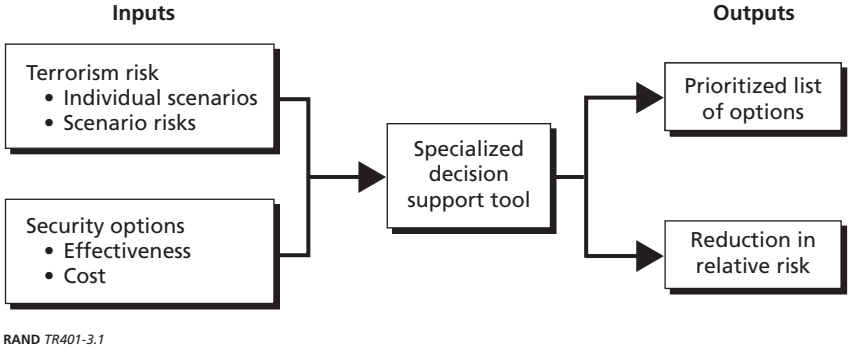
For a single security option applied to a given scenario, the relationship among risk, likelihood, consequences, and security option effectiveness is expressed as

$$R = LC(1-Dt)(1-Dn)(1-Mt), \tag{3.1}$$

where R is risk, L is the likelihood of that scenario occurring, C is consequence if that scenario does occur, and Dt, Dn, and Mt are the deter, deny, and mitigate values, respectively, for the security option in the given scenario.

The overall effectiveness of a set of N potential security options in a given scenario depends on which individual options are implemented and the effectiveness of each option. We assume that, when multiple security options are implemented, they act independently such that the net effectiveness of multiple options can be expressed as

Figure 3.1
Modeling Approach



$$Dt = 1-\left(1-Dt_1\right)^{X_1/\$_1}\left(1-Dt_2\right)^{X_2/\$_2}\ldots\left(1-Dt_N\right)^{X_N/\$_N}$$
$$= 1-\prod_{i=1}^{N}\left(1-Dt_i\right)^{X_i/\$_i},$$

where the subscript i refers to a particular option, X_i is the amount of money spent on option i, $\$_i$ is the cost of option i, N is total number of options being considered, and $\prod$ indicates taking the product. Analogous expressions hold for Dn and Mt. In our analysis, we assume that any option has a fixed effectiveness for any scenario (i.e., options cannot be partially implemented) so that the values X_i must be either 0 (option excluded) or $\$_i$ (option included). The risk for a given scenario when multiple security options are implemented is then given by

$$R_j = L_j C_j \prod_{i=1}^{N}\left[\left(1-Dt_{ij}\right)\left(1-Dn_{ij}\right)\left(1-Mt_{ij}\right)\right]^{X_i/\$_i},$$

where the subscript j refers to a particular scenario. The overall risk is the sum of the risks from each scenario:

$$R = \sum_{j=1}^{S} R_j = \sum_{j=1}^{S}\left(L_j C_j \prod_{i=1}^{N}\alpha_{ij}^{X_i/\$_i}\right),$$

where S is the number of scenarios being considered and

$$\alpha_{ij} = \left(1-Dt_{ij}\right)\left(1-Dn_{ij}\right)\left(1-Mt_{ij}\right).$$

Because the absolute likelihood of any terrorist attack is very difficult to estimate, our modeling uses relative likelihoods for the various scenarios considered. Relative likelihood refers to the likelihood of one scenario relative to the likelihoods of the other scenarios. Thus, the relative likelihood is a measure of the likelihood that a particular scenario will be used in a given terrorist attack. Relative likelihood estimates are presented below. It is important to note that, by using relative likelihoods, our analysis does not address the overall risk of terrorist attacks on shopping centers relative to other security risks. This has an important implication for the ultimate decisions about implementing security options: By prioritizing the various security options for reducing terrorism risk, the analysis helps guide decisions about which options are the most effective and the order in which they should be implemented. However, this model provides no insight into when to begin to implement terrorism security options.

Prioritizing Security Options

Given a set of scenarios, security options, security option costs, and deterrence, denial, and mitigation effectiveness values for each option in each scenario, the model prioritizes the selection of security options based on a cost-effectiveness algorithm. Security options are selected sequentially in such a way that each selection generates the greatest reduction in risk for the

lowest cost. Starting with a baseline risk value (i.e., no options implemented), the optimum option is selected and implemented. The overall risk is then recalculated with that option in place, and a new optimum option is selected from the remaining pool of options. Some options are mutually exclusive (e.g., unarmed security guards and armed security guards) and are therefore prohibited from being selected together. This process is repeated until all options have been selected or a maximum spending budget has been reached.

At each step, the optimum option is identified by computing the derivative of risk with respect to amount spent,

$$\frac{\delta R}{\delta X_i} = \sum_{j=1}^{S}\left[\left(L_j C_j \prod_{i=1}^{N} \alpha_{ij}^{X_i/\$_i}\right)\frac{\ln \alpha_{ij}}{\$_i}\right] = \sum_{j=1}^{S}\left(R_j \frac{\ln \alpha_{ij}}{\$_i}\right),$$

and choosing the option for which $\delta R/\delta X_i$ gives the greatest negative magnitude. This can be understood intuitively as the option that results in the greatest decrease in risk (R) for the smallest number of dollars spent (X_i).[1]

Model Inputs

This section summarizes the various input parameters used in the security options model. Each subsection discusses the rationale for the parameters chosen, data sources, and uncertainties. Input parameters were also informed by site visits to each of the three shopping centers examined in this report. Site visits comprised discussions with center operators, engineers, and security managers, along with tours of systems and individual components essential to security, such as entrances, parking facilities, loading docks, service halls, and roofs.

It is important to acknowledge that the parameters that contribute to terrorism risk are highly uncertain and therefore difficult to estimate. Our estimates of scenario likelihoods are informed by statistical analysis of past terrorist attacks, but there is substantial uncertainty as to whether historical trends are good predictors of future attacks (see Chapter Two). The consequences of the various scenarios we consider are also informed by past terrorist attacks and, while they are better understood than likelihoods, are still subject to uncertainty stemming from details of individual attacks that are complex to predict and beyond the resolution of this analysis. And the effectiveness of a particular security option in a given scenario is also often difficult to estimate, either because its technical effectiveness is uncertain or because its effectiveness depends on scenario details that have not been modeled (e.g., will a terrorist appear to be a customer or attempt to impersonate an employee?).

We also tested the sensitivity of our estimates to a varying set of assumptions. These analyses, which are discussed in the Modeling Results section below, illustrate how the rankings of security options vary with the various parameters used to define risk.

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[1] Under some conditions, the modeling approach used here, known as a marginal analysis, will not necessarily produce the optimum solution. However, under conditions of a pseudoconcave objective and a single, linear budget constraint such as is used here, marginal analysis will lead to the optimal answer (Hillestad, 2006).

Attack Scenarios

We examined 17 terrorist attack scenarios in this analysis. These scenarios are summarized in Table 3.1. The scenarios were drawn from analysis of past terrorist attacks at shopping centers and elsewhere (see Chapter Two) as well as discussions with shopping center operators and security contractors about particular concerns and vulnerabilities.

Table 3.1
Terrorist Attack Scenarios

ID	Scenario Name	Description
1	Sniper	Sniper on center roof, neighboring building, or other vantage point shooting victims in parking lot, at exits, or in open mall.[b]
2	Commando attack—outsider	Coordinated gunfire attack by small team intended to kill many.[a,b]
3	Commando attack—insider	Commando attack led or assisted by tenant or contractor. Guns brought in off-hours and stored.[b]
4	Hostage taking—outsider	Armed commando team takes hostages. Effectively suicide because terrorists die in stand-off.[a,b]
5	Hostage taking—insider	Hostage taking led or assisted by tenant or contractor. Weapons brought in off-hours and stored.[b]
6	Placed bomb—outsider	Uses explosive packed (e.g., with nails) in a bag left in crowded area.[b]
7	Placed bomb (hidden)—insider	Placed bomb led or assisted by tenant or contractor. Bomb brought in off-hours and hidden.[b]
8	Pedestrian suicide bomber	Uses explosive vest in crowded shopping center.[a,b]
9	Vehicle bomb outside	Vehicle bomb detonated at outside wall. Could be from street, surface parking or roadways, or attached parking structure.
10	Car bomb in mall—crash in from street	Vehicle drives into entrance or common area.[a,b]
11	Car bomb in underground parking—sneak in	Applies to parking underground or under overhang.
12	Suicide car bomb in underground parking—crash entrance	Applies to parking underground or under overhang.[a]
13	Truck bomb in loading dock—sneak in	Below or above shopping center.
14	Suicide truck bomb in loading dock—crash entrance	Below or above shopping center.[a]
15	Anthrax release from unattended device—outsider	Anthrax released into air inside indoor center.[b]
16	Anthrax release from unattended device—insider	Anthrax release led or assisted by tenant or contractor. Device brought in off-hours and hidden.[b]
17	Chemical release from cart/kiosk	Sarin released by insider from carts or kiosks in indoor center. Materials enter via loading dock.[b]

[a] Includes willingness to "crash" checkpoints.

[b] Assumes that parking lot is not used, so parking security has no effect.

Scenarios fall into three general categories based on the weapons used: firearms, explosives, and chemical or biological. The scenario set includes the most common terrorist attack modes, as well as several modes that are less commonly employed or that have never occurred. Although it is impossible to predict with any certainty how a terrorist strike may occur, the selected set is intended to span the range of attack types of general concern and the range of vulnerabilities present in commercial shopping centers.

Scenario Likelihoods

The first major component of risk is event likelihood. The more likely an event is, the more often it will occur over the long term. Scenarios with higher likelihoods will therefore occur more often and have higher overall losses. Because risk represents an estimate of expected loss, higher likelihood translates into higher risk.

We treated the overall terrorist threat to shopping centers as uniform at all centers. In reality, exogenous factors may cause the threat to be higher at particular centers. However, such factors are elusive and often evolve with time, so our analysis did not take into account differences in scenario likelihoods stemming from different threat environments that may exist among the three centers. Where necessary, however, we excluded particular scenarios at a specific center if the physical design of that center made the particular scenarios impossible (e.g., a car bomb in an underground parking lot is not an option in a center with no underground parking). As noted above, we restricted our estimates to relative likelihoods, or the likelihood of a particular scenario occurring relative to the likelihoods of other scenarios.

The relative likelihood assigned to each scenario was estimated based on our analyses of the frequency of use of different weapons in past terrorist attacks at shopping centers (see Table 2.1). Likelihoods for 10 of the 17 scenarios were taken directly from these historical frequency data (the relative frequency of firearms attacks from Table 2.1 was applied to the commando attack). From these data, for example, we estimated that a terrorist attack at a shopping center is most likely to involve a placed bomb. Likelihoods for the remaining scenarios were estimated in two ways. First, likelihoods for attacks perpetrated by an insider (i.e., tenant employees, contractors, and delivery people) were assumed to be one-tenth the likelihood of the same attack being perpetrated by an outsider. Second, likelihoods for three scenarios were estimated based on the frequencies for similar scenarios for which we had likelihoods estimates: The hostage taking was assigned the same likelihood as the commando attack, the sniper attack was assigned a likelihood 2.5 times greater than that of the commando attack, and the suicide truck bomb likelihood was estimated from the nonsuicide truck bomb frequency multiplied by the ratio of suicide and nonsuicide car bomb frequencies (10).

Relative likelihood values for each scenario are listed in Table 3.2. The values listed in Table 3.2 are normalized to the likelihood of the scenario with the greatest likelihood (*placed bomb—outsider*). Values are normalized to a 0–1 scale so that they will be equally weighted with consequences in the risk calculations.

Table 3.2
Scenario Relative Likelihoods

ID	Scenario	Base Case Normalized Likelihood
6	Placed bomb—Outsider	1
8	Pedestrian suicide bomber	0.2
7	Placed bomb (hidden)—Insider	0.1
9	Vehicle bomb outside	0.07
11	Car bomb in underground parking—sneak in	0.07
1	Sniper	0.05
2	Commando attack—outsider	0.02
4	Hostage taking—outsider	0.02
10	Car bomb in mall—crash in from street	0.007
12	Suicide car bomb in underground parking—crash entrance	0.007
17	Chemical release from cart/kiosk	0.004
3	Commando attack—insider	0.002
5	Hostage taking—insider	0.002
13	Truck bomb in loading dock—sneak in	0.002
15	Anthrax release from unattended device—outsider	0.002
14	Suicide truck bomb in loading dock—crash entrance	0.0002
16	Anthrax release from unattended device—insider	0.0002

Because attack likelihoods are so poorly understood, they are the most uncertain parameters in our analysis. We examined the sensitivity of our findings to this uncertainty in two ways. In the first, we developed three likelihood profiles that reflect different basic assumptions about terrorist intentions and capabilities. These profiles are summarized in Table 3.3. The profiles differ in the assumptions made about two factors. The first is the likelihood of attacks involving terrorist suicide relative to the likelihood of a similar type of attack not involving suicide (e.g., a car bomb in an unoccupied car compared with a suicide car bomb). The second is the likelihood of attacks being led or assisted by insiders relative to the likelihood of the same type of attack being conducted by outsiders. Distinguishing characteristics for all three profiles are presented in Table 3.3.

The profiles in Table 3.3 entail scaling the likelihoods of groups of scenarios up or down uniformly. It is also informative to explore how the rankings of security option selected by the model respond to independent changes in the likelihoods of individual scenarios. Different security options are effective against different scenarios, so the ranking of options is expected to be sensitive to large changes in likelihoods. We therefore conducted a second analysis to determine how much the likelihoods can be varied before the option rankings begin to change significantly. This analysis, which is described below, shows that likelihoods can be varied

Table 3.3
Likelihood Profiles for Terrorist Attack Scenarios

Likelihood Profile	Distinguishing Characteristics
Base case	Nonsuicide likelihood = 10x suicide likelihood Outsider likelihood = 10x insider likelihood
High suicide	Nonsuicide likelihood = suicide likelihood
High insider	Outsider likelihood = insider likelihood

independently by as much as a factor of 10 before the rankings of security options begin to change.

Scenario Consequences

The second major component of risk is event consequence. Because risk is a measure of expected loss, the greater the consequences of an event, the greater its risk. As discussed in Chapter Two, there are several types of potential consequences of terrorist attacks, including casualties, property damage, business interruption, liability, and indirect economic impacts. However, as also mentioned in Chapter Two, most of these consequences are difficult to estimate, particularly given that casualties are generally the only consequence metric recorded in historical terrorism data. For this analysis, we have modeled terrorist attack consequences in terms of two components: fatality count, which is intended to reflect the human loss component, and the amount of time a center would be shut down after an attack, which is intended to reflect the economic loss component of terrorist attacks. Because our analysis examines relative likelihoods and, therefore, relative risks, including separate estimates of well-correlated components does not help distinguish the relative risks of different scenarios and thus adds no value to the analysis.

Fatalities. The numbers of injuries and fatalities in terrorist attacks are very sensitive to details such as the relative locations of weapons, structures, and victims; the population density in the affected area; and structural characteristics of any buildings involved. Our scenarios do not stipulate this level of detail, and we have not attempted to tailor fatality estimates precisely to the multitude of possible outcomes of a given scenario. Rather, fatalities for each scenario were estimated from the historical fatality data for terrorist attacks on shopping centers using associated weapon types (see Chapter Two).

The average number of fatalities resulting from attacks using a particular weapon was assumed to reflect the most likely outcome of that type of attack and thus the appropriate value to use in our risk modeling. Where available, fatality estimates were taken directly from historical averages for shopping center incidents in Table 2.2: The value for *placed bombs* was taken from *explosives (nonsuicide)*, the value for *pedestrian suicide bomber* was taken from *explosives (suicide)*, the value for *vehicle bomb outside* was taken from *car bomb (nonsuicide)*, and the value for gunfire attacks (scenarios 1–5) was taken from *firearms*. Based on the data for all incidents, the value for the *truck bomb in loading* scenarios was taken from *truck bomb* and the value for *car bomb in mall—crash in from street* was taken to be 10 times the value for *vehicle bomb outside*. The value for the *car bomb in parking* scenarios was assumed to be the same as for *vehicle bomb outside*. Note that, for a vehicle bomb in an underground parking lot or loading dock, there is no obvious reason that a suicide attack would lead to more fatalities than would

a nonsuicide attack, so the fatality values for suicide and nonsuicide attacks are the same. Finally, fatality values used for biological and chemical weapons are 10 times higher than those observed in the historical data for all incidents in order to reflect potential improvements in terrorist capabilities with these weapons. Note that, despite using higher fatality estimates, the likelihoods of chemical and biological attacks are sufficiently low that they have negligible influence on the overall risk.

Normalized fatality values for each scenario are listed in Table 3.4. The values in Table 3.4 are normalized to the number of fatalities of the scenario with the greatest number of fatalities (*suicide truck bomb in loading dock—crash entrance*). Values are normalized to a 0–1 scale so that they will be equally weighted with likelihoods in the risk calculations.

Downtime. Downtime is a measure of the time that part or all of a shopping center would remain closed following a terrorist attack. Very few data reporting closure durations or property damage are available for past terrorist attacks. Consequently, we developed a fairly coarse

Table 3.4
Scenario Consequences

ID	Scenario	Normalized Fatalities	Downtime	Net Consequence[a]
1	Sniper	0.04	0.25	0.145
2	Commando attack—outsider	0.04	0.5	0.27
3	Commando attack—insider	0.04	0.5	0.27
4	Hostage taking—outsider	0.04	0.75	0.395
5	Hostage taking—insider	0.04	0.75	0.395
6	Placed bomb—outsider	0.04	0.5	0.27
7	Placed bomb (hidden)—insider	0.04	0.5	0.27
8	Pedestrian suicide bomber	0.166	0.5	0.333
9	Vehicle bomb outside	0.1	0.75	0.425
10	Car bomb in mall—crash in from street	1	0.75	0.875
11	Car bomb in underground parking—sneak in	0.1	0.75	0.425
12	Suicide car bomb in underground parking—crash entrance	0.1	0.75	0.425
13	Truck bomb in loading dock—sneak in	0.34	0.75	0.545
14	Suicide truck bomb in loading dock—crash entrance	0.34	0.75	0.545
15	Anthrax release from unattended device—outsider	0.2	1	0.6
16	Anthrax release from unattended device—insider	0.2	1	0.6
17	Chemical release from cart/kiosk	0.06	0.75	0.405

[a] Consequence = $(0.5 \times \text{fatalities}) + (0.5 \times \text{downtime})$.

five-point scale that attempts to account for such activities as clean-up, investigation, reconstruction, and decontamination (Table 3.5). In contrast to high-rise office buildings, shopping centers generally have very low height-to-footprint ratios, making total structural collapse highly unlikely. Thus, it would be very difficult for even a very large explosion to result in an entire center remaining shut down for an extended period. Given the uncertainties regarding decontamination methods and standards, an anthrax attack may require a particularly long downtime. Downtime values used in our analysis are listed in Table 3.5.

Net Consequences. Our base case analysis uses an equal weighting of casualties and downtime to compute the overall consequences for each scenario:

$$\text{consequences} = (0.5 \times \text{fatalities}) + (0.5 \times \text{downtime}).$$

An equal weighting is used because we find no a priori justification for alternate weighting schemes. One major impediment to devising a more sophisticated weighting approach is that it is difficult to compare the value of a casualty loss with that of loss from property closure or damage. In principle, casualty losses can be converted into dollars using estimates of insurance coverage, lost productivity, or other estimates of the statistical value of a life. However, such conversions are controversial and, given the lack of precision in our fatality and downtime estimates, not warranted in this analysis. We have examined the effect of alternate weightings in our sensitivity analysis (see below) and find that option rankings are quite insensitive to consequence weighting factors. Table 3.4 lists net consequences for each scenario.

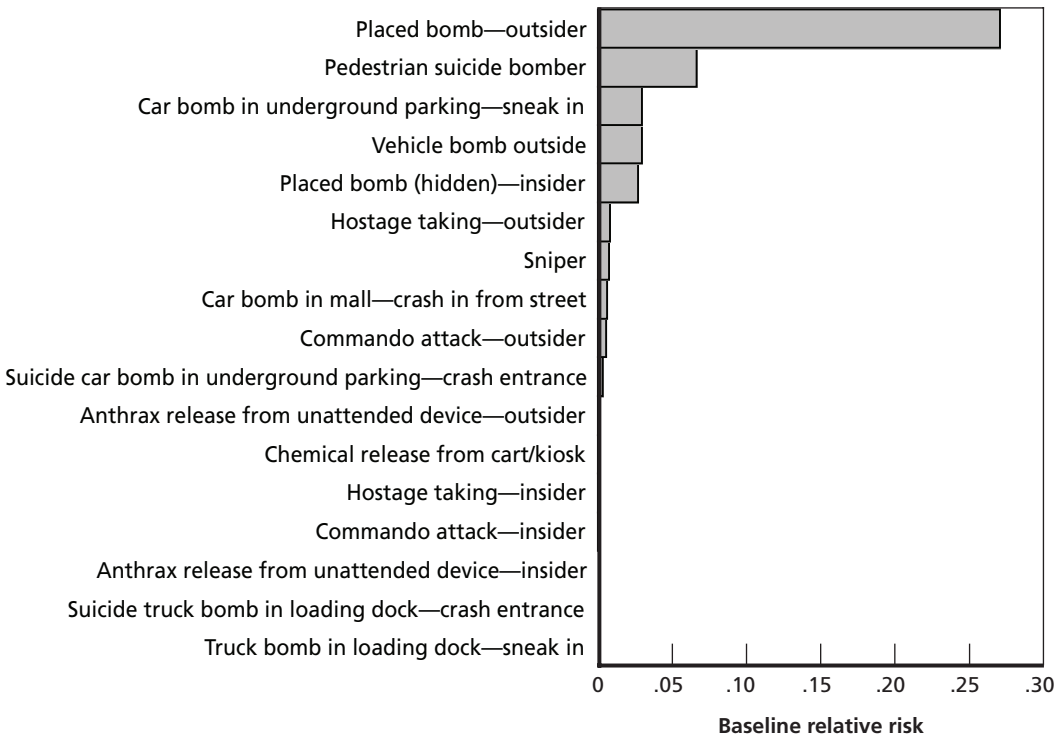
Baseline Relative Risk Estimates

Using these inputs, the baseline relative risk values for each scenario calculated from Equation 3.1 (where no security options are implemented and so *Dt*, *Dn*, and *Mt* are each zero) are shown in Figure 3.2. This figure illustrates that placed bombs dominate the overall risk, primarily because the likelihood of this type of attack is so much higher than for any other scenario (see Table 3.2).

Table 3.5
Downtime Scale

Downtime Value	Complete Mall (Days)	Partial Mall (Days)
1	> 7	> 7
0.75	1–7	> 7
0.5	1	1–7
0.25	1	1
0	0	0

Figure 3.2
Baseline Relative Risk for Scenarios



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Security Options

We have examined the effectiveness of 39 security options in our analysis. Several criteria were used to arrive at the final set of security options included. Many options were chosen based on established and emerging security approaches used in other environments (e.g., airports; see Stevens et al., 2004). Options were also designed in response to consultation with mall operators and security contractors. Finally, some options were selected or tailored to address particular vulnerabilities to the various scenarios that exist in a shopping center operational environment. For example, to cover insider and outsider threats separately, customer entrance checkpoint options are divided into two sets—one for the hours during which the center is open to the public (when outsiders have access) and another for the hours during which it is closed to the public (when only insiders have access).

The options considered target individual facilities—our modeling focuses on deterring, denying, or mitigating terrorist attacks at a given center and does not consider implications for other centers within a company or across the industry. For example, a security option that causes a potential terrorist to choose a different target is considered entirely effective because it has deterred an attack at the center of interest.

The options we consider in our modeling cover operations, technology, staffing, and management, but exclude major design and construction issues. Although property development and redevelopment are important aspects of the shopping center industry, design and construction go beyond the scope of our analysis and our expertise. Several government agencies have developed guidance in this area and we include in Chapter Four a brief summary of this topic.

The security options we used in our analysis are listed in Table 3.6. For each option, we include a brief explanation, along with the options with which it is mutually exclusive. Mutual exclusivity occurs when options provide essentially redundant capabilities (e.g., explosives detectors and explosives dogs) or when one option includes another (e.g., customer entrance checkpoints include security personnel and so are mutually exclusive with security guards at entrances).

Table 3.6
Security Options

Option Category	Op ID	Option	Explanation	Mutually Exclusive Options
Communication and Education	1	Employee threat ID training	Periodic training seminars for staff (center, permanent contractor, tenant) to help understand and identify threats such as suspicious packages or possible suicide bombers.	
	2	Suspicious package reporting	Public information campaign consisting of signs around center reminding people to be on the lookout for suspicious packages.	
Emergency Response	3	Emergency response teams	Subset of tenant staff trained and exercised to help with emergency response (evacuation and assistance).	
Employee Management	4	Employee background checks	Basic check on center staff, contractors, and tenant employees: criminal, credit, driving.	
	5	Photo ID badge for contractors and delivery	Registration and identification for all temporary contractors and delivery staff.	

Table 3.6—Continued

Option Category	Op ID	Option	Explanation	Mutually Exclusive Options
Customer Entrance Management	6	Search bags and remove coats at entrances, open hours	Manual search of bags, including shopping bags, and temporary removal of coats for all people entering customer entrances during business hours.	7, 8, 12
	7	Mandatory coat and bag check, open hours	All bags and coats taken and stored while shopping.	6, 8, 12
	8	Metal detectors and search bags at entrances, open hours	Walk-through metal detectors plus search bags and remove coats for all people entering.	6, 7, 12
	9	Millimeter wave cameras at entrances, open hours	Walk-through gun and bomb detector—searches people only (not bags).	12
	10	Trace detector portals at entrances, open hours	Walk-through trace explosive detectors—searches people and bags.	11, 12
	11	Dogs at entrances, open hours	Two teams of a bomb dog plus handler at each entrance. Teams alternate 20 minutes on, 20 minutes off.	10, 12
	12	Security guard at entrances, open hours	Security guard posted at each entrance.	6, 7, 8, 9, 10, 11
	13	Search bags and remove coats at entrances, closed hours	Same as 6, but for employees and contractors entering during off-hours.	14, 15, 19
	14	Mandatory coat and bag check, closed hours	Same as 7, but for employees and contractors entering during off-hours.	13, 15, 19
	15	Metal detectors and search bags at entrances, closed hours	Same as 8, but for employees and contractors entering during off-hours.	13, 14, 19
	16	Millimeter wave cameras at entrances, closed hours	Same as 9, but for employees and contractors entering during off-hours.	19
	17	Trace detector portals at entrances, closed hours	Same as 10, but for employees and contractors entering during off-hours.	18, 19
	18	Dogs at entrances, closed hours	Same as 11, but for employees and contractors entering during off-hours.	17, 19
	19	Security guard at entrances, closed hours	Same as 12, but for employees and contractors entering during off-hours.	13, 14, 15, 16, 17, 18

Table 3.6—Continued

Option Category	Op ID	Option	Explanation	Mutually Exclusive Options
Building Management	20	Control access to service areas	Limit access to service halls, loading, utilities, roofs, and the like to authorized employees.	
	21	Search carts/kiosks daily	Quick (< 5 min) search for guns, bombs, chemical agents, and such each morning.	
	22	Security with 100-percent visual coverage of common area	Triple current number of security guards on site (see Table B.2).	23
	23	Armed security with 100-percent visual coverage of common area	Arm and triple current number of security guards on site (see Table B.2).	22
	24	Police substation in center	Small police station with 1–2 officers; includes patrol.	
	25	More clearly label exits	Signage to label paths to exits more clearly.	
Vehicle Management	26	Vehicle inspection at parking, open hours	Manually search cars for bombs at parking entrance.	27, 30
	27	Vehicle inspection and hydraulic bollards at parking, open hours	Search parking cars for bombs and prevent detected (suicide) bombs from entering lot.	26, 30
	28	Loading dock access control	Limit access to loading area to authorized vehicles.	29
	29	Loading dock access control and hydraulic bollards	Limit access to authorized vehicles and prevent detected (suicide) bombs from entering dock.	28
	30	Increase building stand-off distance with bollard fence	Maintain 100-foot distance between building and parking or roadways and limit access with bollards.	26, 27, 31
	31	Bollards at pedestrian entrances	Bollards to block suicide car bombers from entering pedestrian entrances.	30
	32	Dogs at parking and loading, open/delivery hours	Same as 11 but for parking and loading entrances.	33
	33	Explosive detectors at parking/loading, open/delivery hours	Explosives detection portal at parking and loading entrances.	32

Table 3.6—Continued

Option Category	Op ID	Option	Explanation	Mutually Exclusive Options
Chemical-Biological	34	Air filters	High-efficiency filters to remove anthrax from common area air system in first pass.	36
	35	Anthrax detectors	Real-time anthrax spore detector with alarm.	36, 39
	36	Anthrax detectors and filters	Filters and alarm.	34, 35, 39
	37	Chemical detectors	Real-time chemical agent detector with alarm.	38, 39
	38	Chemical detector and individual protection	Real-time chemical agent detector with alarm plus stock of quick masks.	37, 39
	39	Anthrax and chemical detector and auto-response HVAC	Real-time detector with alarm and that diverts air flow away from people.	35, 36, 37, 38

Option Effectiveness

Each option was assigned values for its effectiveness at deterring, denying, and mitigating each of the 17 scenarios. In some cases, the distinctions between deter, deny, and mitigate can be ambiguous. For clarity, we use the following definitions in apportioning effectiveness between deter, deny, and mitigate:

- An attack scenario is deterred if no attempt is made at the facility. Examples of deterrence include background checks, checkpoints, and security patrols.
- An attack scenario is denied if an attack attempt is not successful, where attack success is defined for different scenario types as follows: for firearms, at least one shot is fired in the intended location; for explosives, the explosive is detonated where intended; for chemical or biological weapons, the agent is released. Examples of denial include checkpoints, bollards, and threat awareness training.
- An attack scenario is mitigated if the consequences of a successful attack are reduced. Examples of mitigation include emergency response, security patrols, and chemical and biological agent detectors.[2]

Note that many options are effective in more than one of these three categories.

[2] One consequence of these definitions is that we do not completely account for a suicide attacker's adaptability. Though we account for the possibility that a suicide attacker may successfully crash a checkpoint (e.g., a suicide car bomber may be able to drive through a checkpoint), our definitions do not account for the possibility that a bomber may detonate an explosive at a checkpoint. This is because a checkpoint is not the intended detonation location in any scenario and thus detonation at a checkpoint is not considered a successful attack. Though suicide bombers have detonated at checkpoints in the past, such an outcome is expected to be very unlikely in a commercial shopping center setting because terrorists would be expected to conduct substantial planning and surveillance and therefore would avoid situations in which they would need to force their way through a checkpoint; shopping centers generally allow unimpeded access and so a terrorist would likely chose an alternative location or method of attack if faced with enhanced security.

Effectiveness values vary between 0 and 1, with 0 indicating no effectiveness and 1 indicating complete effectiveness (and therefore zero risk; see Equation 3.1). General criteria used to judge effectiveness are shown in Table 3.7.

Effectiveness values estimates were informed by multiple factors, including the effectiveness of technologies, theories of deterrence and situational crime prevention (Clarke, 1983; Shapland, 1995), research on the effect of environmental modifications on workplace violence (Mair and Mair, 2003), and research discussing prior terrorist attacks (Lesser et al., 1999; Jackson et al., 2005b). In many cases, a security option's effectiveness was uncertain and analytical judgment was employed.

Estimates of the effectiveness of the different options were made in the context of two important aspects of terrorism risk in commercial shopping centers. First, shopping centers are numerous, are largely interchangeable in terms of their attractiveness as targets, and generally allow unimpeded access. Stated differently, the opportunities for terrorist attacks in shopping centers are ubiquitous. Second, terrorists are expected to conduct substantial planning and surveillance and will try to avoid situations in which they may get caught.

As a consequence of these aspects, reducing terrorism risk in commercial shopping centers hinges strongly on deterrence. Strong denial effectiveness is less important than in nominally higher-security environments (e.g., federal government buildings) because deterrence is more effective in sending a terrorist planning to attack a shopping center to an alternate center (or comparable soft target) than in sending a terrorist planning to attack a federal building to an alternate federal building. Mitigation, or reducing consequences of a successful attack, is even less effective, primarily because the majority of terrorism risk comes from explosive attacks (see Figure 3.2). Outcomes of large terrorist bombings indicate that the chances for saving lives after a terrorist bombing are minimal. In an analysis of 29 terrorist bombings that produced 30 or more casualties, Arnold et al. (2004) found that 94 percent of the fatalities in these events occurred immediately at the site or in transport to a hospital. If rapid medical attention were

Table 3.7
Effectiveness Criteria

Meaning of Value	Deterrence Effectiveness (Dt)	Denial Effectiveness (Dn)	Mitigation Effectiveness (Mt)
0	Attempts are as likely as at any other similar target.	No attempts are impeded in any way.	No mitigation occurs beyond what would happen in any emergency (e.g., call an ambulance)
1	Deterrence so great that no attempts are made because other similar targets are much easier.	All attempts completely foiled; attempt may be apparent, but no loss occurs.	Attack succeeds but no loss occurs. Note that we assume no mitigation value for options that prevent attack as planned (e.g., for car crashing into mall, bollards deter and deny attack but do not mitigate because bombing at bollards is not considered a success).

an important factor in saving people with life-threatening injuries, we might expect a higher fraction to survive longer before dying.

An implication of the high value of deterrence for our modeling is that the perceptual deterrence effectiveness of any option is always greater than the denial effectiveness of that option.[3] The threshold for deterrence might increase if terrorism security were widely implemented at soft targets. In this situation, terrorists would have no easy alternatives and might attempt attacks that they would not have attempted if less secure targets were available. Under such conditions, the deterrence effectiveness values used in this analysis might need to be raised to reflect this new environment. However, the United States is currently far from these conditions.

Effectiveness values are listed in Table B.1 in Appendix B. A single set of effectiveness values was used for all three shopping centers examined in this study. While the centers differ in important ways, these differences are accounted for in our analysis by including or excluding particular scenarios and security options in our modeling (e.g., outdoor centers have no common area air system and so air filters cannot be used).[4]

Option Costs

Security option costs were estimated in terms of a total annual cost, regardless of which stakeholder (e.g., center owner, tenants, employees) would ultimately bear that cost. In particular, as noted above, we assume that implementation of security options includes anchor tenant facilities.

Costs comprise primarily labor and equipment. Other cost elements include staff time (for training), lost rental income (from rental space used for security purposes), and minimal construction, installation, and maintenance requirements. We do not include the effects of economic inflation or depreciation in our estimates.

Equipment costs were estimated from quotes from vendors. In general, equipment costs were amortized over 10 years. Most commercial shopping centers undergo significant redevelopment about this often, at which point equipment may be replaced or upgraded. The service life of a few items (e.g., escape hoods) is less than 10 years, and, in such cases, an appropriately smaller value was used.

Labor costs are estimated based on an average security staff salary of $10 per hour (U.S. Bureau of Labor Statistics, 2005); higher values were used for some positions requiring special training (equipment operators and dog handlers).

Brief explanations of the cost elements for each option are listed in Table B.2 in Appendix B. Annual costs for the security options at each of the three centers we examined are listed in Table B.3. Costs are more center-specific than any other variable because they depend

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[3] This holds for security options of which terrorists are aware. Therefore, it behooves a shopping center to make visible as many security efforts as possible.

[4] Our effectiveness estimates also assume that anchor tenants participate fully in all options. Anchor tenants in shopping centers often own their own land and building, operate their own loading docks and service areas, have their own security staff, and control street entrances. Any option that affects a system in which an anchor tenant may own or operate separate components is assumed to be implemented at both non–anchor- and anchor-operated components.

on the number and size of elements of a system. For example, the cost of security checkpoints at customer entrances depends on the number of entrances.

Collateral Benefits and Detriments of Security Options

The security options analyzed in this study were chosen for their ability to reduce the risk of specific terrorist scenarios. However, the options also have some important collateral benefits and detriments. Some of the options have collateral benefits in terms of their effect on other security concerns. On the other hand, several of the options are likely to have a negative impact on the conventional shopping center operational environment, such as impeding customer access.

The impacts of such collateral effects may be important considerations in security decisions. However, these impacts are very difficult to characterize because they may include both logistical (e.g., time lost waiting at a security checkpoint) and psychological (e.g., concern about the risks of terrorism in shopping centers) aspects. Consequently, we did not include quantitative estimates of collateral effects in our risk modeling. Rather, we present a simple qualitative tabulation of collateral benefits and detriments associated with each security option that accompanies the prioritized list of options.

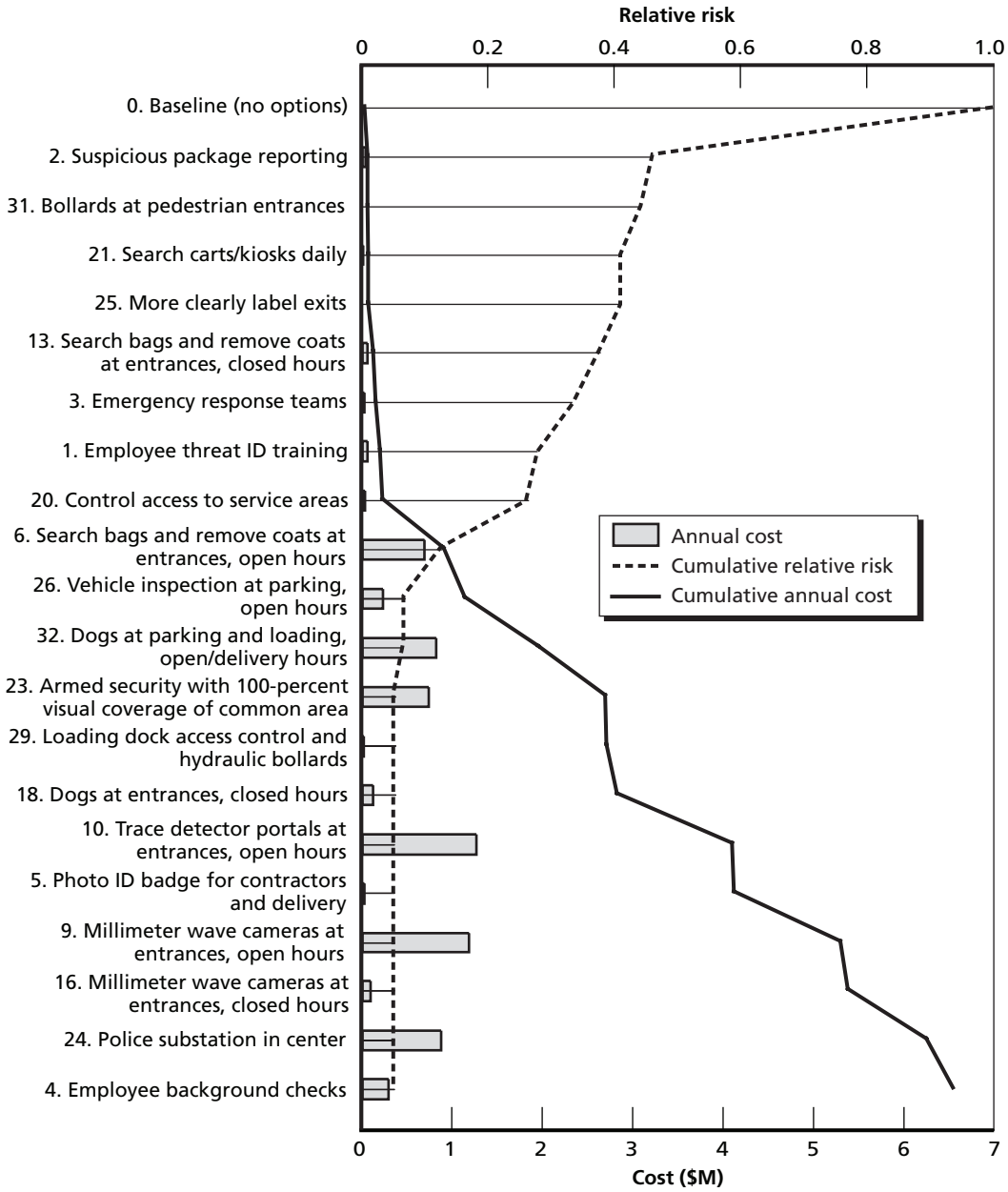
Each option was assessed for collateral impact in five categories. Non–terrorism-related security benefits include aiding loss prevention and reducing workplace violence. Operational detriments include impeding customer access, inconveniencing employees, and negative psychological impacts. The assessment simply indicates in which benefit and detriment categories each option is judged to have an impact—we made no attempt to assess the magnitude of the impact of any option in any category. Collateral impact assessments for each option are shown in Figure B.1. The Modeling Results section presents collateral impact assessments associated with each of the prioritized security options for each center.

Modeling Results

Our analytical model generates a prioritized list of security options, the cumulative reduction in risk as each option is added, and the cumulative annual cost as each option is added. The results for the three centers we examined in this study are displayed in Figures 3.3–3.5.[5] Each figure shows the prioritized list of selected security options, with the priority decreasing from top to bottom. The figures also show the cost for each security option, the cumulative cost of the options up to any point in the list, and the cumulative relative risk at any point achieved by implementing the options up to that point in the list. These results are also listed in tabular form in Tables B.4–B.6.

[5] The characteristics of each center are described in Chapter One.

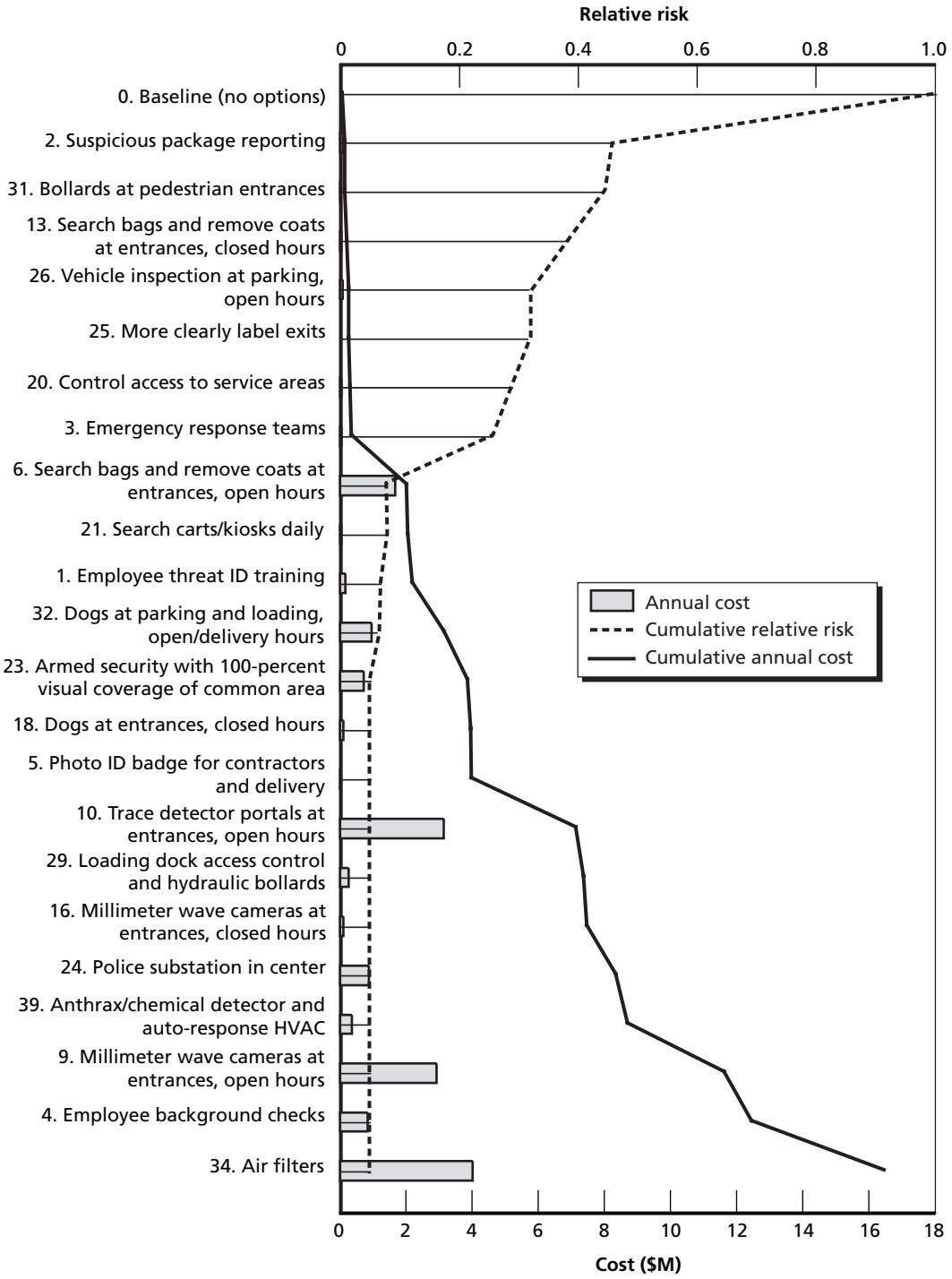
Figure 3.3
Prioritized Security Options for Center A



NOTES: Chemical and biological weapon scenarios (scenarios 15–17) and options that apply to chemical and biological weapons only (options 34–39) are excluded from this analysis because Center A is outdoors. Loading dock access control (option 28) is excluded from this analysis because this option is already implemented at Center A. Increase building standoff distance with bollard fence (option 30) is excluded from this analysis because there is no space for a standoff zone at Center A.

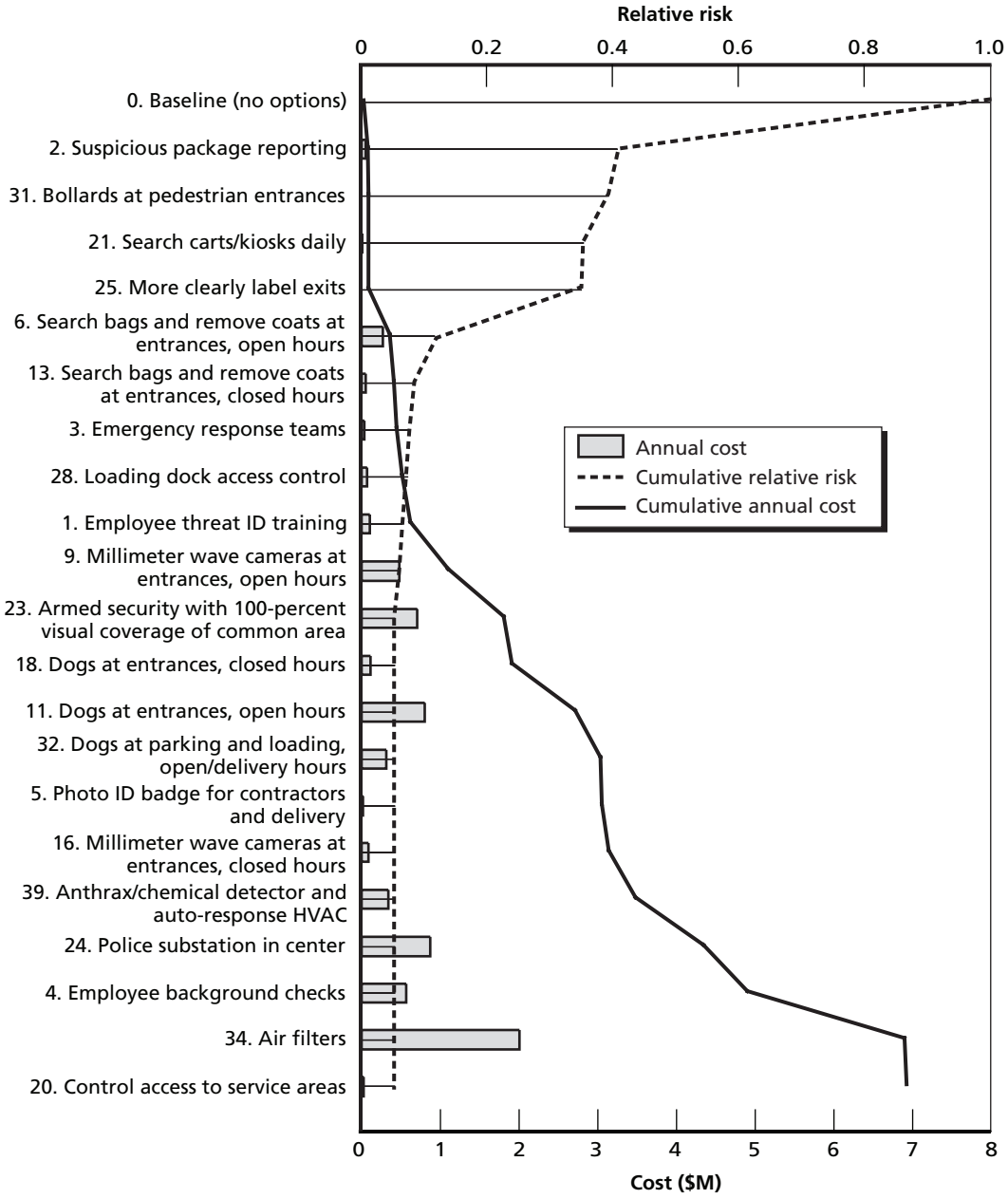
RAND *TR401-3.3*

Figure 3.4
Prioritized Security Options for Center B



RAND *TR401-3.4*

Figure 3.5
Prioritized Security Options for Center C



NOTES: Car bomb in underground parking scenarios (scenarios 11 and 12) and options that apply to these scenarios only (options 26 and 27) are excluded from this analysis because Center C has no underground parking. Increase building standoff distance with bollard fence (option 30) is excluded from this analysis because there is no space for a standoff zone at Center C.

RAND *TR401-3.5*

General Findings

The modeling results for the different centers share several common characteristics that reflect some important general conclusions about terrorism security at commercial shopping centers that can be drawn from our analysis. These conclusions are listed below and summarized in Table 3.8.

- Based on our model and assumptions, implementing security options can substantially decrease the terrorism risk at a shopping center: We find that if all the security options considered in this study were implemented, the risk of terrorism could be reduced by a factor of 20.
- The prioritization of security options is similar for the different centers. Eight of the top 10 options for each of the three centers are the same, and few options are shifted by more than two positions among the three centers. This result is discussed further below.
- The prioritization of security options is strongly driven by the risk of bomb attacks. Because bomb attacks dominate the overall terrorism risk, the model selectively chooses options that address bomb attacks.
- Most of the risk reduction occurs with the highest priority options. The cumulative risk drops steeply with the initial options, then decreases more gradually as additional options are added. We find that 95 percent of the total reduction achievable with all options is provided by the first six to ten options (the high-priority set).
- Most risk reduction occurs with less expensive options; the average cost of each of the options in the high-priority set is 20–35 percent of the average cost of all the options. This result is discussed further below.
- The high-priority set of security options spans a diverse range of approaches; the high-priority set of options include entries from five of the seven option categories listed in Table 3.6.

Differences Between Centers

As noted above, the prioritized list of security options is similar for the different centers examined. This reflects the fact that the analyses for each center are based on the same set of scenarios and security options and that the same security option effectiveness values were used for each center. Security option costs differ substantially between centers, but most costs correlate

Table 3.8
Summary of Key General Results

Result	Value
Risk reduction with all options	Factor of 20
Number of options needed to reach 95% of total risk reduction (high-priority set)	6–10
Average cost of each option in high-priority set/average cost of all options	20–35%
Number of option categories represented in high-priority set	5 of 7

with center size, so option costs tend to scale uniformly between centers and thus have little effect on the relative priority of different options.

The differences in option priorities among the three shopping centers stems mainly from the inclusion or exclusion of particular scenarios or options that are unique to these centers. For example, Center A is an outdoor center for which dispersal of biological or chemical agents is ineffective. Scenarios 15–17 (anthrax or chemical release) and options 34–39 (air filters and anthrax and chemical detectors) (see Tables 3.1 and 3.6, respectively) are therefore excluded from the prioritization analysis for Center A.

Costs and Effectiveness of Prioritized Security Options

The annual costs of the candidate security options range from $550 for option 25 (*more clearly label exits*) at Center C to nearly $5 million for option 11 (*dogs at entrances, open hours*) at Center B. The model algorithm prioritizes the security options according to their cost-effectiveness. Since costs do not necessarily correlate with effectiveness, the model preferentially selects the less expensive, more effective options. Consequently, the average cost of each option in the high-priority set is only 20–35 percent of the average cost of all the options. The total annual cost of the high-priority set of options is $1.1 million at Center A, $2.0 million at Center B, and $0.4 million at Center C. For comparison, typical annual common area maintenance costs are $15 to $20 per square foot (Field and Bodamer, 2005), or $15 million to $20 million per year for a 1 million–square-foot center.

The most cost-effective option at all three centers is *suspicious package reporting* (option 2). Its value stems from the ability to take advantage relatively easily of the surveillance capability of the large number of customers in a shopping center. As with most other options, the greatest strength of this option is as a deterrent—if a terrorist group knows that an unattended bag or package will be reported swiftly, it will choose another target or choose another method to attack the same target.

Note that the model does not necessarily select options in the order of their individual cost-effectiveness. This is because the model algorithm recalculates the overall risk after each selected option is implemented and then selects the option that is most cost-effective at reducing the risk from that point. Previously selected options will have already reduced some of the risk for various scenarios, which could potentially decrease or even nullify the incremental effectiveness of a remaining option. In other words, the cost-effectiveness of any option depends on which options have already been implemented.

In terms of pure effectiveness (i.e., setting aside cost considerations), the most effective options entail security screening at customer entrances—*dogs at entrances, open hours* (option 11), *search bags, open hours* (option 6), *mandatory coat and bag check, open hours* (option 7), *metal detectors and search bags, open hours* (option 8), and *trace detector portals at entrances, open hours* (option 10). Note that some options in this group are mutually exclusive. Security screening at customer entrances is the most effective approach because it is very good at preventing bomb attacks, which constitute the majority of the terrorism risk (see Figure 3.2). However, security screening is also an expensive approach, because it requires staff and, in some cases, equipment at every entrance. Because of their high cost, the highest any of these options rank in the three centers is fifth.

Collateral Impacts of Security Options

Figures 3.6–3.8 show the qualitative collateral impacts for the prioritized security options at each center. In general, cumulative collateral impacts (either negative or positive) do not correlate with the prioritized rank of the security options. Although these collateral impacts are not considered when the model prioritizes the security options, they may be helpful for decisions about which options to implement or about the details of how an option is implemented.

Screening checkpoints, in particular, could have strong negative collateral impacts if they cause people to wait in line to enter a shopping center or parking lot. We have examined the effect of screening checkpoints on line formation by using a simple queuing theory model. The queuing model calculates the wait time at a checkpoint as function of the arrival rate of people or cars and the number of security checkpoints in operation.

Analyses were conducted for a manual search of bags at customer entrances and for a manual search of vehicles entering a parking garage. Search times were assumed to be 30 seconds per bag at customer entrances (and we assume that half the people entering have bags that require searching) and 1 minute per vehicle. Arrival rates (30 people per minute and 17 cars per minute) are based on daily average rates for Center A during peak customer traffic times (mid-December). Peak arrival rates during the busiest part of the day could be as much as double the daily average rate. On the other hand, arrival rates at slower times of year could be less than half the rates in December. These two effects will tend to offset each other, so the rates we examine approximate typical values for this center. Results are shown in Figure 3.9 and 3.10.

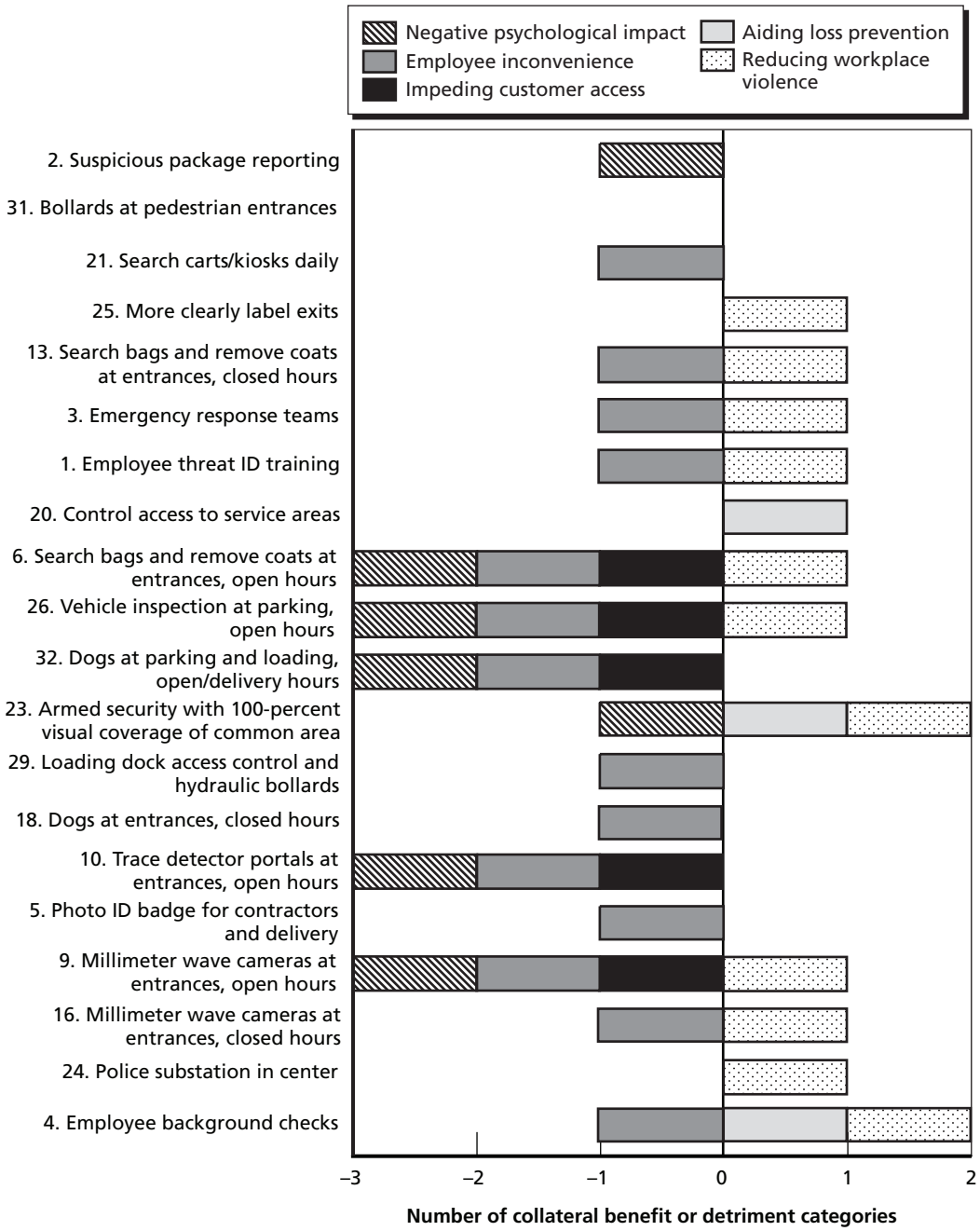
The lowest value shown for the number of servers in each figure (eight for customer entrances and 18 for vehicle entrances) is the minimum number of checkpoints needed to prevent the line from growing to infinite length. The results show that nine checkpoints for searching bags at customer entrances is sufficient to keep the wait time under 1 minute. Vehicle screening, however, requires a minimum of 18 checkpoints, which could be infeasible.

Note that analyses made with this model are only approximate, since they assume a steady arrival rate and do not allow for natural fluctuations in arrival rates. In particular, lower numbers of servers may suffice if arrival rate variations allow a backlog of excess arrivals in one time interval to be "made up for" in a subsequent lower-traffic time interval.

Sensitivity to Model Parameters

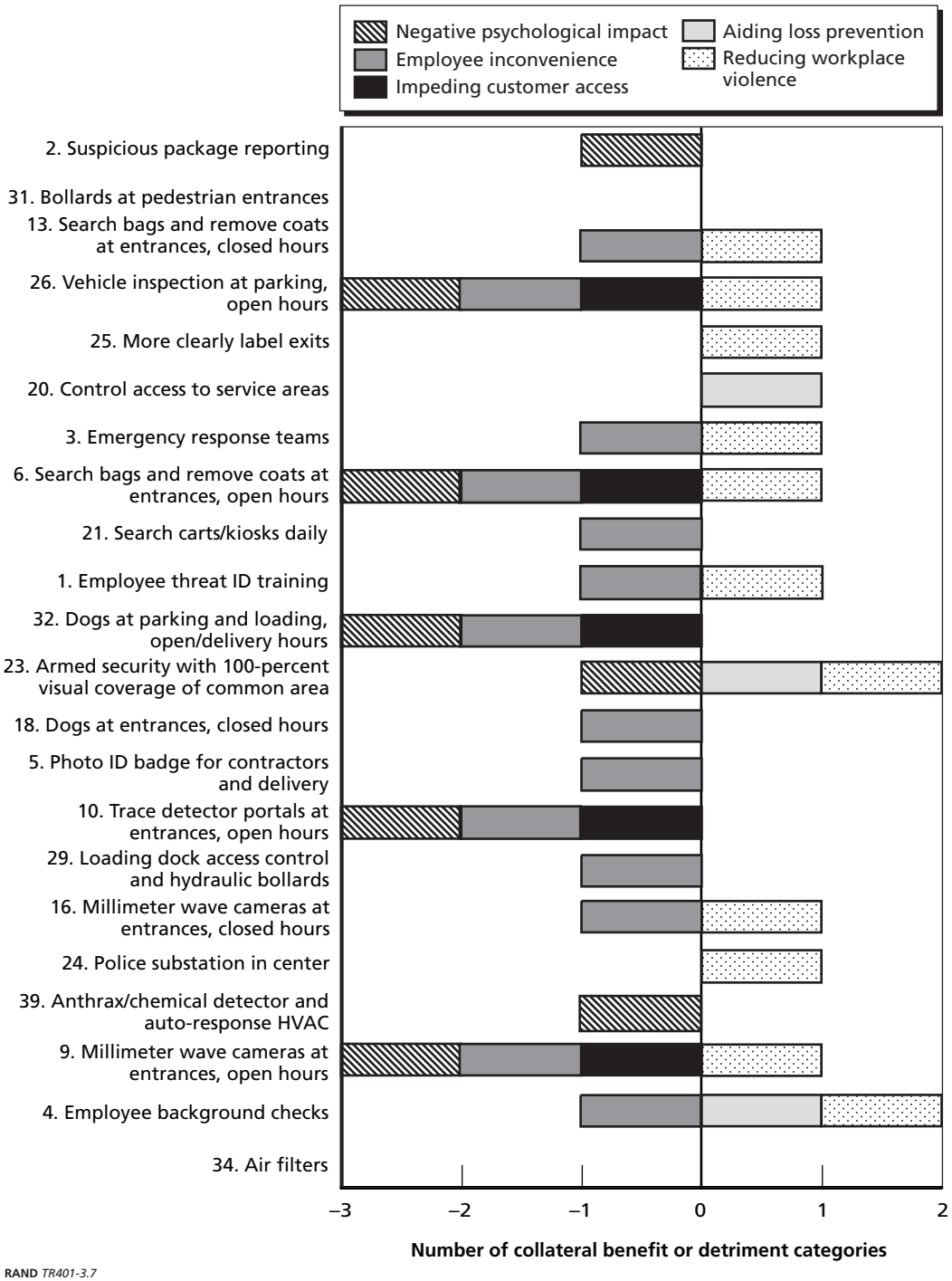
The security option rankings generated in our analysis depend on certain assumptions, and it is informative to examine the sensitivity of the rankings to the various parameter values. In this section, we examine the sensitivity of the results to different input parameters. This provides a measure of how much security option rankings change when we vary our estimates of likelihoods and other assumptions.

Figure 3.6
Collateral Impacts of Prioritized Security Options for Center A



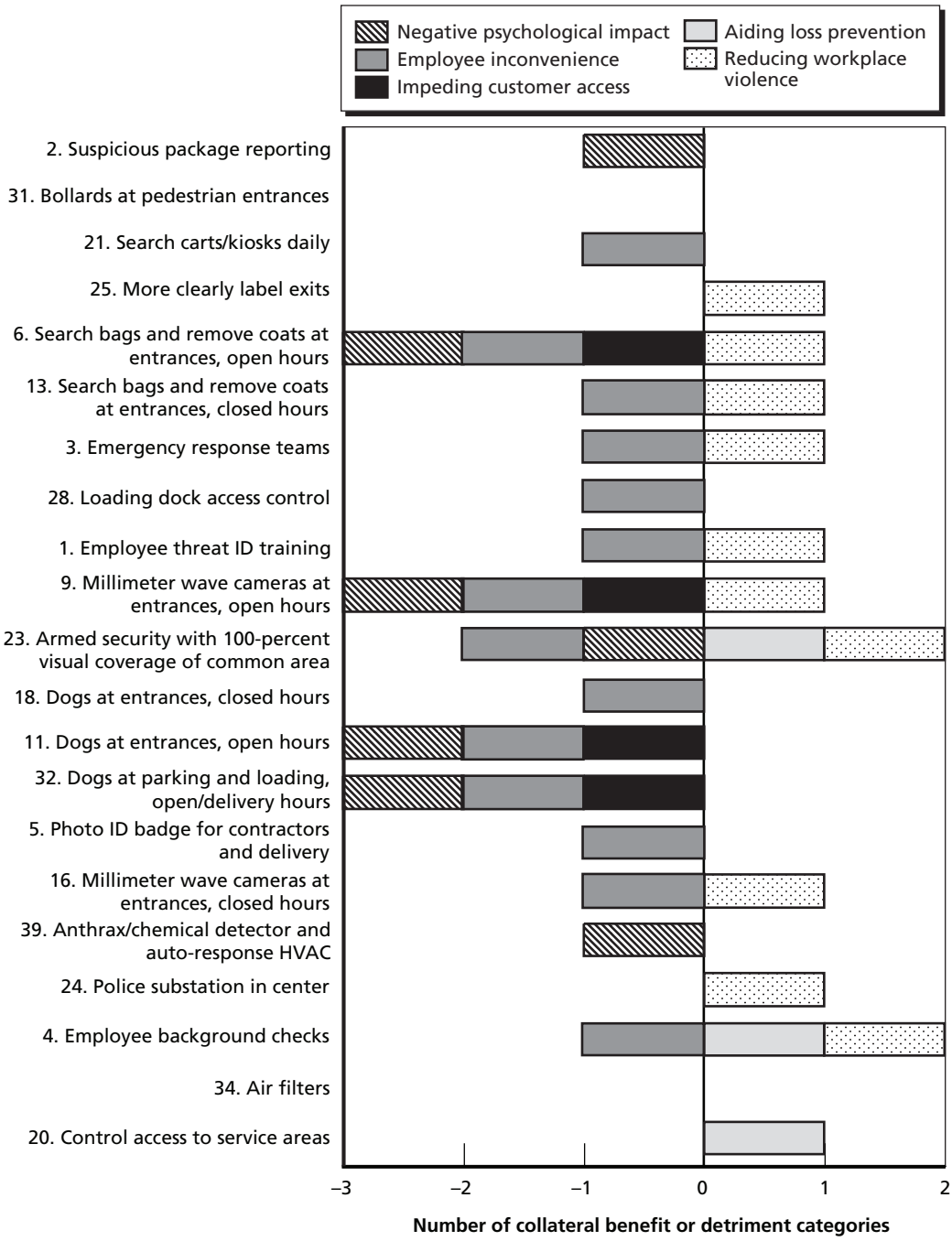
RAND *TR401-3.6*

Figure 3.7
Collateral Impacts of Prioritized Security Options for Center B



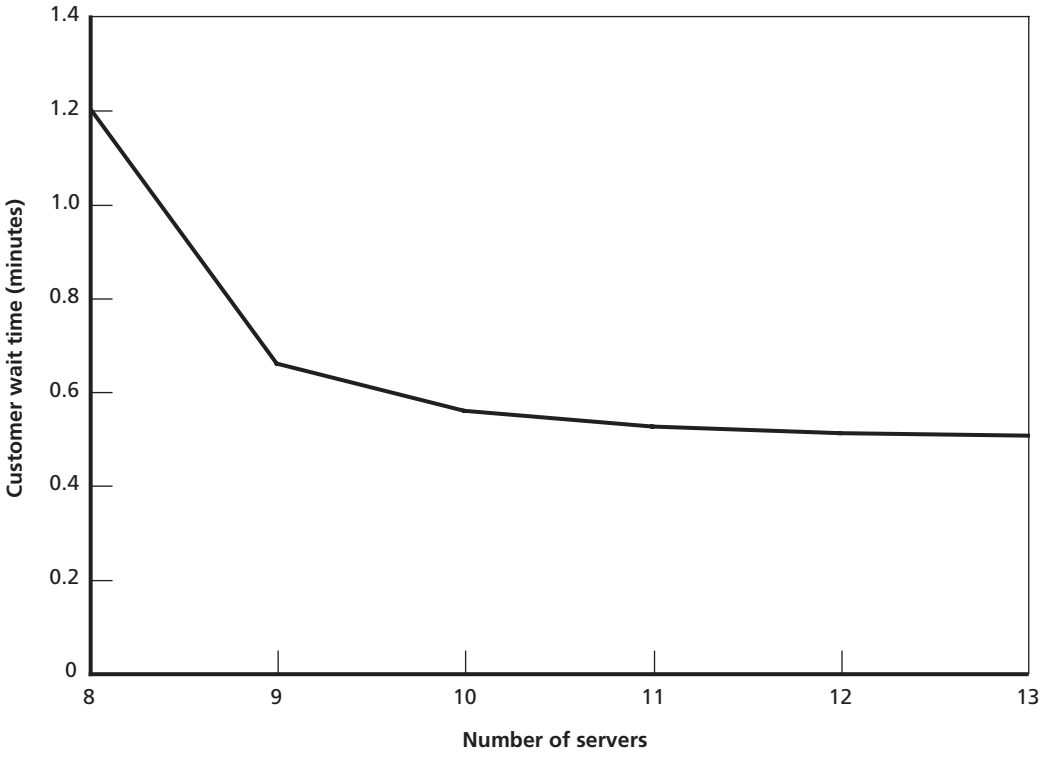
RAND *TR401-3.7*

Figure 3.8
Collateral Impacts of Prioritized Security Options for Center C



RAND *TR401-3.8*

Figure 3.9
Wait Times for Customer Entrance Security Screening Checkpoints

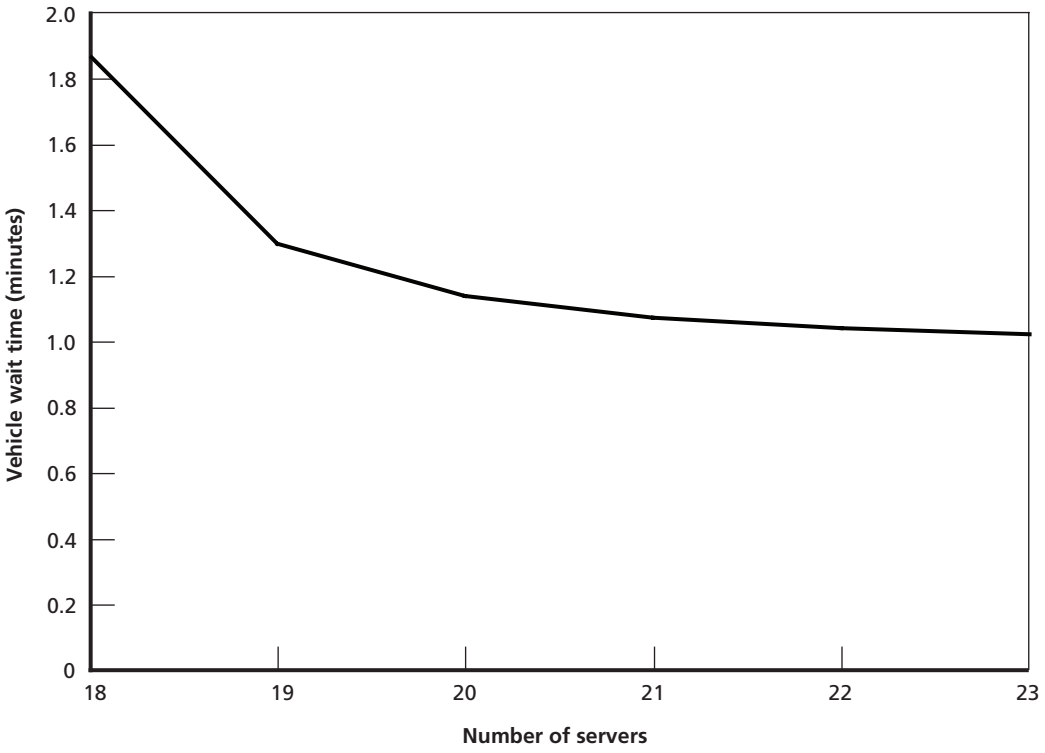


RAND *TR401-3.9*

Likelihood Estimates. Because different security options are effective against different scenarios, the option rankings selected by the model depend on the relative likelihoods of the scenarios. To understand how sensitive the rankings are to changes in likelihoods, we conducted an analysis to determine how much the likelihoods could be varied before the option rankings began to change significantly. We used a Monte Carlo simulation[6] to calculate the frequency with which each option was assigned a particular rank, since the likelihood values for each scenario were varied independently. Based on this analysis, we found that the option rankings did not begin to change appreciably until likelihoods were varied by more than a factor of 10. This indicates that the security option rankings determined by the model are insensitive to uncertainties of a factor of 10 in the scenario likelihoods. That the results are insensitive to such a large range in likelihood values may seem surprising, but can be understood in light of the fact that the likelihood for the different scenarios span a range of 5,000 (Table 3.2).

[6] Monte Carlo simulations involve running multiple analyses in which the values of particular variables change from run to run according to a prescribed formula. In this analysis, the likelihood values for each scenario were drawn from a triangular distribution for each run.

Figure 3.10
Wait Times for Vehicle Security Screening Checkpoints

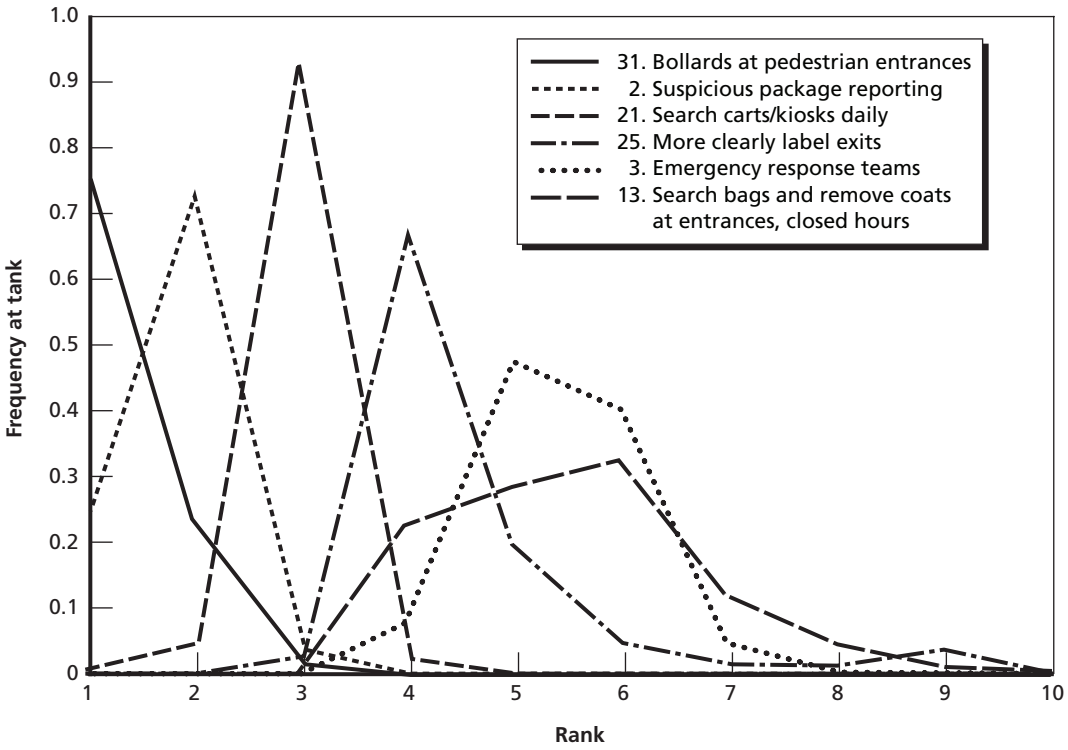


RAND *TR401-3.10*

Results for the Monte Carlo analysis for Center A, which are typical of all centers, are summarized in Figure 3.11. This figure shows distributions of the individual rankings for each of the top six options considered. The peak of each distribution corresponds to the rank for that option when using fixed likelihoods (see Figure 3.3). For example, option 21, which is ranked third when using fixed likelihoods, ranks first in 0.5 percent of the model runs, ranks second in 4 percent of the runs, ranks third in 92 percent of the runs, and ranks fourth or higher in 2 percent of the runs as the likelihood values are varied.

Likelihood Profiles. To examine further the effect of likelihood values on our results, we also varied the conditions so that future attack likelihoods depart from historical trends. For this analysis, we developed alternate likelihood profiles in which the relative likelihoods of suicide attacks and insider attacks are increased by a factor of 10 relative to the historical base case (see Table 3.3). The results for the different profiles are illustrated in Figure 3.12 for Center B. Security options in Figure 3.12 are listed in the prioritized order for the base case likelihood profile, and the columns show the change in rank for each option for each of the alternate likelihood profiles. A positive value for a given option indicates that the rank of that option has moved up in the list in the indicated likelihood profile relative to the base case profile. A negative value indicates that it has moved down in the list. A zero value indicates that it has remained in the same position.

Figure 3.11
Distributions of Rank Assignments for Top Six Options



RAND *TR401-3.11*

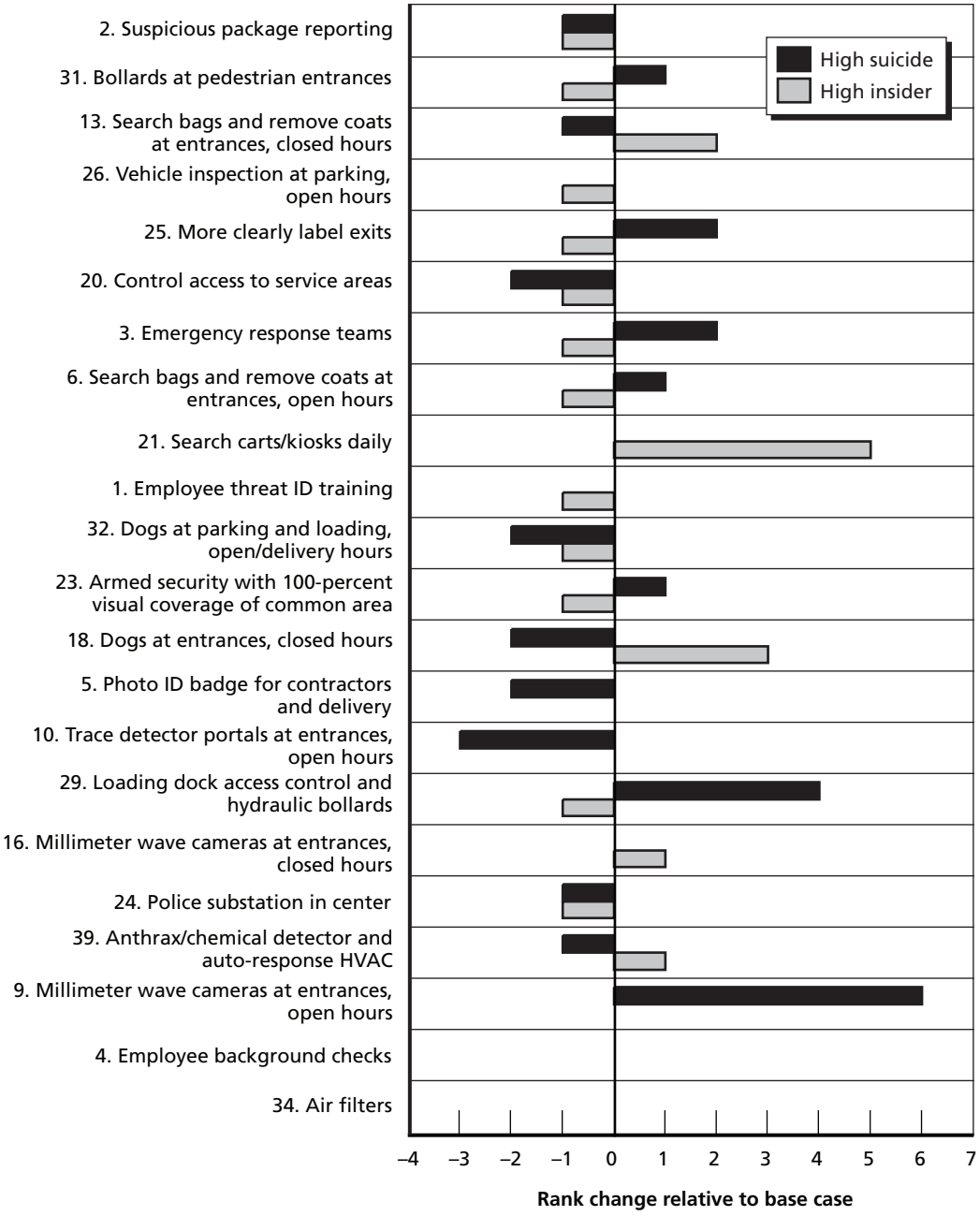
The changes in ranking of various options under the alternate likelihood profiles can generally be understood in terms of the differential effectiveness of options for suicide and insider attacks. For example, option 21, *search carts/kiosks daily*, is effective against insider attacks only, so it moves up five positions under the high insider profile.

Consequence Weighting. We also examined the effect of alternate weightings of fatalities and shopping center downtime on the rankings of security options. Results for Center B are shown in Figure 3.13. This analysis indicates that the option rankings are less sensitive to the relative weightings of fatalities and downtime than they are to likelihood profiles. This appears to result from the fact that the dynamic range of both consequence metrics is small compared with the dynamic range of the likelihood values: Fatalities vary by a factor of 25 among the scenarios, while likelihoods vary by a factor of 5,000. Thus, security option rankings are less sensitive to changes in consequences than they are to changes in relative likelihoods.

Results for Heightened Threat Conditions

Thus far, our model results have addressed conditions under which there is no specific heightened threat of a terrorist attack. Here we examine how the model can be used to prioritize security options under such conditions. A heightened terrorist threat at shopping centers could occur in two ways. One is a general increased terrorist threat nationwide, in a particular local

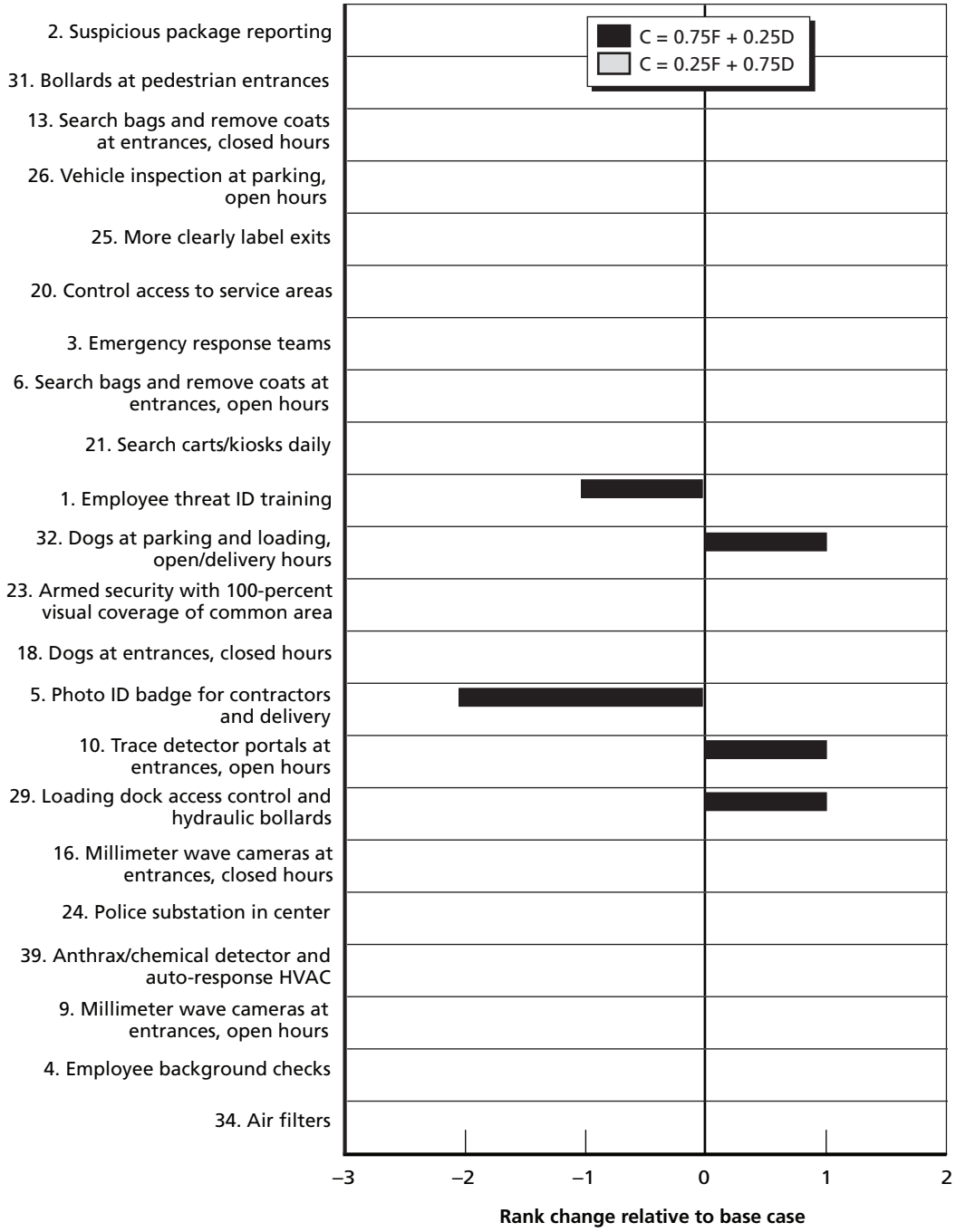
Figure 3.12
Effect of Alternate Likelihood Profiles on Option Rankings for Center B



RAND *TR401-3.12*

area, or for shopping centers in particular. In this situation, the overall likelihood of an attack is higher, but there is no specific information to indicate that a particular weapon or scenario is planned. Consequently, the likelihoods for all scenarios would increase uniformly and there

Figure 3.13
Effect of Consequence Weighting on Option Rankings for Center B



RAND *TR401-3.13*

would be no effect on the relative prioritization of security options. Note, however, that more options would need to be implemented to reduce the risk to the same level as when no heightened threat condition exists.

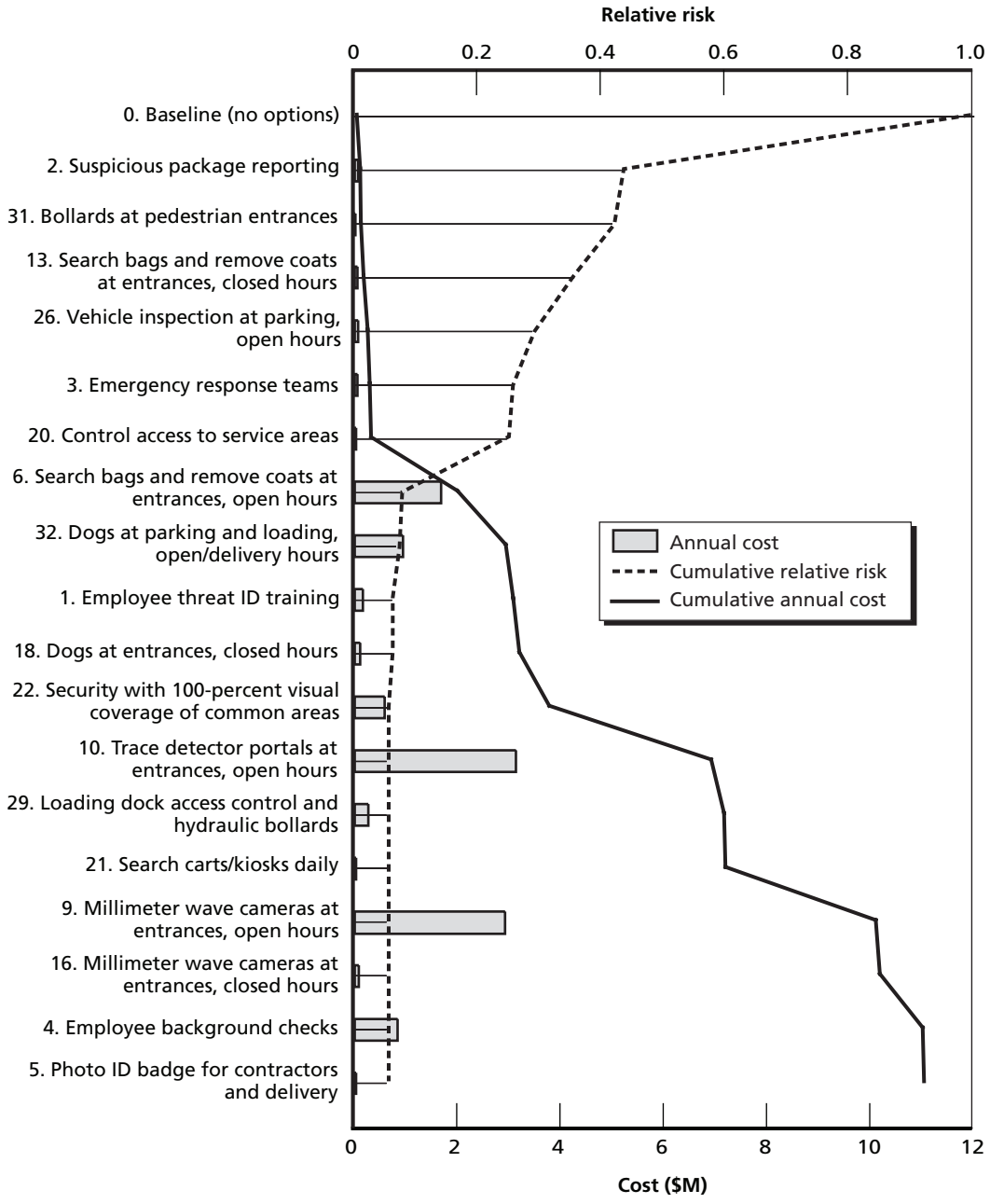
The other way in which the threat level could increase is if authorities indicated that they had reason to believe that terrorists were planning specific scenarios or planning to use particular weapons. In this case, the relative likelihoods of the various scenarios would change, which could have a strong effect on the optimal prioritization of security options. We have examined three cases in which particular weapon types are identified as the likely threat. In each case, we exclude all scenarios that do not use the given weapon type, effectively raising the likelihoods of the identified weapon type. Results are presented for Center B.

Explosives. Results for the case when only scenarios using explosives are included are shown in Figure 3.14. Comparison with the results for the case when all scenarios are included (Figure 3.4) shows that the results for explosives scenarios only are generally quite similar to results for all scenarios. The top four options are identical, and the ranks of most other options change by only a few positions. This similarity reflects the overall high risk of explosives scenarios relative to other types of scenarios. The higher risk for explosives means that the explosives scenarios dominate the overall risk, and so options effective against explosives are selected preferentially even when other scenario types are included.

Firearms. Results for the case when only scenarios using firearms are included are shown in Figure 3.15. In contrast to the case for explosives, the prioritized options for firearms scenarios are markedly different from those for all scenarios. Twelve of the options in the all-scenario case, including the top four options, are not selected when the scenarios are limited to firearms only. In addition, three options are selected in the firearms-only case that were not selected in the all-scenario case. These differences reflect the fact that the effective options in firearms attacks are generally different from the effective options in explosives attacks; enhancing the risk of firearms attacks by excluding explosives attacks results in a large shift in security option priorities.

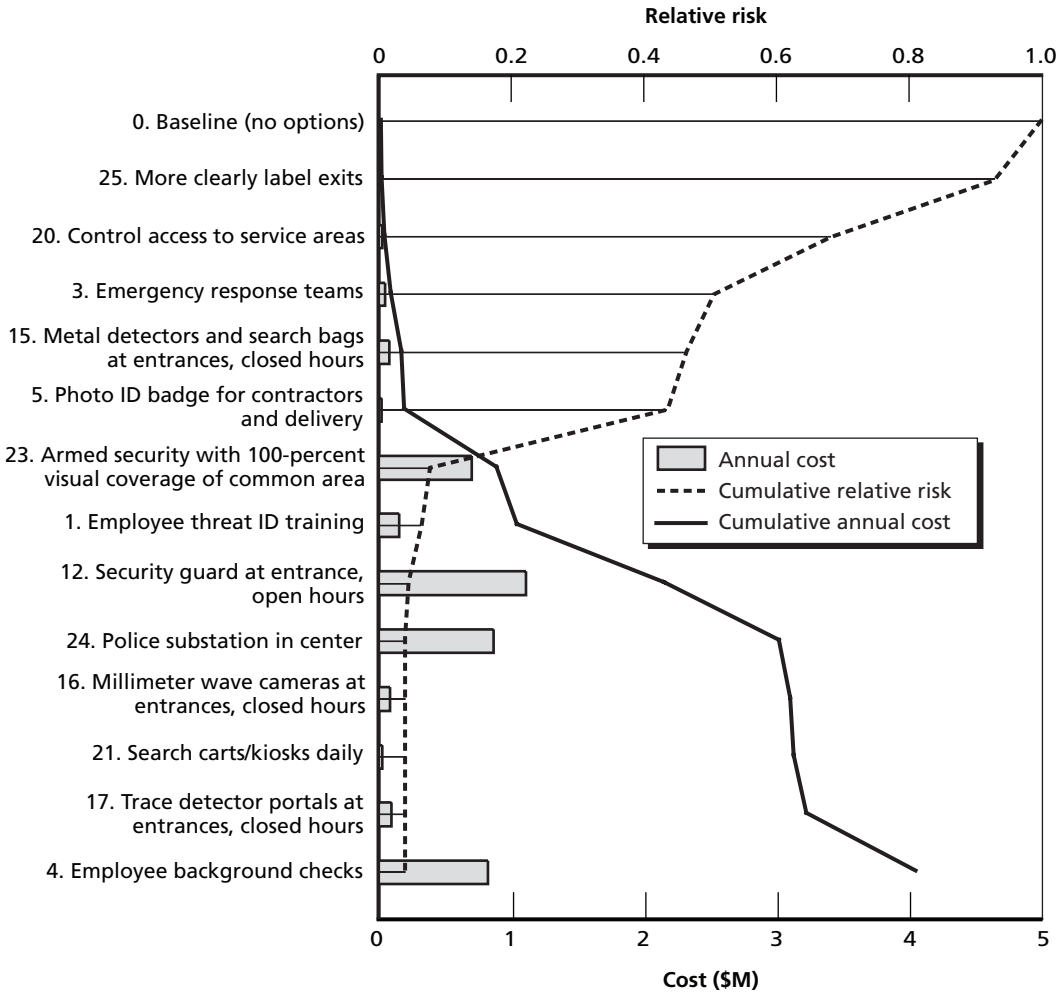
Chemical and Biological Weapons. Results for the case when only scenarios using chemical and biological weapons are included are shown in Figure 3.16. As would be expected, there are substantial differences between these results and the all-scenario case, both because the chemical and biological scenarios are quite different from the explosives scenarios and because several options (34–39) are specific to chemical and biological weapons. However, it is worth noting that the highest-priority risk reduction option is a traditional security approach of searching kiosks daily, which is also a high-priority option under normal conditions.

Figure 3.14
Prioritized Security Options for Explosives Scenarios



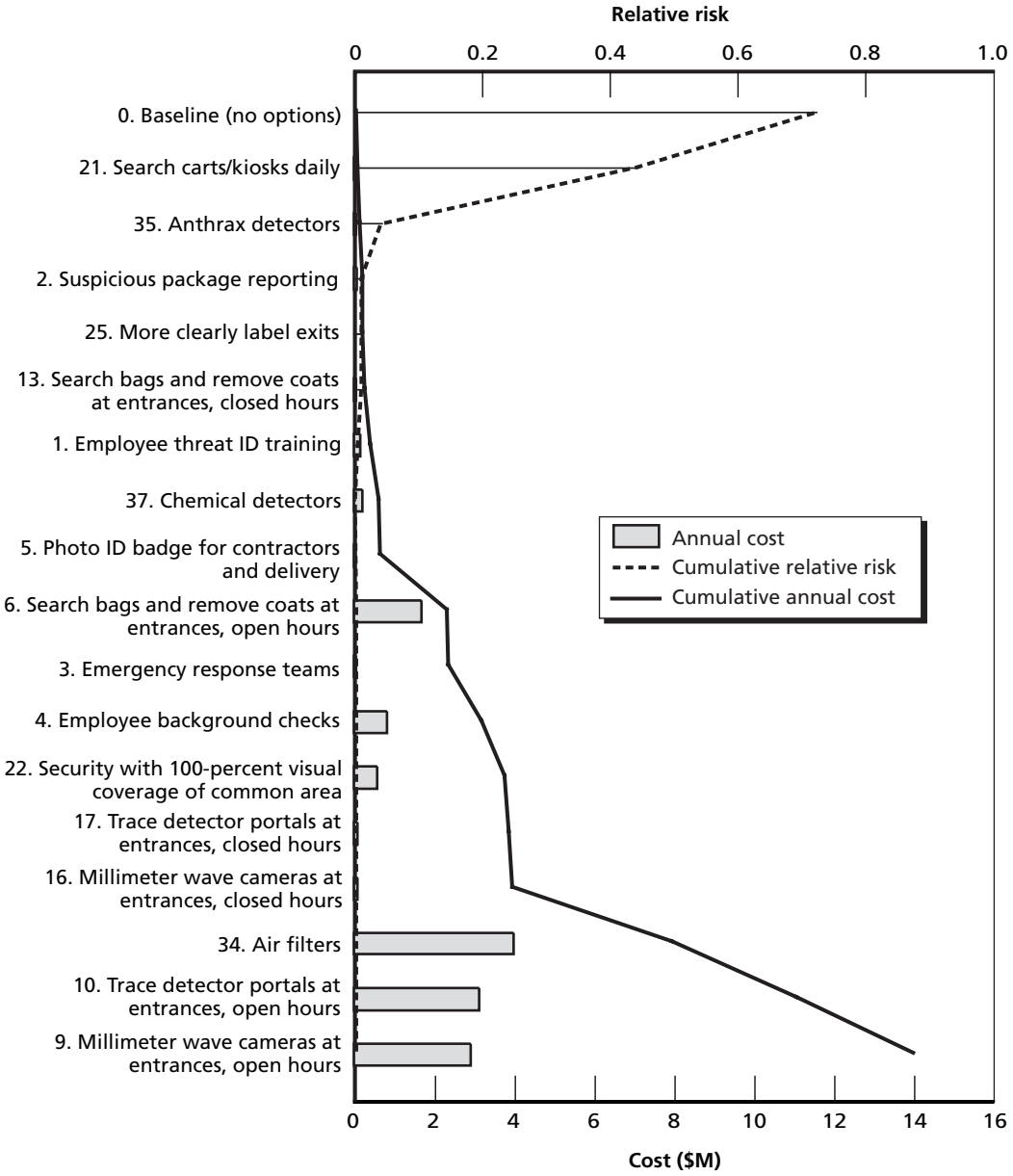
RAND *TR401-3.14*

Figure 3.15
Prioritized Security Options for Firearms Scenarios



RAND *TR401-3.15*

Figure 3.16
Prioritized Security Options for Chemical and Biological Weapon Scenarios



RAND *TR401-3.16*

Summary

Our analysis shows that implementing about 10 security options that span a range of approaches and that deter, deny, or mitigate a range of potential terrorist threats can substantially reduce the terrorism risk at commercial shopping centers. The majority of these options involve traditional security approaches, such as installing bollards at pedestrian entrances, searching bags, encouraging suspicious package reporting, and searching vehicles.

Although there are some differences in the order of the high-priority options selected for different centers, overall the prioritizations of security options for the different centers examined in this report are similar. The similarity among centers ultimately reflects the fact that shopping centers generally share a similar set of vulnerabilities to terrorism and lend themselves to the same types of security options to reduce the terrorism risk.

Qualitatively estimated collateral impacts of high-priority options are likely to influence security decisions. A simple queuing model applied to a modest-sized center indicates that customer entrance security checkpoints could easily be implemented with minimal wait times but that vehicle screening at parking entrances may result in substantial wait times.

The total annual cost of the high-priority options (those that generate 95 percent of the total possible risk reduction) ranges from $0.4 million to $2.0 million at the three centers examined.

Prioritization results are largely insensitive to the relative weighting of fatalities and center downtime and are moderately sensitive to variations in likelihood estimates. Results are most sensitive to variations in which scenarios are included, which could vary if authorities indicate an increased likelihood of attacks using a specific weapon type.

CHAPTER FOUR

Additional Components of Terrorism Security at Shopping Centers

The model presented in Chapter Three prioritizes the security options considered under assumptions about likelihood and consequence of varying types of attacks and effectiveness of options. There is a wide spectrum of nuanced strategies and implications that this model does not attempt to characterize yet that are important considerations. This chapter discusses some perspectives that the model does not address, but nonetheless may be important for guiding decisionmaking about reducing terrorism risk at shopping centers.

Standby Considerations

Some of the high-priority security options identified in our modeling may be appropriate to implement immediately. Indeed, some shopping centers have begun implementing terrorism security strategies that include some of the options identified in this report. On the other hand, stakeholders may choose not to implement many of the security options unless the terrorism threat conditions were to change for the worse.

If the risk of terrorist attacks were to increase rapidly, e.g., if periodic attacks began occurring in the United States, it would be important for shopping center operators to be in a position to implement additional security options quickly. The security options identified in this report cannot leap immediately from concept to implementation. Much consideration will have to be brought to each option to develop a suitable implementation plan. This section discusses some things that center operators could do now to facilitate the implementation of security options.

Preparing for Future Acquisitions

Some of the security options require physical assets (e.g., metal detectors) that shopping centers may not already possess. Many of the options will require substantial changes in security operations and staffing levels. Some will require light construction. All options will require some level of public relations effort to educate tenants and customers about new procedures. All these steps could be facilitated by contacting suppliers and prepositioning agreements with specific vendors for assets that might be needed in the future. This would increase how quickly shopping centers could respond to a particular threat environment to continue operations.

Data Collection Opportunities

The model does not take into account every consideration that management would have to weigh for each security option. Many of these considerations are very site specific and would be exceedingly difficult to build into a general model. For example, inspecting the vehicles of all patrons parking at the facility could require more inspection stations than there are entrances to a garage. This is a physical constraint that particular shopping centers face, which is not represented in the model. Similarly, a decisionmaker cannot make a sound judgment as to whether a particular site can inspect every vehicle entering a parking structure without knowing something about projected volume of vehicles entering. Decisionmakers must have access to detailed data in order to make sound judgments, estimate costs accurately, and develop implementation plans. An effort to collect relevant data ahead of time would enable management to determine whether and how to implement various security options in particular environments when the need arises.

Modeling Opportunities

Implications of many of the security options could be explored further using site-specific data mentioned above. Queuing theory could be applied to several of the security options considered. More sophisticated queuing models could elucidate optimal strategies for specific sites. Such models would allow decisionmakers to determine the appropriate number of stations needed and define efficient staffing schedules. Queuing models have been successfully used in a variety of industries to optimize operations.

Psychological Implications

Implementation of some of the security options may have a negative psychological impact on shopping center customers and employees. For example, requiring shoppers to go through a screening checkpoint imposes a disutility that might turn away the consumers on the margin. It is difficult to project how consumers will react to measures taken to increase security. Much will likely be determined by the public's perception of the risk environment at a particular point in time. For example, after September 11, 2001, the public accepted increased security measures at airports that might have been met with more resistance earlier. There may be strategies that shopping centers could design to mitigate the psychological impact of shoppers. Such strategies should seek to communicate to consumers that facilities have taken appropriate security measures while still providing a permissive environment for shopping.

Structural Design Considerations

As noted in Chapter Three, the security options considered in this report exclude major design and construction issues. In some cases, the risk of bomb attacks can be mitigated by means of structural design approaches. Given that property development and redevelopment are important aspects of the shopping center industry, structural design and construction options may be useful approaches. In this section, we summarize some guidance available from government agencies regarding structural hardening (physically strengthening a structure) and building

standoff zones. This material is provided for informational purposes only and has not been reviewed for accuracy or effectiveness.

As described in Chapter Two, explosives are the most common weapon used in terrorist attacks. Notable examples include pedestrian suicide bombers in Israel and vehicle bombs at the Murrah building in Oklahoma City, Khobar Towers in Saudi Arabia, and the U.S. embassies in Kenya and Tanzania. The blast from explosives affects structures and the people inside them in multiple ways. People can be injured or killed by the blast pressure, by being propelled into walls or objects, and by fragments created and propelled by the blast wave. Fragments can come from glass and structural materials as well as from shrapnel placed around the bomb. Blast can also cause localized damage to a structure, knocking down walls and columns and causing sections of a building nearest the explosion to collapse. The effects of a particular bomb depend on its size and the distance it is detonated from the building. Table 4.1 summarizes the effects of bombs at different distances.

In shopping centers, bombs can also damage merchandise, equipment, and real property. Bombs can lead to revenue losses for the merchants and the shopping center owner by forcing the closure of a portion or even the entire facility.

A bomb's effects can be amplified many times over if the blast from a bomb causes a structure to undergo a progressive collapse, where an initial local structural failure spreads to other elements in the structure, resulting in collapse that is much larger than the explosive would have caused on its own (Federal Emergency Management Agency, 2003a). The collapse of the two World Trade Center buildings in 2001 illustrates the amplifying effect that progressive collapse can have on casualties and property losses. Many of the deaths and injuries in the Oklahoma City bombing were in the zone of progressive collapse (Mallonee et al., 1996).

Structural mitigation measures can be broken into two basic groups: those that keep the bombs away from the structure or critical elements of the structure and those that harden the structure, making it more resistant to the effects of a bomb.

Standoff

The most effective mitigation measure for bomb attacks is to keep bombs as far away from the structure as possible. This is accomplished by establishing a standoff distance between a structure and potential bomb detonation locations. This approach takes advantage of the

Table 4.1
Structural Damage and Injuries Due to Explosion Effects

Distance from Explosion	Most Severe Building Damage Expected	Associated Injuries
Close	General collapse	Fatality due to impact and crushing
Moderate	Exterior wall failure, damage to floor slabs in rooms along exterior wall	Skull fracture, concussion
Far	Window breakage, falling light fixtures, flying debris	Lacerations from flying glass, abrasions from being thrown against objects or objects striking occupants

SOURCE: Federal Emergency Management Agency (2003a, pp. 4–8).

fact that the blast effects from a bomb decrease rapidly with distance. It is possible to create standoff zones to some extent for truck and car bombs at shopping centers where access can be restricted. But this can be difficult in urban areas if a shopping center adjoins city streets and sidewalks.

Exterior Standoff. U.S. Department of Defense (2003) guidance for military facilities mandates standoff distances of 80–150 feet for inhabited buildings. This guidance was developed primarily for sleeping quarters and office buildings. The topology of shopping centers provides comparatively greater protection to the occupants from bombs detonated outside of the structure. There generally are not many windows facing outside, and the storefronts face the internal common area rather than the road or parking areas. Moreover, the areas closest to the exterior of the structure tend to be storage areas and service hallways, where the density of people is very low. This topology means that the standoff distance needed for a shopping center is likely to be smaller than that needed for an office building.

Interior Standoff. The open nature of shopping centers creates risks that are less common in office buildings—the public can simply walk into the common area where the density of people is the highest. Keeping package bombs and pedestrian bombers out of a shopping center is thus difficult, requiring security checkpoints to screen people and bags at shopping center entrances.

Even without security screening, however, the structure still could be protected to some degree against these smaller bombs by preventing them from being placed in direct contact with vulnerable points in the structure. This could be accomplished by hiding critical columns and beams in walls or spaces that are inaccessible to the public. Critical columns that must remain exposed could be protected by creating architectural barriers around them that are at least six inches away from the columns. In a shopping center, these standoff distances could be created by placing columnar billboards around the columns.

Critical structural columns may be present both in a center's interior and in exterior areas such as beneath overhangs or in underground parking structures. Movie theaters above parking lots or other easily accessible spaces are particularly vulnerable to bombs targeting columns.

Hardening Structures

Hardening the structure can be a useful mitigation strategy in some situations, particularly where it would be difficult to establish standoff zones for vehicles or where package bombs could be placed near critical structural elements. Extensive hardening would require radically different construction techniques and architecture than are used today. Shopping centers would end up looking more like concrete military bunkers and would be extremely expensive to build. Nevertheless, several steps short of building bunkers could be taken to strengthen the structure of a shopping center, particularly against progressive collapse.

The first of these is to harden specific elements of the structure, particularly those columns and beams that are critical to preventing progressive collapse. Several useful references provide a general overview of potential measures for new and existing structures.[1] According to

[1] The Federal Emergency Management Agency has publications that provide general guidance on protecting structures from so-called WMD attacks, including explosives. They include Federal Emergency Management Agency (2003a, 2003b,

these references, concrete columns in existing facilities can be retrofitted with protective wrappings of steel or composite materials that would hold the column in place even if the concrete inside had been turned to rubble. Steel columns can be wrapped with concrete to protect them from the force of the blast. In new structures, important columns can be built with spiral reinforcing, column spacing can be minimized, and floor slabs can be attached to columns so that they can withstand the upward pressures of an explosion.

The degree to which an existing or new structure should be hardened and the best measures for achieving the desired level of protection would depend on an assessment of the likely threat and the effectiveness of the measures in reducing that threat. It would also require detailed analysis of the proposed protective measures by a structural engineer specializing in hardening against explosives.

Strategic Security Considerations

Our analysis addresses security options implemented at the individual center level. Such tactical-level security, however, is only one component of the overall terrorism security strategy protecting a shopping center. Higher-level security efforts can also be important and should be included in any terrorism security strategy. An example of a potentially valuable mid-level security option that can be implemented company- or industry-wide is developing and sharing databases of suspicious persons and events (e.g., unexplained recurring visits to a particular center, visits to numerous centers). Most higher-level strategic components, such as intelligence gathering and analysis, border security, emergency response, and terrorism insurance, are generally outside the influence of a shopping center operator or the shopping center industry. However, by staying informed about initiatives and progress in these areas, shopping center operators may identify opportunities to express their interests and influence activities.

Special Operational Environments

The model does not consider the implications of special operational environments created by nonroutine events. Special events (e.g., concerts) have the potential to create unique situations that could have an impact on the likelihood or consequences of attacks and on the types and effectiveness of security options. A special event may increase the number and density of people (increasing the consequences) and might make an attack more desirable to terrorists (increasing the likelihood). In addition, these events generate deviations from routine activities, making it more difficult to notice unusual activities that could be indications of a terrorist attack (decreasing the effect of security measures). A special event transforms the venue from its originally designed purpose. Security measures taken to provide a permissive environment for shopping may not be optimal for special events.

2005). Other useful references on the effects of explosions on structures include U.S. Department of Defense (2003) and U.S. Army Corps of Engineers (1999).

CHAPTER FIVE

Implications for Terrorism Security at Shopping Centers

We conclude with a discussion of some implications for terrorism security at commercial shopping centers raised by our analysis. These implications derive from the prioritization of terrorism security options at three centers that, in turn, is based on estimates of the relative risks of different types of terrorist attacks at shopping centers of how well different security options reduce these risks. It is important to reiterate that terrorism risk is uncertain, and the results of our analysis are contingent upon various assumptions about the likelihoods of different attack scenarios, the consequences of these scenarios, and the effectiveness and cost of security options. We have examined the sensitivity of our results to several parameters and find that the results are generally robust over large variations in fundamental assumptions. In addition, we have attempted to be comprehensive when including scenarios and security options for consideration. Nonetheless, as discussed in Chapter Two, terrorism risk is evolving and it is unclear how well the future terrorism risk can be predicted from historical trends. This tenet applies not only to the likelihoods of different scenarios, but also to the lethality of attacks and the type and effectiveness of terrorism security strategies. Terrorism risk is dynamic, and assessments of terrorism security strategies must be updated frequently (e.g., Jackson et al., 2005a, 2005b). The implications discussed here apply to the current threat environment.

A strategy to reduce the risk of terrorism will be similar for most shopping centers. Our analysis indicates that the principal risk-reducing security options do not differ dramatically across the three types of centers examined in this report. Because the characteristics of the centers we examined are quite diverse, including large and small, indoor and outdoor, urban and suburban, this similarity is expected to hold for shopping centers in general. This means that many of the decisions regarding implementing terrorism security options can be managed centrally.

Centralized management of a similar set of options at multiple centers would facilitate information sharing among centers, allowing pitfalls to be identified and avoided and best practices to be promoted. Given the fairly substantial operational impacts of some options, this could help minimize transition problems. Centralized security management can also create an economy of scale and increase efficiency.

A similar set of options at most shopping centers may also help mitigate the confusion and anxiety among the public that could potentially arise if security efforts are increased. Espe-

cially if accompanied by a company- or industry-wide public relations effort, this could increase confidence that the increased security is safe and effective and is being well monitored.[1]

Disaster preparedness plans and exercises that focus primarily on emergency response do little to reduce terrorism risk. The vast majority of terrorism risk derives from attacks using explosives (Figure 3.2), for which the effects are immediate and the hazard abates very quickly. As a result, little can be done to reduce consequences (casualties or property damage) of a terrorist attack once it has occurred. While security options may help mitigate consequences in some cases, the effects are small and generally apply to low-risk attack scenarios (see Table B.1). As opposed to mitigating consequences, terrorism risk must be reduced by deterrence. This is the primary way in which most of the security options considered in this analysis are effective.[2]

Consequently, existing disaster preparedness plans and exercises, which focus primarily on the emergency response to a disaster, offer little toward reducing the risk of terrorism. Such plans have great benefit for reducing the risks of threats such as fires and earthquakes and therefore represent an essential part of a shopping center's security strategy. However, shopping center operators should not assume that in having such a plan they have adequately addressed terrorism security. Terrorism security is very different from disaster preparedness. This means that terrorism security will involve separate planning, training, and exercising approaches that focus on concerns such as reporting suspicious packages and detecting weapons.

Centers that move to implement terrorism security options early may experience both challenges and advantages. As illustrated in Figures 3.6–3.8, some of the high-priority security options identified in the analysis are expected to have negative collateral effects. Some options, primarily security checkpoints at parking and customer entrances, will impede access of shoppers into a center. Some high-priority options may also elicit some amount of negative psychological reaction from customers. If these effects are great enough, they may cause some shoppers to choose to go to alternate shopping centers or to avoid shopping centers altogether. This effect would be a disadvantage to centers that implement terrorism security options.

On the other hand, were the threat from terrorism to be perceived as increasing, the psychology may be reversed and customers may feel safer in centers with increased security. This would almost certainly be the case in the aftermath of an attack in the United States. One possible sequence is that a center that decides to implement terrorism security may at first suffer some decrease in customer traffic only to have it resume or increase as people become more accustomed to the new environment.

It would be instructive to examine the customer responses to increasing terrorism security. As noted earlier, some of the options highlighted in this analysis are being implemented at shopping centers currently, and customer responses could be tracked and evaluated. Case stud-

[1] We note that the effectiveness values for the security options were assigned under the assumption that terrorists deterred from one shopping center could easily choose an alternate shopping center to attack. If all centers implement terrorism security options, this logic may fail because terrorists might not be so easily deterred and effectiveness values would need to be adjusted to reflect this. On the other hand, in the face of strong deterrence at shopping centers, terrorist may seek alternate target types.

[2] As noted in Chapter Three, deterrence is most effective when unprotected alternate targets are available.

ies in regions with greater terrorist threats and greater security, such as Israel and the United Kingdom, could provide useful reference models and lessons that could assist decisionmaking and security implementation in shopping centers in the United States.

Tiered implementation may be the best strategy. One way to approach the problem of reducing the risk of terrorist attack is to implement a set of measures that is most appropriate for today's environment and develop plans today for further measures if the environment changes for the worse. Those plans should address the issue of how best to deal with the long-lead aspects of those measures, including precontracting for equipment or activities such as light construction or training staff to implement the measures in case they are needed. Efforts taken today to reduce the time it will take to implement future measures could reduce the disruptions to operations and revenue that could occur if the threat changes and customers are afraid to patronize shopping centers.

Ultimately, decisions about when to implement security options will be driven by assessments of the absolute risk of terrorism. Our analysis does not include any assumptions about the recurrence intervals of different attack scenarios or the likelihood of a terrorist attack compared with other security threats. Thus, though the analysis provides guidance about the relative priority of security options and how effective they are at reducing terrorism risk, it does not specify the absolute threat conditions necessary to warrant implementing any security options. In other words, the model indicates what to do once the initial decision has been made to implement terrorism security options, but it does not indicate how or when to make that initial decision.

Limiting terrorism security to temporary efforts such as is done currently may be entirely appropriate under the current conditions of generally low terrorism risk. Decisions to ramp up terrorism security would ideally be based on an understanding of the absolute terrorism risk, expressed in expected annual losses. Such estimates, however, are even more difficult to make and uncertain than the relative scenario likelihoods derived in this study. Some attempts to estimate absolute terrorism risk have been put forth in insurance industry models, but these attempts are restricted to catastrophic events (greater than 100 fatalities or $1 billion in losses).

In lieu of any reliable information about the absolute risk of terrorist attacks, decisions about when to implement security options are likely to be informed indirect indicators, such as government actions and guidance, political changes, media reporting, or industry trends.

APPENDIX A

Summary of Terrorist Attacks at Shopping Centers

Table A.1
Summary of Terrorist Attacks at Shopping Centers

Date	Country	City	Weapon	Suicide	Description
12/6/98	Turkey	Semdinli	Explosives	No	An explosive device detonated in a small shopping mall in Semdinli, in Hakkali Province, causing damage to some of the shops in the mall. The blast occurred in the middle of the night and so no injuries were caused.
2/9/99	Indonesia	Jakarta	Explosives	No	A bomb exploded near the Ramayana Department Store inside the Kelapa Gading Shopping Mall in north Jakarta. No significant damage was reported.
3/10/99	Turkey	Istanbul	Explosives	No	A group calling itself the "National Kurdish Revenge Teams" (Milliyetci Kurt Intikam Timleri) claimed responsibility for a bomb blast that killed a taxi driver and wounded eight others. The blast took place outside a shopping mall in the Bakirkoy neighborhood of Istanbul. A man was seen running from the scene shortly before the explosion.
3/10/99	Turkey	Istanbul	Explosives	No	A TNT bar was placed under a car at a shopping mall in the Atakoy neighborhood of Istanbul, where it exploded. Even though the explosion took place during the busiest hour at the shopping mall, there were no injuries. Extensive damage was caused to cars parked nearby. A group calling itself the "Nationalist Kurdish Revenge Teams" (Milliyetci Kurt Intikam Timi) claimed responsibility for this blast and another at a shopping center in the Bakirkoy neighborhood. The group stated that "No Turk will sleep comfortably from now on" in their claim.

Table A.1—Continued

Date	Country	City	Weapon	Suicide	Description
3/13/99	Turkey	Istanbul	Fire or fire bomb	No	Thirteen people were killed and at least six others injured when an explosive device ripped through a shopping center in the Goztepe neighborhood of Istanbul. The blast was caused when Molotov cocktails were hurled at the center. Authorities blamed the Kurdistan Workers' Party for the attack but the group denied all responsibility. On March 15, 1999, police captured a student from Marmara University whom they suspect was involved in this attack.
8/30/99	Russia	Moscow	Explosives	No	A powerful explosion occurred in the underground shopping mall in Manezhnaya Square in Moscow. The bomb was activated by a timer and was placed in the Dinamit amusement arcade. It was likely a homemade device with an explosive power of 200–300g of TNT. Around 40 people were injured in the attack. Police found a leaflet that was written by the Union of Revolutionary Writer that stated, ". . . ladies and gentlemen, we do not like your way of life." The leader of the group is named Dmitriy Pimenov and is vocal about his anticop and anti-Semitic views. There was suspicion that the group may have been involved in the blast. However, in early September, the Dagestan Liberation Group, an extremist organization called the Agence France Presse office in Dagestan and claimed responsibility for the blast. They told reporters that events like this would occur until the Russian army left Dagestan.
12/12/99	France	Porto-Vecchio	Explosives	No	On the evening before a meeting between Prime Minister Lionel Jospin and Corsican representatives, a bomb, which failed to ignite, was found at a shopping center in Porto-Vecchio. A man in custody for another incident admitted responsibility for this and two other incidents in Porto-Vecchio that night. Two other men were also arrested in connection with the incidents.

Table A.1—Continued

Date	Country	City	Weapon	Suicide	Description
12/19/99	Turkey	Istanbul Province	Explosives	No	Two explosive devices detonated 10 minutes apart at a shopping center in Istanbul Province. The first blast occurred at a shop that sells alcohol and injured one woman. The second blast, 10 minutes later, occurred under a tree next to the Carrefour shopping center. The attack caused panic among shoppers, who flooded out of the mall after the first explosion. The Islamic Great East Raiders' Front, a radical Islamic group that opposes the secular government in Turkey, claimed responsibility for the two explosions. Note: Islam forbids the consumption of alcohol, the suspected reason that the group targeted these shops.
5/19/00	Philippines	Makati	Explosives	No	A bomb exploded in the upscale Glorietta mall in the financial district of Makati, injuring 13 and causing a collapse in the peso and stock market. Defense Secretary Orlando Mercado suggested that the attack was intended to create a situation of disorder and panic. Muslim rebels were among the prime suspects.
5/21/00	Philippines	Manila	Explosives	No	A bomb exploded in a moviehouse inside the Philippines' largest shopping mall, causing at least eight casualties and one death. The blast occurred inside the women's bathroom, and the majority of injuries occurred to utility workers. Police have not ruled out the involvement of Muslim separatists.
6/19/00	Colombia	Medellin	Firearms	No	Antioquia Department Deputy Gueillermo Leon Valencia Cossio, the brother of the government's negotiator in the peace talks with the Revolutionary Armed Forces of Colombia (FARC), was kidnapped from a shopping center in Medellin by the United Self Defense Forces of Colombia (AUC). One of the paramilitaries and one of Cossio's bodyguards were killed during the incident. The AUC said that the kidnapping was in response to Fabio Valencia's "irresponsible attitude" during a recent trip to Spain with a FARC leader and because he supported Raul Reyes' efforts in the peace process. Cossio was released four days later.
8/11/00	South Africa	Cape Town	Explosives	No	A bomb was detonated outside a busy shopping center, injuring two. Neither the perpetrators nor the motivation for the attack has been determined. However, People Against Gangsterism and Drugs is suspected in the attack. The bomb was hidden in a Toyota vehicle that was also destroyed in the incident.

Table A.1—Continued

Date	Country	City	Weapon	Suicide	Description
8/17/00	Estonia	Riga	Explosives	No	Two explosions rocked the downtown Riga shopping center "Centrs." The two blasts occurred in the lobby of the supermarket 10 minutes apart. One person died from the injuries and 35 were wounded in the attack. Police were investigating, but had not yet arrested any suspects.
1/10/01	Saudi Arabia	Riyadh	Explosives	No	A small bomb exploded at a shopping mall in Riyadh, causing damage but no injuries. The explosion at Euromarche—a shopping complex favored by Western expatriates—occurred at the entrance to the mall's supermarket. The Saudi Interior Minister downplayed the significance of the blast, citing children's firecrackers.
4/29/01	Philippines	Manila	Remote-detonated explosive	No	Two explosive devices detonated simultaneously in a Manila mall. The bombs exploded on the ground floor and the upper floor of the mall, injuring 37 people. Note: Police think that the bombings may be terrorist incidents but that they may also be related to the ongoing rallies in support of ousted Joseph Estrada.
5/18/01	Israel	Netanya	Explosives	Yes	Around 11:30 a.m., 21-year-old Mahmoud Ahmed Marmash, from the West Bank town of Tulkarem, blew himself up at the entrance to the Hasharon shopping mall. Marmash was wearing a heavy blue coat over the explosive device when he tried to enter the mall and detonated the bomb shortly after being stopped by a security guard at the mall's entrance. This explosion caused injuries to at least 50 people and killed seven, including the suicide bomber. At a rally in Gaza later that day, Hamas claimed responsibility for this attack made in retaliation for the killing of five Palestinian police officers by Israeli security forces earlier that week. Note: On May 19, 2001, Hamas distributed the videotape of suicide bomber Mahmoud Ahmed Marmash to news agencies. In that tape, Marmash stated that he would carry out this attack to ". . . avenge the killing of the people of Palestine, its women, elderly and children, to avenge the killing of Iman Hejjo. . . ." ("Bomber Leaves Video," 2001).
8/1/01	Philippines	Muntinlupa City	Explosives	No	An explosive device injured a painter working in the parking area of a shopping mall in Muntinlupa City. No further information was available for this incident.

Table A.1—Continued

Date	Country	City	Weapon	Suicide	Description
8/2/01	Indonesia	Jakarta	Remote-detonated explosive	No	An explosive device detonated in front of a mall, injuring six people.
8/4/01	Philippines	General Santos City	Remote-detonated explosive	No	A small explosive device detonated in the TSP Kimball Plaza shopping mall in General Santos City. The explosion occurred at the baggage counter at the entrance to the mall. No casualties.
9/23/01	Indonesia	Jakarta	Remote-detonated explosive	No	Two bombs exploded in the garage of the Atrium Plaza Mall. Several people were reportedly injured. Note: A blast at this mall on August 6, 2001, injured six.
10/26/01	Colombia	Barranquilla	Remote-detonated explosive	No	Two bombs exploded in Barranquilla. The first bomb exploded near Superalmacenes Olimpica in Soledad municipality, and the second bomb exploded at the La Macarena shopping center in the southern part of the city. There are no further details. Authorities suspect that the National Liberation Army is responsible for the attack.
12/1/01	Israel	Jerusalem	Explosives	Yes	Two suicide bombers detonated nail-studded explosives in a downtown Jerusalem mall, killing themselves and 10 others and wounding 150 more. The two attacks occurred almost simultaneously 40 meters apart. Hamas claimed the attacks.
1/12/02	Spain	Bilbao	Car bomb	No	Two people were injured by a car bomb containing 15–20 kilos of dynamite that exploded across the street from a large shopping center in the center of Bilbao. A warning had been phoned in, but police did not reach the stolen car in time. Note: In a communiqué sent to the Basque daily "Gara" on March 27, 2002, the Basque Fatherland and Freedom (ETA) group claimed responsibility for this attack that was aimed at the BBVA and the Banco de Espana banks.
1/12/02	Spain		Car bomb	No	A car bomb exploded in the busy shopping center of Bilbao. The blast occurred several minutes after police evacuated the area upon receiving a telephone call from someone claiming to be from ETA and giving a 40-minute warning of the attack. The blast occurred close to the regional headquarters of the Bank of Spain and the El Corte Ingles department store, which had been evacuated. The explosion injured at least two people.

Table A.1—Continued

Date	Country	City	Weapon	Suicide	Description
2/16/02	West Bank/ Gaza	Qarney Shomron	Explosives	Yes	The Popular Front for the Liberation of Palestine claimed responsibility for a suicide attack that killed two people and wounded 14. One of the wounded died from her injuries 10 hours later. The attack took place at a shopping mall in the West Bank settlement of Qarney Shomron.
3/4/02	Northern Ireland	Belfast	Knives and sharp objects	No	Anthony Rice, a Catholic teenager, was stabbed in the back as he left a shopping center in north Belfast. The perpetrators fled to the loyalist Tiger's Bay area after stabbing Rice a single time. Authorities are calling this an unprovoked sectarian attack.
7/1/02	Indonesia	Jakarta	Explosives	No	Police blame the Free Aceh Movement (GAM) for a bomb explosion at the Cijantung Mall that wounded nine people. The mall is located in a building owned by Kopassus, the army's special forces.
8/8/02	Israel	Yarqonim	Explosives	No	A missile was fired at Yarqonim Junction—a popular shopping mall near the northeast of Tel Aviv—and fell in an open field near its launch site. There were no injuries and there was no damage.
8/28/02	Nepal	Kathmandu	Explosives	No	A bomb exploded on the third floor of the Bishal Bazaar shopping center. Communist Party of Nepal—Maoist rebels are suspected.
9/21/02	United States		Fire or fire bomb	No	Two young members of the Earth Liberation Front (ELF) attempted to set fire to a construction crane at the Short Pump Town Center Mall, in Henrico County, Virginia. The teenagers rolled up a U.S. flag, which had been dipped in kerosene, and shoved it into the crane's fuel tank. They lit the fuse, but the makeshift device failed to detonate. The two perpetrators, along with a third teenager, were eventually arrested in connection with this and other attacks in Henrico County. The boys, Adam Blackwell, Aaron Linas, and John Wade, also left a threatening letter in the mailbox of the construction company's office. The note read, "how can you sleep at night, in your house, with your beautiful wife, knowing that none of it was earned by the merit of your character, but by destroying the environment and contributing to urban and suburban decay by establishing revolting SPRAWL such as Short Pump? Think about it. ELF."

Table A.1—Continued

Date	Country	City	Weapon	Suicide	Description
10/24/02	Indonesia	Bandung	Explosives	No	An explosive device blew up at the Bandung supermall, slightly wounding two people. The devices were inside a cleaning cart in the basement of the mall and were apparently intended to frighten rather than kill.
10/27/02	Nepal	Thamel	Explosives	No	In a series of three nearly simultaneous explosions close to the royal palace set off by Communist Party of Nepal—Maoist rebels, an explosion damaged a bookshop in a tourist shopping mall in Thamel. No injuries were reported. Note: These explosions occurred two days after the rebel leader Pushpa Kamal Dahal (also known as Prachanda) announced that he was willing to hold talks with the government to end the six-year insurgency.
11/4/02	Israel	Kfar Sava	Explosives	Yes	Two people were killed and 69 wounded when a suicide bomber blew himself up at the entrance to Kfar Sava's open-air Arim shopping mall. One of the dead was a security guard who is believed to have prevented the bomber from entering a Shekem electronic store, where a detonation would have caused higher numbers of casualties. Palestinian Islamic Jihad claimed responsibility for the attack, as did an unknown group calling itself the Jerusalem Group (or Battalions) and believed to be composed of both Palestinian Islamic Jihad and al-Fatah activists.
12/5/02	Indonesia	Makassar	Explosives	No	In the first of two bombings in the south Sulawesi capital of Makassar on this day, a bomb explosion ripped through a McDonald's restaurant in the Ratu Indah shopping mall. Three people, including the bomber, were killed and two were injured in this explosion. Agence France Presse reported on April 11, 2003, that Agung Hamid was believed to be the main suspect in this bombing and the car showroom explosion. Agence France Presse reported on July 21 that an Indonesian accused of helping to bomb the McDonald's testified that he had received weapon training in the Philippines. Four others accused in this case have admitted being members of the Laskar Jundullah Islamic militia. On December 22, 2003, an Indonesian court sentenced Galazi bin Abdul Somad to 18 years in prison for his role in this attack. Prosecutors say that he was guilty of transporting the bomb before passing it on to the actual bombers.

Table A.1—Continued

Date	Country	City	Weapon	Suicide	Description
1/5/03	Israel	Tel Aviv	Explosives	Yes	A pair of suicide bombers blew themselves up 500 feet and 30 seconds apart—the first in front of a bus stop, the second next to a currency exchange kiosk in a pedestrian mall—in a Tel Aviv neighborhood home to many foreign workers and a local transportation hub. Over 100 people were injured (approximately 108) and 23 were killed, including two people from China, two from Romania, one from Ghana, and one from Bulgaria. Nails, ball bearings, and metal pieces had been planted in the bombs to sharpen their effect. The attack was the first suicide bombing since November 21, 2002, and the deadliest attack since a March 2002 suicide bombing that took 29 lives (as well as the second deadliest attack of the current intifada, which began in September 2000). Both Palestinian Islamic Jihad's al-Quds Squads and the al-Fatah–linked al-Aqsa Martyrs Brigades claimed responsibility for the attack; the al-Aqsa Martyrs Brigades rescinded their claim but had identified the bombers. In March 2005, a court indicted Mu'afaq Iruk, an Israeli Arab, to 42 years in prison for this bombing. According to the court, Iruk was responsible for transporting the two suicide bombers to the site.
1/16/03	Colombia	Medellin	Car Bomb	No	A car bomb exploded in the parking lot of the El Cid shopping center, killing five people and injuring 32. The target was apparently the Regional Prosecutors Office, located next to the shopping center. The explosives were placed in an abandoned taxi and were likely on a timed device. Although authorities suspect the FARC, they say it may also be the work of local urban militias. This is one of three car bombings in January 2003.
3/5/03	Colombia	Cucuta	Explosives	No	An explosive device was left in the Alejandria shopping mall in Cucuta. The attack occurred at about 10:00 a.m. The bomb contained approximately 30 kg of dynamite. A fire resulting from the explosion of a nearby truck's gas tank caused most of the damage. Authorities are unclear about which nearby guerrilla group conducted the attack, but they suspect the National Liberation Army. Notably, FARC and National Liberation Army had been conducting joint operations during this period.

Table A.1—Continued

Date	Country	City	Weapon	Suicide	Description
3/22/03	Venezuela	Valencia	Explosives	No	A small bomb exploded at the Sambil Shopping Center in Valencia, Venezuela. The bomb was filled with small metal objects that dispersed widely during the explosion.
3/23/03	Venezuela	San Cristobal	Explosives	No	An explosive device detonated in San Cristobal, Venezuela. This bomb was one in a series of three containing metal objects that dispersed upon detonation in Venezuela this week. This bomb was placed in an automobile near a shopping mall.
5/19/03	Israel	Afula	Explosives	Yes	A suicide bomber blew herself up at the entrance to a shopping center in the northern Israeli town of Afula, killing three people and wounding 48. She had been headed into the Ha'amakim Mall when a guard stopped her for a security check, at which point she detonated her explosives. The bomber—19-year-old Hiba Daraghmeh from the West Bank village of Tubas—was an English literature student and described as a very devout Muslim. She usually wore a veil over her entire face except her eyes, a particularly conservative covering rarely seen even among religious Palestinian women. Both the al-Fatah–linked al-Aqsa Martyrs Brigades and Palestinian Islamic Jihad claimed responsibility for the attack, with the al-Aqsa Martyrs Brigades stating that it was a joint operation. Palestinian Islamic Jihad's al-Quds Brigades then claimed full and sole responsibility.
6/22/03	Macedonia	Skopje	Explosives	No	Two powerful explosive devices detonated in the center of Skopje almost simultaneously. Both bombs were planted in trash bins, one in the vicinity of a shopping center and across from a university, and the second near an office of Macedonian Telecommunications. The exact targets of the bombs are unclear. One person was slightly injured by one of the blasts and material damage was caused in both cases. Authorities believe that the assailants were Kosovars who entered the country through Gosince and may have detonated the devices with a cell phone.

Table A.1—Continued

Date	Country	City	Weapon	Suicide	Description
8/12/03	Israel	Tel Aviv	Explosives	Yes	A Palestinian suicide bomber blew himself up at a strip mall in the Tel Aviv suburb of Rosh Haayin. (Another bomber blew himself up less than an hour later at a bus stop in a Jewish settlement.) The first bomber killed himself and injured ten others. This is the most serious violation of the "hudna" to date. The al-Aqsa Martyrs Brigade claimed responsibility for the Rosh Haayin bombing in a Web site announcement, naming the bomber as Islam Yousef Qteishat.
11/20/03	Turkey	Istanbul	Explosives	No	At least two explosions rocked downtown Istanbul, near the British and Israeli consulates, the HSBC Bank headquarters, and the Metro City shopping center. Health officials stated that at least 28 people were killed and 450 injured. A man calling the semi-official Anatolia news agency claimed that al Qaeda and the militant group Islamic Great East Raiders' Front carried out the attacks. Later a unit of the al Qaeda network, Abu Hafz al-Masri Brigades, issued a statement claiming responsibility for the explosions. Nine people were being held on November 25, 2003, in connection with these attacks. They are being charged with "belonging to, aiding and abetting an illegal organization." In late December, Turkish police had seized over 500 kg of explosives that they believe were to be used in similar attacks. In another incident, 69 suspected members of a Turkish al Qaeda cell were put on trial for connection with this attack and a second at a synagogue in Istanbul. In January 2006, police arrested Loa'I Mohammad Haj Bakr al-Saqa, a prominent al Qaeda member believed to be behind these Istanbul attacks. Al-Saqa eluded police for years by faking his own death and remaining hidden in Turkey.
11/21/03	Colombia	Medellin	Explosives	No	A bomb, consisting of 2.5 kg of dynamite packed into a pressure cooker, exploded on the top floor of a three-story shopping center in Medellin. The explosion took place in the early morning before the shopping center opened. It damaged 14 stores and injured three people. It is unknown what motivated the bombing, although President Uribe was scheduled to preside over a community council meeting during the afternoon. Another bomb, also disguised in a pressure cooker, was found and disarmed on Thursday night several hours before this bomb exploded.

Table A.1—Continued

Date	Country	City	Weapon	Suicide	Description
1/5/04	Thailand	Pattani	Explosives	No	Two police officers were killed as they attempted to defuse an explosive device that was strapped to a motorcycle and parked at the Diana shopping mall in Pattani. Authorities blamed this attack and other similar attacks in recent days on the Muslim separatist group, Mujahideen.
8/31/04	Russia	Moscow	Explosives	Yes	A female suicide bomber blew herself up outside of the entrance to the Rizhshkaya subway station and the Krestovskiy shopping center. The explosive device was equivalent to 2 kg of TNT. The explosion was intended to occur inside the station, but the woman apparently was afraid of the police searching people and papers at the entrance to the station. Police believe that the incident may be connected to the airline crashes that occurred one week earlier, perhaps by one of the other two women seen leaving Khasavyurt with the women suspected of perpetrating the airliner attacks. The same group, the Islambouli Brigade of Martyrs, claimed responsibility for the attack. Eleven people were killed in the attack and at least 50 wounded. The suicide bomber was identified as Roza Magayeva, the sister of Aminat Nagayev, who is believed to be responsible for one of the two airliner crashes. Later, officials reported that Nikolay Kipkeyev was one of the victims of the blast. Kipkeyev was on a most-wanted list for participation in illegal and terrorist-related activity. Officials speculate that he may have been involved somehow in the attack. In a letter following the Beslan school hostage taking, Shamil Basayev claimed responsibility for the incident.
11/7/04	Pakistan	Turbat	Explosives	No	Three bombs exploded on Sunday around Quetta. The first bomb exploded in a drain, near a shopping center in Turbat. No casualties were reported. The windows of the nearby shopping center were shattered.

Table A.1—Continued

Date	Country	City	Weapon	Suicide	Description
2/14/05	Philippines	General Santos City	Explosives	No	The Abu Sayyaf Group claimed responsibility for three nearly simultaneous attacks on Manila, General Santos City, and Davao. In General Santos City, the explosion occurred at Gaisano Mall at approximately 6:30 p.m., killing at least three and wounding 33 others. A total of at least 13 were killed and 140 injured in the three attacks. In late March 2005, Philippine authorities arrested a man they would identify only as "Rohmat," a member of Jemaah Islamiyah whom they believe was also involved in these Valentines Day bombings. Authorities believe that Rohmat may have ordered and financed these attacks.
2/14/05	Philippines	Makati	Explosives	No	The Abu Sayyaf Group claimed responsibility for three nearly simultaneous attacks on Manila, General Santos City, and Davao. In Makaki City, the business district of Manila, an explosion at approximately 7:50 p.m. on a bus at a commuter terminal near a crowded mall killed six and injured at least 74. The dead were identified as Jose Marie Balboa, Bernardo de la Cruz Rizarito, and an unidentified female. At least 13 were killed and 140 injured in the three attacks. The Abu Sayyaf Group claimed they carried out the bombings in retaliation for alleged abuses of the military during missions against Muslim rebels. One week after the attacks, two suspects were arrested in Mandaluyong in connection with this attack. Gamal Baharan and Abu Khalil Trinidad are both believed to be members of the Abu Sayyaf Group. Trinidad is being accused of being "the guy who devised the bomb." Both Baharan and Trinidad reportedly made confessions to news reporters. In late March 2005, Philippines authorities arrested a man they would only identify as 'Rohmat,' a member of Jemaah Islamiyah whom they believe was also involved in these Valentine's Day bombings. Authorities believe Rohmat may have ordered and financed these attacks.

Table A.1—Continued

Date	Country	City	Weapon	Suicide	Description
3/23/05	Lebanon	Kaslik	Explosives	No	A bomb exploded in a shopping mall in Kaslik, north of Beirut, an area made up mostly of anti-Syrian Christians. The blast at the Alta Vista Center was caused by a 45-lb bomb left at the back entrance to the mall and destroyed most of the building. The attack killed three people, all workers, including a Sri Lankan and two Indians. Five other people were wounded in the attack, including a police officer wounded while inspecting the building. This was the second bombing of a Christian-inhabited area in five days and came amid instability in the country following the assassination of former Prime Minister Rafik Hariri and the partial withdrawal of Syrian troops.
3/28/05	Northern Ireland	Belfast	Fire or fire bomb	No	An incendiary device was found and made safe at a Belfast shopping complex. The device caused a major traffic backup, and the shopping center had to be evacuated for hours. Authorities blamed this attempted attack and two others in the area on dissident republicans.
3/28/05	Northern Ireland	Newtownsard	Fire or fire bomb	No	An explosive device was found burned out at the Ards shopping center in Newtownsard. This was one of three such devices found in the area, which authorities are blaming on dissident republicans.
4/1/05	Lebanon	Beirut	Explosives	No	A bomb exploded in the Christian resort village of Broummana at the Rick Plaza shopping center. The bomb consisted of a suitcase that was filled with TNT (20–25 kg) and placed at the entrance to the underground car garage of the center, shattering windows and destroying several nearby cars. The blast wounded nine people (including one Kuwaiti citizen). This was the fourth bombing in a Christian area of Beirut in two weeks. The attack came as Lebanon tried to prepare for May elections and occurred after an announcement that Prime Minister Omar Karami would not step down as he had previously promised, but would stay and try to form a new government to oversee elections. Instability in Lebanon had been high since the assassination of former Prime Minister Hariri less than two months earlier.

Table A.1—Continued

Date	Country	City	Weapon	Suicide	Description
5/6/05	Lebanon	Jounieh	Explosives	No	A bomb exploded near the main square of the Lebanese port city of Jounieh, north of Beirut. The explosion destroyed a shopping center and caused a fire near a Christian religious radio station, Sawt al-Mahabba, and a Maronite Catholic Church. Earlier in the day, the radio station had aired a program featuring live broadcasts of a sit-in by relatives of Lebanese prisoners in Syrian jails. One person was killed and 25 injured in the attack. The blast comes amid political unrest in Lebanon and on the day before the return of an anti-Syrian politician, Michel Aoun, from exile. Several blasts targeting Christians in Lebanon occurred during this year.
5/7/05	Burma (Myanmar)	Rangoon	Explosives	No	Three powerful explosive devices detonated in the city of Rangoon in a seemingly coordinated attack on private citizens. The second device detonated at the City Mart at Junction-8 Center, a shopping center in the middle of city. The device, a time bomb, had been planted in a bag and left at a counter where many shoppers leave their belongings. In the three blasts, 11 people died and over 162 were injured (no disaggregated data are available). Authorities were blaming dissident terrorist groups such as the Karen National Union, the Shan State Army, the Karenni National Progressive Party, or the National Coalition Government of Union of Burma for perpetrating the attacks in order to undermine the state's stability.
5/7/05	Burma (Myanmar)	Rangoon	Explosives	No	Three powerful explosive devices detonated in the city of Rangoon in a seemingly coordinated attack on private citizens. The third device detonated at the Dagon Center, a shopping mall. The device, a time bomb, had been planted in a bag and left near the ground floor escalator. In the three blasts, 11 people died and over 162 were injured (no disaggregated data are available). Authorities were blaming dissident terrorists groups such as the Karen National Union, Shan State Army, Karenni National Progressive Party, or National Coalition Government of Union of Burma for perpetrating the attacks in order to undermine the state's stability.

Table A.1—Continued

Date	Country	City	Weapon	Suicide	Description
7/12/05	West Bank/ Gaza	Netanya	Explosives	Yes	A Palestinian suicide bomber detonated his explosives outside the Sharon shopping mall near a group of teenagers in Netanya, on the Israeli coast. Two women were killed in the attack and two others died later of their injuries. One Israel Defense Forces soldier also died of his wounds. At least 30 other people were wounded in the attack. Islamic Jihad claimed responsibility for the attack. The mall in Netanya had been the site of previous suicide bombings in 2001 and 2002. This was the first suicide attack in Israel since February 2005. The attack came in the lead-up to the Gaza pullout and during a time of increased violence in the region. The attack also came as a blow to the Israeli-Palestinian truce that had been in place over the previous five months. The bomber was identified as 18-year-old Sami Abu Khalil from the village of Atil near Tulkarem. In response to the attack, Israel Defense Forces raided Tulkarem and cut off access to Gaza settlements. Four suspects were arrested in connection with the bombing in July 2005, including an Israeli Jew, two Israeli Arabs, and a Palestinian, who assisted in smuggling the bomber into Israel and to his location. The men were identified as Isaf Zahran, Kfir Levi, Yasif Azzam, and Aya Rahman Abu-Moh.
8/15/05	Turkey	Istanbul	Explosives	No	A resonant explosive device detonated outside an underground shopping center in the Bakirkoy neighborhood in Istanbul. The blast injured one woman slightly and caused major damage to the premises. The bomb had been planted near the entrance to the mall when it detonated.
8/22/05	Lebanon	Beirut	Explosives	No	A bomb exploded in Eastern Beirut, in the Zalka neighborhood, wounding five people. The bomb detonated between the Moussa Shopping Center and the Promenade Hotel, which is frequented by tourists, and caused extensive damage to nearby buildings. The bomb was made of about 45 kg of TNT and appeared similar in size and construction to the bombs used in other recent blasts in Lebanon. At least five suspects were arrested in connection to the attack. The explosion was the latest in a series of bombings in Lebanon in recent months that had targeted politicians (first among them former Prime Minister Hairi) and other figures as well as commercial areas in the country.

Table A.1—Continued

Date	Country	City	Weapon	Suicide	Description
10/15/05	Iran	Ahvaz	Explosives	No	Two bombs placed in garbage cans exploded five minutes apart in a market, the Karoun mall, in Ahvaz. The attack occurred just after dusk as people bought food for the break-fast meal during Ramadan. The bombs caused significant damage to cars and shops in the vicinity, killed six people, and wounded at least 102. Several explosive devices were detonated in the same area in June, prior to the Iranian elections. Iranian officials said that they suspected British involvement in the attacks, although British officials denied such a connection. Similar accusations have been made following other bombings in the region and in recent weeks as Iran believes that British forces play a role in stirring unrest in the Khuzestan province. They also accused Israeli security agents from Mossad and Sin Bet of being involved in the attacks. On October 18, 2005, Iranian officials announced that they had detained more than 20 suspects in the bombings. On October 30, 2005, Ministry of Intelligence officials announced that 30 suspects arrested in connection with the bombing on this day and earlier the same year in June had confessed to their involvement and given information about their terrorist group and future planned attacks. Note: Casualties are for both bombings.

Table A.1—Continued

Date	Country	City	Weapon	Suicide	Description
10/15/05	Iran	Ahvaz	Explosives	No	Two bombs placed in garbage cans exploded five minutes apart in a market, the Karoun mall, in Ahvaz. The attack occurred just after dusk as people bought food for the break-fast meal during Ramadan. The bombs caused significant damage to cars and shops in the vicinity, killed six people and wounded at least 102. Several explosive devices were detonated in the same area in June, prior to the Iranian elections. Iranian officials said that they suspected British involvement in the attacks, although British officials denied such a connection. Similar accusations have been made following other bombings in the region and in recent weeks as Iran believes British forces play a role in stirring unrest in the Khuzestan province. They also accused Israeli security agents from Mossad and Sin Bet of being involved in the attacks. On October 18, 2005, Iranian officials announced that they had detained more than 20 suspects in the bombings. On October 30, 2005, Ministry of Intelligence officials announced that 30 suspects arrested in connection with the bombing on this day and earlier the same year in June had confessed to their involvement and given information about their terrorist group and future attacks. Note: Casualties are for both bombings.

Table A.1—Continued

Date	Country	City	Weapon	Suicide	Description
12/5/05	Israel	Netanya	Explosives	Yes	A suicide bomber blew himself up outside of a mall in Netanya, killing five people and wounding at least 40. An off-duty security guard sitting in traffic outside the mall spotted a suspicious man carrying a black bag and alerted police in the car behind him. An officer then approached the individual. However, the bomber began to run, placing his hand inside the bag. The policewoman screamed for people to get away and a security guard was able to push the bomber from the crowded entrance. He then detonated his explosive device, killing himself, the security guard, and four others. The military wing of Islamic Jihad (al-Quds Brigades) claimed responsibility for the attack and identified the bomber as 23-year-old Lotfi Abu Saada from Illar, a village north of the West Bank town of Tulkarem. The man's family described him as illiterate and a primary school dropout. In response to the bombing, the Israeli defense ministry decided to resume killing Islamic Jihad leaders in the West Bank and to continue arrests in the territory. The day following the attack, Israel virtually banned all Palestinians from Israel and arrested 15 Palestinian militants, including eight Islamic Jihad operatives near the bomber's hometown (his father and brother were among those detained). The Palestinian Authority arrested 13 Islamic Jihad members in the West Bank. On December 7, 2005, an Israeli airstrike killed Mahmoud Arkhan, a leader of the Popular Resistance Committees, as he was traveling in Rafah. The attack wounded nine other Palestinians.

SOURCE: RAND-MIPT Terrorism Incident Database (2003).

APPENDIX B

Model Input Parameters and Results

Table B.1a
Security Option Effectiveness: Scenarios 1–9

		Scenario								
Option	**Effect**	**1. Sniper**	**2. Commando Attack—Outsider**	**3. Commando Attack—Insider**	**4. Hostage Taking—Outsider**	**5. Hostage Taking—Insider**	**6. Placed Bomb—Outsider**	**7. Placed Bomb (Hidden)—Insider**	**8. Pedestrian Suicide Bomber**	**9. Vehicle Bomb Outside**
1. Employee threat ID training[a]	Deter									
	Deny		0.33	0.33	0.33	0.33	0.5	0.1	0.15	0.1
	Mitigate									
2. Suspicious package reporting[a]	Deter						0.75			
	Deny						0.66			
	Mitigate									
3. Emergency response teams[b]	Deter									
	Deny									
	Mitigate	0.33	0.25	0.25	0.25	0.25	0.1	0.1	0.1	0.1
4. Employee background checks[c]	Deter			0.5		0.5		0.5		
	Deny									
	Mitigate									
5. Photo ID badge for contractors and delivery[d]	Deter		0.05		0.05		0.05			
	Deny		0.025		0.025		0.05			
	Mitigate									
6. Search bags and remove coats at entrances, open hours[e]	Deter		0.66		0.66		0.9		0.95	
	Deny		0.25		0.25		0.8		0.75	
	Mitigate									

Table B.1a—Continued

		Scenario								
Option	Effect	1. Sniper	2. Commando Attack—Outsider	3. Commando Attack—Insider	4. Hostage Taking—Outsider	5. Hostage Taking—Insider	6. Placed Bomb—Outsider	7. Placed Bomb (Hidden)—Insider	8. Pedestrian Suicide Bomber	9. Vehicle Bomb Outside
7. Mandatory coat and bag check, open hours[e]	Deter		0.66		0.66		0.9		0.95	
	Deny		0.25		0.25		0.8		0.75	
	Mitigate									
8. Metal detectors and search bags at entrances, open hours[e]	Deter		0.66		0.66		0.9		0.95	
	Deny		0.25		0.25		0.8		0.75	
	Mitigate									
9. Millimeter wave cameras at entrances, open hours[f]	Deter		0.66		0.66		0.33		0.95	
	Deny		0.25		0.25				0.75	
	Mitigate									
10. Trace detector portals at entrances, open hours[g]	Deter		0.5		0.5		0.95		0.95	
	Deny						0.95		0.75	
	Mitigate									
11. Dogs at entrances, open hours[g]	Deter		0.5		0.5		1.0		0.95	
	Deny						1.0		0.75	
	Mitigate									
12. Security guard at entrances, open hours[h]	Deter		0.25	0.1	0.25	0.1	0.25		0.33	
	Deny								0.1	
	Mitigate	0.25	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
13. Search bags and remove costs at entrances, closed[i]	Deter			0.765		0.765		0.9		
	Deny			0.765		0.765		0.9		
	Mitigate									
14. Mandatory coat and bag check, closed hours[i]	Deter			0.765		0.765		0.9		
	Deny			0.765		0.765		0.9		
	Mitigate									
15. Metal detectors and search bags at entrances, closed[i]	Deter			0.9		0.9		0.9		
	Deny			0.9		0.9		0.9		
	Mitigate									

Table B.1a—Continued

Option	Effect	Scenario								
		1. Sniper	2. Commando Attack—Outsider	3. Commando Attack—Insider	4. Hostage Taking—Outsider	5. Hostage Taking—Insider	6. Placed Bomb—Outsider	7. Placed Bomb (Hidden)—Insider	8. Pedestrian Suicide Bomber	9. Vehicle Bomb Outside
16. Millimeter wave cameras at entrances, closed hours[i]	Deter			0.855		0.855		0.3		
	Deny			0.855		0.855				
	Mitigate									
17. Trace detector portals at entrances, closed hours[i]	Deter			0.45		0.45		0.855		
	Deny							0.855		
	Mitigate									
18. Dogs at entrances, closed hours[i]	Deter			0.45		0.45		0.9		
	Deny							0.9		
	Mitigate									
19. Security guard at entrances, closed hours[i]	Deter			0.225		0.225		0.225		
	Deny									
	Mitigate									
20. Control access to service areas[j]	Deter	0.5					0.25			
	Deny	0.5								
	Mitigate									
21. Search carts/kiosks daily[k]	Deter			0.15		0.15		0.33		
	Deny			0.15		0.15		0.33		
	Mitigate									
22. Security with 100 percent visual coverage of common area[l]	Deter		0.25	0.25	0.25	0.25	0.5		0.33	
	Deny						0.33			
	Mitigate	0.25								0.1
23. Armed security with 100 percent visual coverage of common area[m]	Deter		0.75	0.75	0.75	0.75	0.5		0.33	
	Deny						0.33			
	Mitigate	0.25	0.66	0.66	0.66	0.66				0.1

Table B.1a—Continued

Option	Effect	Scenario									
		1. Sniper	2. Commando Attack—Outsider	3. Commando Attack—Insider	4. Hostage Taking—Outsider	5. Hostage Taking—Insider	6. Placed Bomb—Outsider	7. Placed Bomb (Hidden)—Insider	8. Pedestrian Suicide Bomber	9. Vehicle Bomb Outside
24. Police substation in center[n]	Deter		0.25	0.25	0.25	0.25				
	Deny									
	Mitigate		0.25	0.25	0.25	0.25				
25. More clearly label exits[o]	Deter									
	Deny									
	Mitigate		0.1	0.1	0.1	0.1				
26. Vehicle inspection at parking, open hours[p]	Deter									
	Deny									
	Mitigate									
27. Vehicle inspection and hydraulic bollards at parking, open hours[q]	Deter									
	Deny									
	Mitigate									
28. Loading dock access control[r]	Deter									
	Deny									
	Mitigate									
29. Loading dock access control and hydraulic bollards[s]	Deter									
	Deny									
	Mitigate									
30. Increase building standoff distance with bollard fence[t]	Deter									0.95
	Deny									0.95
	Mitigate									
31. Bollards at pedestrian entrances[u]	Deter									
	Deny									
	Mitigate									

Table B.1a—Continued

Option	Effect	Scenario								
		1. Sniper	2. Commando Attack—Outsider	3. Commando Attack—Insider	4. Hostage Taking—Outsider	5. Hostage Taking—Insider	6. Placed Bomb—Outsider	7. Placed Bomb (Hidden)—Insider	8. Pedestrian Suicide Bomber	9. Vehicle Bomb Outside
32. Dogs at parking and loading, open/ delivery hours[v]	Deter									
	Deny									
	Mitigate									
33. Explosive detectors at parking/ loading, open/ delivery hours[v]	Deter									
	Deny									
	Mitigate									
34. Air filters[w]	Deter									
	Deny									
	Mitigate									
35. Anthrax detectors[x]	Deter									
	Deny									
	Mitigate									
36. Anthrax detectors and filters[y]	Deter									
	Deny									
	Mitigate									
37. Chemical detectors[z]	Deter									
	Deny									
	Mitigate									
38. Chemical detector and individual protection[aa]	Deter									
	Deny									
	Mitigate									
39. Anthrax/ chemical detector and auto-response HVAC[bb]	Deter									
	Deny									
	Mitigate									

Table B.1a—Continued

NOTE: Deterrence estimates are based on the premise that alternate targets with no terrorism security are available and that terrorists will choose an alternate target when faced with convincing security measures. In cases in which detection is insufficient to deter or deny an attack (e.g., suicide attacks, where terrorists can crash checkpoints) not all detected attacks are deterred and even fewer are denied. In these cases, deterrence and denial effectiveness values are discounted to reflect feasibility of successfully completing a detected attack. Conversely, in other cases (e.g., getting placed bombs through some security screening checkpoints), deterrence effectiveness is greater than detection capability because terrorists are unfamiliar with the detection capabilities or because the mere existence of a checkpoint is a partial deterrent.

[a] With proper training, employees may be able to detect and report suspicious persons, packages, and vehicles; the primary limitation is that employees do not patrol center. Suspicious package reporting is similar but targets the public (shoppers) and focuses on suspicious packages only; detection ability is assumed to be extensive and rapid. Both have been very effective in reducing terrorism in transit systems in the United Kingdom (Taylor, 2005; Jenkins and Gerston, 2001).

[b] Limited impact in bomb attacks based on past casualty patterns (Arnold et al., 2004). Quick reaction can result in slightly higher effectiveness for gunfire attacks.

[c] Assumed to catch 50 percent of terrorists applying for jobs.

[d] Assumed 100-percent effective in deterring imposters, but assume imposter is only 5 percent of outsider threat.

[e] Highly effective at detecting guns, bombs, and anthrax devices.

[f] Same as e but only for person-carried items, so less effective against placed bomb and anthrax device.

[g] Very effective for bombs but will not detect guns or anthrax devices.

[h] Provides limited deterrence and very limited mitigation.

[i] Same as e–h applied to insider attacks except that detection is decreased by 10 percent to account for possibility that materials are brought in via loading dock rather than customer entrance and that detection is a perfect deterrent because there is no incentive to crash a checkpoint during closed hours.

[j] Primary effectiveness is denying access to rooftop for sniper scenario.

[k] Very effective for detecting insider guns, bombs, and chemical or biological devices, but overall effectiveness discounted to account for other possible locations these items could be stored.

[l] Increased security presence provides some deterrence and minimal mitigation for some scenarios.

[m] Similar to l but with much greater deterrence and mitigation for gunfire scenarios.

[n] Minimal deterrence and mitigation for gunfire scenarios.

[o] Minor mitigation value for gunfire scenarios.

[p] Effective for detecting car bombs.

[q] Same as p but no deter or deny discount for suicide attack.

[r] Effective for detecting imposter deliveries.

[s] Same as r but no deter or deny discount for suicide attack.

[t] Very effective at preventing car bombs outside center and crashing into center.

[u] Very effective at preventing car bombs crashing into center.

[v] Very effective at detecting vehicle bombs.

Table B.1a—Continued

[w] Appropriate filters remove anthrax in approximately one hour where it would otherwise remain airborne up to 24 hours, thereby reducing the number of victims. Presence of filters would not be publicly known, so option is a strong deterrent to insiders only.

[x] New technologies allow real-time anthrax detection that will trigger alarm and allow evacuation and rapid administration of antibiotics to reduce number of victims.

[y] Same deterrence and combined mitigation benefit of filters and detectors.

[z] Strong deterrence for chemical attack; mitigation is moderate because attack will be apparent quickly from victim reactions, decreasing benefit of detector alarm.

[aa] Adds moderate deterrence for anthrax attack (less for insiders, who know chemical detector cannot detect anthrax) and minimal mitigation for anthrax attack (in the case that an anthrax attack is recognized in real time); decreases mitigation for chemical attack because taking time to locate and don escape hoods increases exposure.

[bb] Best chemical-biological option—strong deterrence and mitigation effectiveness.

Table B.1b
Security Option Effectiveness: Scenarios 10–17

		Scenario							
Option	Effect	10. Car Bomb in Mall—Crash in from Street	11. Car Bomb in Underground Parking—Break In	12. Suicide Car Bomb in Underground Parking—Crash Entrance	13. Truck Bomb in Loading Dock—Break In	14. Suicide Truck Bomb in Loading Dock—Crash Entrance	15. Anthrax Release from Unattended Device—Outsider	16. Anthrax Release from Unattended Device—Insider	17. Chemical Release from Cart/Kiosk
1. Employee threat ID training[a]	Deter								0.5
	Deny				0.1		0.5	0.5	0.33
	Mitigate								
2. Suspicious package reporting[a]	Deter						0.75		
	Deny						0.66		
	Mitigate								
3. Emergency response teams[b]	Deter								
	Deny								
	Mitigate	0.1	0.1	0.1	0.1	0.1			0.25
4. Employee background checks[c]	Deter							0.5	0.5
	Deny								
	Mitigate								
5. Photo ID badge for contractors and delivery[d]	Deter						0.05		
	Deny						0.05		
	Mitigate								

Table B.1b—Continued

Option	Effect	Scenario							
		10. Car Bomb in Mall—Crash in from Street	11. Car Bomb in Underground Parking—Break In	12. Suicide Car Bomb in Underground Parking—Crash Entrance	13. Truck Bomb in Loading Dock—Break In	14. Suicide Truck Bomb in Loading Dock—Crash Entrance	15. Anthrax Release from Unattended Device—Outsider	16. Anthrax Release from Unattended Device—Insider	17. Chemical Release from Cart/Kiosk
6. Search bags and remove coats at entrances, open hours[e]	Deter						0.9		
	Deny						0.8		
	Mitigate								
7. Mandatory coat and bag check, open hours[e]	Deter						0.9		
	Deny						0.8		
	Mitigate								
8. Metal detectors and search bags at entrances, open hours[e]	Deter						0.9		
	Deny						0.8		
	Mitigate								
9. Millimeter wave cameras at entrances, open hours[f]	Deter						0.33		
	Deny								
	Mitigate								
10. Trace detector portals at entrances, open hours[g]	Deter						0.5		
	Deny								
	Mitigate								
11. Dogs at entrances, open hours[g]	Deter						0.5		
	Deny								
	Mitigate								
12. Security guard at entrances, open hours[h]	Deter						0.25		
	Deny								
	Mitigate	0.1	0.1	0.1	0.1	0.1			0.1
13. Search bags and remove costs at entrances, closed[i]	Deter							0.9	
	Deny							0.9	
	Mitigate								

Table B.1b—Continued

		Scenario							
Option	Effect	10. Car Bomb in Mall—Crash in from Street	11. Car Bomb in Underground Parking—Break In	12. Suicide Car Bomb in Underground Parking—Crash Entrance	13. Truck Bomb in Loading Dock—Break In	14. Suicide Truck Bomb in Loading Dock—Crash Entrance	15. Anthrax Release from Unattended Device—Outsider	16. Anthrax Release from Unattended Device—Insider	17. Chemical Release from Cart/Kiosk
14. Mandatory coat and bag check, closed hours[i]	Deter							0.9	
	Deny							0.9	
	Mitigate								
15. Metal detectors and search bags at entrances, closed[i]	Deter							0.9	
	Deny							0.9	
	Mitigate								
16. Millimeter wave cameras at entrances, closed hours[i]	Deter							0.3	
	Deny								
	Mitigate								
17. Trace detector portals at entrances, closed hours[i]	Deter							0.45	
	Deny								
	Mitigate								
18. Dogs at entrances, closed hours[i]	Deter							0.45	
	Deny								
	Mitigate								
19. Security guard at entrances, closed hours[i]	Deter							0.225	
	Deny								
	Mitigate								
20. Control access to service areas[j]	Deter								
	Deny								
	Mitigate								
21. Search carts/kiosks daily[k]	Deter							0.15	0.9
	Deny							0.15	0.75
	Mitigate								

Table B.1b—Continued

		Scenario								
Option	Effect	10. Car Bomb in Mall—Crash in from Street	11. Car Bomb in Underground Parking—Break In	12. Suicide Car Bomb in Underground Parking—Crash Entrance	13. Truck Bomb in Loading Dock—Break In	14. Suicide Truck Bomb in Loading Dock—Crash Entrance	15. Anthrax Release from Unattended Device—Outsider	16. Anthrax Release from Unattended Device—Insider	17. Chemical Release from Cart/Kiosk
22. Security with 100 percent visual coverage of common area[l]	Deter						0.5		
	Deny						0.33		
	Mitigate	0.1	0.1	0.1	0.1	0.1			0.25
23. Armed security with 100 percent visual coverage of common area[m]	Deter						0.5		
	Deny						0.33		
	Mitigate	0.1	0.1	0.1	0.1	0.1			0.25
24. Police substation in center[n]	Deter								
	Deny								
	Mitigate								
25. More clearly label exits[o]	Deter								
	Deny								
	Mitigate								0.1
26. Vehicle inspection at parking, open hours[p]	Deter		0.85	0.425					
	Deny		0.66	0.2					
	Mitigate								
27. Vehicle inspection and hydraulic bollards at parking, open hours[q]	Deter		0.85	0.85					
	Deny		0.66	0.66					
	Mitigate								
28. Loading dock access control[r]	Deter				0.85	0.425			
	Deny				0.85	0.15			
	Mitigate								
29. Loading dock access control and hydraulic bollards[s]	Deter				0.85	0.85			
	Deny				0.85	0.85			
	Mitigate								

Table B.1b—Continued

		Scenario							
Option	Effect	10. Car Bomb in Mall—Crash in from Street	11. Car Bomb in Underground Parking—Break In	12. Suicide Car Bomb in Underground Parking—Crash Entrance	13. Truck Bomb in Loading Dock—Break In	14. Suicide Truck Bomb in Loading Dock—Crash Entrance	15. Anthrax Release from Unattended Device—Outsider	16. Anthrax Release from Unattended Device—Insider	17. Chemical Release from Cart/Kiosk
30. Increase building standoff distance with bollard fence[t]	Deter	0.95							
	Deny	0.9							
	Mitigate								
31. Bollards at pedestrian entrances[u]	Deter	0.95							
	Deny	0.9							
	Mitigate								
32. Dogs at parking and loading, open/ delivery hours[v]	Deter		1.0	0.5	1.0	0.5			
	Deny		0.95	0.2	0.95	0.2			
	Mitigate								
33. Explosive detectors at parking/ loading, open/ delivery hours[v]	Deter		1.0	0.5	1.0	0.5			
	Deny		0.9	0.2	0.9	0.2			
	Mitigate								
34. Air filters[w]	Deter							0.75	
	Deny								
	Mitigate						0.5	0.5	
35. Anthrax detectors[x]	Deter						0.75	0.75	
	Deny								
	Mitigate						0.66	0.66	
36. Anthrax detectors and filters[y]	Deter						0.75	0.75	
	Deny								
	Mitigate						0.82	0.82	
37. Chemical detectors[z]	Deter								0.75
	Deny								
	Mitigate								0.33

Table B.1b—Continued

		Scenario							
Option	Effect	10. Car Bomb in Mall—Crash in from Street	11. Car Bomb in Underground Parking—Break In	12. Suicide Car Bomb in Underground Parking—Crash Entrance	13. Truck Bomb in Loading Dock—Break In	14. Suicide Truck Bomb in Loading Dock—Crash Entrance	15. Anthrax Release from Unattended Device—Outsider	16. Anthrax Release from Unattended Device—Insider	17. Chemical Release from Cart/Kiosk
38. Chemical detector and individual protection[aa]	Deter						0.5	0.25	0.75
	Deny								
	Mitigate						0.1	0.1	0.25
39. Anthrax/ chemical detector and auto-response HVAC[bb]	Deter						0.75	0.75	0.75
	Deny								
	Mitigate						0.82	0.82	0.82

NOTE: Deterrence estimates are based on the premise that alternate targets with no terrorism security are available and that terrorists will choose an alternate target when faced with convincing security measures. In cases in which detection is insufficient to deter or deny an attack (e.g., suicide attacks, where terrorists can crash checkpoints), not all detected attacks are deterred and even fewer are denied. In these cases, deterrence and denial effectiveness values are discounted to reflect feasibility of successfully completing a detected attack. Conversely, in other cases (e.g., getting placed bombs through some security screening checkpoints), deterrence effectiveness is greater than detection capability because terrorists are unfamiliar with the detection capabilities or because the mere existence of a checkpoint is a partial deterrent.

[a] With proper training, employees may be able to detect and report suspicious persons, packages, and vehicles; the primary limitation is that employees do not patrol center. Suspicious package reporting is similar but targets the public (shoppers) and focuses on suspicious packages only; detection ability is assumed to be extensive and rapid. Both have been very effective in reducing terrorism in transit systems in the United Kingdom (Taylor, 2005; Jenkins and Gerston, 2001).

[b] Limited impact in bomb attacks based on past casualty patterns (Arnold et al., 2004). Quick reaction can result in slightly higher effectiveness for gunfire attacks.

[c] Assumed to catch 50 percent of terrorists applying for jobs.

[d] Assumed 100-percent effective in deterring imposters, but assume imposter is only 5 percent of outsider threat.

[e] Highly effective at detecting guns, bombs, and anthrax devices.

[f] Same as e but only for person-carried items, so less effective against placed bomb and anthrax device.

[g] Very effective for bombs but will not detect guns or anthrax devices.

[h] Provides limited deterrence and very limited mitigation.

[i] Same as e–h applied to insider attacks except that detection is decreased by 10 percent to account for possibility that materials are brought in via loading dock rather than customer entrance and that detection is a perfect deterrent because there is no incentive to crash a checkpoint during closed hours.

[j] Primary effectiveness is denying access to rooftop for sniper scenario.

Table B.1b—Continued

[k] Very effective for detecting insider guns, bombs, and chemical or biological devices, but overall effectiveness discounted to account for other possible locations these items could be stored.

[l] Increased security presence provides some deterrence and minimal mitigation for some scenarios.

[m] Similar to l but with much greater deterrence and mitigation for gunfire scenarios.

[n] Minimal deterrence and mitigation for gunfire scenarios.

[o] Minor mitigation value for gunfire scenarios.

[p] Effective for detecting car bombs.

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[r] Effective for detecting imposter deliveries.

[s] Same as r but no deter or deny discount for suicide attack.

[t] Very effective at preventing car bombs outside center and crashing into center.

[u] Very effective at preventing car bombs crashing into center.

[v] Very effective at detecting vehicle bombs.

[w] Appropriate filters remove anthrax in approximately one hour where it would otherwise remain airborne up to 24 hours, thereby reducing the number of victims. Presence of filters would not be publicly known, so option is a strong deterrent to insiders only.

[x] New technologies allow real-time anthrax detection that will trigger alarm and allow evacuation and rapid administration of antibiotics to reduce number of victims.

[y] Same deterrence and combined mitigation benefit of filters and detectors.

[z] Strong deterrence for chemical attack; mitigation is moderate because attack will be apparent quickly from victim reactions, decreasing benefit of detector alarm.

[aa] Adds moderate deterrence for anthrax attack (less for insiders, who know chemical detector cannot detect anthrax) and minimal mitigation for anthrax attack (in the case that an anthrax attack is recognized in real time); decreases mitigation for chemical attack because taking time to locate and don escape hoods increases exposure.

[bb] Best chemical-biological option—strong deterrence and mitigation effectiveness.

Table B.2
Security Option Cost Elements

Option ID	Security Option	Notes
1	Employee threat ID training	Training is a two-hour course. Cost includes employee time plus course. Time cost: $12/hour/employee; number of employees is based on center staffing level adjusted to full-time equivalent positions and assuming 50 percent of employees are full time and 50 percent are half time. Assume average tenure is one year, so must train all employees each year. Course cost: approximately $1,500/lecture; conduct course in groups of 400 (in theater).
2	Suspicious package reporting	Cost is lost advertising space: $300/month/sign. Number of signs varies with center size.

Table B.2—Continued

Option ID	Security Option	Notes
3	Emergency response teams	Training is a full-day course for selected employees forming response teams. Cost includes employee time plus course. Time cost: $15/hour/employee (managers); number of team members is based on one member per every five stores always on-site or two members per every five stores trained at any time. Assume average tenure is one year, so must train all members each year. Course cost: Emergency response team course for 13–20 people = $5,210 + $24/person for materials (Life Safety Associates, undated).
4	Employee background checks	$150/employee (Best Background Checks, undated).
5	Photo ID badge for contractors and delivery	Labor: administration (enrolling and de-enrolling) = 20 hours/week. Equipment: ID card printer = $2,500, ID cards = $1/person (Evolution ID Card Systems and Badge Supplies, undated; Incode Corporation, undated).
6	Search bags and remove coats at entrances, open hours	Labor: security staff = $10/hour (U.S. Bureau of Labor Statistics, 2005), average 1.5 staff/entrance. Equipment: search table/station = $500/entrance.
7	Mandatory coat and bag check, open hours	Labor: $10/hour (U.S. Bureau of Labor Statistics, 2005), 2 staff/entrance. Lost rent: storage space = 10' by 15' space * $150/sq ft/month.
8	Metal detectors and search bags at entrances, open hours	Labor: equipment operators = $15/hour, average 1.5 operators per detector. Equipment: $7,500 per detector installed (Garrett Metal Detectors, undated), 1 detector/entrance.
9	Millimeter wave cameras at entrances, open hours	Labor: equipment operators = $15/hour, average 1.5 operators per detector. Equipment: Brijot BIS-WDS™ Prime = $65,000 each (Andrew, 2006); need 2 cameras/entrance to scan front and back.
10	Trace detector portals at entrances, open hours	Labor: equipment operators = $15/hour, average 1.5 operators per detector. Equipment: Smiths IonScan = $150,000 each (Laustra, 2006), 1 detector/entrance. Maintenance = $5,000/detector/year.
11	Dogs at entrances, open hours	2 dog teams (team = 1 dog + 1 handler) can staff a continuous portal. Labor: handler = $20/hour, 2 handlers/entrance. Equipment: bomb dog = $12,000 (service life = 5 years). Maintenance: 1 week of formal training per year + food + vet = $5,000/team/year (Reaver, 2006).
12	Security guard at entrances, open hours	Labor: $10/hour (U.S. Bureau of Labor Statistics, 2005).
13	Search bags and remove coats at entrances, closed hours	Labor: $10/hour (U.S. Bureau of Labor Statistics, 2005), 1 staff/entrance, use only 1 entrance during closed hours. Equipment (Center A only): add gates to close entrances at night = $5,000/gate.
14	Mandatory coat and bag check, closed hours	Labor: $10/hour (U.S. Bureau of Labor Statistics, 2005), 1 staff/entrance, use only 1 entrance during closed hours. Lost rent: storage space = 10' by 15' space * $150/sq ft/month.
15	Metal detectors and search bags at entrances, closed hours	Labor: equipment operators = $15/hour, 1 operator per detector. Equipment: $7,500 per detector installed (Garrett Metal Detectors, undated), 1 detector/entrance; use only 1 entrance during closed hours.
16	Millimeter wave cameras at entrances, closed hours	Labor: equipment operators = $15/hour, 1 operator per detector. Equipment: Brijot BIS-WDS™ Prime = $65,000 each (Andrew, 2006); use only 1 entrance during closed hours; can use 1 camera because can have people turn around.
17	Trace detector portals at entrances, closed hours	Labor: equipment operators = $15/hour, 1 operator per detector. Equipment: Smiths IonScan Sentinel II = $150,000 each (Laustra, 2006), 1 detector/entrance, use only 1 entrance during closed hours. Maintenance = $5,000/detector/year.

Table B.2—Continued

Option ID	Security Option	Notes
18	Dogs at entrances, closed hours	Labor: handler = $20/hour, 1 handler/entrance (assume traffic low enough that 1 team is enough; use only 1 entrance during closed hours). Equipment: bomb dog = $12,000 (service life = 5 years). Maintenance: 1 week of formal training per year + food + vet = $5,000/team/year (Reaver, 2006).
19	Security guard at entrances, closed hours	Labor: $10/hour (U.S. Bureau of Labor Statistics, 2005); use only 1 entrance during closed hours.
20	Control access to service areas	Labor: administration (enroll/de-enroll) = 20 hours/week. Equipment: Omnilocks = $1,500/door (OSI Security Devices, undated), ID card printer = $2,500, ID cards = $1/person (Evolution ID Card Systems and Badge Supplies, undated).
21	Search carts/kiosks daily	Search requires 5 minutes/cart/day. Labor: $10/hour.
22	Security with 100 percent visual coverage of common area	Security currently has approximately 30 percent visual coverage, so need to triple guard staff. Labor: $10/hour.
23	Armed security with 100 percent visual coverage of common area	Armed guards make $8,000/year more than unarmed guards do.
24	Police substation in center	Small store space staffed with an officer and an aide. Labor: $100,000/year for officer and $50,000/year for aide. Lost rent: 20' by 20' space * $150/sq ft/month.
25	More clearly label exits	More exit signage, lights, and arrows; $500/entrance.
26	Vehicle inspection at parking, open hours	Labor: $10/hour, 2 staff/entrance.
27	Vehicle inspection and hydraulic bollards at parkingo open hours	Labor: $10/hour, 2 staff/entrance. Equipment: 3-bollard hydraulic system installed = $75,000/entrance + in-ground tiger-teeth barrier = $1,000/exit (Kessinger, 2004; Texas Security Gates, undated).
28	Loading dock access control	Labor: $10/hour, 1 staff/entrance.
29	Loading dock access control and hydraulic bollards	Labor: $10/hour, 1 staff/entrance. Equipment: $76,000/entrance (3-bollard hydraulic system installed = $75,000/entrance + in-ground tiger-teeth barrier = $1,000/exit (Kessinger, 2004; Texas Security gates, undated).
30	Increase building standoff distance with bollard fence	Equipment: security planters = $200 per linear foot of perimeter protection (Stonewear Force Protection, undated)
31	Bollards at pedestrian entrances	Equipment: security planters = $200 per linear foot of perimeter protection (Stonewear Force Protection, undated), 30 feet/entrance.
32	Dogs at parking and loading, open/delivery hours	2 dog teams/entrance (team = 1 dog + 1 handler) can staff a continuous portal. Labor: handler = $20/hour, 2 handlers/entrance. Equipment: bomb dog = $12,000 (service life = 5 years). Maintenance: 1 week of formal training per year + food + vet = $5,000/team/year (Reaver, 2006).
33	Explosive detectors at parking/loading, open/delivery hours	Labor: equipment operators = $15/hour, 2 operators/entrance. Equipment: HiET car bomb finder = $950,000 (Moore, 2006), 1 detector/entrance. Maintenance = $5,000/detector/year.
34	Air filters	Equipment: $15/sq ft. Maintenance = $0.50/sq ft/year (NIOSH, 2003).

Table B.2—Continued

Option ID	Security Option	Notes
35	Anthrax detectors	Equipment: $80,000/detector, 1 detector/250,000 sq ft. Maintenance = $6,000/year/detector (Ettehadieh, 2006).
36	Anthrax detectors and filters	Sum of options 34 and 35.
37	Chemical detectors	Equipment: chemical agent detector = $10,000, 1 detector/75,000 sq ft. Maintenance = $1,000/detector/year.
38	Chemical detector and individual protection	Option 37 costs + QuickMasks = $165/mask, 7,500–10,000 masks/center, 4-year shelf life (Quick Mask, undated).
39	Anthrax/chemical detector and auto-response HVAC	Option 37 costs + $2 million modification to air-handling system.

Table B.3
Security Option Annual Costs for Centers

Option ID	Security Option	Center A ($)	Center B ($)	Center C ($)
1	Employee threat ID training	54,029	153,180	104,063
2	Suspicious package reporting	36,000	72,000	54,000
3	Emergency response teams	22,830	47,388	32,360
4	Employee background checks	292,050	828,000	562,500
5	Photo ID badge for contractors and delivery	20,750	21,000	20,850
6	Search bags and remove coats at entrances, open hours	684,600	1,675,550	270,250
7	Mandatory coat and bag check, open hours	1,182,000	2,502,000	630,000
8	Metal detectors and search bags at entrances, open hours	1,035,000	2,534,250	416,250
9	Millimeter wave cameras at entrances, open hours	1,182,000	2,914,000	477,500
10	Trace detector portals at entrances, open hours	1,266,000	3,131,000	512,500
11	Dogs at entrances, open hours	2,001,600	4,922,800	804,000
12	Security guard at entrances, open hours	456,000	1,116,000	180,000
13	Search bags and remove coats at entrances, closed hours	54,500	51,000	51,000
14	Mandatory coat and bag check, closed hours	54,500	51,000	51,000
15	Metal detectors and search bags at entrances, closed hours	80,250	77,750	76,750
16	Millimeter wave cameras at entrances, closed hours	86,000	83,500	82,500
17	Trace detector portals at entrances, closed hours	99,500	97,000	96,000

Table B.3—Continued

Option ID	Security Option	Center A ($)	Center B ($)	Center C ($)
18	Dogs at entrances, closed hours	117,400	110,400	109,400
19	Security guard at entrances, closed hours	54,500	51,000	51,000
20	Control access to service areas	24,050	26,300	24,800
21	Search carts/kiosks daily	4,710	24,150	5,250
22	Security with 100 percent visual coverage of common area	608,000	576,000	576,000
23	Armed security with 100 percent visual coverage of common area	736,000	704,000	704,000
24	Police substation in center	870,000	870,000	870,000
25	More clearly label exits	1,000	2,000	550
26	Vehicle inspection at parking, open hours	228,000	72,000	—
27	Vehicle inspection and hydraulic bollards at parking, open hours	250,500	79,500	—
28	Loading dock access control	—	216,000	72,000
29	Loading dock access control and hydraulic bollards	15,000	261,000	87,000
30	Increase building standoff distance with bollard fence	—	90,000	—
31	Bollards at pedestrian entrances	1,800	8,000	3,000
32	Dogs at parking and loading, open/delivery hours	822,000	938,400	316,800
33	Explosive detectors at parking/loading, open/delivery hours	1,070,000	1,248,000	420,000
34	Air filters	—	4,000,000	2,000,000
35	Anthrax detectors	—	56,000	42,000
36	Anthrax detectors and filters	—	4,056,000	2,042,000
37	Chemical detectors	—	210,000	235,000
38	Chemical detector and individual protection	—	622,500	544,375
39	Anthrax/chemical detector and auto-response HVAC	—	356,000	342,000

Figure B.1
Collateral Benefits and Detriments of Security Options

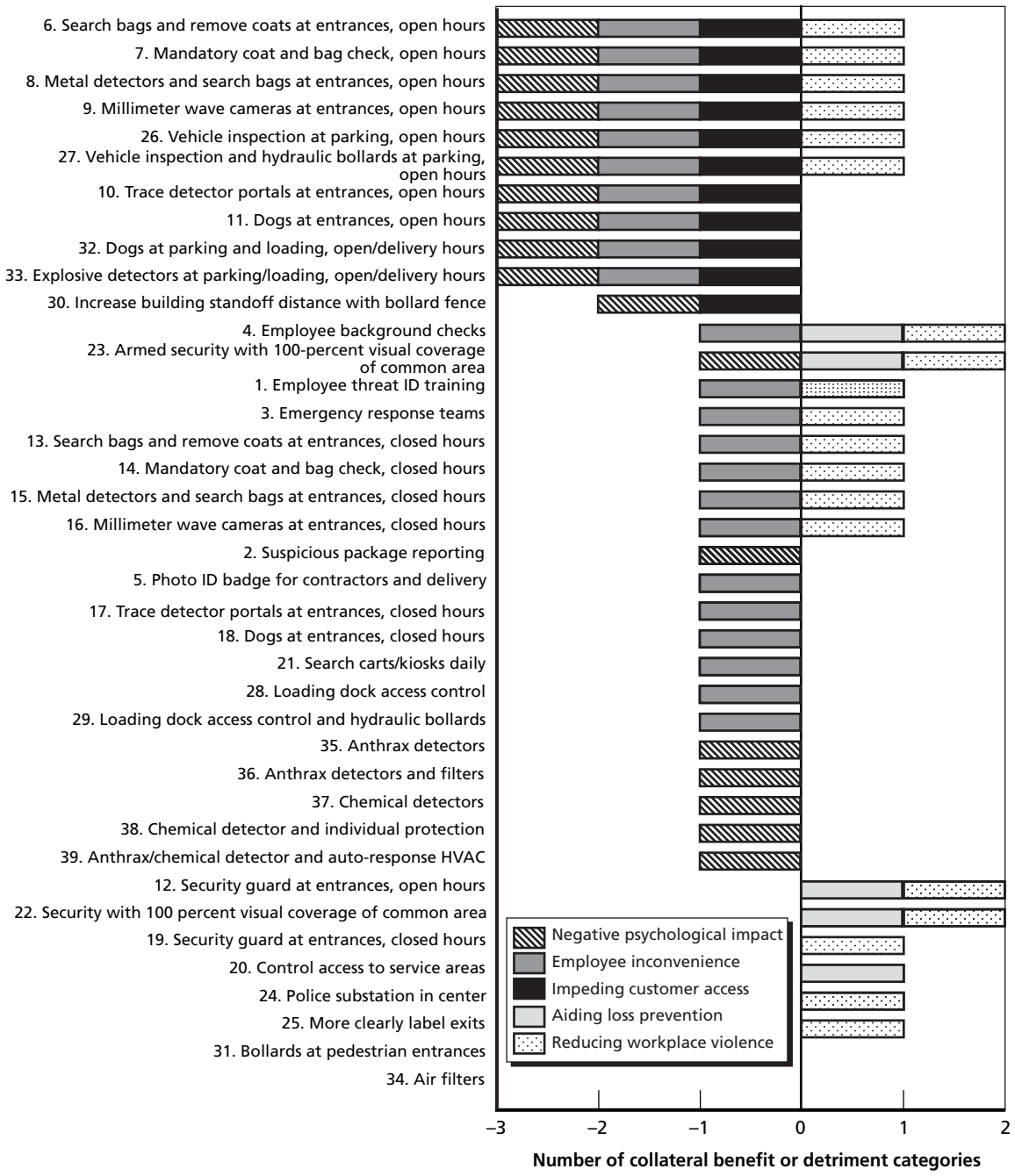

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Table B.4
Prioritized Security Options for Center A

Rank	Option	Annual Cost ($)	Cumulative Annual Cost ($)	Cumulative Relative Risk	Fraction of Total Risk Reduction
1	2. Suspicious package reporting	36,000	36,000	0.455	0.5731
2	31. Bollards at pedestrian entrances	1,800	37,800	0.442	0.5872
3	21. Search carts/kiosks daily	4,710	42,510	0.408	0.6226
4	25. More clearly label exits	1,000	43,510	0.405	0.6259
5	13. Search bags and remove coats at entrances, closed hours	54,500	98,010	0.377	0.6556
6	3. Emergency response teams	22,830	120,840	0.331	0.7035
7	1. Employee threat ID training	54,029	174,870	0.277	0.7614
8	20. Control access to service areas	24,050	198,920	0.263	0.7759
9	6. Search bags and remove coats at entrances, open hours	684,600	883,520	0.126	0.9206
10	26. Vehicle inspection at parking, open hours	228,000	1,111,520	0.067	0.9829
11	32. Dogs at parking and loading, open/delivery hours	822,000	1,933,520	0.062	0.9879
12	23. Armed security with 100 percent visual coverage of common area	736,000	2,669,520	0.052	0.9983
13	29. Loading dock access control and hydraulic bollards	15,000	2,684,520	0.052	0.9984
14	18. Dogs at entrances, closed hours	117,400	2,801,920	0.052	0.9986
15	10. Trace detector portals at entrances, open hours	1,266,000	4,067,920	0.051	0.9999
16	5. Photo ID badge for contractors and delivery	20,750	4,088,670	0.051	0.9999
17	9. Millimeter wave cameras at entrances, open hours	1,182,000	5,270,670	0.051	1.0000
18	16. Millimeter wave cameras at entrances, closed hours	86,000	5,356,670	0.051	1.0000
19	24. Police substation in center	870,000	6,226,670	0.051	1.0000
20	4. Employee background checks	292,050	6,518,720	0.051	1.0000

NOTES: Chemical and biological weapon scenarios (scenarios 15–17) and options that apply only to chemical and biological weapons (options 34–39) are excluded from this analysis because Center A is outdoors. Loading Dock Access Control (option 28) is excluded from this analysis because this option is already implemented at Center A. Increase building standoff distance with bollard fence (option 30) is excluded from this analysis because there is no space for a standoff zone at Center A.

Table B.5
Prioritized Security Options for Center B

Rank	Option	Annual Cost ($)	Cumulative Annual Cost ($)	Cumulative Relative Risk	Fraction of Total Risk Reduction
1	2. Suspicious package reporting	72,000	72,000	0.4567	0.5713
2	31. Bollards at pedestrian entrances	8,000	80,000	0.4434	0.5854
3	13. Search bags and remove coats at entrances, closed hours	51,000	131,000	0.3820	0.6501
4	26. Vehicle inspection at parking, open hours	72,000	203,000	0.3169	0.7188
5	25. More clearly label exits	2,000	205,000	0.3138	0.7220
6	20. Control access to service areas	26,300	231,300	0.2894	0.7478
7	3. Emergency response teams	47,388	278,688	0.2554	0.7837
8	6. Search bags and remove coats at entrances, open hours	1,675,550	1,954,238	0.0783	0.9705
9	21. Search carts/kiosks daily	24,150	1,978,388	0.0768	0.9721
10	1. Employee threat ID training	153,180	2,131,568	0.0685	0.9809
11	32. Dogs at parking and loading, open/ delivery hours	938,400	3,069,968	0.0618	0.9879
12	23. Armed security with 100 percent visual coverage of common area	704,000	3,773,968	0.0520	0.9983
13	18. Dogs at entrances, closed hours	110,400	3,884,368	0.0518	0.9985
14	5. Photo ID badge for contractors and delivery	21,000	3,905,368	0.0517	0.9986
15	10. Trace detector portals at entrances, open hours	3,131,000	7,036,368	0.0506	0.9998
16	29. Loading dock access control and hydraulic bollards	261,000	7,297,368	0.0505	0.9999
17	16. Millimeter wave cameras at entrances, closed hours	83,500	7,380,868	0.0505	0.9999
18	24. Police substation in center	870,000	8,250,868	0.0504	0.9999
19	39. Anthrax/chemical detector and auto-response HVAC	356,000	8,606,868	0.0504	0.9999
20	9. Millimeter wave cameras at entrances, open hours	2,914,000	11,520,868	0.0504	1.0000
21	4. Employee background checks	828,000	12,348,868	0.0504	1.0000
22	34. Air filters	4,000,000	16,348,868	0.0504	1.0000

Table B.6
Prioritized Security Options for Center C

Rank	Option	Annual Cost ($)	Cumulative Annual Cost ($)	Cumulative Relative Risk	Fraction of Total Risk Reduction
1	2. Suspicious package reporting	54,000	54,000	0.4048	0.6271
2	31. Bollards at pedestrian entrances	3,000	57,000	0.3902	0.6425
3	21. Search carts/kiosks daily	5,250	62,250	0.3518	0.6831
4	25. More clearly label exits	550	62,800	0.3483	0.6867
5	6. Search bags and remove coats at entrances, open hours	270,250	333,050	0.1158	0.9326
6	13. Search bags and remove coats at entrances, closed hours	51,000	384,050	0.0849	0.9652
7	3. Emergency response teams	32,360	416,410	0.0753	0.9753
8	28. Loading dock access control	72,000	488,410	0.0729	0.9779
9	1. Employee threat ID training	104,063	592,473	0.0638	0.9875
10	9. Millimeter wave cameras at entrances, open hours	477,500	1,069,973	0.0594	0.9921
11	23. Armed security with 100 percent visual coverage of common area	704,000	1,773,973	0.0525	0.9994
12	18. Dogs at entrances, closed hours	109,400	1,883,373	0.0523	0.9997
13	11. Dogs at entrances, open hours	804,000	2,687,373	0.0521	0.9999
14	32. Dogs at parking and loading, open/delivery hours	316,800	3,004,173	0.0520	1.0000
15	5. Photo ID badge for contractors and delivery	20,850	3,025,023	0.0520	1.0000
16	16. Millimeter wave cameras at entrances, closed hours	82,500	3,107,523	0.0520	1.0000
17	39. Anthrax/chemical detector and auto-response HVAC	342,000	3,449,523	0.0520	1.0000
18	24. Police substation in center	870,000	4,319,523	0.0520	1.0000
19	4. Employee background checks	562,500	4,882,023	0.0520	1.0000
20	34. Air filters	2,000,000	6,882,023	0.0520	1.0000
21	20. Control access to service areas	24,800	6,906,823	0.0520	1.0000

NOTES: Car bomb in underground parking scenarios (scenarios 11 and 12) and options that apply only to these scenarios (options 26 and 27) are excluded from this analysis because Center C has no underground parking. Increase building standoff distance with bollard fence (option 30) is excluded from this analysis because there is no space for a standoff zone at Center C.

References

Andrew, Brian, Brijot Imaging Systems, Inc., meeting with the authors, product demonstration, Marriott Los Angeles Downtown, March 24, 2006.

Arnold, Jeffrey L., Pinchas Halpern, Ming-Che Tsai, and Howard Smithline, "Mass Casualty Terrorist Bombings: A Comparison of Outcomes by Bombing Type," *Annals of Emergency Medicine*, Vol. 43, No. 2, February 2004, pp. 263–273.

The Bellwether Group, Inc., *Disaster and Terrorism Preparedness: An Examination of the State of Corporate Preparedness in the US Among Eight Leading Corporations*, Boston, Mass.: The Bellwether Group, Inc., 2005.

Best Background Checks, "Employment Background Check," undated Web page. Online at http://www.bestbackgroundchecks.com/employment.html (as of September 25, 2006).

"Bomber Leaves Video," *The Jerusalem Post*, May 20, 2001, p. 2.

Briggs, Rachel, ed., *The Unlikely Counter-Terrorists*, London: Foreign Policy Center, 2002. Online at http://fpc.org.uk/fsblob/45.pdf (as of October 18, 2006).

Carroll, Stephen J., Tom LaTourrette, Brian G. Chow, Gregory S. Jones, and Craig Martin, *Distribution of Losses from Large Terrorist Attacks Under the Terrorism Risk Insurance Act*, Santa Monica, Calif.: RAND Corporation, MG-427-CTRMP, 2005. Online at http://www.rand.org/pubs/monographs/MG427/index.html (as of September 23, 2006).

Clarke, Ronald V., "Situational Crime Prevention: Its Theoretical Basis and Practical Scope," in Michael H. Tonry and Norval Morris, eds., *Crime and Justice: An Annual Review of Research*, Vol. 4, Chicago, Ill.: University of Chicago Press, 1983, pp. 225–256.

DeLisle, James R., *Shopping Center Classifications: Challenges and Opportunities*, New York: International Council of Shopping Centers, September 2005. Online at http://www.icsc.org/srch/rsrch/wp/USSC_Class_091305.pdf (as of September 23, 2006).

Dixon, Lloyd, Stephen J. Carroll, Darius N. Lakdawalla, Robert T. Reville, and David Adamson, *Issues and Options for Government Intervention in the Market for Terrorism Insurance*, Santa Monica, Calif.: RAND Corporation, OP-135-ICJ, 2004. Online at http://www.rand.org/pubs/occasional_papers/OP135/ (as of September 23, 2006).

Ettehadieh, Amir, Universal Detection Technology, telephone conversation with the authors, February 23, 2006.

Evolution ID Card Systems and Badge Supplies, undated homepage. Online at http://www.evolution-1.com (as of September 26, 2006).

Farmer, Richard D., *Homeland Security and the Private Sector*, Washington, D.C.: Congress of the United States, Congressional Budget Office, 2004. Online at http://purl.access.gpo.gov/GPO/LPS70724 (as of September 23, 2006).

Federal Emergency Management Agency, *Primer for Design of Commercial Buildings to Mitigate Terrorist Attacks: Providing Protection to People and Buildings*, Washington, D.C.: FEMA, December 2003a. Online at http://purl.access.gpo.gov/GPO/LPS44083 (as of September 23, 2006).

———, *Reference Manual to Mitigate Potential Terrorist Attacks Against Buildings: Providing Protection to People and Buildings*, Washington, D.C.: FEMA, December 2003b. Online at http://purl.access.gpo.gov/GPO/LPS43825 (as of September 23, 2006).

———, *Risk Assessment: A How-To Guide to Mitigate Potential Terrorist Attacks Against Buildings: Providing Protection to People and Building*, Washington, D.C.: FEMA, January 2005.

Field, Anne, and David Bodamer, "Targeting the Mall," *Retail Traffic*, September 1, 2005. Online at http://retailtrafficmag.com/mag/retail_targeting_mall/index.html (as of September 23, 2006).

Garrett Metal Detectors, "Security Division," undated Web page. Online at http://www.garrett.com/security (as of September 25, 2006).

Grossi, Patricia, and Howard Kunreuther, eds., *Catastrophe Modeling: A New Approach to Managing Risk*, New York: Springer Science+Business Media, 2005.

Haimes, Yacov Y., *Risk Modeling, Assessment, and Management*, 2nd ed., Hoboken, N.J.: Wiley-Interscience, 2004.

Hillestad, Richard, personal communication with the authors, August 22, 2006.

Incode Corporation, undated homepage. Online at http://www.incodenet.com (as of September 25, 2006).

Jackson, Brian A., John C. Baker, Peter Chalk, Kim Cragin, John V. Parachini, and Horacio R. Trujillo, *Aptitude for Destruction, Volume 1: Organizational Learning in Terrorist Groups and Its Implications for Combating Terrorism*, Santa Monica, Calif.: RAND Corporation, MG-331-NIJ, 2005a. Online at http://www.rand.org/pubs/monographs/MG331/ (as of September 23, 2006).

———, *Aptitude for Destruction, Volume 2: Case Studies of Organizational Learning in Five Terrorist Groups*, Santa Monica, Calif.: RAND Corporation, MG-332-NIJ, 2005b. Online at http://www.rand.org/pubs/monographs/MG332/ (as of September 23, 2006).

Jenkins, Brian Michael, and Larry N. Gerston, *Protecting Public Surface Transportation Against Terrorism and Serious Crime: Continuing Research on Best Security Practices*, San Jose, Calif.: Mineta Transportation Institute, San Jose State University, MTI Report 01-07, 2001.

Kessinger, Richard, "From Jericho to Jersey Barrier," *Security Management Online*, August 2004. Online at http://www.securitymanagement.com/library/001641.html (as of September 25, 2006).

Lakdawalla, Darius N., and George Zanjani, *Insurance, Self-Protection, and the Economics of Terrorism*, Santa Monica, Calif.: RAND Corporation, WR-171-ICJ, 2004. Online at http://www.rand.org/pubs/working_papers/WR171/index.html (as of September 23, 2006).

LaTourrette, Tom, Edward Wei-Min Chan, Jennifer Brower, Jamison Jo Medby, and K. Scott McMahon, *Emergency Response to Terrorist Attacks: An Analysis of Mission Performance Requirements*, Santa Monica, Calif.: RAND Corporation, 2006. Limited distribution.

Laustra, Mark, Smiths Detection, telephone conversation with the authors, March 17, 2006.

Lesser, Ian O., Bruce Hoffman, John Arquilla, David Ronfeldt, Michele Zanini, and Brian Michael Jenkins, *Countering the New Terrorism*, Santa Monica, Calif.: RAND Corporation, MR-989-AF, 1999. Online at http://www.rand.org/pubs/monograph_reports/MR989/ (as of September 23, 2006).

Life Safety Associates, undated homepage. Online at http://www.lifesafety.com (as of September 25, 2006).

Mair, Julie Samia, and Michael Mair, "Violence Prevention and Control Through Environmental Modifications," *Annual Review of Public Health*, Vol. 24, January 2003, pp. 209–225.

Mallonee, Sue, Sheryll Shariat, Gail Stennies, Rick Waxweiler, David Hogan, and Fred Jordan, "Physical Injuries and Fatalities Resulting from the Oklahoma City Bombing," *The Journal of the American Medical Association*, Vol. 276, No. 5, August 7, 1996, pp. 382–387.

Memorial Institute for the Prevention of Terrorism, *Terrorism Knowledge Base*, undated Web page. Online at http://www.tkb.org (as of September 23, 2006).

MIPT—*see* Memorial Institute for the Prevention of Terrorism.

Moore, Sean, HiEnergy Technologies, Inc., telephone conversation with the authors, April 3, 2006.

National Institute for Occupational Safety and Health, *Guidance for Filtration and Air-Cleaning Systems to Protect Building Environments from Airborne Chemical, Biological, or Radiological Attacks*, Cincinnati, Ohio: Department of Health and Human Services, Centers for Disease Control and Protection, NIOSH, Publication No. 2003-136, 2003. Online at http://purl.access.gpo.gov/GPO/LPS66157 (as of September 25, 2006).

OSI Security Devices, Inc., undated homepage. Online at http://www.omnilock.com (as of September 25, 2006).

Quick Mask, "Commercial Pricing," undated Web page. Online at http://www.quickmask.com/comm_pricing.htm (as of September 25, 2006).

Reaver, David, Adlerhorst International, Inc., telephone call with the authors, March 15, 2006.

Riley, K. Jack, Gregory F. Treverton, Jeremy Wilson, and Lois M. Davis, *State and Local Intelligence in the War on Terrorism*, Santa Monica Calif.: RAND Corporation, MG-394-RC, 2005. Online at http://www.rand.org/pubs/monographs/MG394/index.html (as of September 23, 2006).

Sauter, Mark, and James Jay Carafano, *Homeland Security: A Guide to Understanding, Preventing, and Surviving Terrorism*, New York: McGraw-Hill, 2005.

Shapland, Joanna, "Preventing Retail-Sector Crimes," in Michael H. Tonry and David P. Farrington, eds., *Building a Safer Society: Strategic Approaches to Crime Prevention*, Crime and Justice Series, Vol. 19, Chicago, Ill.: University of Chicago Press, 1995, pp. 263–342.

Stevens, Donald, Terry Schell, Tom Hamilton, Richard Mesic, Michael Scott Brown, Edward W. Chan, Mel Eisman, Eric V. Larson, Marvin Schaffer, Bruce Newsome, John Gibson, and Elwyn Harris, *Near-Term Options for Improving Security at Los Angeles International Airport*, Santa Monica, Calif.: RAND Corporation, DB-468-1-LAWA, 2004. Online at http://www.rand.org/pubs/documented_briefings/DB468-1/ (as of September 23, 2006).

Stonewear Force Protection, undated homepage. Online at http://www.planterbarrier.com (as of September 25, 2006).

Taylor, Brian D., *Designing and Operating Safe and Secure Transit Systems: Assessing Current Practices in the United States and Abroad*, San Jose, Calif.: Mineta Transportation Institute, College of Business, San Jose University, MTI Report 04-05, 2005.

Texas Security Gates, undated homepage. Online at http://www.texassecuritygates.com (as of September 25, 2006).

U.S. Army Corps of Engineers, *Estimating Damage to Structures from Terrorist Bombs Field Operations Guide*, Washington, D.C.: The Corps, July 14, 1999.

U.S. Bureau of Labor Statistics, *National Compensation Survey: Occupational Wages in the United States, July 2004*, Washington, D.C.: The Bureau, September 2005. Online at http://www.bls.gov/ncs/ocs/sp/ncbl0757.pdf (as of September 23, 2006).

U.S. Department of Defense, *Unified Facilities Criteria (UFC): DoD Minimum Antiterrorism Standards for Buildings*, Washington, D.C.: Department of Defense, UFC 4-010-01, October 8, 2003. Online at http://www.acq.osd.mil/ie/irm/irm_library/UFC4_010_01.pdf (as of September 23, 2006).

Willis, Henry H., Andrew R. Morral, Terrence K. Kelly, and Jamison Jo Medby, *Estimating Terrorism Risk*, Santa Monica, Calif.: RAND Corporation, MG-388-RC, 2005. Online at http://www.rand.org/pubs/monographs/MG388/index.html (as of September 23, 2006).

Yang, Debra W., "Tanzanian Man Who Called in Bogus Tip About Plot to Bomb Los Angeles Shopping Malls Enters Guilty Plea to Federal Charges," press release 04-159, U.S. Attorney, Central District of California, December 21, 2004. Online at http://www.usdoj.gov/usao/cac/pr2004/159.html (as of September 23, 2006).