

# **Cost-Effectiveness Tool for Evaluating the Management of Terrorist Risks**

## **A Background Paper by**

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## **Introduction**

The September 11<sup>th</sup> attacks on the World Trade Center buildings and the Pentagon indicate that there are now legitimate risks of future terrorist attacks. Depending on the target, such attacks could result in physical damage to buildings, industrial facilities, and infrastructure (e.g., bridges and dams). It is also likely that such attacks would result in personal injury and financial losses to building/facility tenants, occupants, and other stakeholders (e.g., building/facility owners and managers, investors, and third parties).

Building/facility owners and managers are now faced with the daunting task of responding to the potential for future terrorist attacks in a financially responsible manner. Three strategies for reducing exposure to terrorist-related losses are: (1) enhanced building practices for disaster mitigation (e.g., pre-emptive counter-terrorism management policies<sup>1</sup> and technologies, designs that can better withstand attack, and retrofits of existing structures to reduce the estimated loss of life and property from a terrorist attack); (2) risk-reduction strategies based on insurance (e.g., transferring risk of losses by purchasing insurance and bearing risk exposure through self-insurance); and (3) economic incentives (e.g., tax write-offs, reduced insurance premiums, and government cost-sharing arrangements for investments that protect against terrorism). How investments in these “mitigation” strategies are integrated into a cohesive disaster mitigation plan is a complex decision problem.

## **Problem Description**

Economic tools (evaluation methods and software for implementing these methods) are needed to direct limited resources to investments in mitigation strategies that will provide the maximum likely reduction in damages to buildings, industrial facilities, and infrastructure. Such tools will enable key decision makers—the intended customers<sup>2</sup>—to produce a disaster mitigation plan that responds to the potential for future terrorist attacks

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<sup>1</sup> Management policies include selecting safer building sites and the use of physical security personnel.

<sup>2</sup> Customers are the intended users of the economic tools; they are either directly or indirectly empowered to decide which combination of mitigation strategies to employ. Stakeholders are organizations or individuals affected by mitigation activities or disaster-related losses. Therefore, customers are a subset of stakeholders.

in a financially responsible manner. By using economic tools to promote more informed decisions, we improve our responses to terrorist threats and reduce the costs of these responses. Ultimately, both our customers and other stakeholders will accrue significant benefits through reduced exposure to terrorist-related losses.

The economic tool envisioned is a flexible decision methodology, embedded in user-friendly, decision-support software, that helps building/facility owners and managers to maximize the likely reduction in terrorist-related damages while considering the tradeoffs among alternative levels of investment in the three mitigation strategies. The economic tool will provide decision makers with the basis for generating a disaster mitigation plan.

The project through which the economic tool will be developed is planned as a three-year effort. The first year will focus on identifying the most appropriate evaluation methods, developing collaborative efforts with potential customers and stakeholder groups, and developing specifications for the software development effort. The second and third years will focus on software development, testing and distribution, and on documenting, publishing, and disseminating our research findings.

### **Customers and Stakeholders**

Potential customers for the economic tool are: (1) civilian federal agencies that are charged with operating and maintaining federal buildings (e.g., GSA and the State Department); (2) military installations; (3) the Office of Homeland Security; (4) FEMA; (5) construction trade associations through which we can effectively reach a broad cross section of building/facility owners and managers (e.g., the Construction Industry Institute, an organization that includes both major building/facility owners as well as the contractors who construct these buildings/facilities); (6) other researchers with whom we wish to collaborate or inform about our findings; and (7) consultants specializing in the design and installation of risk-reduction strategies in buildings and facilities. We plan outreach efforts to potential customers through direct contact, including the June 11<sup>th</sup> Wharton Roundtable, through NIST staff detailed to the Office of Homeland Security, and through construction trade associations. The immediate objective is to hone the list of potential customers, and then to identify individuals and contact them early enough in the project to insure that their specific customer needs are reflected in the design and implementation of the economic tool.

### **Potential Products**

OAE seeks to provide the right product mix for its customers. At this time, four potential products are envisioned: (1) research papers and reports; (2) a software product; (3) a series of workshops on how to evaluate investments in mitigation strategies; and (4) standard methods for evaluating mitigation strategies.

Our initial efforts will focus on identifying the most promising approaches for developing the flexible decision methodology. We anticipate that new insights will come out of this effort. For example, what are the most appropriate economic evaluation methods and

how do we use them to combine alternative levels of investment in the three mitigation strategies into a disaster mitigation plan? These findings will be published in a series of NIST reports on the project. We will also seek to interact with other researchers through the publication of journal articles.

The software product will provide decision makers with a tool for generating a disaster mitigation plan that responds to the potential for future terrorist attacks in a financially responsible manner. The software product is the focus of the software development section, so it is not discussed further in this section.

OAE's experience in teaching workshops on energy conservation will serve as a model for the disaster mitigation workshops. OAE's research on energy conservation led to a life-cycle cost standard practice and a software product known as BLCC.<sup>3</sup> The OAE also developed a training module on how to apply life-cycle cost analysis to energy conservation projects. The OAE uses this module in providing basic life-cycle cost workshops and specialized workshops to certify trainers. This same workshop approach will be followed in bringing to our customers the proposed software product for evaluating investments in mitigation strategies.

A draft ASTM<sup>4</sup> standard guide illustrating how to use the flexible decision methodology to produce a disaster mitigation plan is our final product. Specifically, working through the Building Economics Subcommittee (E06.81) of ASTM, OAE will develop a standard guide, submit it to ASTM for balloting, and work with the E06.81 Subcommittee and the E06 Main Committee to produce a finalized consensus standard. ASTM standards are an excellent means for disseminating research results to our customers.

### **Software Development Issues**

The software product envisioned will consist of a graphical user interface, an "engine" for computing economic output measures and evaluating alternative levels of investment in the three mitigation strategies, and a special-purpose, financial risk module. The design of the user interface, the engine, the financial risk module, and ultimately the integrated software product will build on the expertise that OAE has developed through past software products (e.g., BLCC).

The integrated software product will facilitate a variety of user-specified analyses. These analyses are designed to be self-documenting (i.e., they clearly report user-defined inputs). The software product will also summarize economic output measures in both tabular and graphical formats.

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<sup>3</sup> The BLCC software product is available on-line through the Federal Energy Management Program website at <http://www.eren.doe.gov/femp/techassist/softwaretools/softwaretools.html>.

<sup>4</sup> The American Society for Testing and Materials is a not-for-profit organization which provides a forum for producers, users, and representatives of government and academia to meet and write standards for materials, products, systems, and services.

The software product will support two generic types of analysis: (1) baseline analysis;<sup>5</sup> and (2) sensitivity analysis.<sup>6</sup> The financial risk module will work in tandem with the sensitivity analysis capability. Each generic type of analysis will support a wide range of user-defined inputs. The two generic types of analysis are designed to complement and reinforce each other. The two generic types of analysis will provide decision makers with the basis for generating a disaster mitigation plan that responds to the potential for future terrorist attacks in a financially responsible manner.

OAE plans to test the beta version of the software product as part of a collaborative effort between NIST and the Wharton Risk Management and Decision Processes Center. The software product will then be field-tested with a team of potential customers drawn from industry and governmental partners. The finalized version of the software product will be made available for electronic distribution through NIST, the Office of Homeland Security, and FEMA.

Investments in cost-effective mitigation strategies offer the potential to improve our responses to terrorist threats and to reduce the costs of these responses. But investments in mitigation strategies will be forthcoming only if industry perceives that the economic benefits outweigh the costs of using them. Being able to demonstrate net economic benefits from investments in mitigation strategies will encourage their acceptance and use.

### **Next Steps**

OAE will focus on identifying key customers and stakeholders and on developing collaborative efforts with them. The purpose of these collaborative efforts is to determine our customers' needs and insure that these needs are reflected in the design and implementation of the software product. In addition, OAE is interested in identifying other research organizations and individuals that could collaborate with us on either the identification of promising modeling approaches or the software development effort.

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<sup>5</sup> The term baseline analysis is used to denote a complete analysis in all respects but one; it does not address the effects of uncertainty. In a baseline analysis, values based on point estimates are used for all data when calculating the economic output measures. Use of point estimates—also known as baseline values—in the calculations represents a fixed state of analysis.

<sup>6</sup> Sensitivity analysis measures the impact on project outcomes (i.e., the economic output measures) of changing the values of one or more key input variables about which there is uncertainty. Sensitivity analysis can be performed for any economic output measure. Therefore, a sensitivity analysis complements the baseline analysis by evaluating the changes in project outcomes when selected key sets of data vary about their baseline values.