

Advanced Risk and Decision Analysis
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In Year 3, the major research accomplishments in advanced risk and decision analysis were:

- Developing and testing of advanced methods and software tools for eliciting expert opinion about the relative likelihood of bioterrorist attacks
- Developing advanced models and tools to assess terrorists' preferences for alternative modes and targets of attack
- Using sequential and adaptive decision trees to model shifting threats and vulnerabilities

The research had impact on important decisions and policies related to homeland security. Specifically, we developed expert elicitation methodology for risk assessment for the National Biodefense Analysis and Countermeasures Office (NBACC). CREATE researchers trained NBACC staff and its subcontractors in the use of state-of-the-art expert elicitation methodologies in support of the ongoing bioterrorism risk assessment. During 2007, NBACC used this methodology to elicit numerous probabilities related to bioterrorism risks. The results of these elicitations and the overall risk analysis are part of the bi-annual report to the White House on bioterrorism, which is due in January, 2008. This work resulted, among other things, in a software tool to assist in this elicitation task and some demonstrations on how to conduct expert elicitations.

We also developed advanced and still experimental methods to model the terrorists' utilities for alternative modes and targets of attack and to model their perceptions of the likelihood of success of these alternative attacks. This results in an expected utility model as seen from the perspective of terrorists. Since we don't know many of the input parameters of this expected utility model, we can assign probability distributions over the parameters of the model and, in effect, estimate a random expected utility model. Using standard risk estimation procedures, we can then infer the relative probability of choosing one attack mode over another.

Finally, we used sequential and adaptive decision trees to extend the analysis of the costs and benefits of MANPADS countermeasures, including an analysis of the risks of MANPADS attacks and the direct and indirect economic impacts. A major finding was that the indirect economic impacts due to losses to the airline industry and the ripple effects through the economy were very high – between 250 billion and \$400 billion. This and other findings of CREATE's MANPADS study were part of a report submitted to Congress by the DHS Counter MANPADS Office in 2007.

The main tool developed for vulnerability assessment was a project risk analysis tool. This tool consists of two parts: A standard project analysis, using Microsoft project and a risk analysis part using @Risk for Microsoft Project. Microsoft Project is used to map out an attack as a complex project, like any other business or government project. @Risk for Microsoft Project is used to identify those parts of the project that are likely to fail, due to interdiction by intelligence and policy efforts as well as to security measures at the attack site. This tool was successfully applied in the analysis of a dirty bomb attack on the Los Angeles and Long Beach harbors. The scientific paper published in 2007 won the award for best paper in decision science by the Society for Risk Analysis. In addition, we are developing the same tool in the context of an explosives attack using TATP on transportation targets to support an ongoing CBP tabletop exercise. Fault trees are another useful tool, which we have explored in some applications.

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Our previous studies of MANPADS attacks on commercial airplanes and dirty bomb attacks on harbors had continued impacts in 2007. Early in 2007, the DHS Counter-MANPADS office requested additional information from CREATE to incorporate into its report to Congress regarding the cost-effectiveness of MANPADS countermeasures. The overall message to Congress, due to many factors and reports, was that the initially proposed directed infrared countermeasures (DIRCIMS) installed on planes were not yet cost-effective. Congress has re-evaluated the issue and the DHS is examining alternative means to protect commercial airplanes against MANPADS attacks. The dirty bomb studies did not have a direct impact on policy making, but it did make clear that the major threat is psychological and economic, not on health. The study resulted in several discussions with officials of the ports of Los Angeles and Long Beach on how to protect the port better against dirty bomb attacks.