WHITE PAPER

RAND

Safer Skies

Baggage Screening and Beyond

Gary Kauvar, Bernard Rostker, Russell Shaver

National Security Research Division

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Prepared for
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Preface

This paper is the result of an examination of plans for implementing explosive detection systems for checked baggage at all U.S. airports, and it contains suggested changes to the existing plans for implementation of the systems.

The work was funded by RAND's independent research and development funds. It should be of interest to those concerned about whether the Federal Aviation Administration's (FAA's) plans (now part of the Aviation and Transportation Security Act) appropriately respond to the security threats against our air transportation system. It should also interest those who wish to better understand how to address the natural tension between unfettered access to our commercial aircraft and enhanced transportation security. The research and the writing of this paper were completed in March 2002, and hence it does not reflect subsequent developments in this field. Its publication serves to document RAND's approach to this problem as well as its analytical findings.

This study was conducted by RAND as part of its continuing program of self-sponsored research. We acknowledge the support for such research provided by the independent research and development provisions of RAND's contracts for the operation of its Department of Defense federally funded research and development centers: Project AIR FORCE (sponsored by the U.S. Air Force), the Arroyo Center (sponsored by the U.S. Army), and the National Defense Research Institute (sponsored by the Office of the Secretary of Defense, the Joint Staff, the unified commands, and the defense agencies).

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Safer Skies: Baggage Screening and Beyond

On November 19, 2001, Congress passed the Aviation and Transportation Security Act.[1] The legislation highlights the importance of baggage screening as part of a comprehensive program to increase airport security. Specifically, it mandates that by December 31, 2002, 100 percent of checked baggage at all the nation's airports must be screened for explosives. RAND examined existing plans for implementing explosive detection systems (EDSs) for checked baggage at all airports in the United States and suggested changes that might be advisable.

An EDS is a very large scanning machine that uses magnetic resonance imaging (MRI) technology to generate three-dimensional images of the contents of individual bags.[2] EDS machines are expensive and take up a great deal of room. While our study was in progress, the newly created Transportation Security Administration (TSA) became interested in the possible use of explosive trace detection (ETD) machines, which "sniff" molecules that adhere to a swab run over the surface of a piece of baggage. ETD machines are less expensive and take up less room than EDS machines do, but they are less sensitive and less accurate in detecting explosive materials. To achieve detection rates comparable to those for EDS machines, samples must be taken from inside each bag. We also evaluated the use of ETD machines, applying the same methodology we applied to the EDS machines. Recently, it has been suggested that, while all bags will be scanned, only some of them will be (randomly) selected to be subject to the full ETD screening. While this selectivity may help increase safety while easing delays, it does not change our basic conclusions or recommendations.

The Importance of Getting It Right

In 2001, 710 million passengers traveled on civil airliners in the United States. For these passengers, baggage screening is a necessary part of an overall plan for airport and airline security. History has shown, however, that passengers want security without having to undergo substantial inconvenience. Since September 11, TV news programs have shown airline passengers who profess to be willing

[1]Public Law No. 107-71.

[2]MRI is the technology that generates CAT (computerized axial tomography) scanner images of the human body.

to endure any inconvenience in the name of security. But these programs have not shown the many people who have decided not to fly because of long and intrusive security procedures. Congress passed the Aviation and Transportation Security Act partly out of fear that the public would lose confidence in the safety of flight and thus would cease flying altogether. The remedy for that fear—baggage screening, together with enhanced passenger screening—should not make flying so onerous as to produce the same result.

An analysis of the cost of providing security without massively inconveniencing the flying public suggests that this cost is small compared with the losses commercial aviation will suffer if potential passengers elect not to fly. Some people, especially those who fly infrequently, will tolerate substantial delays at airports if they think that real security is the result. But those for whom time is valuable and who may have a reasonable alternative to commercial air travel are considerably less likely to fly in such circumstances. Substantial loss of these travelers would seriously harm the aviation industry—and the nation's economy. Thus the cost of "getting it right" in terms of balancing security needs against inconvenience would be more than compensated by the financial returns resulting from a stronger national economy.

RAND's Approach

Before September 11, the Federal Aviation Administration (FAA) planned to deploy EDS machines nationwide using a government-imposed, "top-down" approach whereby the federal government would provide EDS machines to individual airports. This initial plan, which was not coordinated with individual carriers or the airports where the equipment would be installed, called for deployment by 2013. After September 11, the FAA advanced that date to 2005 and prepared a deployment plan showing how the new timeline might be met. Federal legislation spurred by the terrorist attacks on September 11 then called for a further compression of the FAA's schedule, and machines for screening 100 percent of checked baggage were to be deployed by December 2002. Again, the approach was top-down and did not incorporate input from air carriers or local airports.

To determine the feasibility of this deployment schedule, we examined the FAA's analysis to better understand the calculations and assumptions that supported both the 2005 and the new deployment schedule. We also visited two major airports: Dulles International (Washington, D.C.) and Dallas–Fort Worth. At Dulles, we examined the process that airports and airlines would have to go through to meet the 2002 deployment deadline. At Dallas–Fort Worth, we

discussed the possible EDS deployments with officials of a major national airline and a team of independent experts in the analysis and design of airport facilities. We then built a simple queuing model to test the assumptions and robustness of the FAA projections of the number of machines that would be needed to screen 100 percent of checked baggage at all airports.[3]

Problems with the Federal Legislation

Our analysis revealed that the FAA's 2005 deployment plan was not based on an adequate assessment of the consequences of fielding an effective baggage screening system of the sort envisioned by Congress. For example, the plan did not adequately account for the demands that peak loads place on the baggage handling system, nor did it account for the actual performance and reliability of machines already deployed. Moreover, it was not clear how the available EDS equipment would be allocated among the various airports or what metric was to be used to ensure that the national aviation transportation system was running effectively. Most important, however, the deployment plan did not consider the severe space constraints that airports would have to overcome if they were to field all the new EDS equipment needed to screen every bag.

We identified six main problems with the deployment schedule set out in the Aviation and Transportation Security Act:

1. A rudimentary queuing model showed that the FAA estimate of the number of EDS machines needed to screen 100 percent of checked baggage for the major airports was too low by a factor of about 2.5.
2. The allocation of EDS equipment to the nation's airports has not been tested against a model of the national transportation system to ensure that bottlenecks will not develop during the implementation period or that the requirements of the hub system can be met.
3. Most disturbing, a top-down analytic approach is inappropriate for conducting a thorough analysis of the requirements for solving the problems of airport baggage screening. A more appropriate approach—one that has been used by a number of airports in planning the design of new terminals—is a stochastic simulation incorporating a realistic and detailed representation of the movement of passengers and baggage through the

[3]See Appendix A of the companion document, WP-131/1, for a quantitative assessment of potential delays in baggage handling and their sensitivity to the number of machines deployed, level of demand, machine reliability, and other factors.

airport.[4] Indeed, simulations already exist for 24 of the 25 largest airports. The stochastic simulations we examined, which were provided by the TransSolutions Corporation, showed how critical each airport's design is to the number and placement of EDS machines at that airport. Each of the 453 commercial airports in the United States presents a unique challenge to baggage system designers.

4. Although the FAA did initiate a "go-team" to determine what could be done to increase the number of approved EDS machines, the deployment plan does not take into account the ability of industry to produce FAA-certified machines.

5. The FAA's "top-down" approach does not adequately consider local constraints, such as the size of the airport terminal. It is space constraints, not machine availability, that is the proverbial long pole in the tent. Until suitable airport facilities are constructed, many of the EDS machines now being acquired at a highly accelerated rate cannot be installed.

6. The shortcomings of deploying EDS machines also hold for ETD machines. While the latter are much smaller than EDS machines, they are also less reliable in detecting bombs. Tests show that for ETD machines to achieve results that even roughly approximate those provided by EDS machines, trace samples must be taken from inside each bag. The process of opening every bag and taking multiple samples from each also requires additional airport floor space—space that might not be available at some airports without additional construction. Use of the ETD machine would likely also increase processing times. In sum, ETD machines will not likely provide an easy answer.

We concluded that the deployment plan proposed in the Aviation and Transportation Security Act for EDS machines, particularly because of its top-down orientation, was not workable and that replacing EDS with ETD machines will not eliminate the problem. However, a number of steps can be taken to improve system performance. These improvements will not achieve the congressional mandate for 2002, but they will go a long way toward providing increased levels of airport security through a more effective program of baggage screening.

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[4]See Appendix B of the companion document, WP-131/1, for a general description of the properties and capabilities of a detailed simulation model.

An Alternative Approach

As an alternative to the top-down approach of the Department of Transportation's (DOT's) deployment plan, we propose a bottom-up approach that will empower airports and airlines to work together to solve what is essentially a local problem. Moreover, we recommend that the problem-solving teams follow the example of the Dallas–Fort Worth Airport in using the most appropriate stochastic simulation models to provide the best possible forecasts and projections. With such an approach, the federal government will play a different but no less important role. That role will be to organize, coordinate, and ensure the quality of a bottom-up system that fully enfranchises local airports and airlines in developing baggage-screening solutions that can work in the field. The government should

- Establish the standards for machine and system performance.
- Participate in local partnerships that are designing local solutions.
- Integrate the local plans into a national architecture.
- Evaluate the effectiveness of each airport's security systems.
- Set parameters now for the longer term so that airports will be able to incorporate the new requirements into their modernization/expansion programs, many of which are now on hold.
- Test proposed options against a model of the national transportation system to ensure that bottlenecks do not develop during the implementation period and that the requirements of a hub system can be met.

A bottom-up approach should be implemented immediately, giving the local partnerships a period of perhaps 60 days to report to the DOT concerning their requirements for government-funded EDS machines and to provide an estimate of the facility modifications needed to incorporate EDS into the airport infrastructure.

With this approach, the DOT will still have the responsibility for determining the timeline for airports to receive EDS equipment consistent with the plans submitted by the partnerships. To do so, the DOT will need to model and develop metrics to address the overall performance of the civil aviation system, particularly the impact that new security procedures have on the functionality of hub airports and, ultimately, on the performance of the entire air transportation system as a vital element in the nation's economy.

Profiling: A Strategy for Reducing the Problem to a Manageable Level[5]

Even if the best planning tools are available, a bottom-up approach is used, all the airports and airlines work productively with the DOT, and maximum production of new EDS equipment is achieved—even then, the 2002 congressional deadline for the fielding of EDS machines almost certainly cannot be met. What is needed is an interim measure, a way of ensuring that the existing baggage scanning capacity focuses on those bags most likely to pose a threat. This can be done by adopting baggage handling procedures that have been proven around the world to increase aviation security without overburdening the traveling public.

One of the most effective of these procedures would be expanded use of the Computer Assisted Passenger Profiling System (CAPPS). For example, airport security could use a so-called "trusted traveler" program to focus on identifying the bags least likely to pose a threat. This approach is consistent with generally accepted standards of nondiscriminatory profiling used by civil aviation authorities throughout the world. The procedure would be based not on gender, race, or national origin, but rather on "selecting" passengers about whom a great deal is known and who exhibit behaviors that keep them off any likely-threat list. U.S. citizens who have detailed background investigations on record with the government would be obvious trusted traveler candidates. Numerous other indicators exist as well, many of which could be used successfully in a nondiscriminatory manner.

Such expanded use of CAPPS in no way alters the desirability or utility of using CAPPS to positively identify likely threats. Civil aviation authorities should have up-to-date access to the entire range of information that can be provided by law enforcement and intelligence organizations about people who are on "watch lists," have overstayed their visas, or have drawn attention to themselves for other reasons. Similar systems are used in Israel, which is generally believed to have the world's most secure civil aviation system. While it would be impractical to try to import Israel's successful system on a wholesale basis—the scale and logistics of Israeli and U.S. operations are vastly different—the concept is sound: focus security efforts on those who arouse suspicion.

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[5]See Appendix C of the companion document, WP-131/1, for further discussion of passenger profiling.

Conclusion

We propose an approach that is based on developing security solutions that are appropriate to individual locations while ensuring that national interests are safeguarded. Such a bottom-up approach not only empowers airports and airlines by involving them in new partnerships with one another and with the federal government, but also constitutes a systemwide effort that uses the best analytic tools available to provide the most reliable forecasts and projections. These are the keystones to an effective program. Baggage screening is an important component of a full spectrum of security measures that can be brought to bear immediately. The common goal should be a fully functioning air transportation system that provides passengers with safe, efficient, and convenient means of carrying out the nation's business.