



Project 2a: Innovations in Risk and Economic Modeling of Counter-Terrorism (Bier)

This work combines game theory and risk analysis to identify optimal strategies for defensive investment in counter-terrorism, taking potential adversary responses into account.

Modeling Area: Risk Assessment

Application Area: Infrastructure Security, Risk-based Resource Allocation

Principal Investigator: Vicki Bier

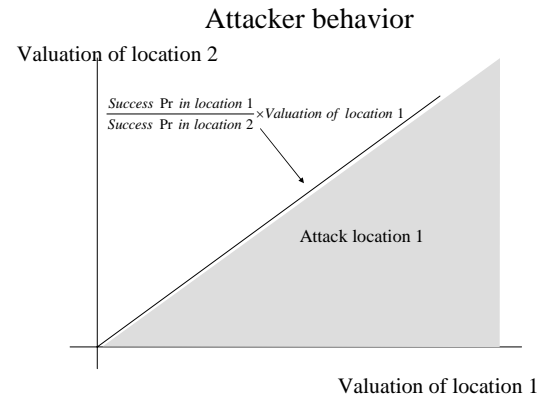
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Brief Description:

This work studies the optimal allocation of defensive resources in complex systems. The approach combines risk analysis and game theory to anticipate which components are likely to be targeted in a potential attack (based on assumed terrorist goals and constraints), and determine the optimum allocation of defensive resources.



Attacker behavior depends on values of targets, and success probabilities of attacks.

Objectives:

The goal of this research is to expand the existing tools and techniques of risk analysis to more effectively address security considerations, taking into account the fact that terrorists can observe our defenses and adapt their strategies accordingly.

Major Products and Customers:

- Techniques for vulnerability assessment and portfolio allocation that could be used by facility owners or managers in the public and private sectors
- Models and guidelines for the optimum (most cost-effective) allocation of defensive resources, as a function of system structure and attacker goals and motivations
- Guidelines on the circumstances under which secrecy and/or deception are appropriate in defending against terrorism, and when publicly known defenses provide better deterrence

Interfaces to other CREATE Projects:

This project will contribute to the case study on resource allocation. It also relates to the work being done on critical infrastructure protection, and to basic methodological work being undertaken in other projects (e.g., development of software for portfolio allocation, modeling of terrorist decision processes).

Interfaces to non-CREATE Projects:

Project personnel are working closely with the National Center for Food Protection and Defense at the University of Minnesota, looking at interdependent security risks in the supply chains for grain, dairy, and other types of food products. We are also in the process of completing a project for the National Center for Foreign Animal and Zoonotic Disease Defense at Texas A&M

University, applying risk analysis, uncertainty analysis, and decision analysis to the threat of foot-and-mouth disease in the livestock industry.

Technical Approach:

Traditional economic game-theoretic models of defense fail to give adequate consideration to the complex networked structures of the systems that we are interested in defending. By contrast, risk analysis generally neglects the fact that terrorists are intelligent and adaptive, and can observe our defenses and adapt their strategies accordingly. By combining both approaches, we can adequately reflect both the adaptive nature of terrorist threats and the structures of the systems to be defended.

The key theoretical issue to be addressed this year involves extending existing models to explore the circumstances under which it is better to disclose defensive investments (in order to deter potential terrorists), versus those circumstances under which secrecy or even deception may be better strategies for the defender. We also plan to continue applying existing methods to realistic case studies, including foot-and-mouth disease and aviation security.

Major Milestones and Dates:

1. Revise paper on “Balancing Terrorism and Natural Disasters” in response to referee comments from *Operations Research* – September 2006.
2. Submit paper on “Secrecy in Defensive Allocations as a Strategy for Achieving More Cost-Effective Attacker Deterrence” to *Journal of Risk and Uncertainty* – September 2006.
3. Revise paper on “Securing Passenger Aircraft from Man-Portable Air Defense Systems (MANPADS)” in response to referee comments from *Risk Analysis* – December 2006.
4. Write paper on uncertainty analysis of foot-and-mouth disease in the livestock industry for submission to a refereed journal such as *Preventive Veterinary Medicine* – March 2007.
5. Extend models of aviation security to include game-theoretic considerations – May 2007.
6. Complete work on economic modeling of secrecy and deception – May 2007.