STATUS REPORT ON FAA'S OPERATIONAL EVOLUTION PLAN

Federal Aviation Administration

Report Number: AV-2003-048
Date Issued: July 23, 2003

Memorandum

U.S. Department of Transportation
Office of the Secretary of Transportation
Office of Inspector General

Subject: ACTION: Status Report on FAA's Operational Evolution Plan
AV-2003-048

Date: July 23, 2003

From: Alexis M. Stefani
Principal Assistant Inspector General
for Auditing and Evaluation

Reply to Attn. of: JA-10

To: Federal Aviation Administrator

We are providing you with the results of our review of the Federal Aviation Administration's (FAA) Operational Evolution Plan (OEP). The Chairman and Ranking Member of the House Committee on Transportation and Infrastructure asked us to develop a status report and observations on how to move forward on the OEP. As agreed with their offices, we focused on 12 major initiatives in the Plan, which include new runways, new technologies, and air traffic procedures. We selected these projects based on discussions with FAA and industry on their potential to increase capacity of the National Airspace System.

We periodically met with the Associate Administrator for Research and Acquisitions (who is responsible for the OEP) and discussed our observations on the Plan. We provided FAA a discussion draft report, and on June 18, 2003, we met with the Associate Administrator for Research and Acquisitions and representatives from Air Traffic Services and the Operational Evolution Staff to discuss our results and recommendations. We have incorporated their comments where appropriate. We conducted our work in accordance with Government Auditing Standards as prescribed by the Comptroller General of the United States. Exhibit A provides information on our objectives, scope, and methodology.

BACKGROUND

The OEP is the general blueprint for enhancing capacity of the National Airspace System (NAS) over the next decade. FAA developed the OEP in direct response to delays and cancellations that reached intolerable levels in the summer of 2000. The OEP formalizes plans for a wide range of efforts that were already underway, such as automated controller tools, new weather systems, data link communications for pilots and controllers, airspace changes, new runways, and air traffic procedures. The Plan establishes solution sets for problem areas, which include increasing airport arrival rates, minimizing congestion at high altitudes, and reducing the impact of bad weather at airports. The first version of the Plan was introduced in June 2001, and updated versions of the Plan were published in December 2001 and December 2002. Since it was established, progress has been made; two new runways at Detroit and Phoenix have opened, and work has been completed on airspace "choke points" that impacted air traffic east of the Mississippi.

RESULTS IN BRIEF

The OEP is an important effort because it will shape FAA and industry investments over the next decade. However, much has changed since the OEP was introduced—the demand for air travel has declined, major network carriers are in financial distress, and Aviation Trust Fund revenues have declined sharply. Moreover, we found that fundamental assumptions about the OEP, such as the cost, schedule, and benefits of key efforts as well as the ability of airspace users to pay for and equip with new technologies in the near term, are no longer valid and need to be revisited.

FAA now forecasts that domestic passenger numbers will return to September 2000 levels in the 2005 to 2006 timeframe. Thus, FAA has a window of opportunity to make capacity enhancing changes that will better position the agency for when the demand for air travel returns. FAA has recently published a draft 5-year strategic plan that recognizes the importance of enhancing capacity and seeks to provide a system that meets or exceeds the demand for air traffic services.

In our view, a combination of factors—the financial health of the major network airlines, decline in Trust Fund revenues, delays in OEP initiatives, a draft strategic plan, and a new FAA reauthorization proposal—make it an appropriate time to take a closer look at the OEP.

We also found that FAA is evaluating the OEP and looking at what can be done in the near-term, and determining how to make better use of small airports, developing policies for making better use of congested airspace, and developing a longer term vision for the National Airspace System beyond the OEP—all of which are important steps in the right direction. In conjunction with these efforts, FAA needs to take a number of actions for the OEP to be realistic, cost-effective and executable. The following actions will enable the OEP to be a solid foundation for decisionmaking.

- **Determining How Much the Plan Will Cost.** FAA has not developed a comprehensive cost estimate for the OEP, and cost estimates for individual projects are not included in the Plan. Moreover, FAA's assumptions about what projects in the OEP will cost and what can be delivered are based on projects that do not have reliable cost and schedule baselines. For example, the *Integrated Terminal Weather System* (ITWS) is a new weather system that provides controllers with a 20-minute forecast of weather near airports. Production costs for ITWS have skyrocketed from $360,000 to over $1 million per unit. As a result, its deployment has been stretched out until 2008, FAA may procure fewer systems than planned, and production systems will be less capable than prototypes currently in use.

  FAA also needs to determine what projects are in the OEP and what projects are being deferred. For example, *Controller Pilot Data Link Communications* (data link) is a new way for controllers and pilots to communicate that is analogous to e-mail. The approved baseline of almost $167 million (for 20 locations) is no longer valid. FAA estimates that it would cost $237 million for eight locations—an increase of $70 million for less than half of the planned locations to move forward, exclusive of controller training costs. Because of these cost increases and uncertainty about how quickly airspace users will equip with new systems, FAA is deferring plans for data link.

- **Linking the OEP to the Agency's Budget to Help Decisionmakers Set Priorities.** Linking the Plan to the Agency's budget is important because funding in the modernization account (Facilities and Equipment) will remain essentially flat over the next several years as outlined in the Administration's reauthorization proposal, and several OEP initiatives do not have reliable cost or schedule estimates. This will help decisionmakers determine which projects should be accelerated, deferred, or scaled back.

  Linking the Plan to the budget is also important because there are large-scale, billion-dollar acquisitions (new controller displays and related computer equipment) not in the Plan that are critical for achieving capacity gains. For example, the *En Route Automation Modernization* will provide new software and hardware for facilities that control high altitude traffic at an estimated cost of $2.1 billion. FAA needs to determine what its priorities are among OEP and modernization projects.

- **Establishing a Path for Addressing Uncertainty With Initiatives That Require Airspace Users to Purchase and Install New Technologies.** The OEP assumed that airspace users would invest in a wide range of new technologies at a cost of $11 billion over 10 years. However, the current economic environment makes it difficult for the airline industry to make decisions about investing in new avionics. For example, FAA estimates the cost to equip a single commercial aircraft with *Automatic Dependent Surveillance-Broadcast* (a new satellite-based surveillance system) ranges from $168,000 to over $500,000, excluding the cost to take aircraft out of revenue service. FAA faces major policy questions about how to transition to the new systems, i.e. through voluntary equipage or mandating the use of new systems and weighing the costs.

- **Taking Full Advantage of Airspace Redesign, New Procedures, and Systems Currently Onboard Aircraft.** FAA and industry officials we spoke with believe that considerable benefits can be obtained through airspace changes, new procedures, and systems currently onboard aircraft—none of which will require airspace users to make major investments. Focusing on these areas may be less costly to airspace users, and will give FAA time to address issues with new technologies that require airspace users to equip with new systems.

  FAA recognizes the importance of airspace redesign, new procedures, and systems currently onboard aircraft in its draft strategic plan but has not decided on the best way to execute such a shift in the OEP. Capitalizing on airspace redesign, new procedures, and existing onboard aircraft systems has resource implications because the Agency will have to shift resources from existing programs. For example, a planning document shows that FAA would need an additional $27 million between fiscal years (FY) 2003 and 2005 to accelerate the work to take advantage of systems currently onboard aircraft. This is a modest shift and underscores the need to link the OEP to the budget and set priorities.

- **Assessing Benefits of OEP Initiatives and Using Metrics to Assess Progress to Help Make Informed Investment Decisions.** The OEP is expected to provide a 30 percent increase in capacity over the next 10 years, assuming all runways are completed, new systems are delivered, and airspace users equip with new systems. Of the OEP initiatives we reviewed, building new runways provides the largest increase in capacity, and runways account for 42 percent of the projected increase in capacity promised by the Plan.

  Other than runways, it is less certain what level of increased capacity OEP initiatives will deliver. Our analysis of the anticipated benefits of OEP projects shows that benefits have shifted or are not clearly defined for some projects. For example, the Local Area Augmentation System was expected to provide Category II/III precision approach capability (equates to auto landings under all weather conditions) in 2005, but this is now a research and development effort with an uncertain end date.

As FAA moves forward with implementing the OEP as well as a new strategic plan, it is critical to determine which projects provide the most benefits for the investment. To its credit, FAA has developed high level metrics (such as average delay per flight) but is still working on metrics specifically to assess how OEP initiatives translate into increases in capacity. Additional work is needed to refine OEP metrics, and agreement needs to be reached among FAA offices on how to use the metrics and report results. Without an agreed-upon approach for assessing OEP initiatives, it will be difficult to make informed investment decisions.

FAA Needs to Establish Realistic Cost Estimates for the OEP

FAA has not developed a comprehensive cost estimate for the OEP, and cost estimates for individual projects are not included in the Plan. The OEP is a "rolling 10-year plan," and we have seen estimates for the plan in the $11.5 billion to $13 billion range for acquiring new systems and related efforts (Facilities and Equipment), but this does not include costs for sustaining new systems once they are fielded, training, developing new procedures, making airspace changes, or building new runways.

FAA's assumptions about what the OEP will cost and what can be delivered are based on projects that do not have reliable cost and schedule baselines, as shown in the following examples and more fully described in Exhibit B.

- The *Local Area Augmentation System* (LAAS) is a new precision approach and landing system that can boost airport arrival rates under all weather conditions. It was planned to be operational in 2002 (CAT I performance) and has enjoyed considerable industry support over the years but has now slipped to late 2006. The more demanding LAAS performance (CAT II and III) is now a research and development effort with an uncertain end date.[1] Costs, schedule, and expected benefits for LAAS are under review.

- The ITWS is a new weather system that provides controllers with a 20-minute forecast of weather near airports. Production costs for ITWS have skyrocketed from $360,000 to over $1 million per unit. As a

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[1] CAT I precision approach has a 200-foot ceiling/decision height and visibility of 1/2 mile. CAT II precision approach has a 100-foot ceiling/decision height and visibility of 1/4 mile. CAT III precision approach and landing has a decision height less than 100 feet and visibility down to the airport surface.

result, its deployment has been stretched out until 2008, FAA may procure fewer systems than planned, and production systems will be less capable than prototypes currently in use.

- Data link is a new way for controllers and pilots to communicate that is analogous to e-mail. The approved baseline of almost $167 million (for 20 locations with deployment complete by late 2005) is no longer valid. FAA estimates that it would cost $237 million for eight locations—an increase of $70 million for less than half of the planned locations—to move forward. Because of this and uncertainty with respect to how quickly airspace users will equip, FAA is deferring plans for data link.

- FAA is pursuing 30 separate *airspace redesign* projects funded through the Operations account. These projects include revamping high altitude airspace and a major airspace redesign effort in the New York/New Jersey/Philadelphia area planned for 2005. FAA spends about $20 million annually on airspace redesign. However, records show that an additional $15 million to $30 million annually would be needed to complete OEP initiatives as planned.

Without better information on the cost and schedule of OEP initiatives, it is unclear how much the plan will cost and whether or not it can be executed.

FAA Needs to Link the OEP to the Agency's Budget to Help Set Priorities

As currently structured the OEP includes over 100 initiatives, including runways, new satellite navigation systems, new controller tools, and airspace changes. However, priorities among OEP projects have not been established, and the Plan is not linked to FAA's $14 billion annual budget. Linking the OEP and the budget is important because the Plan cuts across various lines of business, and implementing OEP initiatives depends on funding from different FAA accounts. This will help decisionmakers set priorities and determine which projects should be accelerated, deferred, or scaled back.

Setting priorities and linking the Plan to the budget is also important because funding for modernization (the Facilities and Equipment account) as outlined in the Administration's reauthorization proposal is expected to remain essentially flat over the next 4 years. Historically, FAA modernization projects have suffered significant cost increases; four major acquisitions we tracked have experienced cost growth ranging from 21 to 227 percent. Even modest cost growth in major acquisitions (or OEP initiatives) will have a cascading effect on the schedules of existing projects, and may limit the number of new projects that can be started.

Also, there are large-scale, billion-dollar acquisitions not in the Plan that are critical for its success because they provide the necessary infrastructure (controller displays and computer processing equipment) for achieving capacity gains. For example, the *En Route Automation Modernization* (ERAM) will provide new software and hardware for facilities that control high altitude traffic at an estimated cost of $2.1 billion. It will also allow for more timely and flexible management of airspace, referred to as dynamic resectorization.[2] By far, ERAM is one of the most expensive and software-intensive automation projects FAA has embarked on since the ill-fated Advanced Automation System. FAA will spend over $260 million annually—or over $21 million a month—beginning in FY 2005 on ERAM.

The OEP will also impact FAA's Operations budget, which has witnessed inordinate cost growth over the years (from $4.6 billion in FY 1996 to $7.1 billion in FY 2003) largely due to increasing salaries.[3] Some OEP initiatives, such as airspace redesign, are funded principally from this account.

One reason FAA is deferring plans for data link is that it would have added $54 million to the Operations account between FYs 2005 and 2008 for, among other things, controller training and overtime for just eight locations, and about $19 million annually beginning in FY 2009 for the cost of data link messages. If cost growth in the Operations account is not controlled, it could limit the number of new systems that can be fielded, and FAA officials told us that the Agency will have to begin funding some OEP initiatives normally funded through the Operations account, such as airspace redesign, through the modernization account.

FAA Needs to Address Uncertainty About How Quickly Airspace Users Will Invest in New Systems

The OEP assumed that airspace users would invest in a wide range of new technologies, but much has changed since the Plan was first introduced in 2001. Major network carriers reported losses of $11 billion in 2002 and are projecting billion-dollar losses for 2003. They are also making significant changes to their fleets. Overall, U.S. airlines have reduced their fleets by over 10 percent since September 11, 2001, but are making much greater use of regional jets.

FAA and the MITRE Corporation estimate the OEP would cost airspace users $11 billion over 10 years to equip with new technologies. Four[4] of the 12 projects

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[2] Dynamic resectorization is a key element of ERAM, which allows for the more flexible management of airspace (in almost real-time) to adjust traffic patterns in response to bad weather or surges in traffic.

[3] For additional details on the cost growth in FAA's Operations account, see <u>Cost Control Issues for the Federal Aviation Administration's Operations and Modernization Accounts</u> (CC-2003-098, April 9, 2003).

[4] The four projects are Local Area Augmentation System, Automatic Dependent Surveillance-Broadcast, Reduced Vertical Separation Minima, and Controller Pilot Data Link Communications.

we reviewed require airspace users to equip with new or make costly adjustments to existing avionics. For example, FAA estimates the cost to equip a single commercial aircraft with *Automatic Dependent Surveillance-Broadcast* (ADS-B) (a new satellite-based surveillance system) ranges from $168,000 to over $500,000. The cost for data link ranges from $30,000 to $100,000 per installation, excluding the cost to take the aircraft out of revenue service. Exhibit B provides details on the cost, schedule, and key factors affecting the implementation of the 12 projects we analyzed.

The current economic environment makes it difficult for the airline industry to make decisions about investing in new avionics—a clear path for moving forward does not yet exist. However, our analysis of OEP projects—LAAS, data link, and ADS-B—shows that more details about operational requirements, costs, and benefits are needed before airspace users can make informed decisions and financial commitments. It is also unclear what airspace users should equip with first, or with what combination of systems. Even if the major network carriers were profitable, FAA would have to articulate costs and expected benefits before airspace users would make investment decisions.

FAA faces major policy decisions about *how* and *when* to transition to these new systems. The OEP relies on a voluntary path for airspace users to equip with new systems. This approach is less controversial but will prolong the time to reap benefits and exacerbates concerns about "mixed equipage" scenarios, where controllers must handle aircraft that are and are not equipped with new systems. Some industry and FAA officials believe FAA can mandate new systems by stating that users will be denied access to certain airspace if they are not properly equipped. This will change FAA's current policy (i.e., "first come, first served") on access to segments of the National Airspace System described in FAA Order 7110.65N.[5]

FAA Needs to Take Full Advantage of Airspace Redesign, New Procedures, and Systems Currently Onboard Aircraft

FAA and industry officials we spoke with believe that considerable benefits can be obtained through airspace changes, new procedures, and systems currently onboard aircraft—none of which will require airspace users to make major investments in new avionics. Focusing on these areas will be less costly to airspace users and will give FAA time to address issues with the OEP initiatives that call for airspace users to equip with new systems.

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[5] Order 7110.65N, Air Traffic Control, prescribes air traffic control procedures and phraseology for use by persons providing air traffic control services.

Many aircraft in commercial service already have sophisticated inertial navigation/flight management systems that rely on many different sensors on the aircraft to navigate. Harnessing this capability is referred to as *Required Navigation Performance (RNP).* RNP is not a new technology but rather an innovative air navigation concept that describes and defines the navigational accuracy required for an aircraft to operate in a given airspace. It has the potential to increase arrival rates during reduced visibility at airports and may provide more flexible routing and curved and segmented approaches (in conjunction with instrument landing systems) to airports—a long sought-after benefit for large airlines.

According to the Air Transport Association (ATA), airspace users—principally large airlines—are looking to FAA to take an aggressive role in determining how the use of RNP can enhance capacity, and how quickly new procedures that take advantage of RNP can be widely implemented. FAA has approved a small number of new RNP procedures, including new approach and landing routes for San Francisco Airport.

Officials from the ATA told us that the large network airlines are retiring older aircraft and that in the next 2 years about 80 percent of all aircraft in commercial service will be RNP-capable to some extent. FAA is surveying the airlines to determine what level of RNP performance currently exists in the commercial transport fleet.

Capitalizing on RNP has resource implications for FAA because the Agency will have to shift resources from other areas to accelerate the development and approval of new procedures. For example, a planning document stated that FAA would need an additional $27 million between FYs 2003 and 2005 to accelerate RNP development. An additional $40 million over the same period would be needed for related airspace redesign and procedures development. These additional funds would have to come from existing programs. This is a modest shift and underscores the need to link the OEP to the budget and the need to set priorities among many diverse programs.

FAA Needs to Assess Benefits of OEP Initiatives and Use Metrics to Assess Progress

The OEP is expected to provide a 30 percent increase in capacity over the next 10 years, assuming all runways are completed, new systems are delivered, and airspace users equip with new systems. Of the OEP initiatives we reviewed, building new runways provides the largest increase in capacity, accounting for 42 percent of the projected increase in capacity promised by the Plan. Since the Plan was introduced, two new runways at Detroit and Phoenix have been built, and the first phase of a runway project at Cleveland was opened December 2002, with completion of phase two planned for 2004.

The OEP now tracks 12 new runways (see Exhibit B) scheduled for completion in the next 10 years. Four of the 12 new runway projects are expected to be completed in 2003 (at Denver, Houston, Miami, and Orlando airports). However, construction on several other runways has been delayed from 5 months to 2 years. For example, a new runway in Seattle has been postponed from November 2006 to November 2008. The most common reasons airports cited for delays focus on financial and economic issues. There are other new runways that are planned but not yet in the OEP, such as Chicago O'Hare, that can materially increase capacity.

FAA also notes that some new parallel runways (for Dulles and Miami) are being built at less than standard spacing (4,300 feet) from other runways. This means that additional surveillance systems (radars and other systems to identify aircraft), or a combination of new air traffic procedures and systems currently onboard aircraft, will be required to get the full benefits associated with parallel operations during bad weather.

Other than runways, it is less certain what level of capacity OEP initiatives will deliver. Our analysis of the anticipated benefits of OEP projects shows that benefits have shifted or are not clearly defined for some projects. For example, LAAS was expected to provide Category II/III precision approach capability (equates to auto landings under all weather conditions) in 2005, but this segment of the LAAS effort is now a research and development effort with an uncertain end date.

Moreover, the benefits of some projects vary significantly by location, and solutions at one airport may not work at another. For example, the *Precision Runway Monitor* (high-speed radar that can help aircraft land) can help boost arrival rates in poor weather, but it is only useful for airports that have closely-spaced parallel runways. Similarly, the *Traffic Management Advisor* (a new automated controller tool) is helping boost airport throughput by assisting controllers sequence aircraft and assign runways. Results show that benefits of the new controller tool vary by location due to the complexity of airspace. As FAA moves forward with implementing the OEP, it is critical to determine which projects provide the most benefits for the investment.

To its credit, FAA has developed high level metrics (such as average delay per flight) and performance targets for its draft strategic plan (such as airport arrival efficiency rates). FAA is still working on metrics specifically to assess the impact of OEP initiatives and exactly how they can translate into increases in capacity. It is also important to develop metrics to assess how a combination of efforts (new runways, new controller tools, and airspace changes) impact capacity.

Although FAA is developing metrics specifically for the OEP, it is unclear how they will be used. FAA published a draft OEP metrics plan in September 2002 and obtained comments from industry. However, FAA officials told us FAA's lines of business responsible for executing OEP initiatives have not yet agreed to implement the metrics or report results. Without an agreed-upon approach for assessing the success or failure of OEP initiatives, it will be difficult, if not impossible, to make informed investment decisions.

Recommendations

We recognize that FAA has published a draft strategic plan and has efforts underway to revise the OEP, including reviewing efforts that can be accelerated to reduce airline costs or increase efficiency. However, it will take time to reconfigure the Plan, and FAA officials point out difficult decisions will need to be made on many projects with respect to funding levels and schedules. A number of actions need to be taken as FAA revamps the OEP. Specifically, FAA needs to:

- √ Develop realistic cost estimates, and link the OEP with the Agency's budget in order to set priorities for what can be accomplished in the short term.

- √ Determine—in concert with the aviation community—how to move forward (and at what pace) with systems that require airspace users to purchase and install new technologies.

- √ Determine and maximize the benefits associated with airspace design changes, new procedures, and capabilities currently onboard aircraft to enhance system capacity.

- √ Quantify benefits associated with OEP initiatives, such as LAAS, and use metrics to assess whether initiatives are having the desired impact on capacity.

AGENCY COMMENTS

On June 18, 2003, we met with the Associate Administrator for Research and Acquisitions and representatives from Air Traffic Services and the Operational Evolution Staff to obtain their oral comments to our discussion draft report. We incorporated FAA's comments where appropriate and made adjustments to this report. FAA officials from those offices generally agreed with our analysis and recommendations. We are requesting that FAA provide written comments to the final report.

ANALYSIS AND RECOMMENDATIONS

Perspectives on the Health of the Airline Industry, the Demand for Air Travel, and Financing FAA Programs

The OEP needs to be viewed against the backdrop of how airlines are responding to the state of the national economy, increased competition from low-fare carriers, and a sustained downturn in high-fare business travel. Although the industry had begun to recover in the 4th quarter of 2001 from the sharp drop in travel that followed the terrorist attacks, that recovery has since stalled when measured by key indicators such as scheduled capacity, the number of business travelers, airline yield[6] and revenue, and financial losses.

Figure 1: Scheduled Capacity

Percent Change in Scheduled Flights and Available Seats at All Airports from 2000 (FAA Data)

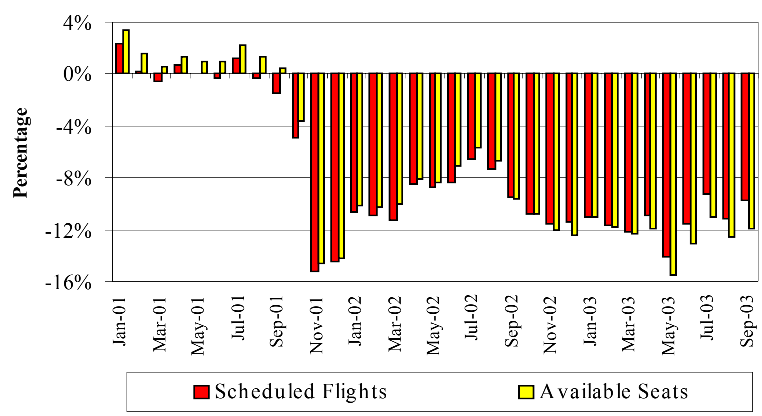

Figure 1 illustrates that airlines increased scheduled flights and passenger seats during the first half of 2002 in expectation of a continuing recovery of demand. The recovery stalled, however, and airlines responded by reducing capacity in the second half of 2002. The war in Iraq resulted in further cuts in capacity, so that by May 2003, the percentage loss of scheduled flights nearly equaled the lows reached in November 2001. With the end of the war, flight schedules have begun to recover, with the airlines currently scheduling about 12 and 13 percent fewer flights and available passenger seats, respectively, in June 2003 than in June 2000 (a decline of 106,000 flights and 11.1 million seats). Schedules for this summer, however, show little added improvement, with flights and available passenger seats remaining down, between 9 and 13 percent, from the same period in 2000.

Airlines have responded to the weakness in demand by reducing the size of aircraft operated as well as the number of flights offered. Between June 2000 and June 2003, scheduled flights involving the smaller regional jets[7] increased 142 percent (from 71,764 to 173,732). Flights involving other aircraft types

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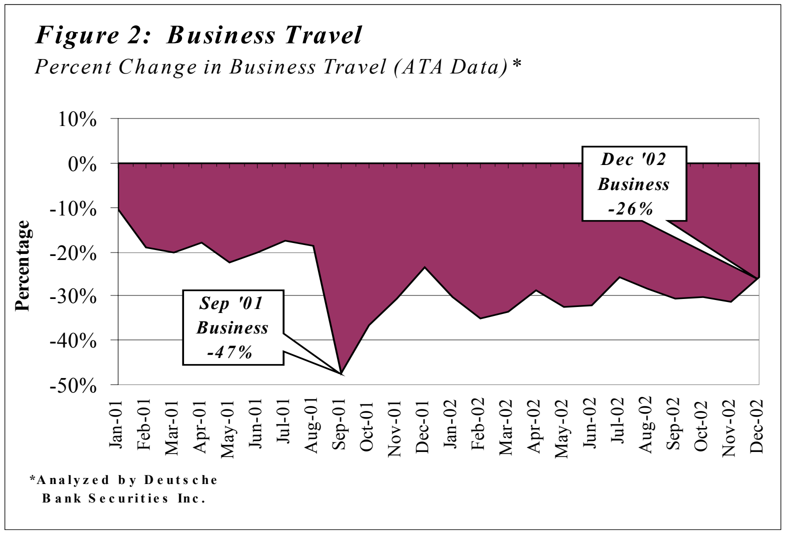
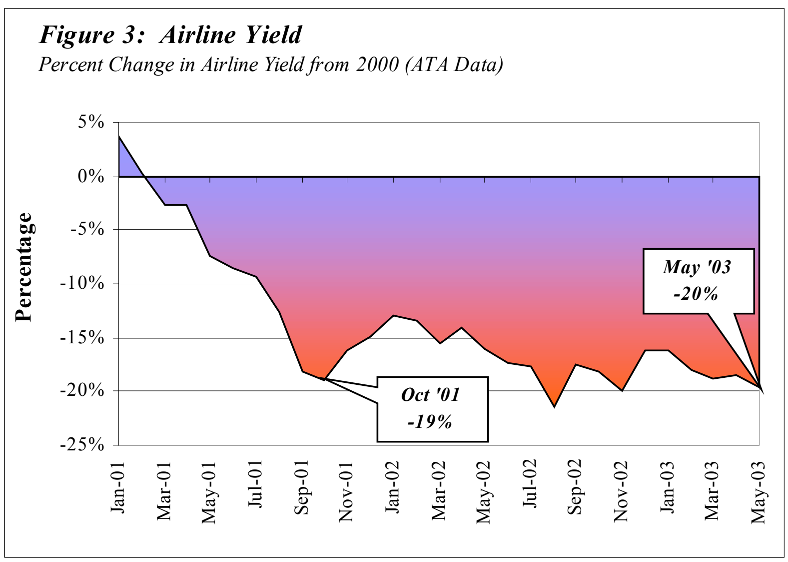
[6] Airline yield is a standard measurement unit of airline revenue, defined as average revenue per revenue passenger mile, or revenue ton mile.

[7] For this analysis, we defined regional jets as those jet aircraft seating from 30 to 80 passengers.

experienced far less growth or experienced sharp declines, including piston (no change), turboprop (-44 percent), and large jets (-18 percent). Overall, the portion of scheduled flights involving regional jets has grown from 8 percent to 21 percent between June 2000 and June 2003.



The decline in higher-fare business travelers has mainly affected the major, network airlines. These carriers rely on business travelers for a disproportionate share of their revenues, the rule of thumb being that 20 percent of passengers provide 50 percent of passenger revenues. Data provided by the ATA show that business demand was down for 2001 and 2002 (see Figure 2). In 2002, business travel was down by an average of 30 percent compared to 2000. Given this continued weakness in demand, security-driven inconvenience to passengers at airports, and a growing reluctance of many companies to pay high business fares, industry analysts now question whether high-fare business travel will ever return to previous levels.[8]



Overall, the decline in high-fare travel coupled with a general decline in ticket prices, has significantly reduced airline yield and revenue. As Figure 3 illustrates, airline yields were down in 2001 and 2002 and, in May 2003, were down 20 percent from 3 years earlier. Moreover, although the major airlines have undertaken significant cost-cutting efforts, the drop

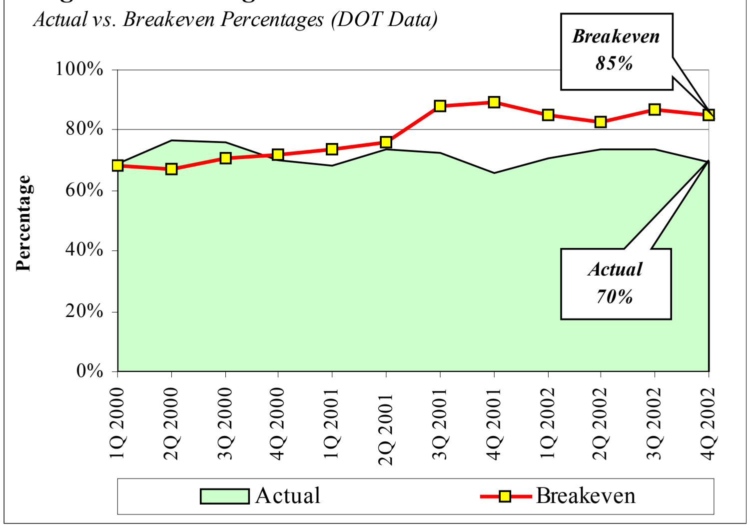
[8] This point is further confirmed by ATA's decision to no longer track full-fare business travel. According to an ATA official, tracking of business versus leisure travel is no longer relevant due to the lessening distinction between full-fare and discount ticket prices.

in revenue continues to outpace reductions in expenses. For example, operating revenue declined 22 percent for the quarter ending December 2002 compared to the same period in 2000, whereas operating expenses declined 10 percent. One factor hampering the airlines' efforts to reduce expenses has been the increase in jet fuel costs, which increased over 20 percent between April 2002 and April 2003.

With lower yields and persistently high operating costs, "breakeven" load factors (the average percentage of paying passengers needed on all flights to cover airline costs) have increased for most carriers. For example, in the 4th quarter of 2002, average passenger load factors were 70 percent—matching the level achieved during the same period in 2000—but the "breakeven" load factor was 85 percent (see Figure 4).

Figure 4: Passenger Load Factors

Actual vs. Breakeven Percentages (DOT Data)



Due to the gap between actual and breakeven load factors, the airline industry continues to incur sizable losses in 2003. According to ATA, the airline industry is expected to lose $19 billion in 2001 and 2002 (after taking into account over $5 billion in direct Government assistance) and is projected to lose an additional $10 billion in 2003 (excluding Federal reimbursements for security costs relief).

Congress has taken steps to help the airlines. The Air Transportation Safety and System Stabilization Act (P.L. 107-42) provided $5 billion in funds for passenger operations and all-cargo operations that were impacted by the September 11 terrorist attacks. This Act also established a loan guarantee program for airlines, authorizing up to $10 billion in loan guarantees. Thus far, the Air Transportation Stabilization Board[9] has received 16 applications for loan guarantees—5 have been approved and 1 other has been conditionally approved. Also, the Emergency Wartime Supplemental Appropriations Act, 2003 (Public Law 108-11), provides $100 million to reimburse air carriers for cockpit door hardening, and another $2.3 billion will be provided to the airlines for security expense reimbursement.

[9] Air Transportation Stabilization Board was established by P.L. 107-42 to review and decide on loan applications.

In addition, airlines have been granted a reprieve from security fee collection from June 1 through September 30, 2003.

The financial weakness in the aviation markets will also affect how FAA funds its future modernization efforts. Less air travel and lower fares have reduced the amount of tax revenue FAA will have to fund its programs. Projected revenues from the Aviation Trust Fund for FY 2004 have dropped from an estimated $12.6 billion in April 2001 to about $9.8 billion in July 2003. Over the next 4 years (FY 2004 through FY 2007), the Trust Fund is expected to collect about $12 billion less in taxes than anticipated in April 2001. Table 1 provides information on the estimated aviation tax revenue.

Table 1. Projected Trust Fund Tax Revenue

(Dollars in Billions)

	FY 2004	FY 2005	FY 2006	FY 2007	Total
Trust Fund Tax Estimates: April 2001	$12.6	$13.3	$14.1	$14.9	$54.9
Trust Fund Tax Estimates: July 2003	$9.8	$10.5	$11.1	$11.7	$43.1
Difference	$2.8	$2.8	$3.0	$3.2	$11.8

Source: FAA

The decline in tax revenues comes at a time when the Federal Government is in deficit spending and new financial commitments, such as paying for new security requirements and the war on terrorism, will further stretch the Government's resources. As a result, FAA will look to the General Fund to make up differences in its budget at a time when there are many other competing priorities. Also, with the Aviation Investment and Reform Act for the 21st Century (AIR-21) expiring at the end of FY 2003, it is still uncertain what the authorized levels for FAA will be and whether the new authorization will have funding priorities similar to those in AIR-21.[10] In any case, FAA must consider the financial impact on the OEP and adjust the Plan accordingly.

Factors That Affect the Implementation of the Operational Evolution Plan

The OEP is a reasonable plan because it focused on specific problem areas, such as improving airport arrival rates and how the NAS responds to and recovers from

[10] Currently, AIR-21 requires that FAA's Airport Improvement Program and Facilities and Equipment accounts be funded at authorized levels before allocating any additional Trust Fund revenue to FAA's Operations budget.

bad weather. However, much has changed since the Plan was introduced in June 2001—the demand for air travel has declined, Trust Fund revenues have declined sharply, and the major network carriers are in financial distress. We recognize that FAA has efforts underway to revise the OEP and develop a longer term vision for the National Airspace System, but there are several factors that the Agency must consider when updating the OEP. They are:

- determining how much the Plan will cost and when benefits will be delivered;
- linking the Plan to the budget and establishing priorities;
- establishing a path for moving forward with initiatives that require airspace users to install new technologies;
- taking full advantage of airspace changes, new procedures, and systems currently onboard aircraft; and
- determining the level of increased capacity that can be expected from key initiatives, other than runways.

FAA Needs to Establish Realistic Cost Estimates for the OEP

The OEP is estimated to cost between $11.5 billion and $13 billion for acquiring new systems, excluding the cost to sustain new systems once they are fielded, the cost of airspace changes, and the cost to build new runways. The true cost of the Plan is unknown since it is now a "rolling 10-year plan," and because of the developmental nature of many systems such as data link and LAAS. In addition, FAA is looking at whether the implementation of some new technologies (such as ADS-B) at the local level rather than nationally would generate earlier and more effective benefits.

FAA's estimates of what the OEP will cost and what can be delivered are based on projects that themselves do not have reliable cost and schedule baselines as shown in the following examples.

- The LAAS is a new precision approach and landing system that can boost airport arrival rates under all weather conditions. It was planned to be operational in 2002 (CAT I performance) and has enjoyed considerable industry support over the years but has now slipped to late 2006. The more demanding LAAS performance (CAT II and III) is now a research and development effort with an uncertain end date. Costs, schedule, and expected benefits for LAAS are under review.

- The ITWS is a new weather system that provides controllers with a 20-minute forecast of weather near airports. Production costs for ITWS have skyrocketed from $360,000 to over $1 million per unit. As a result, its deployment has been stretched out until 2008, FAA may procure fewer systems than planned, and production systems will be less capable than prototypes currently in use.

- Data link is a new way for controllers and pilots to communicate that is analogous to e-mail. The approved baseline of almost $167 million (for 20 locations to be deployed by late 2005) is no longer valid. FAA now estimates that it would cost $237 million for eight locations—an increase of $70 million for less than half of the planned locations—to move forward. Because of this and uncertainty about how quickly airspace users will equip with data link technology, FAA is deferring plans for data link.

- FAA is pursuing 30 separate *airspace redesign* efforts, which include revamping high altitude airspace, and has planned a major airspace redesign effort in the New York/New Jersey/Philadelphia area for 2005. Adjustments to airspace are critical to bring new runways, technologies, and procedures on line and obtain maximum benefits. FAA has budgeted about $20 million annually for airspace redesign. However, documents we reviewed show that an additional $15 million to $30 million annually would be needed to complete OEP initiatives as planned. These estimates do not include costs associated with new communications equipment or new air traffic control sectors that often result from airspace changes like the National Choke Points Initiative.

Without better information on the cost and schedule of OEP initiatives, it is unclear how much the plan will cost and whether or not it can be executed.

FAA Needs to Link the OEP to the Agency's Budget to Help Set Priorities

As currently structured, the OEP includes over 100 initiatives, including runways, new satellite navigation systems, new controller tools, and airspace changes. However, priorities among OEP projects have not been established, and the Plan is not linked to FAA's $14 billion budget. This is important because the Plan cuts across various lines of business and because implementing OEP initiatives depends on funding from different FAA accounts. A clear connection between the OEP and the budget will help decisionmakers set priorities and understand relationships between efforts. For example, FAA's Research, Engineering, and Development Plan is linked to the Agency budget and provides funding information as well as a crosswalk to research conducted in various Agency accounts by budget number and line item.

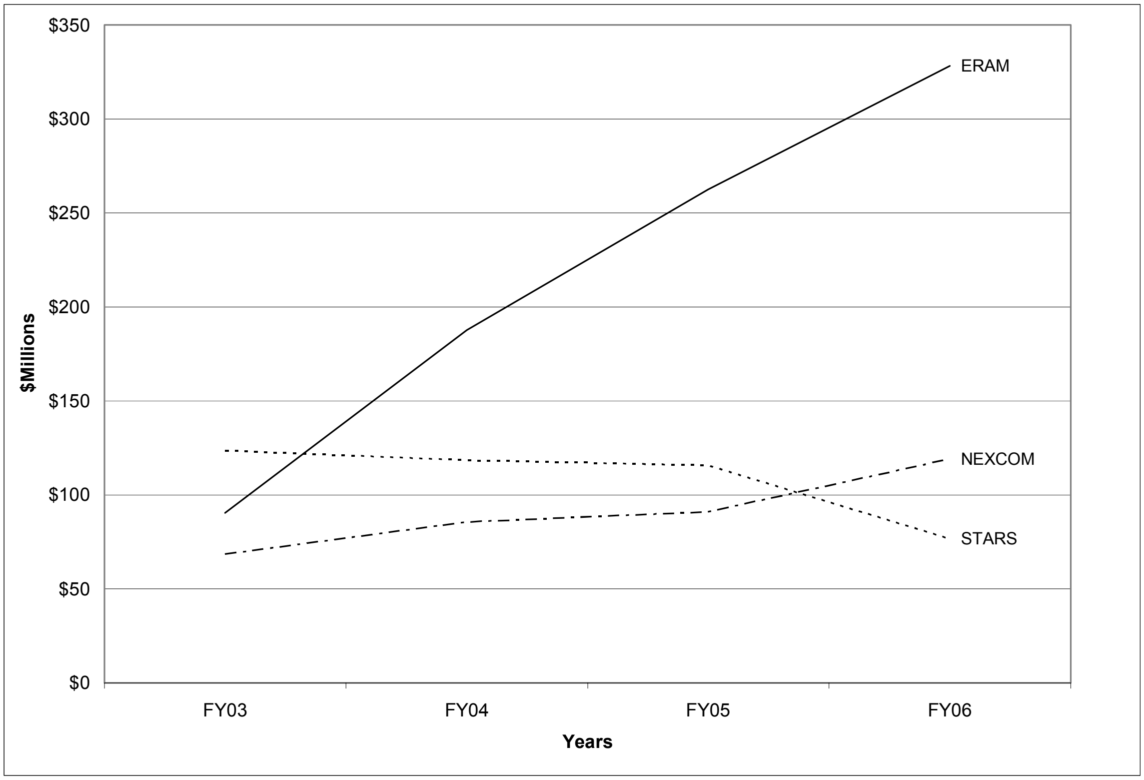
Setting priorities and linking the Plan to the budget is also important because funding for modernization (the Facilities and Equipment account), as outlined in the Administration's reauthorization proposal, is expected to remain essentially flat over the next 4 years. Moreover, of the $2.9 billion FY 2004 request for modernization, only 60 percent is for new systems; the remaining funds are for facilities and salaries. Historically, FAA modernization projects have suffered significant cost increases: four major acquisitions we tracked have experienced cost growth ranging from 21 to 227 percent.[11] Even modest cost growth in major acquisitions (or OEP initiatives) will have a cascading effect on the schedules of existing projects, and may limit the number of new projects that can be started.

Also, there are large-scale, billion-dollar acquisitions (see Figure 5) not in the Plan but critical for its success because they provide the necessary infrastructure (controller displays and related computer equipment) for achieving capacity gains. These projects must be taken into account when establishing expectations for when new capabilities can be brought on line. They will be competing with OEP initiatives for funds over the next several years. The following illustrates three of these projects and FAA's anticipated level of investment through FY 2006.

[11] The four major acquisitions are Wide Area Augmentation System, Standard Terminal Automation Replacement System, Airport Surveillance Radar (ASR-11), and Weather and Radar Processor (covered in our report Cost Control Issues for the Federal Aviation Administration's Operations and Modernization Accounts (CC-2003-98, April 9, 2003).

Figure 5. Major Acquisitions Not in the OEP

(FYs 2003 to 2006)



Program	**Description**	**Estimated Cost**
Standard Terminal Automation Replacement System (STARS)	Provides new controller displays, improved software, and related equipment for FAA air traffic control facilities.	$1.7 billion (Costs are under review)
En Route Automation Modernization (ERAM)	Replaces existing hardware and software at facilities (the nerve center) that control high altitude traffic and will allow for more timely and flexible routing of aircraft.	$2.1 billion
Next-Generation Air/Ground Communications (NEXCOM)	New multi-mode radios for air traffic control facilities that will replace analog with digital systems. FAA plans to use NEXCOM for both voice and data.	$986 million (Segment 1)

FAA expects to spend $1.3 billion on these three programs alone between FY 2004 and FY 2006, exclusive of other modernization programs. By far, ERAM is one of the most expensive and software-intensive automation projects FAA has embarked on since the Advanced Automation System.[12] FAA will spend

[12] See the OIG Audit Report, Advanced Automation System (AV-1998-113, April 15, 1998).

over $260 million annually—or over $21 million a month—beginning in FY 2005 on ERAM. Progress and problems with ERAM will affect how quickly FAA can move forward with other modernization programs, including new automated controller tools and data link.

The OEP will also impact FAA's Operations budget, which has experienced inordinate cost growth over the years (from $4.6 billion in 1996 to $7.1 billion in 2003) due to increasing salaries.[13] Some OEP initiatives, such as airspace redesign, are funded principally from this account.

One reason FAA is deferring plans for data link is that it would have added $54 million to the Operations account between FYs 2005 and 2008 for, among other things, controller training and overtime for just eight locations, and about $19 million annually beginning in FY 2009 for the cost of data link messages. If cost growth in the Operations account is not controlled, it could limit the number of new systems that can be fielded, and FAA officials told us that the Agency will have to begin funding some OEP initiatives, such as airspace redesign, through the Facilities and Equipment account.

FAA Needs to Address Uncertainty About How Quickly Airspace Users Will Invest in New Systems

The issue of equipage is one of the biggest challenges facing FAA and industry. The OEP assumed that a majority of airspace users would invest in and install an unprecedented range of new communication, navigation, and surveillance technologies. However, much has changed since the Plan was first introduced in 2001. Major network carriers reported losses of $11 billion in 2002 and are projecting billion-dollar losses for 2003. They are also making significant changes to their fleets. Four of the 12 projects we reviewed require airspace users to equip with new systems or make costly adjustments to existing avionics, including satellite navigation, data link (for controllers and pilots), and ADS-B.

The cost for industry to implement OEP initiatives has been estimated by FAA and the MITRE Corporation to be about $11 billion over 10 years. However, the current economic environment makes it difficult for the airline industry to make decisions about investing in new avionics.

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[13] For additional details on the cost growth in FAA's Operations account, see the OIG Report on Cost Control Issues for the Federal Aviation Administration's Operations and Modernization Accounts (CC-2003-098, April 9, 2003).

Table 2 provides information on OEP initiatives that will require airspace users to modify their aircraft.

Table 2. OEP Programs Requiring Aircraft Equipment Installations

Program	Purpose	Type of Upgrade	Cost per Aircraft
LAAS	Augmentation of the Global Positioning System signal to provide precision approach capability to airports.	Changes to navigation receivers.	\$56,000-88,000
ADS-B	New satellite-based surveillance system that enables airborne collision detection and improved runway throughput.	Installation of cockpit display and upgrades to aircraft transponder.	\$168,000-500,000
Reduced Vertical Separation Minima (RVSM)	Permits aircraft flying above 29,000 feet to operate with reduced vertical separation between aircraft.	Changes to aircraft altimetry systems may be required for some operations, including Traffic Alert and Collision Avoidance System, and altitude alerting systems.	\$13,000-207,500
Data Link	New way for controllers and pilots to communicate that is analogous to e-mail.	Installation of new cockpit display and aircraft transmitter/receiver unit.	\$30,000-100,000

Source: FAA and MITRE Corporation estimates

FAA tasked the RTCA[14]—a joint Government/industry forum—to examine the equipage issue and to explore associated implementation issues. In August 2002, RTCA reported that more details about requirements, costs, and benefits are needed before commitments can be made. Our analysis of OEP projects—LAAS, data link, and ADS-B—confirms the need for much more clarity with respect to operational requirements, costs, and benefits before airspace users can make informed decisions and financial commitments.

FAA faces major policy decisions about *how* and *when* to transition to these new systems. It is also unclear what airspace users should equip with first, or with what combination of systems.

FAA can make equipping with new systems voluntary as it is now or mandate (through rulemaking) that airspace users equip with new systems. The voluntary path is less controversial, but prolongs the time it takes to reap benefits and exacerbates concerns about "mixed equipage" scenarios, where controllers must

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[14] RTCA, Inc., is a private, not-for-profit corporation that develops recommendations regarding communications, navigation, surveillance, and air traffic management system issues. RTCA functions as a Federal advisory committee. FAA considers its recommendations when shaping policy, program, and regulatory decisions.

handle aircraft that are and are not equipped with new systems. To address this, some industry and FAA officials believe FAA can deny access to certain airspace if aircraft are not properly equipped. This will change FAA's current policy ("first come, first served") of granting access to segments of the National Airspace System outlined in FAA Order 7110.65N.

A recent report on the future of the U. S. aerospace industry notes that a fundamental barrier to realizing benefits with systems that require equipage is the lack of operator incentives for implementing system-wide innovations.[15] This is partly because "early equippers" receive few efficiency benefits until there are enough similarly-equipped aircraft to make air traffic operational changes practical and system efficiencies a reality. The report set forth several alternatives to resolving the equipage issue, including Federal funding for airborne equipment. We believe careful consideration must be given to this critical policy issue before Federal funds are committed to help airspace users equip with new systems.

FAA Needs to Take Full Advantage of Airspace Redesign, New Procedures, and Systems Currently Onboard Aircraft

FAA and industry believe that considerable capacity benefits can be obtained through a combination of airspace changes, new procedures, and systems currently onboard aircraft. Coupled with planned new runways, the capacity gains from these efforts could be significant.

Many aircraft in commercial service already have sophisticated inertial navigation/flight management systems that rely on many different sensors (Distance Measuring Equipment and the Global Positioning System) to navigate. These are being used to implement a capability referred to as *Required Navigation Performance (RNP).*

RNP is not a new technology but rather an innovative navigation concept that describes and defines the navigational accuracy required for an aircraft to operate in a given airspace. It has the potential to increase arrival rates during reduced visibility at airports and may provide more flexible routing and curved and segmented approaches to airports—a long sought-after benefit for large airlines.

According to ATA, airspace users—principally large airlines—are looking to FAA to take an aggressive role in determining how RNP-equipped aircraft can enhance capacity, and how quickly new procedures (that take advantage of RNP) can be widely implemented. Officials from ATA told us that the large network airlines are retiring older aircraft and that in the next 2 years about 80 percent of all commercial aircraft in service will be RNP-capable to some extent. FAA is

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[15] See the Final Report of the Commission on the Future of the United States Aerospace Industry (November 2002).

surveying the airlines to determine what level of RNP performance currently exists in the commercial transport fleet.

FAA has established a special program office to move forward with RNP capability and, to date, has approved a small number of new procedures. For example, FAA has approved new approach and landing routes for San Francisco Airport. However, FAA officials told us that much work remains to refine standards, criteria, and procedures.

Capitalizing on RNP has resource implications for FAA that have not yet been resolved. A planning document we reviewed stated that FAA would need an additional $27 million between FY 2003 and FY 2005 to accelerate RNP development. An additional $40 million over the same period would be needed for related airspace redesign and procedures development. Funding will have to come from existing programs.

FAA Needs to Assess Benefits of OEP Initiatives and Use Metrics to Determine Progress

FAA estimates that the OEP will provide a 30 percent increase in capacity over the next 10 years (2003 to 2013), assuming all systems are delivered on time and planned runways reach fruition.

New runways are the surest way to enhance capacity, and FAA estimates that new runways will account for 42 percent of the projected increase in capacity promised by the Plan. For example, the planned new runway at Atlanta International Airport is expected to increase airport throughput capacity by 31 percent in good weather and 27 percent in bad weather. Since the plan was introduced, two new runways at Detroit and Phoenix have been built, and the first phase of a runway project at Cleveland was opened December 2002, with completion of phase two planned for 2004.

The OEP now tracks 12 new runways scheduled for completion in the next 10 years. Four of the 12 new runways are expected to be completed in 2003 (at Denver, Houston, Miami, and Orlando airports). However, construction on several other runways has been delayed from 5 months to 2 years. For example, a new runway in Seattle has been postponed from November 2006 to November 2008. The most common reasons airports cited for delays focus on financial and economic issues. There are other new runways that are planned but not yet in the OEP, such as Chicago O’Hare, that can materially enhance capacity.

FAA also notes that some new parallel runways (for Dulles and Miami) are being built at less than standard spacing (4,300 feet) from other runways. This means that additional surveillance systems (radars or other systems such as ADS-B to identify aircraft) will be required to get the full benefits associated with parallel operations during bad weather.

Aside from runways, it is less certain what level of capacity OEP initiatives will deliver. Our analysis of the anticipated benefits of OEP projects we reviewed shows that benefits have changed, have diminished, or are not clearly defined. For example, LAAS was expected to provide Category II/III precision approach capability under all weather conditions in 2005, but this segment of the LAAS effort is now a research and development effort with an uncertain end date.

Moreover, the benefits of some projects vary significantly by location, and solutions at one airport may not work at another. For example, the Precision Runway Monitor (high-speed radar that can help aircraft land) can help boost arrival rates in poor weather, but it is only useful for airports that have closely-spaced parallel runways. Similarly, the Traffic Management Advisor (a new automated controller tool) is helping boost airport throughput by helping controllers sequence aircraft and assign runways. Results show that benefits of the new controller tool vary by location due to the complexity of airspace. As FAA moves forward with implementing the OEP, it is critical to determine which projects provide the most benefits for the investment.

To its credit, FAA has developed high level metrics (such as average delay per flight) and performance targets for capacity initiatives in its strategic plan. FAA is still working on metrics specifically to assess the impact of OEP initiatives and exactly how they can translate into increases in capacity at the 35 benchmark airports.[16] Metrics are important and will be used two ways—as a means to count and as a means to evaluate new initiatives. It is also important to assess how a combination of efforts (new runways, new controller tools, and airspace changes) impact capacity.

FAA published a draft OEP metrics plan in September 2002 and obtained comments from industry. However, FAA officials told us FAA's lines of business responsible for executing OEP initiatives have not yet agreed to implement the metrics or report results. Without an agreed-upon approach for assessing success or failure of OEP initiatives, it will be difficult, if not impossible, to make informed investment decisions.

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[16] See OEP Metrics Plan (version 1.2 September 30, 2002).

RECOMMENDATIONS

We recommend that the Federal Aviation Administrator:

1. Develop realistic cost estimates, and link the OEP with the Agency's budget in order to set priorities for what can be accomplished in the short term.

2. Determine—in concert with the aviation community—how to move forward (and at what pace) with systems that require airspace users to purchase and install new technologies.

3. Determine and maximize the benefits associated with airspace design changes, new procedures, and capabilities currently onboard aircraft to enhance system capacity.

4. Quantify benefits associated with OEP initiatives, such as data link and LAAS, and use metrics to assess whether initiatives are having the desired impact on capacity.

AGENCY COMMENTS

On June 18, 2003, we met with the Associate Administrator for Research and Acquisitions and representatives from Air Traffic Services and the Operational Evolution Staff to obtain their oral comments to our discussion draft report. We incorporated FAA's comments where appropriate and made adjustments to this report. FAA officials from those offices generally agreed with our analysis and recommendations. Although no changes were needed in the report, FAA officials pointed out that they are reviewing the costs for airspace users to equip with new systems called for in the Plan, such as ADS-B, and expect these costs to decline.

ACTION REQUIRED

In accordance with Department of Transportation Order 8000.1C, we would appreciate receiving your written comments on this report within 30 calendar days. If you concur with the finding and recommendations, please indicate the specific action taken or planned for each recommendation and the target date for completion. If you do not concur, please provide your rationale. You may provide alternative courses of action that you believe would resolve the issues presented in this report.

We appreciate the courtesies and cooperation of Federal Aviation Administration representatives during this audit. If you have any questions concerning this report, please call me at (202) 366-1992 or David A. Dobbs, Assistant Inspector General for Aviation Audits, at (202) 366-0500.

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EXHIBIT A. OBJECTIVES, SCOPE AND METHODOLOGY

As requested by the House Committee on Transportation and Infrastructure, our objective was to develop an overall status report on the OEP. Based on discussions with FAA and industry officials, we selected 12 projects (ranging from new runways to new automated controller tools) to review in detail. These projects were selected because of their potential to increase the capacity of the National Airspace System. For each project, we analyzed (1) cost and schedule data, (2) anticipated level of capacity improvements, and (3) factors that impact a project's implementation and its capability to achieve anticipated capacity increases.

We performed our work at FAA Headquarters between January 2002 and June 2003. Our Atlanta and Seattle Regional Offices assisted our efforts on selected OEP initiatives. Our scope covered all pertinent OEP activities between June 2001 and June 2003. All work was performed in accordance with Government Auditing Standards as prescribed by the Comptroller General of the United States and included such tests of procedures, records, and other data as warranted.

- We reviewed (1) selected reports and testimonies issued by our office and the General Accounting Office, (2) relevant reports and other literature on topics applicable to the OEP, and (3) information on OEP activities available on FAA and other aviation-related web sites.

- We analyzed cost and schedule data on the 12 projects from FAA program offices.

- We analyzed available data on anticipated benefits from key initiatives provided by various FAA program offices to determine reliability of the data and methodology used.

- We interviewed managers and staff of the FAA OEP Program Office as well as managers and staff of other relevant FAA offices responsible for the 12 projects reviewed. We interviewed representatives of: the aviation community such as the MITRE Corporation and RTCA; industry groups such as the Air Transport Association and General Aviation Manufacturers Association; and the National Air Traffic Controllers Association.

- We attended a wide range of FAA and industry related meetings that shaped the direction of the OEP, including the NAS Operational Evolution Industry Day, and the RTCA and Air Traffic Control Association symposia.

EXHIBIT B. STATUS OF SELECTED CAPACITY ENHANCING INITIATIVES

Automatic Dependent Surveillance-Broadcast (ADS-B)

Original Cost Estimate	Current Cost Estimate	Original Deployment Schedule	Current Deployment Schedule
$215.1 million (Part of Safe Flight 21)	$268.4 million	2001 (Limited deployment—Bethel, Alaska)	2012 (NAS-wide)

Purpose/Background	Anticipated Benefits	Status and Key Issues Affecting Implementation
ADS-B is an air-to-air, air-to-ground, ground-to-ground communications, navigation and surveillance system that relies on the Global Positioning System (GPS) to broadcast the positions of properly equipped aircraft and surface vehicles. ADS-B is being pursued as part of the Safe Flight 21 Program, which has focused on initiatives in the Ohio River Valley and Alaska. Pilots, controllers and surface vehicle operators are able to track ADS-B equipped aircraft and surface vehicles using real-time moving maps/multi-function displays. ADS-B broadcasts aircraft and surface vehicle identification, position, altitude, velocity and direction once per second.	ADS-B has both safety and capacity benefits. ADS-B, in conjunction with moving map displays in the cockpit, shows potential for reducing runway incursions because it gives pilots a "second set of eyes" in the cockpit. It also shows considerable potential for improving surveillance in non-radar environments, such as Alaska. It will provide: • Improved terminal operations in low visibility. • Enhanced see-and-avoid and air-to-air operations. • Improved surface surveillance and navigation for the pilot. • Enhanced airport surface surveillance for the controller. • Reduced delays through improved planning of movement and decisionmaking due to shared situational awareness of surface operations for controllers and pilots. • Use of cockpit tools and displays to achieve high levels of capacity in all weather conditions.	FAA and industry believe that Safe Flight 21 has made important progress in developing ADS-B as well as new avionics and cockpit displays. FAA has purchased 200 sets of avionics for aircraft in Alaska (Phase 1-Bethel area) and plans to procure an additional 200 sets of avionics under Phase 2 in the Juneau area. The following issues need to be closely watched: • Considerable human factors work remains for both controllers and pilots. • Airspace users must equip to obtain benefits. FAA estimates the cost to equip at $168,000 to over $500,000 for large commercial aircraft. • Requirements for ADS-B continue to evolve. • Safety assessments will need to be conducted as greater reliance is placed on ADS-B for separating aircraft. • Significant challenges remain with integrating ADS-B with other NAS systems. FAA has efforts underway to integrate ADS-B with existing controller displays. • ADS-B is now a key element in other FAA programs, including the Airport Surface Detection Equipment-X effort, which will help prevent accidents on runways.

Collaborative Decision Making (CDM)

Original Cost Estimate	Current Cost Estimate	Original Deployment Schedule	Current Deployment Schedule
FFP1[1]—$ 64.4 million FFP2[2]—$ 75.9 million Total—$140.3 million	FFP1—$ 60.7 million FFP2—$ 75.1 million Total—$135.8 million	FFP1—2001 FFP2—2005	FFP1—2001 FFP2—2005

Purpose/Background	Anticipated Benefits	Status and Key Issues Affecting Implementation
CDM is not a new air traffic management technology but rather an information exchange system that links participating airlines with FAA's Command Center and facilitates the real-time exchange of information on changes to flight schedules. It allows FAA and airlines to more easily respond to changing conditions. FAA reports that over 30 airlines and NavCanada are participating in the CDM initiative.	• CDM does not add new capacity, but it helps make better use of reduced airport and en route capacity during inclement weather. • When inclement weather causes FAA to propose a general ground delay program, airlines may change their flight schedules in response and communicate changes to FAA. Airlines may cancel, combine, swap, or delay flights, which will affect the availability of arrival slots. CDM uses a complex process to distribute any unused arrival slots. • FAA reports that CDM's Ground Delay Program Enhancement "avoided" over 20 million minutes of delay between January 1998 and November 2002.	CDM was implemented in 2001 as part of the Free Flight Phase 1 initiative and is one of the most successful Free Flight Phase 1 initiatives. As part of Free Flight Phase 2, FAA will provide additional information, and new tools, and will assess ways to improve information security. The following issues need to be closely watched: • According to FAA, to further use CDM to increase capacity and reduce delays, it needs to develop a more secure information sharing architecture. • As FAA moves forward with CDM, the agency believes it must examine and resolve issues associated with sharing information between airlines that have anti-trust implications. FAA has indicated that greater information sharing (among airlines) planned for CDM may be disallowed under current anti-trust regulations.

[1] Free Flight Phase 1
[2] Free Flight Phase 2

Controller Pilot Data Link Communication (Data Link)

Original Cost Estimate	**Current Cost Estimate**	**Original Deployment Schedule**	**Current Deployment Schedule**
$166.7 million	$166.7 million (Under review)	Build 1—2002 (Miami Center) Build 1A—2003	Build 1—2002 Build 1A—Program Deferred

Purpose/Background	**Anticipated Benefits**	**Status and Key Issues Affecting Implementation**
Data link is a new way for controllers and pilots to communicate that is analogous to email. The pilot can read the message displayed on a screen in the cockpit and respond to the message with the push of a key. The initial phase will only consist of four services: initial contact, altimeter setting, transfer of communication, and predefined instructions via menu text.	FAA is working to quantify the benefits associated with data link. It is generally believed that data link will allow controllers to communicate with more aircraft thereby increasing productivity. Anticipated benefits include: • Shifting routine transmissions from voice to data link to reduce delays. • Reducing the number of miscommunications and operational errors resulting from miscommunications. • Reducing frequency congestion. • Easing controller workload.	FAA began initial daily use of data link at Miami Center in October 2002. American Airlines, utilizing Rockwell-Collins avionics, has equipped a number of aircraft (Boeing 757s and 767s) to participate in Build 1. FAA planned to deploy data link to 20 facilities as part of Build 1A, but is now deferring plans because of increased costs and uncertainty with respect to how quickly airspace users will equip. The following issues need to be closely watched: • Data link presents complex human factors issues for both controllers and pilots. Continued research and development is needed to explore these issues. • Airspace users must equip with new avionics to obtain benefits. Cost estimates range from $30,000 to $100,000 per aircraft. • With the additional services provided in Build 1A, software for ground systems will be developed to rigorous RTCA standards (known as "DO-178B") or equivalent. • The cost to implement data link in the en route environment remains uncertain and is currently undergoing review. • FAA is working to align data link efforts with plans for ERAM, which provides new software at facilities that control high altitude traffic.

Domestic Reduced Vertical Separation Minimum (DRVSM)

Original Cost Estimate	Current Cost Estimate	Original Deployment Schedule	Current Deployment Schedule
$11.22 million	$11.22 million	December 2004	January 2005

Purpose/Background	Anticipated Benefits	Status and Key Issues Affecting Implementation
DRVSM reduces the vertical separation between aircraft at high altitudes. Currently, aircraft operating above 29,000 must be vertically separated by 2,000 feet. The FAA intends to reduce the vertical separation between aircraft to 1,000 feet. With few exceptions, once DRVSM is implemented, aircraft that do not meet DRVSM equipage requirements will be not be permitted between 29,000 and 41,000 feet.	• Adds six additional flight levels for aircraft operating between 29,000 and 41,000 feet. • Reduces airspace complexity and permits greater maneuverability in vicinity of severe weather. • Allows operators to reduce fuel costs by flying at more fuel-efficient flight levels. FAA estimates that there would be $5.3 billion in fuel savings for commercial operators between 2005 and 2016. • Controllers will not have to take additional steps to transition aircraft from oceanic airspace, which is already using DRVSM, to domestic airspace.	FAA published a notice of proposed rulemaking to implement DRVSM in U.S. domestic airspace in May 2002. DRVSM standards have been used in Europe and oceanic airspace since 1997. The United States will be one of the last to implement DRVSM. The following items need to be closely watched. • Users of some aircraft must modify their aircraft to fly in DRVSM airspace. Modifications are needed to the aircraft's altitude holding, sensing, and alerting systems in addition to upgrades to Traffic Alert and Collision Avoidance System II. FAA estimates that it will cost $869 million to equip the U.S. fleet. • The cost to modify older aircraft may be significant for some operators (up to $150,000 for a DC-9 and $235,000 for a Gulfstream II). FAA is reviewing costs associated with older aircraft. • The aviation industry is concerned that FAA may not have sufficient resources to meet the approval/certification requirements to grant operator approval for the large volume of diverse aircraft and operators. • FAA must complete work on ground-based height monitoring systems, which verify aircraft altitude, and determine where to deploy them.

Exhibit B. Status of Selected Capacity Enhancing Initiatives

Integrated Terminal Weather System (ITWS)

Original Cost Estimate	Current Cost Estimate	Original Deployment Schedule	Current Deployment Schedule
$276.1 million (For 37 systems)	$286.1 million (FAA is re-evaluating how many systems it will procure)	2003	2008 (Deployment strategy is under review)

Purpose/Background	Anticipated Benefits	Status and Key Issues Affecting Implementation
ITWS is FAA's first attempt at providing a system that integrates weather information from various FAA and National Weather Service sensors located at or near airports, including the Terminal Doppler Weather Radar, Airport Surveillance Radar, and the Next Generation Radar. ITWS provides air traffic controllers, air traffic supervisors/managers, dispatchers, and pilots with a graphical picture of current weather that does not require meteorological interpretation. ITWS is planned to provide weather information at airports having significant convective weather exposure (typically thunderstorm activity) and commercial airline operations.	ITWS has both safety and capacity enhancing benefits. An analysis done by Massachusetts Institute of Technology's Lincoln Laboratories in 2002 concluded that ITWS could provide over $627 million in benefits per year, including value of passenger time and reduced cost to airlines. Specific ITWS benefits include: • Avoiding and/or limiting the time runways are closed. • Providing better recognition of when runways can be reopened. • Providing more accurate knowledge of where storms are. • Improving routing efficiency. • Providing terminal wind data to increase effectiveness. • Avoiding diversions and missed connections. • Providing 2-minute predictions of microbursts. • Providing windshear conditions. • Providing lightning warnings. • Providing forecasts to route air traffic away from severe weather.	Prototypes of ITWS that have been in the field for a number of years have been well received by controllers and by the airline industry because they can help improve the flow of air traffic. However, the following issues need to be closely watched: • Production costs are three times more than anticipated – growing from $360,000 per unit to over $1.1 million per unit. Consequently, funding is insufficient to deploy all systems as planned. • Production ITWS units will not be as capable as the prototypes. The production ITWS will not include the Terminal Convective Weather Forecast, which is a pre-planned product improvement, and current users of the ITWS prototypes may not find the production system as beneficial. • FAA plans to extend the deployment schedule 5 years because the program cannot be executed as planned within the existing budget.

Local Area Augmentation System (LAAS)

Original Cost Estimate	Current Cost Estimate	Original Deployment Schedule	Current Deployment Schedule
$530.1 million for 143 systems	$696.1 million for 160 systems (Under Review)	2002 for Category (CAT) I 2005 for CAT II/III	2006 for CAT I Limited Deployment CAT II/III now a Research & Development Program

Purpose/Background	Anticipated Benefits	Status and Key Issues Affecting Implementation
LAAS is a precision approach and landing system that augments the Global Positioning System to provide terminal approach control guidance. LAAS is expected to replace most instrument landing systems (ILS), provide all-weather (CAT I/II/III) precision approach services to more airports, and provide advanced procedures (such as curved and segmented approaches) to airspace users.	LAAS has both capacity enhancements and safety benefits. FAA's 2001 Capacity Benchmark Report suggests that LAAS (in conjunction with other new technologies and procedures) could boost airport operations between 10 percent and 17 percent in good weather. Anticipated benefits include: • Being an enabling technology for preventing runway incursions. • Providing precision approach and landing service to all runway ends and possibly to adjacent airports with one LAAS system, as opposed to requiring a separate landing system at each runway end and at each airport. • Reducing delays due to the ability to land more airplanes in reduced visibility conditions, increasing airport acceptance rates in poor weather. • Supporting reduced separation between airplanes, increasing both throughput and airport acceptance rates. • Enabling new approaches to closely-spaced parallel runways.	FAA needs to reset expectations for LAAS. FAA intended to have CAT I LAAS in 2002, but now estimates the first system will be fielded in late 2006. The more demanding CAT II/III (which include landing under all weather conditions) is now considered a research and development program with an uncertain end date. Other issues include: • Airspace users must equip with new avionics to obtain benefits. • CAT I systems developed through Government-industry partnerships are not as mature as expected—much work remains to transition ground systems from prototype to production systems. • Requirements are still evolving for CAT I and not yet developed for CAT II/III. • Meeting LAAS integrity requirements and ensuring the system is safe for pilots to use are the major cost and schedule drivers. • It is uncertain when capacity-enhancing flight procedures that complement LAAS will be available to airspace users.

Exhibit B. Status of Selected Capacity Enhancing Initiatives

Land and Hold Short Operations (LAHSO)

Original Cost Estimate	Current Cost Estimate	Original Deployment Schedule	Current Deployment Schedule
Funded through procedure development in the Operations account	Funded through procedure development in the Operations account	August 2000	2004 (Initial Dependent Use)

Purpose/Background	Anticipated Benefits	Status and Key Issues Affecting Implementation
Land and hold short operations include landing and holding short of an intersecting runway, an intersecting taxiway, or some other predetermined point on the runway to permit an operation on an intersecting runway, taxiway or flight path. This procedure was previously referred to as "simultaneous operations on intersecting runways" (SOIR).	Implementation of LAHSO can increase airport throughput capacity up to 10 percent by adding arrival capacity. Benefits vary with location and airport configuration.	LAHSO has been controversial because of safety concerns raised by pilots. Specifically, various pilot unions recommended their members refuse LAHSO clearances due to concerns that the procedures established for conducting LAHSO restricted pilot options for rejected landing procedures and created unsafe conditions. Notwithstanding these concerns, FAA and industry continue to pursue LAHSO. Other issues include: • LAHSO is only permitted during visual flight rules under specific limitations on ceiling and visibility, wind, and pavement conditions. • Minimum landing distances must be established for all aircraft types. • Although once authorized, LAHSO is now prohibited at 39 intersecting runways at the 19 largest airports due to safety concerns. • FAA will consider alternative procedures in the future for runways that are not currently authorized for LAHSO. • Airports conducting LAHSO must provide additional runway lighting systems and signage.

National Airspace Redesign (NAR)

Original Cost Estimate	Current Cost Estimate	Original Deployment Schedule	Current Deployment Schedule
$241 million (FAA Operations funding)	$250 million (FAA Operations funding)	2006	2008

Purpose/Background	Anticipated Benefits	Status and Key Issues Affecting Implementation
NAR is a multi-year effort to increase the efficiency of the National Airspace System (NAS) through the re-routing of air traffic, reconfiguration of the Nation's domestic and oceanic airspace, more efficient air traffic management, and changes in air traffic procedures. NAR encompasses a wide range of efforts including: • National Choke Points Initiative, • High Altitude Redesign, • New York/New Jersey/Philadelphia Metropolitan Area Airspace Redesign, • Consolidation of Terminal Airspace Control, • Area Navigation Route (RNAV) Development, and • RNAV Terminal Arrival and Departure Procedures.	In many cases, the full benefit of proposed changes, like new runways or advanced technologies, cannot be realized without the corresponding airspace changes. Benefits include: • Increased on-time departures, • Improved airport capacity utilization effectiveness, • Improved system predictability, • Increased effectiveness of top airports, • Fewer ground stops and decreased ground delay programs, • Improved NAS efficiency by varying arrivals and departures for traffic flows to selected city pairs, and • Reduced traffic management restrictions that result from sector complexity and congestion.	Work on the choke points initiative (seven geographical areas east of the Mississippi) is only a small step to a much larger and more ambitious effort to revamp the Nation's airspace. The following issues need to be closely watched: • Airspace changes are very complex and controversial because they have environmental impacts. • Because of potential operational changes and potential environmental impacts, airspace changes require considerable simulation and modeling, which is expensive. • Airspace changes have ancillary costs and impacts related to controller staffing, new equipment, new sectors, and requirements for new radio frequencies. • FAA spends about $20 million annually on airspace redesign efforts. An additional $15 million to $30 million annually would be needed to support OEP initiatives.

Exhibit B. Status of Selected Capacity Enhancing Initiatives

Precision Runway Monitor (PRM)

Original Cost Estimate	Current Cost Estimate	Original Deployment Schedule	Current Deployment Schedule
$145.8 million (six locations)	$145.8 million (cost under review)	2002	2006

Purpose/Background	Anticipated Benefits	Status and Key Issues Affecting Implementation
PRM is a special-purpose secondary radar with a rapid update rate that enables aircraft to approach an airport in dual arrival streams with shorter separation distances, even in deteriorating weather conditions, at airports with parallel runways spaced less than 4,300 feet apart.	• PRM increases landing throughput and can reduce airport arrival delays. It will only provide benefits at airports that have closely spaced runways. • PRM permits two aircraft to land simultaneously on parallel runways in airports now constricted because of the proximity of runways, thus reducing delays. • PRM will improve airports' acceptance rates under poor weather conditions.	PRM has been under consideration since 1997. FAA plans to install PRM at nine locations. The following issues need to be followed: • Pilots must take special training before flying PRM approaches. • PRM is scheduled for commissioning at JFK in October 2003 after a 4-year delay. The delay was due to a variety of reasons including an extensive analysis to prove the PRM would not interfere with existing radar, changing runway thresholds, construction changes, and site and work hour restrictions. • The Atlanta PRM was delayed from March 2002 to summer 2006 due to construction difficulties on a runway extension. • According to FAA, PRM operations at Minneapolis and Philadelphia have been suspended over a Memorandum of Understanding dispute with the National Air Traffic Controllers Association.

Exhibit B. Status of Selected Capacity Enhancing Initiatives

Build New Runways

Current Cost Estimate	Original Deployment Schedule	Current Deployment Schedule
$5.5 billion (Only the current cost estimate is provided because the current list of runways has changed from the initial OEP.)	2007	2008

Airport	Implementation Schedule		Capacity Improvement (Percentage)		Challenges to Runway Completion
	Initial OEP Version 3.0 (June 2001)	Current Estimate (May 2003)	Visual	Instrument	
Atlanta	2005	2006	31%	27%	The airport is experiencing problems with: obtaining fill material for the runway; local authorities' relocation of existing road, utilities, and navigation aids (NAVAIDS); FAA funding and installation of NAVAIDS; and FHWA and Georgia DOT design concurrence on runway support structures for the runway portion that extends over the interstate.
Boston	2005	2006	0%	0%	There is public and political opposition, including lawsuits from opposing groups and organizations. Also, there are concerns with availability of NAVAIDS and maintaining current operations during construction.
Cincinnati	2005	2005	26%	26%	The airport is concerned with timely land acquisition.
Charlotte	2004	Removed from OEP	N/A	N/A	The airport is uncertain of the runway schedule because of concern with the financial condition of a major carrier.
Cleveland	N/A	Phase 1: opened 2002 Phase 2: 2004	None Indicated		The airport is experiencing difficulties with relocation of a major primary road and relocation of National Aeronautics and Space Administration facilities with associated landfills. There is also mitigation associated with a major creek.
Dallas-Ft. Worth	2007	Removed from OEP	N/A	N/A	The airport will not commit to a desired runway configuration.
Denver	2003	2003	18%	4%	There are no expected challenges to the timely completion of the runway.
Detroit	2001	Operational	N/A	N/A	The runway became operational December 2001.
Dulles	2007	2008	46%	54%	The airport needs a waiver from FAA for 4,000 foot separation from parallel runway.
Houston	2004	2003	35%	37%	There are no expected challenges to the timely completion of the runway.
Miami	2003	2003	10%	20%	There are no expected challenges to the timely completion of the runway.
Minneapolis	2003	2005	29%	26%	Challenges include construction weather delays, the contractor's ability to carry large bonds and complete existing contracts on time after unexpected accidents, labor actions, work force problems, and material shortages.
Orlando	2003	2003	23%	34%	The airport is experiencing construction weather delays.
Phoenix	Operational	N/A	N/A	N/A	The runway became operational in October 2000.
Seattle	2006	2008	52%	46%	The airport expects difficulty in obtaining a U.S. Army Corps of Engineers permit for wetland fills and in resolving pending citizen lawsuits.
St. Louis	2006	2006	14%	84%	There are no expected challenges to the timely completion of the runway.
No. of Runways	15	12			

Exhibit B. Status of Selected Capacity Enhancing Initiatives

Traffic Management Advisor (TMA)

Original Cost Estimate	Current Cost Estimate	Original Deployment Schedule	Current Deployment Schedule
FFP1—$224.2 million FFP2—$135.5 million Total—$359.7 million (FFP1 included TMA and passive Final Approach Spacing Tool collectively known as the Center-TRACON Automation System. FFP2 only includes TMA.)	FFP1—$217.6 million FFP2—$131.8 million Total—$349.4 million	FFP1—2001 FFP2—2006	FFP1—2001 FFP2—2006

Purpose/Background	Anticipated Benefits	Status and Key Issues Affecting Implementation
TMA was pioneered by the National Aeronautics and Space Administration as part of its Center-TRACON Automation System. It helps controllers transition aircraft from en route to terminal airspace for approach and landing. TMA generates routes and schedules to meter fixes (geographical position), provides scheduled and estimated times of arrival, assigns runways, and produces sequence lists for arrival traffic.	FAA reports that TMA is enhancing airport arrival rates but results vary by airport. It has boosted arrival rates at Denver airport by one to two aircraft per hour and Minneapolis by four to five aircraft per hour during arrival peaks. FAA's analysis of TMA at Minneapolis suggests it decreases flight times in the terminal area. Additionally, FAA notes that TMA allows delays to be taken farther out from the airport and at higher, more efficient altitudes. FAA reports that implementation of TMA and "time-based metering" (a method for managing periods of high arrival demand by scheduling the times aircraft cross designated points on the terminal radar approach control boundary) for the sequencing of arriving aircraft (versus the "miles in trail" method) has yielded a composite 5 to 8 percent improvement in arrivals at Los Angeles during inclement weather. The time sequencing of aircraft allows controllers to more readily take advantage of unused inter-aircraft spacing thereby significantly improving efficiency.	TMA was deployed to seven en-route centers as part of Free Flight Phase 1 and will be deployed to four additional centers as part of Free Flight Phase 2 between 2003 and 2006. The following issues need to be closely watched: • To obtain maximum benefits, TMA relies on the use of time-based metering to enhance the flow of air traffic. According to the Free Flight program office, only four centers use time-based metering. • TMA relies on complex algorithms and must be customized (site adaptation) for each location. • To date, work has focused on using TMA as a single en route center tool. Additional work will be required to allow TMA to sequence aircraft transitioning multiple en route centers.

Exhibit B. Status of Selected Capacity Enhancing Initiatives

User Request Evaluation Tool (URET)

Original Cost Estimate	Current Cost Estimate	Original Deployment Schedule	Current Deployment Schedule
FFP1—$296.7 million FFP2—$285.3 million Total—$582.0 million	FFP1—$297.7 million FFP2—$287.4 million Total—$585.1 million	FFP1—2002 FFP2—2006	FFP1—2002 FFP2—2006

Purpose/Background	Anticipated Benefits	Status and Key Issues Affecting Implementation
URET is an automated decision-support tool that assists controllers in managing traffic, supporting pilots' requests for flight plan changes, or detecting potential conflicts between aircraft and between aircraft and restricted airspace. It uses electronic flight data to enhance flight data management currently accomplished with paper flight strips, which controllers use to track the position of aircraft. This capability allows controllers to enter amendments to flight plans directly to the HOST computer (the nerve center of an en route facility) at the click of a button.	URET systems help controllers shorten flight distances and remove altitude restrictions. URET is projected to save more than .5 miles per flight amounting to more than $200 million annually when implemented at all 20 en route centers.	As part of Free Flight Phase 1, FAA deployed URET to six of seven planned locations. Under Free Flight Phase 2, FAA will deploy URET to all 20 en route centers in the United States. The following issues need to be closely watched: • URET represents some human factor issues for controllers because it introduces electronic flight strips and will impact controller workload and team work. An important issue focuses on how controllers will use URET in conjunction with other new systems, such as traffic management advisor, and enhanced weather products. • Training has become an important factor in deploying URET. According to the Free Flight program office, all six centers have 100 percent of their controllers trained on URET. Implementation has been delayed at Atlanta center because of labor management issues. FAA now expects Atlanta center will complete implementation of URET as part of the Phase 2 deployment. • URET relies on complex site adaptation—or "customization"—for each location.

Exhibit B. Status of Selected Capacity Enhancing Initiatives