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COMBATING TERRORISM AGAINST COMMERCIAL AVIATION

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General concern about terrorism and sabotage in the United States has grown in the aftermath of the sabotage of Amtrak in Arizona, the bombing of the federal office building in Oklahoma City, the bomb threat at the New York regional air traffic control center, and the bombing of the World Trade Center. A concomitant concern has developed with regard to the adequacy of security at domestic airports and in commercial aviation. Twice in a three month period in 1995 the Federal Aviation Administration (FAA) increased airport security. In August 1995, the FAA ordered heightened airport security procedures due to concern within the Clinton Administration about the threat of more frequent and more deadly terrorist attacks in the United States.[1] Then, in October 1995, the FAA once again increased airport security due to concern about the visit of Pope John Paul II, progress in the Palestinian and Israeli peace process, and the conviction of ten Muslim terrorists.

Concern with the security of commercial aviation reached an all-time high after the bombing of Pan Am Flight 103 over Lockerbie, Scotland in December 1988. This deadly act of terrorism prompted passage of the Aviation Security Improvement Act of 1990 (1990 Act) which set a number of goals for the enhancement of commercial aviation security. In the early 1990s concern seemed to ebb as acts of terrorism against U.S. targets decreased only to be heightened by the events in Oklahoma City and the explosion aboard TWA Flight 800 in July 1996.[2] There was a realization that terrorists are finding targets in the United States more attractive and attacks on the traveling public were likely to increase.

Heightened commercial aviation security, while good for the safety of the traveling public, is not without its costs. Besides the direct costs associated with employing additional security personnel and equipment are the indirect costs–the opportunity costs–associated with the inevitable delays that accompany more careful screening of passengers and their luggage. Tighter security requires the traveler to allot more time to make flights because curbside check-in is not available, metal detectors are more sensitive leading to more false alarms, more luggage is searched, and gate agents are asking passengers more questions.[3] The obvious question is whether the benefits gained from enhanced aviation security justify the costs.

During the first part of the 1990s strides have been made in the improvement of commercial aviation security in the United States. Despite these advancements, there is a lot yet to be done. This paper provides an overview of developments in commercial aviation security in the United States during the first part of the 1990s, discussing the accomplishments and setbacks encountered, and outlines the challenges that remain.

BACKGROUND

The FAA has responsibility for the safety and security of commercial aviation in the United States. The FAA's approach to ensuring security in commercial aviation has evolved over the years in response to changes in the complexion and frequency of terrorism. The bombing of Pan Am Flight 103 heightened concern about the security of commercial aviation to such an extent that Congress passed the Aviation Security Improvement Act of 1990.

The 1990 Act underscored concern about aviation security shared by Congress and the general public. It contained many mandates and directives for the FAA including:

- "FAA and the FBI were required to jointly assess the threats to and vulnerabilities of the nation's airports
- FAA was required to review the security programs of foreign air carriers and approve those that provide a level of protection similar to that provided by U.S. carriers serving the same airport
- FAA was required to study the need for additional measures to safeguard the transportation of cargo and mail by passenger aircraft
- FAA was directed to support the acceleration of research to develop explosive detection equipment"[4]

It was hoped these measures would greatly improve commercial aviation security in the U.S. and throughout the world.

The Threat

Clearly the 1990 Act was a direct response to the Pan Am bombing and concern about increased terrorist activity against commercial aviation in the United States. Before discussing the progress the FAA has made toward the objectives set forth by the Act, it is reasonable to ask how real is the threat against commercial aviation.

It is important to understand what is meant by terrorism. A working definition of terrorism has been formulated by the Office and Technology Assessment (OTA). OTA defines terrorism as "... the deliberate employment of violence or the threat of violence by sovereign states or subnational groups, possibly encouraged or assisted by sovereign states, to attain strategic or political objectives by acts in violation of law intended to create a climate of fear in a target population larger than the civilian or military victims attacked or threatened."[5]

In truth, terrorist acts within the borders of the United States have been rare. For example, during the 1987-1992 time period there were a total of 38 terrorist incidents, another 31 suspected terrorist incidents, and 24 terrorist acts that were thwarted. These incidents ranged in severity from relatively simple acts with no injuries or loss of life to significant attacks with injuries and loss of life. The incidents involved a variety of approaches including verbal threats, hijackings, explosives, and the use of incendiary devices. However, the acts tended to be on the more simple end of the continuum.

TABLE 1
Terrorist Activity in the United States, 1987-92

Year	Terrorist Incident	Suspected Incident	Terrorist Acts Prevented
1987	9	8	5
1988	9	5	3
1989	4	16	7
1990	7	1	5
1991	5	1	4
1992	4	0	0
Total	38	31	24

Source: United States General Accounting Office, *Aviation Security: Additional Actions Needed to Meet Domestic and International Challenges* (Washington, D.C.: Government Accounting Office, GAO/RCED-94-38, January 1994), Table 1.1, page 11.

During the past five years, there have been few incidents of terrorism against commercial aviation targets either in the United States or the rest of the world. The majority of terrorist incidents that have occurred have been targeted against the flag carriers of countries which have been experiencing a degree of civil unrest or upheaval. While commercial aviation recently has not been targeted by terrorists, the threat is always present.

Traditionally the source of the threat to commercial aviation has been from explosives contained in checked luggage, carry-on baggage, and mail. There is growing concern that, as advances are made in detecting explosives in checked and carry-on luggage, terrorists may turn to more exotic devices as a way to achieve their objectives against commercial aviation. One such device is the handheld missile, a weapon that is becoming more common in the terrorist's arsenal. Up to now, most missile attacks against civilian aircraft have occurred in areas of the world that have been experiencing insurgencies. During the 1978-93 time span, 15 of 26 attacks occurred in Angola, Sudan, and Afghanistan. These attacks were infrequent over the 1978-93 time span, but their frequency has increased in recent years.[6]

TABLE 2
Incidents of Terrorism Against Commercial Aviation Targets

Year	U.S. Airlines	Foreign Airlines
1990	1	39 (26 Aeroflot)
1991	1	24 (11 Aeroflot)
1992	0	12 (5 Ethiopian Airlines)
1993*	0	1 (Lufthansa)
1994*	0	4

* Estimates.
Source: Air Transport Association Congressional briefing materials.

While the data suggest the threat to U.S. commercial aviation has not been severe, there is reason to be concerned about the future. The potential for terrorist activity in the United States is real, and many believe it is growing. The Federal Bureau of Investigation (FBI) has detected an increase in terrorist "networking" and has identified a growing terrorist infrastructure. This infrastructure, which includes logistics support, equipment, training, and financial aid, is in place and ready to be tapped by terrorist groups. Both the FAA and the FBI believe that, as terrorist acts increase in the United States, airports and civilian aircraft will remain among the most attractive targets.[7]

A recent Department of Defense study on the future of terrorism highlights the concern for commercial aviation.[8] Terrorists no longer seem satisfied with a few casualties; the trend is toward acts that cause mass casualties. The United States already is painfully aware of this trend toward more spectacular acts of sabotage. Terrorists will use all targets they consider vulnerable and appropriate; it seems logical that commercial aviation and the infrastructure supporting the air transport system in the United States will be targeted. Recognizing this threat, a lot of effort and money has gone into improving the security of commercial aviation in the United States.

DEVELOPMENTS IN COMMERCIAL AVIATION SECURITY

The Pan Am tragedy in December 1988 served as an impetus to focus attention on the current state of commercial aviation security. In direct response to the Pan Am incident, President Bush created the President's Commission on Aviation Security and Terrorism. The Commission issued its recommendations in May 1990 and many of the recommendations were included in the 1990 Act. During this same time period, the Office of Technology Assessment (OTA) undertook a major study on the subject of using technology to combat terrorism. OTA undertook an in-depth look at a number of security issues including research and development of explosive detection devices and security at airports. A few years after the OTA study, the Government Accounting Office (GAO) released a series of studies that analyzed the current status of commercial aviation security and identified the challenges that remain.

The OTA Study

In 1989, a number of Senate committees asked OTA to investigate the status of research on technologies that could be used to protect the United States and its citizens from acts of terrorism. The study resulted in two separate reports. The first report dealt with research and development efforts on the federal level to counter terrorism, especially against commercial aviation, and the state of technology for the detection and prevention of attempts to introduce explosives aboard aircraft.[9] The second report focused on integrated security systems and the human factors in commercial aviation security.[10]

Research and Development in Explosives Detection Systems (EDS).[11] OTA identified two general approaches to explosives detection that were being pursued by the FAA in 1991–bulk detection and vapor or residue detectors. One bulk detection approach, referred to as a nuclear method, relied on ionizing radiation to penetrate the object being studied. In 1991, Thermal Neutron Analysis (TNA) was the most developed of the nuclear technologies, but OTA felt its usefulness was limited.[12] The other nuclear technologies were not promising candidates either because they required accelerators to generate the necessary active particles. Development of an accelerator that would be useful in a real world setting was a long way off.

A second method of bulk detection was the use of magnetic resonance and nuclear quadrupole resonance.[13] OTA did not believe this approach showed much promise in the near term. A third method of bulk detection was the use of x-ray technologies such as the backscatter x-ray and computerized tomography. Backscatter x-ray systems scan "a pencil beam of x-rays across an object and makes two images: the normal transmission image, created by a single detector on the opposite side, and a backscatter image, created by a large detector on the side of the entering beam."[14] Computerized tomography is an adaptation of the medical CAT scan techniques. These methods of bulk detection seemed the most promising of the three bulk detection approaches.

The second general approach to explosives detection involved detecting vapors or residues left by explosives. These detectors could be as familiar as trained dogs or as advanced as technologies like chemiluminescence, ion mobility spectrometry, and bioluminescence.[15]

TABLE 3
Explosives Detection Technologies

***Bulk detectors*:**

Using ionizing radiation
- Nuclear
  - Thermal Neutron Analysis
  - Fast Neutron Analysis
  - Nuclear Resonance Absorption of Gamma Rays
  - Associated Particle Production
  - Pulsed Fast Neutron Analysis
  - Pulsed Fast Neutron Backscatter
  - Nitrogen-13 Production with Positron Emission Tomography
- X-ray
  - Transmission
  - Backscatter
  - Dual or Multi-Energy
  - Computerized Tomography

Using non-ionizing radiation
- Nuclear Magnetic Resonance
- Electron Spin Resonance
- Nuclear Quadrupole Resonance

***Vapor or residue detectors*:**
- Dogs
- Gas Chromatography (GC)/Chemiluminescence
- GC/Electron Capture
- Ion Mobility Spectrometry
- Mass Spectrometry (two-stage)
- Bioluminescence

Source: U.S. Congress, Office of Technology Assessment, *Technology Against Terrorism: The Federal Effort*, OTA-ISC-481 (Washington, DC: U.S. Government Printing Office, July 1991), Table 4-2, p. 39.

Table 4 provides a brief overview of the strengths and weaknesses OTA found with some of the more promising EDS devices. OTA came to the conclusion that, after its review of the "...current state-of-the-art, [it] sees no evidence that any device, currently at the prototype stage, is capable by itself of *reliably* detecting small quantities of plastic explosives in checked baggage."[16] OTA defined "reliably" as a device that had at least a 90 percent detection rate and a false alarm rate that did not exceed 5 percent.

Aviation Security.[17] OTA made a number of recommendations with regard to aviation security. First, because no current or near-term technology appeared capable of providing the profiling and bomb detection technology needed to increase airline security, OTA concluded that an integrated approach which combined a number of different detection technologies would be preferable over one particular detection technology. This approach would allow the different technologies to complement each other because no one technology was able to provide the level of reliability required.

OTA did not recommend a specific configuration for the integrated approach. Instead it provided a conceptual outline of what the integrated system might look like. In the first stage of the system, passenger profiling and an advanced x-ray system would be used. When there was an indication that explosives were present additional scrutiny would be triggered. Stage two of the system would use a different technology, possibly vapor detection. Stage three would use a more elaborate and expensive device such as computerized tomography or TNA. OTA emphasized that the particular system used by an airport would be tailored to the specific needs and characteristics of that airport. OTA thought determination of the optimal configuration for the system would be fairly easy and be dependent on things like peak passenger flow, required throughput rate (how many bags can be processed per hour), cost constraints, acceptable false alarm rate, and room (size and weight of the system).

The second recommendation that OTA made regarding aviation security was that more emphasis be placed on human factors in commercial aviation security. It noted that technology has its limitations and it was unrealistic to expect commercial aviation security to be totally automated. Therefore OTA suggested paying increased attention to passenger profiling.

OTA also underscored the importance of well-trained and highly motivated "screeners"–those individuals who operate the metal detectors everyone must pass through before boarding a commercial aircraft in the United States. These security jobs require repetitive tasks and are boring because personnel are searching for a rare event–the presence of explosives or weapons. Acknowledging that a security system will only be as good as its weakest link, OTA suggested screeners receive better training and that EDS systems automate the boring and repetitive tasks as much as possible.

Third, OTA thought there was adequate promise in the field of aircraft and cargo container hardening to recommend further research and development. Aircraft and cargo hardening would involve modifying cargo containers to absorb shock waves, prevent fragmentation, and to vent pressures; adding cargo bay liners to contain fragments; placing blow-out panels in the fuselage to control skin ruptures and tearing; and closing cavities and pathways between cargo containers and in the aircraft structure that have the potential of acting as conduits of shock waves.

Developments in the EDS Field Between 1991 and Late 1992

In August 1992 Heathrow airport concluded six weeks of tests on the modified Model 101ZZ backscatter x-ray system.[18] Both the airport and developer seemed pleased with its performance during this operational test. It was estimated about 3,600 bags could be scanned per hour by the system and human intervention was needed only if the x-ray detects an object with characteristics of an explosive.

The FAA, in August 1992 altered its policy and began to allow airlines to voluntarily use enhanced x-ray and vapor screening devices to screen carry-on electronic items.[19] Checked baggage could not be screened by these technologies because the FAA believed there were too many limitations associated with these technologies and their use might provide a false sense of security.

This new policy was met with a cool reception among airlines. The airlines expressed disappointment with the lack of attention and resources the FAA was devoting

TABLE 4
Advantages and Disadvantages of Selected Explosives Detection Techniques*

Type	Advantages	Disadvantages
Chemiluminescence	Cost; size; detects plastics; good at identifying particular molecular compounds	Slow; requires vapors or residues
Electron capture	Very low cost; size; may detect plastics	Slow; requires vapors or residues; not good at identifying particular molecular compounds
Ion mobility	Cost; size; may detect plastics	Requires vapors or residues
TNA	Detects plastics; no vapor needed	Large; expensive; high false-alarm rates; inadequate sensitivity
X-ray, dual energy, or backscatter	Cost and size relatively small; can see other weapons; may see sheets or small quantities of explosives	Not specific to explosives; questionable sensitivity to small or thin quantities of explosives
Computerized tomography	Very high 3-D spatial resolution; good for detection of small quantities	Not specific to explosives; looks only at density; slow; large; expensive

* A major concern with technologies that rely on the detection of explosive vapors or residues was the large amount of "background noise" created by the surrounding environment. In other words, the general atmosphere contains elements that are similar to those generated by explosives making it difficult to develop a vapor or residue detector that has the necessary level of sensitivity without a high false alarm rate.
Source: Adapted from U.S. Congress, Office of Technology Assessment, *Technology Against Terrorism: The Federal Effort*, OTA-ISC-481 (Washington, DC: U.S. Government Printing Office, July 1991), Table 5-1, p. 62.

to explosive detection system development. They pointed out while the FAA had been slow in evaluating and testing devices, European countries have been quite active. Over 52 Egis vapor detection systems had been ordered and 21 machines were already in operation at 12 European airports. In addition, airline officials expressed concern that the explosive detection systems under development would be very costly.[20]

The GAO Studies

The Aviation and Security Improvement Act of 1990 required the FAA to have EDS in place by November 1993. Despite a sizable increase in the FAA's security research and development budget and the opening of the FAA's Technical Center in Atlantic City, the FAA missed the deadline. In fact, it appeared the FAA was years away from meeting the objective. This prompted various members of Congress to ask the GAO to update them on progress with EDS. In addition, two other requests for reports on subjects in the aviation security area were made.[21]

Explosive Detection Systems. The FAA has a central role in developing new security technology. To accomplish this objective the FAA "...(1) establishes performance standards for equipment, (2) selects the mix of technologies for development, (3) provides oversight and technical assistance to contractors, (4) tests equipment to ensure that it meets the performance standards, and (5) certifies (approves) the equipment as suitable for airlines' use."[22] Obviously the FAA has a lot of responsibility and a huge amount of risk. Development of EDS involves new and untested technology and it is difficult to predict how an idea that is conceptually sound and works in a laboratory setting will perform under realistic testing conditions.

Unfortunately, the FAA was not able to meet the November 1993 deadline set forth in the 1990 Act. In fact, there were no devices in operation at airports that had not been approved and in use before the Pan Am bombing in 1988. Compounding the problem, the FAA was unable, as of early 1994, to predict when an EDS capable of meeting its requirements for detecting sophisticated explosives in checked baggage would be approved. Technical difficulties were cited as the reason for the delay:

> "As of December 1993, FAA had 40 research explosive detection projects, including 14 prototype units, 4 of which are suitable for screening checked baggage. Our review of the development status of the 14 prototypes showed that 9 had been delayed–by 1 to 18 months–because of technical problems. Furthermore, FAA has conducted laboratory tests on only seven devices; none fully meets FAA's performance standards. FAA officials said that they expect to have five additional advanced prototypes available for testing in fiscal year 1994 but could not estimate when the new devices would be certified for industry use."[23]

Another criticism leveled at the FAA was its failure to place much emphasis on systems integration when technology is approved for EDS use. While the FAA endorsed the idea that combining systems, as recommended in the OTA report, makes sense, it believed the task of integration should be left to the airlines. Because the airlines ultimately are responsible for the security of their passengers, the FAA suggested they were in a better position to assess their security needs and the needs of the airports they service.

The GAO found this line of reasoning faulty for a number of reasons. First, many potential software and hardware problems could be avoided if integration of systems is promoted from the very beginning instead of attempting to integrate after the technology is developed. Second, EDS technology most likely would continue to evolve and the airlines may not be the correct group to ensure upgrades and improvements are made in EDS. Third, the FAA's approach only seems logical if there are many competing technologies to choose from. This, of course, did not appear to be a reasonable assumption because not one device had been approved by early 1994. Finally, it is questionable whether the airline industry has the financial resources to conduct the research and analysis necessary for integration.[24]

<u>Aircraft Hardening</u>. Aircraft hardening began to receive a fair amount of attention by the FAA in 1992, receiving a dedicated research and development funding line in fiscal year 1993. The FAA and the early tests indicated it was feasible to contain the effects of explosions. Concerns remained about the cost, weight, and durability of the new luggage containers. Also, due to the size of the prototypes the hardened containers only could be used on wide-bodied aircraft. Wide-body aircraft only make up 29 percent of the aircraft worldwide while almost 75 percent of the bombings between 1971 and 1991 occurred on narrow-body aircraft.

Unless the weight and durability concerns with regard to blast resistant luggage containers are remedied, airlines most likely will not voluntarily replace worn out luggage containers with the more secure ones. If these issues cannot be solved, the FAA probably will have to mandate the containers.

Another facet of aircraft hardening is blast management. Blast management involves designing aircraft technology that will allow an aircraft to withstand internal explosions. At the time of the GAO report, little progress had been made in this area.[25]

<u>The Certification Process</u>.[26]Another area that came under close scrutiny by the GAO was the process the FAA set up to approve explosive detection systems. One major criticism the GAO had with the process was its lack of operational testing. The FAA claimed operational testing would add both time and cost to the

TABLE 5
FAA's Security RE&D Budget, Fiscal Years 1988-94 ($ millions)

Program	1988	1989	1990	1991	1992	1993	1994
Explosive Detection	$9.6	$9.9	$17.0	$30.3	$27.3	$26.4	$22.8
Airport Security	0	0	0	$2.0	$4.2	$4.0	$2.5
Aircraft Hardening Program	0	0	0	0	0	$4.5	$7.8
Human Factors	0	0	0	0	0	$1.0	$2.8
Total	$9.6	$9.9	$17.0	$32.3	$31.5	$35.9	$35.9

Source: United States General Accounting Office, *Aviation Security: Additional Actions Needed to Meet Domestic and International Challenges* (Washington, D.C.: Government Accounting Office, GAO/RCED-94-38, January 1994), Table 3.1, page 41 and United States General Accounting Office, *Aviation Security: Development of New Security Technology Has Not Met Expectations* (Washington, D.C.: Government Accounting Office, GAO/RCED-94-142, May 1994), Table 1.1, page 11.

approval process, things critics were already complaining about. In lieu of its own operational tests, the FAA was relying on contractors to perform operational tests.

There were a number of difficulties associated with this arrangement, according to the GAO. Contractors may not be conducting objective, realistic tests; they may be using a laboratory prototype instead of the final market model and the performance may vary dramatically between the two types of machines; most importantly, the FAA was not inspecting the testing conditions nor witnessing the tests, meaning it had no way to verify the contractors' tests.

Another major criticism of the certification process was the lack of reliability standards for the devices being tested. In essence, the FAA could approve an EDS without having any idea how often the system would be out of service. The airlines expressed great reservations with this omission because of the effect unreliable security equipment could have on their performance and operations. The FAA countered that it was too difficult to develop reliability standards, and it would lengthen the approval process if it did. The GAO pointed out that other government agencies, such as the Department of Defense, routinely develop reliability standards for new technology basing the standards on the operational needs of the department.

A third criticism of the approval process was the lack of performance standards for trace detection systems. As late as March 1993 the National Academy of Sciences, which was under contract to the FAA to set performance standards, reported it could not achieve the objective. The Academy cited the difficulty in distinguishing between "...very small traces of explosive material and much larger quantities of other materials in an airport terminal."[27]

Access Control.[28] Access control has been an important component of commercial aviation security in the United States for a number of years. In 1989 the FAA passed stringent regulations governing access control, and the FAA has required more airports to adhere to the regulations over the intervening years. By August 1994, 258 airports were required to "...(1) ensure that only authorized persons gain access to secured areas, (2) immediately deny access to persons whose authorization is revoked, (3) differentiate between persons with unlimited access to the secured area and persons with only partial access, and (4) be capable of limiting access by time and date."[29]

While these regulations seem to be a sensible component of an overall commercial aviation security plan, the cost of adhering to the regulations has greatly exceeded the FAA's own cost estimates. Originally it was projected the costs to meet the regulations would be $211 million for the 1989-98 time span. More recent projections, which include actual costs already incurred, amount to $654 million for the 1989-98 period.[30] Not surprisingly, the costs of access control have been a major concern of airlines which must bear the financial burden.

The reason for these greatly escalated costs, according to GAO, is the FAA's lack of sufficient guidelines and standards for airports to follow while trying to adhere to the regulations. As a result, many airports have purchased access controls that provide a level of control significantly above what is required. Also, many airports contracted with vendors to develop hardware and software for access control systems and now are at the mercy of the vendors because the system is proprietary. In other words, many airports cannot "shop the competition" for maintenance or upgrades because there is no competition.

Similar Security on Domestic and International Routes. The 1990 Act required the FAA to ensure a similar level of protection for U.S. citizens traveling abroad as is provided to those traveling domestically. International security standards generally are less stringent than the ones set by the FAA. The 1990 Act "...permits FAA to accept a foreign carrier's security program only if FAA determines that the program provides a level of protection similar to that provided by U.S. carriers serving the same airports."[31] Despite passing regulations in 1989 that require foreign carriers flying to or from the United States to get their security plans approved by the FAA, there still exists a large discrepancy between security on domestic carriers flying international routes and foreign carriers flying the same routes.

The major stumbling block, according to the FAA, is a diplomatic one. The FAA believes many foreign governments would balk at the United States imposing its standards on their countries' carriers. In addition, the FAA argues that the emphasis should be on the airport the international carrier is flying from rather than the airline itself. Levels of security may vary widely on the same airline depending on what airport the airline is departing. Therefore the focus should be both on international airline security plans and on location. Obviously, this makes FAA's task much more complex and more costly.

The Air Transport Association (ATA) is very concerned with the inconsistency in domestic and international security. While their primary concern is security, the ATA also is concerned about the competitive disadvantage created for domestic carriers by the more stringent security regulations. Table 6 outlines the argument fairly well underscoring the rather steep opportunity costs placed on customers of domestic carriers relative to customers of international carriers serving the same routes.

Recent Developments

In September 1994 it was reported the United Kingdom's Transport Department had set late 1996 as a deadline for screening all baggage carried in the cargo hold of all international commercial flights.[32] This rule affects 50 airports in Great Britain. It requires airports either to inspect 100% of checked baggage by hand, subject all bags to conventional x-rays and search 10% of the bags by hand, or use an automated explosive detection system.

Airports in the U.K. have been taking the lead in improving the screening of luggage. BAA Plc., the private company that operates seven airports in the U.K. including Heathrow and Gatwick, just concluded an 18 month trial of a five-tier screening program at Glasgow airport in 1994. Results indicated that about 80% of bags are cleared at the level one while the other 20% are sent on for further testing. Level two involved a combination of automated screening by dual-energy x-ray devices and close inspection by a human operator. About 1% of the bags originally checked required further screening past level two.

TABLE 6
Differences Related To FAA Security Program

	U.S. Airline	Foreign Flag Airline
1. Passenger processing at airport		
* Security interview at point of baggage acceptance	2-5 minutes - all passengers	Not Applicable
* Physical search of baggage and carry-on items	5-20 minutes - selected passengers (sometimes conducted in special facilities)	Not Applicable
* X-ray of baggage	Required for all checked baggage	Not Applicable
* Security questions at gate	All passengers	Not Applicable
* Total number of passenger processing points including immigration	4-5	2
* Total processing time prior to flight departure	90-120 minutes average	20-30 minutes average
2. Airport terminal facilities		
* Visible security barriers at check-in	Required	Not Applicable
* Check-in counters	Usually segregated in least accessible areas.	Prominent, convenient locations
* X-ray equipment	Often cramped into check-in areas.	Not Applicable
* Off airport check-in-rail stations, cruiseships, hotels, etc.	Generally prohibitive due to security requirements.	No Constraints
* Gate areas	Sterile separation required.	Passenger movement not restricted.
* Aircraft parking locations	May be limited by security requirements, i.e., remote parking.	Flexible
3. Aircraft Servicing		
* Screening of service personnel	Required	Not Applicable
* Cabin searches	Required	Not Applicable
* Guarding of aircraft and cabin during servicing	Required	Not Applicable
* Overnight parking	Sealing and/or guarding of aircraft	Not Applicable
* Catering and cabin supplies	Guarded and/or guarding of aircraft	Not Applicable
* Aircraft turn times	Longer serving time due to security, impacts aircraft utilization	Not Applicable
4. Cargo	Special document and shipper verifications	Not Applicable

Continued . . .

Continuing TABLE 6
Differences Related To FAA Security Program

	U.S. Airline	Foreign Flag Airline
5. Operational Performance		
* Positive passenger bag match	Required	Not required, some carriers conduct bag match on intermittent basis
* Offload of baggage for missing passengers	Required	Several carriers require
* On-Time performance	Impacted by above procedures	Generally not impacted
6. Service Enhancements		
* Advance check-in	Clearance through security measures negates convenience of advance check-in	Service convenience can be offered with advance boarding passes
* Self-check-in and other automation/"ticketless" service	Precluded from full benefit due to security requirements	No Limits
* Expedite or premium service handling	Limited by security requirements	No Limits
7. Customer Reaction		
* Complaints	Written, verbal complaints regarding inconvenience, intrusiveness, or even discrimination	Not Applicable
* Claims	Claims or lawsuits regarding alleged harassment or discrimination	Not Applicable
* Choice of carrier	Security measures cause passengers to avoid U.S. carriers	Benefit from customers diverted from U.S. carriers

Source: Air Transport Association, Congressional briefing materials.

The Egis explosive vapor detector was used for Level 3 screening, and by the end of this level approximately 99.9% of the bags checked were cleared. The remaining 0.1% of the total bags entering the screening system were hand searched in the presence of their owners. If an explosive was detected, the bag entered level 5 which consists of calling in explosive ordnance officials to deal with the situation.[33]

More recently it was reported that full-scale tests on a quadruple resonance EDS were commencing in London.[34] The QSCAN-1000 can be used to inspect checked luggage for explosives, producing either a pass or fail signal. Therefore, it does not require any operator interpretation of results. In a one-week field test at Los Angeles International Airport in late 1995, the QSCAN-1000 performed quite well.

While Great Britain and the rest of Europe continue to make progress in the testing and use of EDS, the United States lags behind. Rather than relying on operational testing like the U.K., the U.S. continues to rely on laboratory testing as the crucial step in the certification process. FAA's use of this approach can be attributed to the requirement in the 1990 Act that a system must be certified before the FAA administrator can mandate its use. Not surprisingly, U.S. airlines are reluctant to voluntarily invest much time or resources in field testing an EDS that ultimately may not receive FAA approval. This means the FAA has little leverage to convince airlines to perform field tests.[35]

On December 9, 1994, the FAA certified its first EDS. The system certified was the CTX 5000 which "...uses transmission x-ray data to acquire an overall map of the objects in the luggage. It then positions strategic computer tomography slices to identify objects that may be explosives. The technical challenges of increasing the size of the scanner opening to accommodate large bags and engineering a constantly rotating (rather than reciprocating) gantry were solved, making it possible to scan passenger bags in seconds rather than the minutes previously required for a medical scan."[36] The certification was the culmination of more than nine years of research and over $8.6 million spent by the FAA.

The next step for the CTX 5000 is at least two operational trials at different airports and each lasting one year. The purpose of the trials is to help anticipate and solve some of the operational challenges that will be faced as the EDS is integrated into baggage handling systems. The FAA estimates it eventually may cost airlines around $500 million to install the CTX 5000 if the FAA chooses to mandate its adoption after the trials end in 1997.[37]

There has been some recent progress in the aircraft hardening area too. A container has been developed that can withstand the force of an explosion that is greater than the one that downed Pan Am 103 in 1988. Also, the prototype container addresses the airlines' concerns with regard to maintenance and the weight of the container is close to the range deemed acceptable.[38]

CONCLUSIONS

While the threat against U.S. commercial aviation remains relatively low, the possible consequences of such an attack are frightening. The World Trade Center and Oklahoma City bombings highlighted the type of damage and casualties terrorists can inflict when they put their minds to it. It does not take much of a stretch to imagine commercial aviation is a tempting target for anyone bent on wreaking havoc and injuring many people with a single explosive device.

Since the Pan Am tragedy in 1988, a lot of attention has been focused on research and development to improve commercial aviation security. There has been progress but it has been slower than most anticipated. General concern has been voiced about the disappointing pace of EDS development and implementation. The FAA missed its deadline by more than one year, certifying its first EDS in December 1994 instead of November 1993 as required in the 1990 Act. Many reasons have been cited for this delay ranging from the FAA not directing the appropriate level of resources or attention to research and development to the daunting technological challenges it has faced in developing EDS.

Another major area of contention involves the integration of EDS. Despite OTA's conclusion that an integrated approach is the only way to proceed and FAA's admission that this was the correct conclusion, the FAA is doing little, if anything, to promote integration. Instead, it is relying on the airlines, who are responsible for the safety and security of their passengers, to decide how best to achieve integration.

The experience with access control should be sufficient to convince the FAA it should re-think its approach to integration. Its failure to set standards and issue guidelines for airlines and airports to follow as they worked to meet the access control regulations has been blamed for the runaway costs of access control.

Taking a similar "hands off" approach to integration raises the probability that enhanced security will be more costly than it would be if the FAA took a leadership role.

A third area of concern is the fact that European countries seem to be way ahead of the United States in the field testing and utilization of EDS. Part of the lag can be attributed to the requirement in the 1990 Act that the FAA must certify a system before it mandates its use. Another contributing factor to the lag is that fact that airlines are responsible for security in the United States while the government generally is responsible in Europe. Airlines are understandably reluctant to take the lead in EDS development and testing due to the high degree of risk associated with the new technology.

Also, it is reasonable to believe there are economies of scale in security technology implementation. The implication is that a more centralized approach to security may be more cost effective. It is not difficult to imagine that one system designed for a particular airport makes more sense than separate systems for each airline serving a particular airport. In reality, security systems generally are designed for the entire airport, but the current arrangement requires lengthy negotiations among the airport and the airlines serving it to arrive at a security plan acceptable to all. It seems logical to vest the responsibility for designing an integrated security system with the airport management, encouraging them to coordinate with the airlines and the FAA. This approach may result in more risk taking with regard to the field testing of EDS, possibly closing the technological gap with European airports.

One thing is clear, enhanced commercial aviation security is costly. In the current budget-cutting atmosphere it is naive to think the FAA will receive additional resources to achieve its security objectives as quickly as most would like. Therefore, the FAA will have to continue to prioritize tasks meaning it will devote time and resources to particular security objectives at the expense of others. This, in turn, will leave plenty of room for disagreement as not everyone will agree with the FAA's priorities.

At some point, the question should be posed: "Do the benefits from increased security warrant the costs?" Congress is implicitly asking (and answering) this question as it revamps the welfare system, Medicaid, and Medicare. It only seems logical the same test ought to be applied to commercial aviation security. The ensuing debate should be quite interesting!

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