

December 2002

AVIATION SECURITY

Vulnerabilities and Potential Improvements for the Air Cargo System




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Highlights

Highlights of [GAO-03-344](#), a report to the Ranking Minority Member, Aviation Subcommittee, Senate Committee on Commerce, Science, and Transportation; and another requester

Why GAO Did This Study

U.S. air carriers transport billions of tons of cargo each year in both passenger planes and all-cargo planes. Typically, about one-half of the hull of each passenger aircraft is filled with cargo. As a result, any vulnerabilities in the air cargo security system potentially threaten the entire air transport system.

GAO agreed to determine the security vulnerabilities that have been identified in the air cargo system, the status of key recommendations that have been made since 1990 to improve air cargo security, and ways in which air cargo security can be improved in the near- and long-term.

What GAO Recommends

GAO recommends that TSA develop a comprehensive plan for air cargo security that identifies priority actions on the basis of risk, costs, and performance targets, and establishes deadlines for completing those actions.

www.gao.gov/cgi-bin/getrpt?GAO-03-344.

To view the full report, including the scope and methodology, click on the link above. For more information, contact Gerald Dillingham, Ph.D., at (202) 512-2834 or dillingham@gao.gov.

AVIATION SECURITY

Vulnerabilities and Potential Improvements for the Air Cargo System

What GAO Found

Numerous government and industry studies have identified vulnerabilities in the air cargo system. These vulnerabilities occur in the security procedures of some air carriers and freight forwarders and in possible tampering with freight at various handoffs that occur from the point when cargo leaves a shipper to the point when it is loaded onto an aircraft. As a result, any weaknesses in this program could create security risks.

FAA or the Transportation Security Administration (TSA), which now has responsibility for ensuring air cargo security, has implemented a number of key recommendations and mandates to improve air cargo security made since 1990 by numerous government organizations. For example, FAA and the air cargo industry developed security training guides for air carriers and ground personnel who handle air cargo. However, a few recommendations by those groups, such as conducting research and operational tests of technology to screen cargo for explosives, are ongoing and not yet completed by TSA, or have not been implemented.

Federal reports, industry groups, and security experts have identified operational and technological measures that have the potential to improve air cargo security in the near-term. Examples of the measures include checking the identity of individuals making cargo deliveries and implementing a computerized cargo profiling system. In addition, long-term improvements, such as developing a comprehensive cargo-security plan, have been recommended by the above sources, but not implemented by TSA. Each potential improvement measure, however, needs to be weighed against other issues, such as costs and the effects on the flow of cargo. Without a comprehensive plan that incorporates a risk management approach and sets deadlines and performance targets, TSA and other federal decisionmakers cannot know whether resources are being deployed as effectively and efficiently as possible in implementing measures to reduce the risk and mitigate the consequences of a terrorist attack.

Cargo Being Loaded on an Airplane



Source: Cargo King, Ltd.

Contents

Letter		1
	Results in Brief	2
	Background	3
	Vulnerabilities Exist in Air Cargo Security	8
	Progress Has Been Made in Implementing Key Recommendations on Air Cargo Security	9
	Near-Term Actions to Enhance Cargo Security Have Been Identified	10
	A Comprehensive Plan and Risk Management Approach Have Been Identified As Ways to Improve Air Cargo Security in the Long Term	18
	Conclusion	20
	Recommendation for Executive Action	21
	Agency Comments	21
Appendix I	Air Cargo Incidents and Follow-Up Actions	22
Appendix II	Proposed Legislation on Air Cargo Security	24
Appendix III	Key Recommendations on Air Cargo Security	25
Tables		
	Table 1: Information on Technologies to Enhance Air Cargo Security	11
	Table 2: Information on Operational Practices to Enhance Air Cargo Security	15
	Table 3: Status of Key Recommendations on Air Cargo Security	25
Figures		
	Figure 1: Flow of Cargo from Shipper to Air Carrier	4
	Figure 2: Amount of Air Cargo Transported (Actual and Projected) on Passenger and Cargo Planes in the United States, 1996–2012	6

Figure 3: Amount of U.S. Mail Transported (Actual and Projected) on Passenger and Cargo Planes in the United States, 1996– 2012	7
Figure 4: Summary Information on the Status of Key Recommendations for Air Cargo Security	10
Figure 5: Elements of a Risk Management Approach	19
Figure 6: Time Line of Key Changes in Air Cargo Security	23

Abbreviations

DOT	Department of Transportation
FAA	Federal Aviation Administration
OIG	Office of Inspector General
TSA	Transportation Security Administration



G A O

Accountability * Integrity * Reliability

United States General Accounting Office
Washington, DC 20548

December 20, 2002

The Honorable Kay Bailey Hutchison
Ranking Minority Member
Aviation Subcommittee
Committee on Commerce, Science, and Transportation
United States Senate

The Honorable Dianne Feinstein
United States Senate

U.S. air carriers transport billions of tons of cargo each year in both passenger planes and all-cargo planes. Keeping that cargo secure is the responsibility of the Department of Transportation's (DOT) Transportation Security Administration (TSA), which was created in November 2001 by the Aviation and Transportation Security Act. Prior to that date, the Federal Aviation Administration (FAA) had this responsibility. To ensure air cargo security, the act requires the screening of all cargo carried aboard commercial passenger aircraft and requires TSA to have a system in place as soon as practicable to screen or otherwise ensure the security of cargo on all-cargo aircraft. To date, TSA has focused much effort and funding on ensuring that bombs and other threat items are not carried onto planes by passengers or in their carry-on or checked luggage. However, about one-half of the hull of each passenger aircraft is typically filled with cargo. If vulnerabilities exist in the transport of air cargo, they potentially threaten the air transport system. You asked us to examine the security of air cargo. In doing so, we addressed the following research questions:

- What security vulnerabilities have been identified in the air cargo system?
- What is the status of key recommendations that have been made within the past 12 years to improve air cargo security?
- How can air cargo security be improved in the near- and long-term?

To answer our research questions, we conducted a comprehensive assessment of pertinent literature, including reports from TSA, FAA, DOT's Volpe Transportation Center, the U.S. Customs Service, federal commissions and working groups, aviation industry groups, and DOT's Office of Inspector General (OIG). We also interviewed TSA officials, industry officials representing passenger and cargo airlines and consolidators of air freight, and aviation security experts. In addition, to determine possible ways in which the security of air cargo can be

improved in the long-term, we reviewed our previous reports on risk management techniques and compared the risk management approach outlined in those reports with TSA's current procedures and plans for air cargo security. We performed our work from August to December 2002 in accordance with generally accepted government auditing standards.

Results in Brief

Vulnerabilities in the air cargo system have been identified by numerous government and industry studies. TSA inspectors have identified vulnerabilities in the security procedures of some air carriers and freight forwarders. Further vulnerabilities have been identified by the aviation industry and government agencies, including possible tampering with freight at various handoffs that occur from the point when it leaves a shipper to the point when it is loaded onto an aircraft and the adequacy of background investigations for all persons handling cargo. In addition, the "known shipper" program, TSA's primary approach for ensuring air cargo security and complying with the cargo-screening requirements of the Aviation and Transportation Security Act, has been reviewed by DOT's Inspector General for possible security weaknesses.

FAA or TSA has implemented a number of the key recommendations and mandates to improve air cargo security made since 1990 by the Aviation Security Improvement Act of 1990, the White House Commission on Aviation Safety and Security (also called the Gore Commission), the Cargo Working Group (an FAA-industry partnership), and DOT's Office of Inspector General. For example, in 1999, FAA, in cooperation with the air cargo industry, developed security training guides for air carriers and ground personnel who handle air cargo. However, a few recommendations made by those groups, such as conducting research and operational tests of technology to screen cargo for explosives, are either ongoing and not yet completed by TSA or have not been implemented.

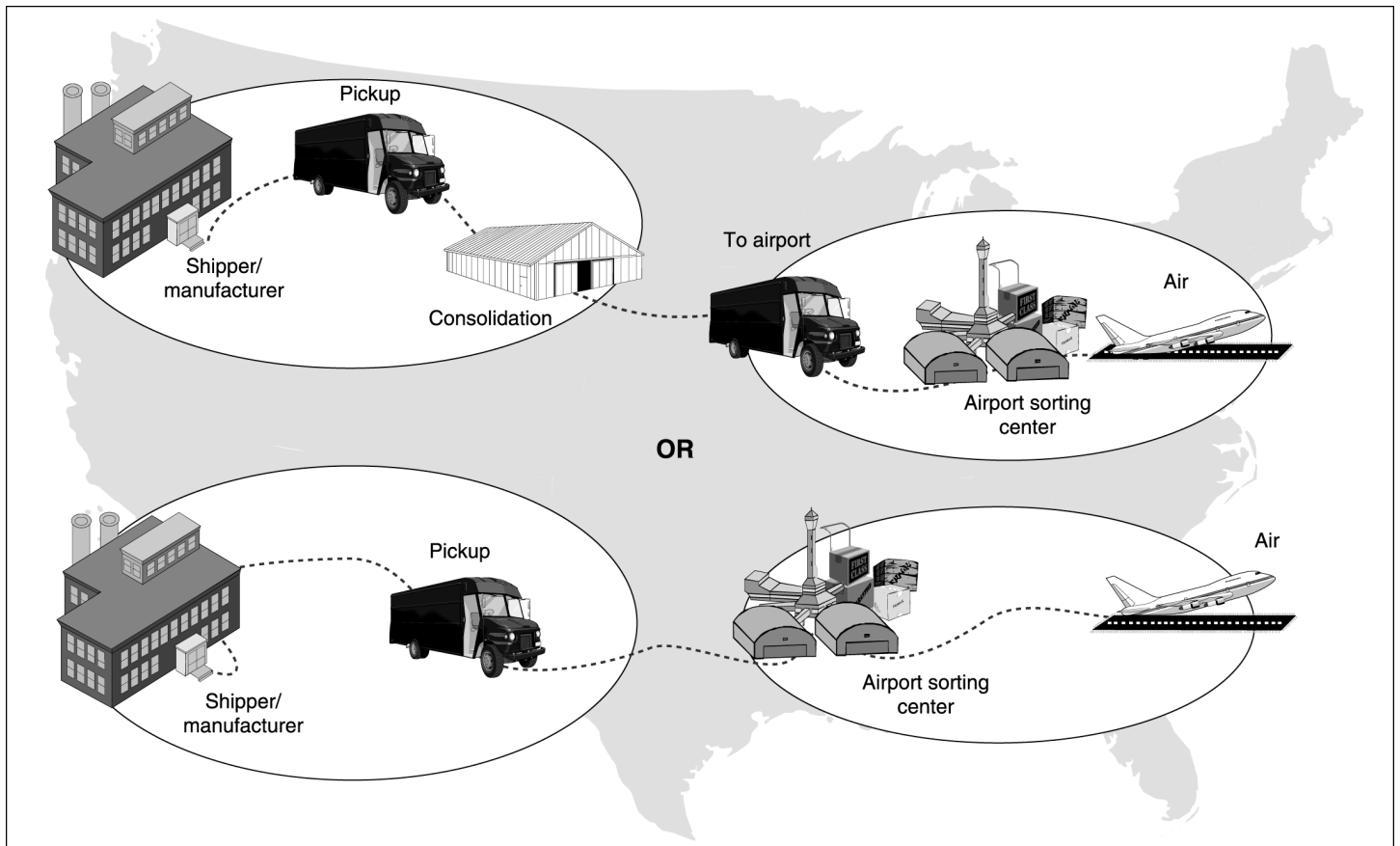
Federal reports, industry groups, and security experts have identified operational and technological measures that have the potential to improve air cargo security in the near-term. The measures incorporate some of the key recommendations made since 1990, as well as best practices for cargo security identified in government reports. Examples of the measures include checking the identity of individuals making cargo deliveries and implementing a computerized cargo profiling system. Each potential improvement, however, needs to be weighed against other issues, such as costs and the effects on the flow of cargo. TSA has been developing some of these measures, such as conducting research on blast-hardened cargo containers; however, other potential measures have not been fully

implemented. In addition, long-term improvements, such as developing a comprehensive cargo security plan, have been recommended by the above sources but have not been implemented by TSA. Moreover, we have recommended that the federal government adopt a risk management approach to combat terrorism. Although TSA has undertaken two elements of the approach we describe—it has assessed some of the threats and vulnerabilities of air cargo—it has not undertaken a third element—assessing the criticality of deploying resources to address the vulnerabilities. Criticality is assessed by evaluating and prioritizing actions in terms of specific criteria. Without a comprehensive plan that incorporates a risk management approach, TSA and other federal decisionmakers cannot know whether resources are being deployed as effectively and efficiently as possible to reduce the risk and mitigate the consequences of a terrorist attack. This report recommends that the Under Secretary of Transportation for Security develop a comprehensive plan for air cargo security that incorporates a risk management approach, includes a list of security priorities, and sets deadlines for completing the actions. DOT agreed with our report and stated that TSA will consider implementing our recommendation as the agency moves forward with its cargo-security program.

Background

Transporting cargo by air involves many participants, including manufacturers and shippers who make routine or occasional shipments, freight forwarders who consolidate shipments and deliver them to air carriers, and cargo facilities of passenger and all-cargo air carriers that store cargo until it is placed aboard an aircraft. Figure 1 depicts these participants and the two primary ways in which a shipper can send cargo by air.

Figure 1: Flow of Cargo from Shipper to Air Carrier



Source: GAO analysis of TSA information.

A shipper may take its packages to a freight forwarder, which consolidates cargo from many shippers and delivers it to air carriers, as illustrated in the top portion of figure 1. The freight forwarder usually has cargo facilities in or near airports and uses trucks to deliver bulk freight to commercial air carriers—either to a cargo facility or to a small-package receiving area at the ticket counter. Freight forwarders operate about 10,000 facilities nationwide. According to TSA, about 80 percent of shippers use freight forwarders. Another way for a shipper to send freight is to directly package and deliver it to an air carrier’s airport sorting center, as pictured in the bottom half of figure 1. Many large companies, including some that produce and distribute perishable goods, have direct accounts with either all-cargo or passenger air carriers.

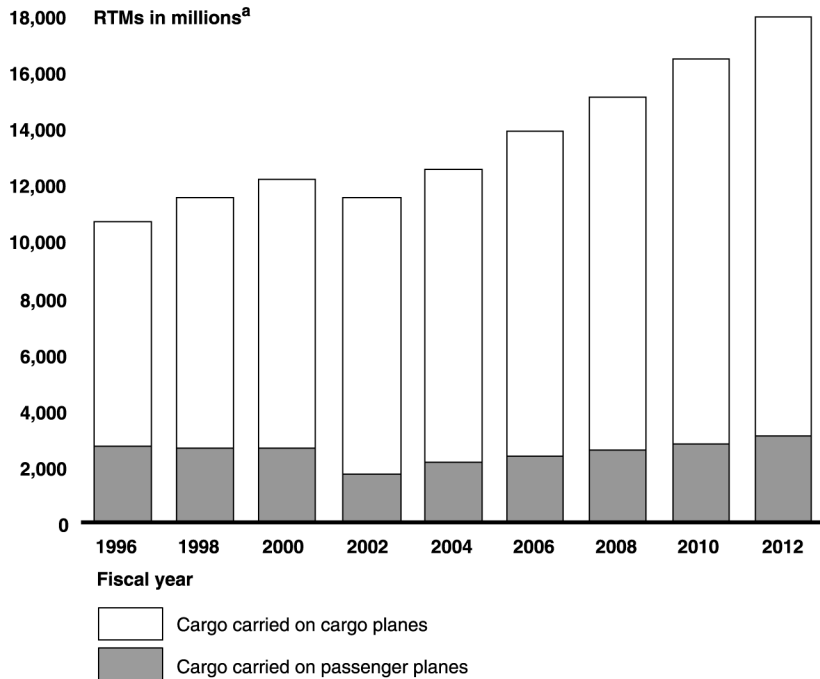
During fiscal year 2000, about 12.2 billion revenue ton miles of freight were shipped in the United States by air.¹ About 22 percent of that total was carried on passenger aircraft; the remainder was carried on all-cargo aircraft.² Freight is a significant source of income to airlines, accounting for about 10 percent of scheduled passenger airlines' revenue and bringing in about \$13 billion in 2001. DOT's projections indicate, moreover, that the amount of freight transported by air will increase faster than the number of passengers in the coming years, thus adding to its importance.³ Figure 2 shows the amount of air cargo actually transported from fiscal years 1996 through 2001 and the amount that DOT projects will be transported from fiscal years 2002 through 2012.

¹A revenue ton mile is one ton of cargo transported one mile.

²In this report, "passenger aircraft" refers to both commercial passenger aircraft and "combination aircraft," in which the fuselage is configured to accommodate both passengers and cargo. The term "cargo aircraft" refers to all-cargo aircraft.

³According to DOT, air cargo (measured in revenue ton miles) carried by U.S. commercial air carriers is expected to grow annually by about one percentage point more than that forecasted for passenger travel (measured in revenue passenger miles) for the 12-year period 2002–2013.

Figure 2: Amount of Air Cargo Transported (Actual and Projected) on Passenger and Cargo Planes in the United States, 1996–2012



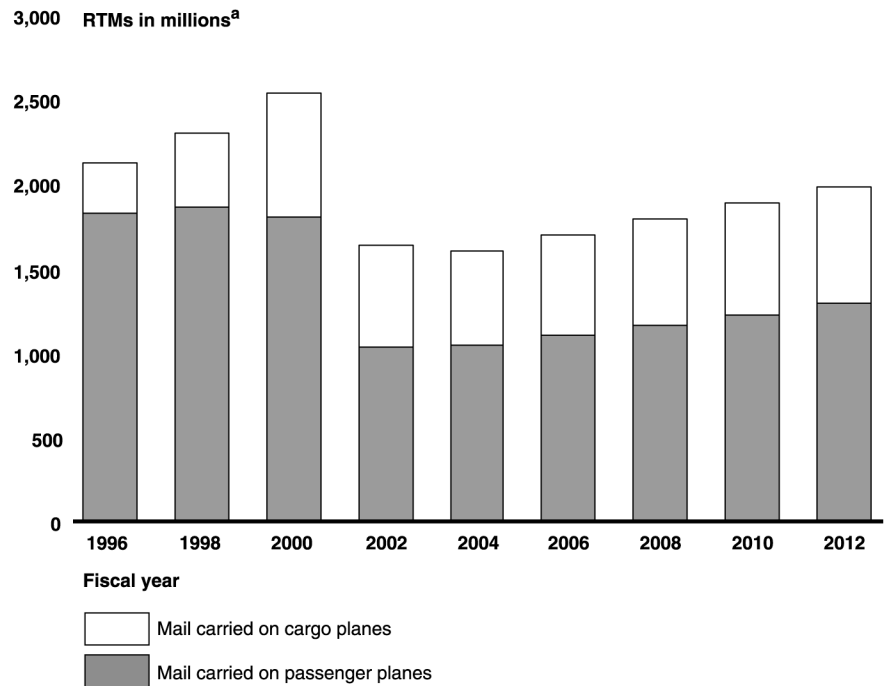
Source: GAO analysis of DOT information.

Notes: DOT's data show actual amounts of cargo for fiscal years 1996 through 2001 and projected amounts for fiscal years 2002 through 2013. Our analysis includes only the even-numbered years.

*A revenue ton mile (RTM) equates to one ton of mail transported one mile.

In addition to freight, air carriers also transport mail. In fiscal year 2000, about 2.5 billion revenue ton miles of mail were shipped in the United States by air and transported predominantly on passenger aircraft (about 70 percent of the total). In September 2001, the amount of domestic mail transported by air decreased significantly—down about 68 percent from the revenue ton miles of mail transported in September 2000. DOT's forecast through 2013 indicates that the amount of domestic mail will resume growth in fiscal year 2004. However, the amount of mail transported by air is not expected to return to 2001 levels during the entire forecast period, in part because of security directives issued by TSA in the aftermath of the September 11th attacks. Figure 3 shows the amount of U.S. mail actually transported by air from fiscal years 1996 through 2001 and the amount that DOT projects will be transported from fiscal years 2002 through 2012.

Figure 3: Amount of U.S. Mail Transported (Actual and Projected) on Passenger and Cargo Planes in the United States, 1996–2012



Source: GAO analysis of DOT information.

Notes: DOT's data show actual amounts of mail for fiscal years 1996 through 2001 and projected amounts for fiscal years 2002 through 2013. Our analysis includes only the even-numbered years.

^aA revenue ton mile (RTM) equates to one ton of mail transported one mile.

The December 1988 bombing of Pan Am flight 103, along with the crashes in 1996 of ValuJet flight 592 and TWA flight 800, led to increased national concerns about air cargo security. The federal government responded to these incidents with studies of the vulnerabilities in the civil aviation system and recommendations to enhance many aspects of the system, including air cargo security. (See app. I for a chronology of the incidents and the federal response.) For example, the Pan Am bombing led to the passage of the Aviation Security Improvement Act of 1990, which required FAA to begin an accelerated 18-month research and development effort to find an effective explosives detection system to screen baggage and cargo. Following the 1996 crashes, the White House Commission on Aviation Safety and Security (known as the Gore Commission) was created. The Commission recommended, among other things, that FAA implement a comprehensive plan to address the threat of explosives and other threat objects in cargo and work with industry to develop new initiatives in this

area. After the 1996 crashes, FAA established the Baseline Working Group and, later, the Cargo Working Group—federal-industry partnerships—to find ways to enhance air cargo security.

The terrorist attacks of September 11, 2001, renewed national concern with cargo security. The Aviation and Transportation Security Act, enacted in November 2001, requires the screening of all passengers and property, including cargo, U.S. mail, and carry-on and checked baggage, that is carried aboard commercial passenger aircraft. It also requires having a system in place as soon as practicable to screen, inspect, or otherwise ensure the security of cargo on all-cargo aircraft. The act transferred responsibility for aviation security from FAA to the newly established TSA. In November 2002, the Senate passed proposed legislation on air cargo security.

Vulnerabilities Exist in Air Cargo Security

Vulnerabilities have been identified in the air cargo system by the 1996 Gore Commission, DOT's OIG, TSA, experts with whom we spoke, and other government and industry studies. Specifically, vulnerabilities have been identified in the security procedures of some air carriers and freight forwarders, including the adequacy of background investigations for all persons handling cargo. For example, TSA inspectors have found numerous security violations made by freight forwarders and air carriers during routine inspections of their facilities. Freight forwarders and air carriers are required to have TSA-approved cargo-security programs, and only freight forwarders with an approved security program are permitted to ship freight on passenger aircraft. In addition, DOT's OIG has reviewed TSA's known shipper program—which allows shippers that have established business histories with air carriers or freight forwarders to ship cargo on planes—and TSA's procedures for approving freight forwarders, checking for possible security weaknesses. The known shipper program is TSA's primary approach for ensuring air cargo security and complying with the cargo-screening requirements of the Aviation and Transportation Security Act.

Other security vulnerabilities include possible tampering with cargo during land transport to the airport or at the cargo-handling facilities of air carriers and freight forwarders. The amount of cargo theft that occurs in these locations indicates the security problem. The National Cargo Security Council, a coalition of public and private transportation organizations, estimates that cargo theft among all modes of transportation accounts for more than \$10 billion in merchandise losses each year. Furthermore, the Federal Bureau of Investigation estimates that

the majority of cargo theft in the United States occurs in cargo terminals, transfer facilities, and cargo-consolidation areas. This type of theft also occurs in other parts of the world. For example, during a series of robberies that took place at the Brussels airport in 2001, robbers stole \$160 million in diamonds from the holds of Lufthansa jets. DOT has reported that thefts are often committed by employees or with employee cooperation, and provided examples of thefts perpetrated at the Port of New York/New Jersey (which includes Kennedy International Airport) and the Port of Boston (which includes Logan International Airport).

Progress Has Been Made in Implementing Key Recommendations on Air Cargo Security

FAA or TSA has implemented a number of key recommendations or mandates to improve air cargo security made over the past 12 years by the Aviation Security Improvement Act of 1990, the Gore Commission, the Cargo Working Group, and DOT's OIG. (See fig. 4.) For example, in 1999, FAA, in cooperation with the air cargo industry, developed security training guides for air carriers and ground personnel who handle air cargo. However, other recommendations by those groups, such as conducting research and operational tests of technology to screen cargo for explosives, are ongoing and not yet completed by TSA or have not been implemented. According to TSA officials, in 1999 FAA requested funds to conduct a feasibility study on a system of third-party inspections, but the study was not funded by the Congress. Additional information on the key recommendations is provided in appendix III and in the subsequent section of this report.

Figure 4: Summary Information on the Status of Key Recommendations for Air Cargo Security

Recommendation	Status
1. Tighten the definition of “known shipper.”	●
2. Conduct a feasibility study on a system of third party inspections.	○
3. Explore technologies to develop a cargo profiling system.	●
4. Establish a training program for passenger air carriers, freight forwarders, and contract ground personnel.	●
5. Establish a training program to improve communication between FAA field inspectors and regional coordinators.	●
6. Conduct research and operational tests of advanced technology to screen cargo for explosives.	◐
7. Implement a comprehensive plan to address the threat of explosives and other threat objects in cargo.	○
8. Conduct regularly scheduled assessments of air carrier and freight forwarder operations.	●

● FAA/TSA has implemented this recommendation.

◐ FAA/TSA has partially implemented this recommendation.

○ FAA/TSA has not implemented this recommendation.

Source: GAO analysis of FAA and TSA information.

Near-Term Actions to Enhance Cargo Security Have Been Identified

Our research identified numerous actions that would enhance air cargo security in the near-term. These actions include and expand upon some of the key recommendations made since 1990, as well as best practices identified for cargo security in government reports. These actions include using existing technologies, such as explosives detection devices, which are currently used to screen baggage, and conducting further research and development of new technologies, such as blast-hardened cargo containers, that have the potential to improve air cargo security. These actions also include instituting additional security procedures and best practices, such as developing an industrywide cargo profiling system and conducting background checks on all individuals who convey and handle air cargo.

Technologies to Enhance Air Cargo Security

Our research identified a number of technologies, such as electronic seals,⁴ that have the potential to strengthen air cargo security by making it more difficult for freight to be tampered with during transport by truck from the shipper to the aircraft and in cargo-handling facilities. Other

⁴An electronic seal is a radio frequency device that transmits shipment information as it passes reader devices and transmits an alarm if a container has been compromised.

technologies, such as x-ray machines and explosives detection equipment, could be used to screen cargo before it is loaded on aircraft. While each technology has security-enhancing benefits, each one also has potential limitations to implementation that need to be weighed. Table 1 describes these technologies as well as the potential cost, benefits, and drawbacks associated with each. Some of the technologies are discussed in greater detail after the table.

Table 1: Information on Technologies to Enhance Air Cargo Security

Type of technology	Description	Cost, benefits, and drawbacks
Technology to screen for threat objects	<p>Technologies that are capable of detecting explosives and weapons of mass destruction, including radiological, chemical, and biological agents. They include:</p> <ul style="list-style-type: none"> • gamma-ray • pulsed fast neutron analysis • thermal neutron activation • x-ray, including bulk explosives detection systems (EDS) • radiation detection • trace detection • vapor detection • canine use 	<p>Cost: Ranges from under \$50,000 per unit for trace/vapor detection and canine use to over \$10 million per unit for pulsed fast neutron analysis and certain x-ray.</p> <p>Benefit: Can indicate potential presence of threat objects without opening packages and containers; canines are considered best means to screen air cargo because they have fewest drawbacks.</p> <p>Drawback: Some technologies (pulsed fast neutron analysis, thermal neutron activation) can take an hour or more per object to screen; some technologies (pulsed fast neutron analysis, bulk EDS) are very costly; some technologies (x-ray, gamma-ray) do not identify specific threat; some technologies (x-ray, gamma-ray) cannot discriminate different materials in high density cargo; some technologies (bulk EDS, pulsed fast neutron analysis) require building modifications in order to accommodate the equipment; all technologies have difficulty identifying biological threats.</p>
Seals and other intrusion-detection technology	<p>Technology that can be used to determine whether a container or conveyance has been tampered with by visual inspection, or that emits an alarm or notifies a central control station. Includes tamper-evident tape that shows “void” when tampered with, tamper-evident seals and locking devices, and electronic seals that emit a radio signal when tampered with.</p>	<p>Cost: Ranges from under \$1 per unit for tamper-evident tape to \$2,500 per unit for electronic seals.</p> <p>Benefit: Easy and inexpensive way to verify tampering within a container or other conveyance.</p> <p>Drawback: All types of seals are known to be vulnerable to tampering, given the appropriate tools, time, and opportunity.</p>
Blast-hardened containers	<p>Technology to harden cargo containers to control the damage caused by an explosion by confining it to a container.</p>	<p>Cost: At least \$15,000 per unit.</p> <p>Benefit: Designed to protect aircraft from catastrophic structural damage or critical system failure caused by an in-flight explosion.</p> <p>Drawback: Containers are expensive and heavy, which results in increased fuel costs.</p>

Type of technology	Description	Cost, benefits, and drawbacks
Access control and authentication	Technologies to identify and authenticate individuals or vehicles allowed into a restricted area, or to authenticate a driver or individual loading goods. This technology includes picture badges, biometrics, and “smart cards.”	<p>Cost: About \$100 per unit for card reader devices; cards are a few cents each.</p> <p>Benefit: Ensures that only authorized persons are handling cargo; creates a record of access to controlled areas.</p> <p>Drawback: Does not protect cargo shipments from tampering by persons who are authorized access to cargo and cargo-handling areas.</p>
Tracking systems	Technology such as global positioning systems and bar codes that can be placed on cargo and used to identify freight being shipped or to track the shipment.	<p>Cost: Ranges from about \$.50 per unit for bar coding to about \$3,000 per unit for some radio frequency tags.</p> <p>Benefit: Tracks the cargo throughout transport.</p> <p>Drawback: Does not protect cargo shipments from tampering; technology only tracks the location of cargo.</p>
Closed circuit television (CCTV)	Video camera to monitor and store video images. CCTV can be used to record the loading of a container into the aircraft and the container can be inspected by viewing the archived video.	<p>Cost: Ranges from about \$50 per camera to about \$1,000 per camera; cost of additional components (switching and recording devices) vary greatly.</p> <p>Benefit: Improves cargo surveillance by reducing time and costs.</p> <p>Drawback: Video screens require continuous monitoring; does not protect cargo shipments from tampering.</p>

Sources:

1. U.S. Treasury Advisory Committee on Commercial Operations of the U.S. Customs Service, *Technology Report* (Washington, D.C.: June 14, 2002).
2. U.S. DOT, John A. Volpe National Transportation Systems Center, *Intermodal Cargo Transportation: Industry Best Security Practices* (Cambridge, Mass.: May 1999).
3. FAA; Air Transport Association, Airforwarders Association; Telair, International.

Screening Technologies. Both the Gore Commission and the Cargo Working Group recommended using existing technology to screen cargo for explosives and developing new technologies to screen cargo for explosives. Trace explosives detection devices and bulk explosives detection systems, which are currently used to screen passenger baggage for explosive material, could also be used to screen cargo containers. According to TSA, the use of trace devices to screen cargo has shown few problems.

Canines have been identified as one of the most effective ways to screen cargo and their use has expanded significantly in recent years, based upon recommendations from the Gore Commission and others. In addition to screening cargo, canine teams are used at airports to respond to suspicious events, such as bomb threats. According to TSA, security experts, and industry officials, canine teams have proven successful at detecting explosives and are the most promising method for screening cargo. As a result, TSA has requested additional funding in its fiscal year

2003 budget to expand the use of canine screening for certain classes of U.S. mail.

FAA and the National Academy of Sciences have examined another method for screening cargo for explosives. Pulsed fast neutron analysis uses gamma rays to identify the chemical composition of items in the container by measuring their density. This analysis, however, takes 1 hour per container, and each machine costs about \$10 million. As a result, according to an FAA official and an aviation security expert, the financial cost and the time needed to screen a container make this option not viable for current use.

Additionally, decompression chambers are used in some countries to screen cargo for bombs. Items to be loaded on a plane are placed in a chamber that simulates the pressures acting on aircraft during takeoff, normal flight, and landing. These conditions will cause explosives that are attached to barometric fuses to detonate.

Intrusion-detection technology. Several technologies, including electronic seals and tamper evident tape, could be used to help indicate whether cargo has been tampered with during its chain-of-custody from the point at which a package is sealed by a known shipper to its placement on an aircraft. For example, an electronic seal (also known as a radio seal) is a radio frequency device that transmits shipment information as it passes reader devices and indicates whether a container has been compromised. Once security staff are alerted to a possible problem, they can physically inspect the cargo. Seals range in cost from less than \$1 per unit for tamper-evident tape to \$2,500 per unit for electronic seals. Within the industry, it is recognized that seals can easily be tampered with, either by entering the cargo without breaking the seal or by removing and replacing the seal. As a result, security experts recommend that seals be used in conjunction with other security procedures as part of a more comprehensive security plan. Additionally, in tests conducted during the fall of 2001, FAA found that electronic seals have limited signal strength and must be read at relatively short, line-of-sight distances. Finally, industry officials have indicated their concern about the use of electronic seals on aircraft because of their potential to interfere with aircraft electronics.

Blast-hardened cargo containers. Hardening cargo containers that are loaded onto aircraft has the potential to reduce damage from explosions, according to experts with whom we spoke. These containers are designed to protect aircraft from catastrophic structural damage or critical system failure caused by an in-flight explosion. TSA continues to conduct

research in this area, which FAA began in 1991 based on requirements in the Aviation Security Improvement Act of 1990. TSA has tested and approved containers made by two manufacturers for use on aircraft. According to industry representatives, air carriers have resisted using the containers because they are significantly more expensive than standard containers. Specifically, a blast-hardened container costs approximately \$15,000, as compared with about \$1,000 for a standard container, according to air carrier representatives. Blast-hardened containers also weigh approximately 150 pounds more than standard containers, which adds to the airplane's fuel costs, according to air carrier representatives. For example, if a Boeing 747 aircraft traveling from New York to Tokyo had blast-hardened containers, the extra weight would result in \$5,000 in additional fuel costs, according to an industry official. Furthermore, as blast-hardened containers are bumped and scratched during shipping, their blast-resistant capabilities are reduced and their lifespan may be shortened to less than 1 year, according to an industry official. By comparison, a standard container lasts as long as 8 years, according to industry officials. Industry officials said that the containers have been used by very few air carriers.⁵ TSA has also conducted research on hardened hulls—that is, placing blast-resistant liners in the cargo hold to protect the aircraft if an explosion occurs—but liners did not successfully resist explosions in initial testing, according to a TSA official. FAA continues to conduct testing on aircraft hardening (both containers and hulls) at a cost of approximately \$3 million per year.

Operational Practices to Enhance Air Cargo Security

Industry and government officials, security experts, and studies we reviewed also identified procedures and best practices to strengthen air cargo security. Some of these activities, such as developing an industrywide cargo profiling system, were recommendations to FAA by the Gore Commission and others; other activities were identified as best practices for companies that transport and handle cargo. (See table 2.) Some of the practices are discussed in greater detail after the table.

⁵El Al Airline, Israel's national airline, uses some blast-resistant containers to transport cargo.

Table 2: Information on Operational Practices to Enhance Air Cargo Security

Practice	Comments
Develop an industrywide computer-assisted cargo profiling system that can be integrated into air carriers' and freight forwarders' reservation and operating systems.	<ul style="list-style-type: none"> • TSA has developed a known shipper database. As of October 10, 2002, information on the known shippers of 250 participating air carriers and freight forwarders had been entered in the data base. • TSA began making the database available to participating air carriers and freight forwarders in October 2002. • Participation is voluntary.
Improve the oversight and enforcement of air carriers and freight forwarders.	<ul style="list-style-type: none"> • TSA estimates that it will need additional cargo inspectors for fiscal year 2003, especially because some cargo inspectors will remain with FAA when TSA is transferred to the Department of Homeland Security.
Use identification card systems to verify individuals authorized to enter cargo-handling facilities.	<ul style="list-style-type: none"> • TSA requires identity checks for individuals entering certain areas of airports. • Requirements for identity checks at cargo facilities that are located off airport property are determined by the individual facilities in accordance with their security plan.
Conduct background checks on all individuals who convey and handle air cargo and have access to cargo areas and documentation.	<ul style="list-style-type: none"> • TSA requires background checks for certain airport workers. • Requirements for background checks on other individuals who convey and handle air cargo are determined by individual employers in accordance with their security plan.
Collect and disseminate information concerning cargo security, including threat-related information , among air carriers, forwarders, and government agencies.	<ul style="list-style-type: none"> • TSA disseminates general threat information to the industry in security directives and information circulars. • Industry officials state that specific threat information is not getting to the airline workers who handle cargo.
Establish written policies and procedures and training programs for the employees of companies that convey and handle cargo.	<ul style="list-style-type: none"> • TSA requires air carriers that transport passengers to have security programs.
Employ a sufficient number of qualified security officers at cargo facilities to provide physical security and access control.	<ul style="list-style-type: none"> • Use of security officers at cargo facilities is determined by the individual facilities in accordance with their security plan.
Use physical barriers (walls, fences) to guard against unauthorized access to cargo areas.	<ul style="list-style-type: none"> • Use of physical barriers at cargo facilities is determined by the individual facilities in accordance with their security plan.

Sources:

1. U.S. DOT, John A. Volpe National Transportation Systems Center, *Intermodal Cargo Transportation: Industry Best Security Practices* (Cambridge, Mass.: May 1999).
2. U.S. Treasury Advisory Committee on Commercial Operations of the U.S. Customs Service, *Technology Report* (Washington, D.C.: June 14, 2002).
3. TSA; final report by the White House Commission on Aviation Safety and Security; Cargo Working Group; Air Transport Association; Airforwarders Association; Cargo Airlines Association.

Cargo profiling. The Gore Commission recommended that FAA work with industry to develop a computer-assisted cargo profiling system that could be integrated into airlines' and freight forwarders' reservations and operating systems. Since 1997, FAA and now TSA have been working to develop a cargo profiling system that is similar to the Computer Assisted

Passenger Prescreening System.⁶ The first phase of developing the cargo profiling system is the nationwide deployment of a database of known shippers. TSA began field-testing a computerized known shipper database in October 2002. About 250 air carriers and freight forwarders have provided information on their known shippers for TSA's database, which contains about 165,000 shipping companies, according to TSA officials. In addition, the database includes the names of restricted entities from the Department of the Treasury's Office of Foreign Assets Control. Participants in the field test have the opportunity to query a TSA Internet site to ascertain the status of shippers unknown to them. An electronic message is provided, indicating whether the shipper is known or unknown. If the shipper is known, a unique identification number is electronically provided to the participant and the cargo can be accepted from that shipper as "known shipper cargo." If the shipper is a restricted entity, the participant receives a warning against receiving shipments from that entity. According to security experts and industry association officials, this system would enhance air cargo security by allowing freight forwarders to quickly determine whether a company is a known shipper. In addition, this system would allow a shipper that is known to one freight forwarder to become known to all freight forwarders. However, during the pilot phase the use of this system is voluntary, and its success will depend, in part, upon widespread participation. According to TSA officials, the agency has made no decision about whether participation will be voluntary after the pilot is completed, at the end of December 2002. According to industry representatives, some freight forwarders are reluctant to participate because of concerns about placing themselves at a competitive disadvantage by including their customers in the database.

Oversight and enforcement. To enhance its oversight of freight forwarders and air carriers, TSA conducts routine inspections. According to TSA officials, the agency is considering increasing the frequency of these inspections. To achieve targeted increases in the number of inspections, TSA estimates that it needs to hire several hundred additional cargo inspectors in fiscal year 2003, especially since some of its current inspector workforce will remain with FAA when TSA is transferred to the Department of Homeland Security.

⁶This system identifies passengers as greater security risks based on characteristics of their travel and targets these individuals for additional screening.

Identification checks. Identification checks of individuals making deliveries to freight forwarders and airline cargo facilities would help to ensure the identities of employees of known shippers and has been recommended as a best practice for cargo security by DOT. Freight forwarders and air carriers are not required to check and record identification information for employees of known shippers. TSA regulations require identification checks of individuals who enter restricted areas of airports, which include cargo-handling areas. That information is usually recorded manually, according to industry officials. However, the use of technology such as smart cards can make this process more efficient and reliable, according to security experts. For example, Chicago's O'Hare Airport, with a \$1.5 million research grant provided by FAA in 1997, developed and operationally tested a smart card/biometric-based security access system. This system uses fingerprint biometrics to verify the identity of truck drivers delivering cargo to the airport and information encoded on a smart card to match the driver with the cargo being delivered. The results of the operational tests, completed in July 1999, indicated that fingerprints provide a highly reliable means of confirming driver identity, and that having the cargo manifests and related information on the smart card dramatically reduces the time required to process cargo deliveries. According to TSA officials, the agency does not have plans to further deploy such identification verification technology to airports.

Threat information. Dissemination of security-related information, including threat information, to carriers and freight forwarders has been recommended by DOT as a best practice for cargo security across the transportation modes.⁷ According to TSA, it provides such information to the aviation industry by means of security directives and information circulars. Since September 2001, TSA has issued three directives related to air cargo. However, industry officials told us that the threat information provided is usually not sufficiently specific to be acted upon by the workers who handle the cargo. Air carrier officials stated that more specific information about threats would allow them to conduct targeted inspections of cargo, which they believe would be more effective than the random inspections that have been proposed in legislation and suggested by some, including DOT's OIG. However, according to TSA officials, the agency provides the best threat information that is generally available.

⁷U.S. DOT, John A. Volpe National Transportation Systems Center, *Intermodal Cargo Transportation: Industry Best Security Practices* (Cambridge, Mass.: May 1999).

A Comprehensive Plan and Risk Management Approach Have Been Identified As Ways to Improve Air Cargo Security in the Long Term

The Gore Commission and aviation industry representatives have suggested that FAA implement a comprehensive plan to address the threat of explosives and other dangerous objects in cargo. In addition, we have recommended that the federal government adopt a risk management approach to combat terrorism. Without a comprehensive plan for air cargo security that incorporates a risk management approach, TSA and other federal decisionmakers cannot know whether resources are being deployed as effectively and efficiently as possible to reduce the risk and mitigate the consequences of a terrorist attack. Moreover, as air cargo security is viewed in the larger context of transportation and homeland security, the lack of a risk management approach hinders efforts to set strategic priorities.

Developing a Comprehensive Plan for Air Cargo Security

Neither FAA nor TSA has developed a comprehensive plan for air cargo security as recommended by the Gore Commission, which would provide a first step toward meeting the requirement of the Aviation and Transportation Security Act to have a system in place to ensure the security of cargo. TSA officials have told us that the agency intends to issue a long-term plan for cargo security, but they were unsure when that would occur. Meanwhile, according to agency officials, TSA is in the early stages of developing an agencywide strategic plan that is to include the air cargo security program. As of April 2002, the draft strategic plan had identified one performance measure concerning air cargo security. Our analysis indicated that this measure—the progress of federalization of the cargo-screening process—focused more on process than on results. However, TSA has stated that it intends to further develop measures in the future. TSA also said that it would include these measures and their associated goals in its fiscal year 2003 performance plan.

Implementing a Risk Management Approach

Over the past year, we have determined that a risk management approach used by the Department of Defense to defend against terrorism also has

relevance for other organizations responsible for security.⁸ This approach can provide those organizations with a process for enhancing their preparedness to respond to terrorist attacks and to support decisionmaking to manage security risks in a cost-effective manner. Figure 5 describes this approach.

Figure 5: Elements of a Risk Management Approach

A risk management approach includes assessments of threats to security, vulnerabilities to those threats, and the criticality, or relative importance, of addressing the identified vulnerabilities.

A threat assessment identifies and evaluates potential threats on the basis of factors such as capabilities, intentions, and past activities. This assessment represents a systematic approach to identifying potential threats before they materialize. However, even if updated often, a threat assessment might not adequately capture some emerging threats. The risk management approach therefore uses vulnerability and criticality assessments as additional input to the decisionmaking process.

A vulnerability assessment identifies weaknesses that may be exploited by identified threats and suggests options to address those weaknesses. For example, a vulnerability assessment would look at the facilities and pathways through which cargo moves from the original shipper to the cargo's placement aboard an aircraft. The assessment would identify the points at which a terrorist could place a bomb or other weapon in the shipment or aircraft.

A criticality assessment evaluates and prioritizes assets and functions in terms of specific criteria, such as their importance to public safety and the economy. The assessment provides a basis for identifying which structures or processes are relatively more important to protect from attack. As such, it helps managers to determine operational requirements and target resources at the highest priorities, while reducing the potential for targeting resources at lower priorities. The criticality assessment may also change over time. For example, specific threat information may indicate that resources should temporarily be deployed to protect cargo in a particular region of the country or a specific airport.

Source: U.S. General Accounting Office, *Homeland Security: A Risk Management Approach Can Guide Preparedness Efforts*, GAO-02-208T (Washington, D.C.: Oct. 31, 2001).

TSA has partially developed a risk management approach. In the fall of 2001, FAA completed an assessment of the threats to and vulnerabilities of air cargo. The assessment examined a single scenario—a terrorist attempting to place a bomb on a commercial passenger aircraft. The assessment did not examine the vulnerabilities associated with the pathways by which shipments are transported by truck or other means from the shipper to the aircraft (see fig. 1 above). According to TSA officials, the agency does not have plans to conduct further threat assessments for air cargo.

⁸U.S. General Accounting Office, *Homeland Security: A Risk Management Approach Can Guide Preparedness Efforts*, GAO-02-208T (Washington, D.C.: Oct. 31, 2001).

TSA has not undertaken a criticality assessment—the third element we identified in a risk management approach—and therefore has no explicit criteria for determining the priority of actions to enhance air cargo security. However, according to TSA officials, passenger aircraft security is a higher priority than all-cargo aircraft security. According to TSA officials, their priorities are spelled out in the Aviation and Transportation Security Act, which has laid out specific deadlines dealing primarily with passenger and baggage screening for TSA to address over the past year. As we have reported, TSA has faced an extraordinary challenge in meeting some of those deadlines, such as hiring and training 33,000 employees to conduct passenger security screening by November 19, 2002.⁹ The act provides no specific deadlines for enhancing air cargo security but requires having a system in place as soon as practicable to screen cargo on all-cargo aircraft or otherwise ensure its security.

Conclusion

Over the past year, with the passage of the Aviation and Transportation Security Act, our nation has placed new emphasis on aviation security. However, few changes have been made to air cargo security, as TSA has focused its efforts on improving passenger and baggage security to meet specific legislative deadlines. The act requires the screening of all cargo aboard commercial passenger aircraft and requires TSA to have a system in place as soon as practicable to screen or otherwise ensure the security of cargo on all-cargo aircraft. The large volume of air cargo and the fact that its delivery is generally considered time-critical result in a limited amount of cargo being screened. Other means to ensure air cargo security include technological and operational improvements that have been identified or recommended by various government and industry groups over the past decade. While TSA has been developing some of these measures, such as blast-hardened containers and a cargo profiling system, it has not implemented other identified improvements. Moreover, TSA lacks a comprehensive plan with long-term goals and performance targets for cargo security, time frames for completing security improvements, and risk-based criteria for prioritizing actions to achieve those goals. A comprehensive plan for air cargo security that incorporates a risk management approach could provide a framework for systematically evaluating and prioritizing the various technological and operational

⁹U.S. General Accounting Office, *Aviation Security: Transportation Security Administration Faces Immediate and Long-Term Challenges*, [GAO-02-971T](#) (Washington, D.C.: July 25, 2002).

improvements that have already been identified, and for identifying and implementing additional improvements. Such a plan would also provide a framework for developing a system to ensure air cargo security, as required by the act.

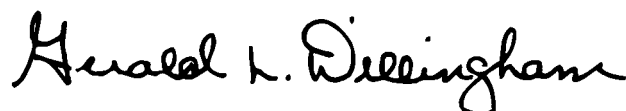
Recommendation for Executive Action

We recommend that the Under Secretary of Transportation for Security develop a comprehensive plan for air cargo security that includes priority actions identified on the basis of risk, costs of these actions, deadlines for completing those actions, and performance targets.

Agency Comments

We provided DOT with a draft of this report for review and comment. DOT provided oral comments. FAA's Deputy Director, Office of Security and Investigations, and agency officials from TSA with responsibility for cargo-security issues generally agreed with the information presented in the report. TSA officials stated that the recommendation was reasonable and that they will consider implementing it as the agency moves forward with its cargo-security program. These officials provided a number of clarifying comments, which we have incorporated where appropriate.

As agreed with your offices, unless you announce the contents of this report earlier, we plan no further distribution until 30 days from the report date. At that time, we will send copies of this report to interested congressional committees, the Secretary of Transportation, and the Under Secretary of Transportation for Security. Copies will also be made available to others upon request and this report will be available for no charge on GAO's Web site at www.gao.gov. If you or your staff have any questions, please call me at (202) 512-2834. Individuals making key contributions to this report included Wayne A. Ekblad, Elizabeth Eisenstadt, Colin J. Fallon, Bert Japikse, Maren McAvoy, John W. Shumann, Teresa F. Spisak, and Cindy M. Steinfink. In addition, we would like to acknowledge, in memoriam, the contributions to this report made by Angela Davis.



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Appendix I: Air Cargo Incidents and Follow-Up Actions

Agency actions and the introduction of new legislation to improve security and safety have often come in reaction to aviation tragedies. The following time line (fig. 6) reflects key changes in air cargo security following the bombing of Pan Am flight 103 over Lockerbie, Scotland; the crashes of ValuJet flight 592 in the Florida Everglades and TWA flight 800 over Long Island; and the terrorist attacks in the United States involving four jet airliners on September 11, 2001.

Appendix I: Air Cargo Incidents and Follow-Up Actions

Figure 6: Time Line of Key Changes in Air Cargo Security

Pan Am Flight 103 was bombed over Lockerbie, Scotland	ValuJet 592 crashed in Florida Everglades	TWA 800 exploded near Long Island, New York	Terrorist attacks
December 21, 1988	May 11, 1996	July 17, 1996	September 11, 2001
<p>Executive Order 12686, August 4, 1989</p> <ul style="list-style-type: none"> • President's Commission on Aviation Security and Terrorism created • 5/90 - Report issued • 9/27/91 - Commission revoked by Executive Order 12774 <p>Secretary of Transportation/Federal Aviation Administration (FAA)</p> <ul style="list-style-type: none"> • 1989 - Aviation Security Advisory Committee (ASAC) created <p>Aviation Security Improvement Act of 1990 (P.L. 101-604, November 16, 1990)</p> <ul style="list-style-type: none"> • The Act mandated recommendations of 1989 President's Commission on Aviation Security and Terrorism • FAA Aircraft Hardening Program initiated in compliance with direction set forth in the above act, and in response to recommendations of President's Commission on Aviation Security and Terrorism 	<p>Executive Order 13015, August 22, 1996</p> <ul style="list-style-type: none"> • White House Commission on Aviation Safety and Security created • 9/9/96 - Initial report issued • 2/12/97 - Final report issued • 9/29/97 - Commission revoked by Executive Order 13062 <p>Department of Transportation (DOT)/Federal Aviation Administration</p> <ul style="list-style-type: none"> • 7/17/96 - Baseline Working Group (BWG) established • 8/30/96 - Report issued • 9/96 - BWG formed Cargo Working Group (CWG) • 12/12/96 - BWG concurred with recommendations issued by CWG and ASAC issued Domestic Security Baseline Final Report • 2/97 - FAA joined with DOT/Inspector General to conduct special emphasis testing of air carrier and indirect air carrier known shipper packages • 5/14/97 - FAA issued for comment proposed amendments to the standard security programs for U.S. air carriers, couriers, freight forwarders, and cargo consolidators, as well as the model security program for foreign air carriers, to enhance aviation cargo security • 5/17/97 - Joint test conducted on a Boeing 747 between FAA and United Kingdom's Civil Aviation Authority to blow up a commercial wide body aircraft • 7/97 - After review of White House Commission recommendations, FAA requested that BWG reconvene with original members. CWG changed its name to Cargo Baseline Working Group (CBWG) and made amplified recommendations • FY 97 - Department of Transportation and Related Agencies Appropriations Act, 1997, provided FAA with over \$10 million to expand and improve the dangerous goods and air cargo security program • 12/98 - Report to Congress on Aviation Security Aircraft Hardening Program issued <p>Federal Aviation Reauthorization Act of 1996 Sec. 313 (P.L. 104-264, (October 9, 1996)</p> <ul style="list-style-type: none"> • 5/98 - Report to Congress on Air Cargo Security issued <p>International Civil Aviation Organization (ICAO)</p> <ul style="list-style-type: none"> • 8/1/97 - Amendment 9 to Annex 17 of the Chicago Convention, which highlighted cargo security, implemented 		<p>Department of Transportation/Federal Aviation Administration</p> <ul style="list-style-type: none"> • 9/13/01 - The U.S. national airspace system was reopened to commercial aviation after a 2 day shutdown • New security restrictions were implemented on the transport of mail and cargo on passenger aircraft <p>Aviation and Transportation Security Act of (P.L. 107-71, (November 19, 2001)</p> <ul style="list-style-type: none"> • Mandated screening of all cargo "as soon as practicable" • Indirect Air Carrier Security relocated to 49 CFR Part 1548 as of February 22, 2002 • Transportation Security Administration created

Source: GAO analysis of DOT Reports to Congress (1996, 1997, and 1998) and legislation (P.L. 101-604, P.L. 104-264, and P.L. 107-71).

Appendix II: Proposed Legislation on Air Cargo Security

In November 2002, the Senate approved S. 2949. The bill, comprising seven sections, includes clauses affecting air cargo security under Title II.

Title II of S. 2949 would instruct TSA to develop a strategic plan to establish systems to screen, inspect, or otherwise ensure the security of all cargo transported through the nation's air transportation system. It also imposes measures that would require TSA to increase inspections of air cargo shippers and their facilities and to work with foreign countries to conduct regular inspections at facilities transporting air cargo to the United States. Title II would require the creation of an industrywide pilot database of known shippers of cargo in passenger aircraft. TSA would also be required to conduct random inspections of freight forwarder facilities, perform an assessment of the current Indirect Air Carrier Program,¹⁰ and report to Congress on the random audit system. Upon the recommendation of the Under Secretary of Transportation for Security, the Secretary of Transportation would be required to suspend or revoke the certificate of a noncompliant freight forwarder.

Title II would direct TSA to develop a training program for air cargo handlers. TSA would also be required to create a program for all-cargo air carriers to develop an approved plan for the security of their facilities, operations, cargo, and personnel. Any plan would need to address the security of the carrier's property at each airport it serves, the background checks for all employees with access to operations, the training for all employees and contractors with security responsibilities, the screening of all flight crews and others aboard flights, the security procedures for cargo, and other necessary measures.

¹⁰An indirect air carrier is another term for a freight forwarder.

Appendix III: Key Recommendations on Air Cargo Security

Since 1990, recommendations have been made or mandates issued to improve air cargo security by the Aviation Security Improvement Act of 1990, the White House Commission on Aviation Safety and Security (also called the Gore Commission), the Cargo Working Group (an FAA-industry partnership), and DOT's Office of Inspector General (OIG). Table 3 summarizes key recommendations. The left column describes the recommendation, the group(s) that made the recommendation, and the date it was made; the right column shows the status of the recommendation.

Table 3: Status of Key Recommendations on Air Cargo Security

Recommendation	Status
Tighten the definition of "known shipper" to ensure a greater measure of security in the transportation of cargo on passenger aircraft. (Cargo Working Group, 1996)	FAA changed the definition of known shipper in September 1999. The change required that a known shipper must have an established business history with the air carrier or freight forwarder.
Conduct a feasibility study on the establishment of a third party inspection and compliance program for the Indirect Air Carrier Program, ^a and distribute inspection results to the industry. (Cargo Working Group, 1996)	Not conducted by FAA.
Cooperate with industry to explore technologies to develop a profile to be applied to cargo shipments. (Gore Commission, 1997)	FAA issued a final report on how to develop a computer-assisted cargo profiling system. TSA began field testing the system in October 2002 and expects to issue a progress report in December 2002.
Establish, in cooperation with the air cargo industry, a training program directed at passenger air carriers, freight forwarders, and contract ground personnel. The training program will: 1) include cargo acceptance and ground transport measures, 2) require initial and recurrent participation and documentation, and 3) be incorporated in the Air Carrier Standard Security Program and the Indirect Air Carrier Standard Security Program. (Cargo Working Group, 1996)	FAA worked with the air cargo industry to develop a training tape and guidance for understanding and implementing program requirements.
Improve the line of communication between FAA field, principal security inspectors, and regional cargo-security coordinators through a training program coordinated with the industry. (Cargo Working Group, 1996)	In September 1999, FAA developed a Cargo Security Basic Course to familiarize newly hired FAA cargo security inspectors with the regulatory requirements placed on domestic and international shippers, and on air carriers who submit and accept freight for air carriage.
Conduct research and development to find an effective explosives detection system to screen baggage and cargo; institute interim screening measures until this system is developed. (Aviation Security Improvement Act, 1990)	TSA conducted operational tests of trace explosives detection devices to screen air cargo, and it considered the test successful. The agency also conducted research on Pulsed Fast Neutron Analysis to screen cargo for explosives and found it not viable because of cost (\$10 million per unit) and time (screens one container per hour). TSA budgeted \$7 million in fiscal year 2002 to conduct research on new technologies to screen air cargo, and budgeted \$13 million in fiscal year 2003 for that purpose.
Deploy advanced technology on a test-and-evaluation for use in screening cargo in an operational environment. (Cargo Working Group, 1997)	

**Appendix III: Key Recommendations on Air
Cargo Security**

Recommendation	Status
Implement a comprehensive plan to address the threat of explosives and other threat objects in cargo, and work with industry to develop new initiatives in this area. (Gore Commission, 1997)	Not implemented.
Conduct regularly scheduled assessments of air carrier and freight forwarder operations. (OIG, 1998)	FAA inspections were expanded to include shippers and freight forwarders, and a database was established to record assessment information.

^aAn indirect air carrier is a freight forwarder.

Sources: GAO analysis of reports by the White House Commission on Aviation Safety and Security (Gore Commission), Cargo Working Group, and DOT's Office of Inspector General; the Aviation Security Improvement Act of 1990; and information provided by TSA.

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