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Efficient Aviation Security

Strengthening the Analytic Foundation for Making Air Transportation Security Decisions

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Commercial aviation plays a central role in our daily lives and is an essential part of the national economy. The importance of aviation to both the public and the private sectors drives concerns about how security threats, such as terrorism, could affect the utility, safety, and economic value of those sectors. It is also undeniable that the aviation system has long been an attractive target for terrorists across the political and ideological spectrum. From hijackings in the 1970s to al-Qa’ida in the Arabian Peninsula’s disrupted bombing operation in May 2012, terrorists continue to try to exploit the aviation system because of both the visibility and the impact that even semi-successful attacks have produced.

Because of the risk of terrorism to aviation targets, aviation security has grown to become a substantial commercial, political, and social influence in the United States and abroad. The portion of the Transportation Security Administration (TSA) budget in the fiscal year 2011 President’s budget devoted to protecting the aviation system was approximately $6.5 billion, counting both the aviation security line item and the budget of the Federal Air Marshal Service (Office of Management and Budget, 2011). Federal expenditures on aviation security represent only a part of the government spending picture, with additional security expenditures made at the state and local levels (e.g., by airport authorities) and by the private sector (e.g., airlines). Security measures also have intangible costs, including the time spent by passengers undergoing security procedures, as well as the hassle and privacy implications of security screening.
Terrorist incidents—most notably 9/11, but also subsequent attempted attacks—have produced significant spikes in policy debate about security performance and effectiveness, and pressure for change has ebbed and flowed as incidents occur and then recede into memory. Reflecting both the dynamics of the policy debate and adaptation by the attackers targeting aviation systems, security technologies and procedures are constantly being developed, tested, implemented, and, occasionally, withdrawn.

Security strategies to protect the aviation system have also been criticized as being reactive and backward-looking, seeming to always be responding to the last observed threat. Concerns have also been raised about the sustainability of security efforts—particularly at passenger checkpoints—that often appear to consist of “ladling on” more and more measures of security in response to every perceived threat.

What the public and other stakeholders expect from security is also complex and has varied over time. At the same time that some constituencies or decisionmakers might express a desire to minimize (or even attempt to eliminate) the risk of terrorist attack on the aviation system, it has also become clear in the past decade that the public’s and private-sector organizations’ tolerance for inconvenience and other security costs is not inexhaustible. The increasing burden that security places on passengers, cargo shippers, and other businesses, coupled with the perception that some security elements are invasive or unclearly justified, has at times led stakeholders, from passenger associations to the U.S. Congress, to question the decisionmaking process used for pursuing aviation security.

Given the resources and attention devoted to aviation security in an era in which resource constraints are likely to become ever more important in policy decisions, it is important that we approach aviation security in a rational and defensible way. The rationale for security expenditures is to reduce the risk from terrorist threats to the aviation system. If we consider risk to be what we stand to lose from successful attacks, then the benefit of security is the expected consequences of terrorist attacks that are avoided because of the security. To make rational security decisions, the benefits of a measure (or group of measures)
must be compared with its varied costs to determine whether those benefits exceed the cost.

In recent years, analysts and researchers both within and outside government have expanded efforts to weigh both the costs and benefits of security interventions. The costs of security are complex, with both immediate, direct components and longer-term, indirect components. Though some costs—such as government expenditures—are comparatively easy to determine, others are less tangible and quantifiable. Substantial progress has been made, but we are still far from the point where policy and security analysis can fully support building efficient and sustainable aviation security strategies.

Even more poorly understood are the benefits of aviation security efforts. Because the magnitude of the risk to the commercial aviation system is low and poorly characterized, it is difficult to assess the extent to which this risk may be decreased after the introduction of a particular security investment. And, even if we determine that the risk has decreased, it is hard to know whether or how much it decreased because of some deliberate action we have taken or because of some other factors whose effect we do not appreciate.

More complete understanding of the costs and benefits of security measures is needed. Only with clear understanding of what security measures truly cost and what we get when we buy those measures will it be possible to get closer to the efficient security we must aspire to in a world of finite resources and many varied policy areas that demand funding and attention.

Addressing Key Uncertainties and Knowledge Gaps in Aviation Security

The goal of crafting truly efficient aviation security strategies is hampered by a variety of uncertainties. It will always be difficult to draw clear, quantitative conclusions about terrorist preferences (threat) and security performance (vulnerability) given the evolution and adaptation by both attackers and defenders. Historical data are one window, but past performance—on both sides of the conflict—provides only
some insight into likely future results. Meeting analysts and policymakers’ eternal pleas for more and better intelligence information could help reduce this uncertainty, but the ability of attackers to change their behavior means that some uncertainty will always remain. Other uncertainties affect the ability to perform detailed cost-benefit type studies, including quantification of the full costs of attempted or successful attacks on aviation targets, most notably their indirect costs; the full costs of security measures; and their full effects both on the ability of attackers to successfully stage attacks and their decisions to do so in the first place. These too are areas where “more and better analysis” could reduce the levels of uncertainty, but only to a point—as changes in society, public preferences, and the nature of terrorist adversaries will make any estimates perishable at best.

However, in spite of uncertainty, it is still possible to perform analyses that define key tradeoffs, map out the major sources of uncertainty, and make it possible to make more informed security decisions. In the work described here, we address several of these areas of uncertainty and analytical complexity:

- Predicting future terrorist risks with certainty will never be possible. However, retrospective analysis of historical threats coupled with systematic approaches for projecting how those threats could change going forward can help to identify security strategies that are relevant across known and possible attack methods—limiting the sensitivity of security performance to future attacker behavior.
- While it is broadly accepted that security measures have intangible costs—and that those costs affect the utility of the aviation system—it is less clear how to appropriately capture them in security analysis. Building out from accepted cost-benefit methodologies, we demonstrate how even approximate estimates for such effects can be used when different security measures are compared or—as has been the strategy in aviation—when increasing numbers of security measures are added on top of one another as threats change over time.
- Though the security strategy of combining many types of security measures into a “layered defense” has been accepted doctrine
for many years, many analyses of that strategy have not fully explored how different layers interact with one another to deliver a net protective posture for the aviation system. In other contexts, assessing the benefits of combining multiple interventions has not always been straightforward—and multiple measures together can produce outcomes that are less than the sum of the individual measures alone. Translating the lessons from these other fields (notably safety engineering) provides approaches to address such concerns in assessments of layered security measures.

- In considering the effect of security measures on terrorism risk, one area that has posed problems has been the effect of deterrence—or the way the presence of security shapes the choices made by attackers before or during an attack. Though it is generally accepted that deterrence is a significant driver of the benefits for some security measures, understanding how to address it in cost-benefit analyses has been less clear. Adapting techniques of break-even analysis can provide a way to do so: Assessments of individual security measures should include the calculation of how much risk reduction (including via deterrence) a given security measure must provide in order to be cost-effective.

- Another area where our analysis reveals useful insights for security decisionmaking is understanding the merits of preferential screening proposals, such as a trusted traveler program. Despite interest in pursuing such a program, progress has been stymied because the potential benefit depends on behaviors of passengers and terrorists that are highly uncertain. Our analysis shows that even when uncertainties are great we can identify plausible conditions under which a trusted traveler program would reduce risk. Two key factors are the fraction of the traveling public that enrolls in the trusted traveler program and the fraction of terrorists that do so. Though decisionmakers cannot control these factors, they can influence them. Such insights add some clarity to a debate beset with uncertainty and ambivalence.

- Finally, a more general area in which our analysis provides helpful insight in addressing uncertainties is in the use of modeling to understand terrorism risks. The limited amount and quality
of data on aviation terrorism incidents combined with our poor understanding of terrorist behavior makes predictive modeling of terrorism risk untenable. The uncertainties associated with any effort to identify best estimates of risk or risk reduction are so great as to make the result meaningless. However, models can be designed and used for less precise and final purposes. Rather than attempting to account for all potential influences and the complex relationships among them, a simpler, low-resolution model may have just a few key parameters and allow users to develop plausible hypotheses about the conditions under which security systems might produce benefits.

Looking to the Future

In the majority of the analyses discussed in this document, we considered the benefit of security measures and examined various types of uncertainties that can affect how those benefits are measured and valued. The four studies that looked at the benefits of security (discussed in Chapters Four through Seven) each capture different complexities regarding human adaptive behavior. Though adaptation by terrorist attackers is frequently the focus in security planning, our examination of a potential trusted traveler program highlights that decisions made by passengers can have their own security implications. Irrespective of the source of the challenge, when considering a potential security investment or evaluating one that is in place now, we do not want to overstate the expected benefits, which can happen if we either neglect interactions between measures in a multilayered security system or ignore how attackers could try to use the characteristics of our security strategies to their benefit.

Looking to the future of aviation security in the United States, the resource constraints that are almost certain to affect most policy areas will be a challenge. For organizations and people charged with protecting citizens from harm, the potential for cuts in resources is always difficult to consider and to implement, and there will always be an understandable trepidation to make cuts out of fear that imprudent
action will undermine effective security efforts. The politics surrounding security is a challenge as well. Since criticizing security performance is a staple of partisan political debate after even unsuccessful terrorist attacks, there is a potent disincentive to scale back security in any form. But if a sufficient analytical basis for assessing security measures and strategies is available, these trepidations might be reduced and resource constraints converted from a crisis into an opportunity. Constraints force choices, which in turn force evaluation to help ensure that we are not spending limited national resources in ways that are not achieving what they are intended to achieve. In aviation security, where the total cost of the national effort has expanded significantly since 9/11, such an evaluation could pay dividends not just in reduced national expenditures, but also by helping to identify ways to get better security for less cost—more efficient aviation security—that could make our homeland security efforts more sustainable and make the country better off in the long run.