
Office of Inspector General
Audit Report

**FAA FACES SIGNIFICANT OBSTACLES IN
ADVANCING THE IMPLEMENTATION AND
USE OF PERFORMANCE-BASED
NAVIGATION PROCEDURES**

Federal Aviation Administration

Report Number: AV-2014-057

Date Issued: June 17, 2014





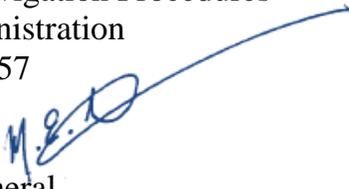
Memorandum

U.S. Department of
Transportation

Office of the Secretary
of Transportation
Office of Inspector General

Subject: **ACTION:** FAA Faces Significant Obstacles in
Advancing the Implementation and Use of
Performance-Based Navigation Procedures
Federal Aviation Administration
Report No. AV-2014-057

Date: June 17, 2014

From: Matthew E. Hampton 
Assistant Inspector General
for Aviation Audits

Reply to
Attn. of: JA-10

To: Federal Aviation Administrator

Improving the efficiency of the National Airspace System (NAS) remains a key priority for the Federal Aviation Administration (FAA), with air travel expected to increase steadily over the next 20 years. To enhance capacity and reduce delays at congested airports, FAA is implementing Performance-Based Navigation (PBN) flight procedures, such as Area Navigation (RNAV)¹ and Required Navigation Performance (RNP).² RNAV and RNP procedures are key building blocks for the Next Generation Air Transportation System (NextGen) and can provide significant near-term benefits such as more direct flight paths and curved approaches to runways, improved on-time aircraft arrival rates, greater fuel savings, and reduced aircraft noise.

To date, FAA has implemented over 1,000 RNAV and RNP procedures,³ but airline representatives have expressed concerns with the procedures' benefits and timeliness. In response to a September 2009 Federal Government-industry task force report,⁴ FAA conducted a study of its internal processes for developing and implementing flight procedures. The study, known as the NAV Lean Project, was published in September 2010 and established 21 recommendations to improve and streamline FAA's policies and processes for developing and implementing flight

¹ RNAV is a method of navigation in which aircraft use satellite signals to fly any desired flight path without the limitations imposed by ground-based navigation systems.

² RNP is a form of RNAV that adds monitoring and alerting capabilities for pilots, thereby allowing aircraft to fly more precise flight paths.

³ This number includes RNAV Standard Instrument Departures, RNAV Standard Terminal Arrival Routes, and RNP approaches.

⁴ RTCA, "NextGen Mid-Term Implementation Task Force Report," Sept. 9, 2009.

procedures. FAA committed to improving the process and reported in June 2011 that it would take an estimated 5 years—until the year 2016⁵—to implement all 21 recommendations.

Concerned with FAA's efforts in this area, the Chairman of the House Committee on Transportation and Infrastructure and the Chairman and Ranking Member of the Subcommittee on Aviation requested that we assess the Agency's progress in providing "high-value" PBN procedures—those that provide measurable benefits to airspace users such as shorter flight paths, improved on-time aircraft arrival rates, and greater fuel savings. The Chairmen also requested that we assess FAA's progress with streamlining its processes for flight procedure development. Accordingly, we assessed (1) FAA's progress in providing high-value PBN routes and procedures that encourage widespread use, and (2) the degree to which the NAV Lean Project is meeting the demand for improved flight procedure development processes.

We conducted this review in accordance with generally accepted Government auditing standards. Exhibit A details our scope and methodology, and exhibit B lists the specific organizations we visited or contacted.

RESULTS IN BRIEF

FAA has deployed PBN procedures and has key projects underway, including adding new procedures at 13 major metropolitan areas, but preliminary data⁶ on high-value RNP procedures show that use is low, particularly at busy airports such as those in the New York City area. For example, at 14 major airports that have RNP procedures with curved runway approaches,⁷ only about 2 percent of eligible flights use these procedures. Several obstacles hinder FAA's efforts to increase implementation and use of PBN procedures, including outdated controller policies and PBN procedures, a lengthy flight procedure development process, the lack of standard training for pilots and controllers, and the lack of automated controller tools to manage and sequence aircraft with differing equipment and capabilities. FAA has not overcome these obstacles or quantified user benefits of new procedures. As a result, airspace users will likely remain reluctant to equip with the avionics needed to advance new procedures.

Although NAV Lean was launched 4 years ago, it has not met stakeholder demand for improved flight procedure development processes. FAA has completed 9 of the

⁵ FAA later changed the NAV Lean schedule to complete this effort by September 2015.

⁶ FAA tasked MITRE with obtaining PBN usage data. MITRE Corporation manages FAA's federally funded research and development center.

⁷ The 14 major airports are Baltimore-Washington International, Chicago Midway, Denver International, Fort Lauderdale International, Hartsfield-Jackson Atlanta International, JFK International and LaGuardia in New York, Memphis, Minneapolis/St. Paul International, Newark Liberty, San Francisco, Seattle-Tacoma, and Dulles and Reagan National in Washington, DC.

21 NAV Lean recommendations to streamline the flight procedure development process and is making progress on the remaining ones. However, the Agency does not expect to implement all 21 recommendations until September 2015, which is longer than desired by stakeholders. In addition, the completed Nav Lean initiatives are those that are less complex and costly, such as issuing interim guidance for environmental reviews. FAA had yet to define requirements or develop schedules for 11 of its most costly and complex improvements, such as creating and providing users access to a single set of databases for procedure development. Ultimately, industry will not get the full benefits of NAV Lean—to decrease the time it takes to implement new procedures by more than 40 percent—until all 21 recommendations are implemented.

We are making recommendations to help FAA mitigate barriers to PBN implementation and expedite the development of new procedures.

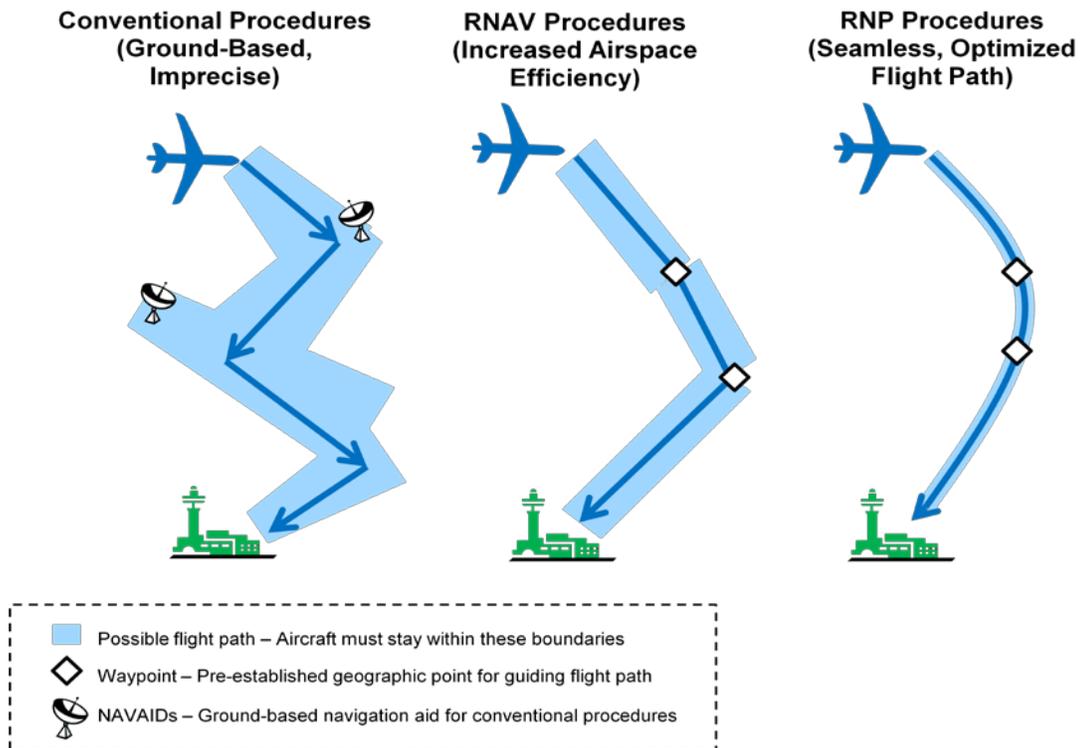
BACKGROUND

One of the most important components of NextGen—especially for achieving near-term benefits—is the implementation of new routes and procedures that rely on satellite-based navigation and on-board aircraft equipment to provide greater navigation precision and accuracy:

- **RNAV** allows pilots to use a combination of satellite signals and other systems on-board aircraft to fly any desired flight path by reducing the limitations imposed by ground-based navigation systems.
- **RNP** is a more advanced form of RNAV as it adds monitoring capabilities to the cockpit to alert the pilot when the aircraft cannot meet specified navigation performance requirements. Key features of RNP are the ability to fly precise, curved approaches, provide predictable flight paths, and provide improved airport access.

Traditionally, aircraft have been required to fly routes between ground-based navigational aids to maintain required navigation accuracy of on-board systems. RNAV and RNP can increase airspace efficiency by providing more direct paths (see figure 1), thereby improving airport arrival rates, enhancing controller productivity, saving fuel, and reducing aircraft noise.

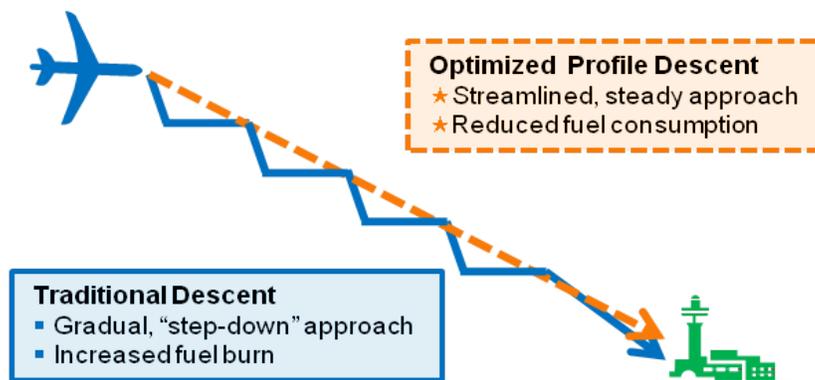
Figure 1. Conventional, RNAV, and RNP Navigational Methods



Source: OIG based on FAA data.

As part of the RNAV implementation strategy, FAA is deploying optimized descent and climb profiles for smoother flight paths that use less fuel than conventional “step-down” approaches, which require aircraft to fly a long series of progressive descents to get closer to the runway (see figure 2).

Figure 2. Comparison of a Conventional “Step-Down” Approach Versus an Optimized Profile Descent



Source: OIG based on FAA data.

According to FAA, any new flight procedure must contain sufficient detail to allow a pilot to navigate safely within the constraints of the airspace. Therefore, before FAA implements a flight procedure, such as a shorter arrival path to a particular airport, the procedure must go through a lengthy FAA process for design, development, and approval. The process also includes safety management, operational approval, environmental review, and coordination of operational requirements such as aircraft speed and altitude.

FAA HAS PROVIDED SOME HIGH-VALUE PROCEDURES, BUT OBSTACLES LIMIT WIDESPREAD IMPLEMENTATION AND USE

While FAA has key PBN projects underway that focus on implementing high-value procedures,⁸ the projects have experienced delays, and benefits remain uncertain. In addition, preliminary data show that use of the high-value PBN procedures that have been deployed is low, particularly at high-density airports. Limited use is due in part to outdated policies and procedures and a lack of training and air traffic automation.

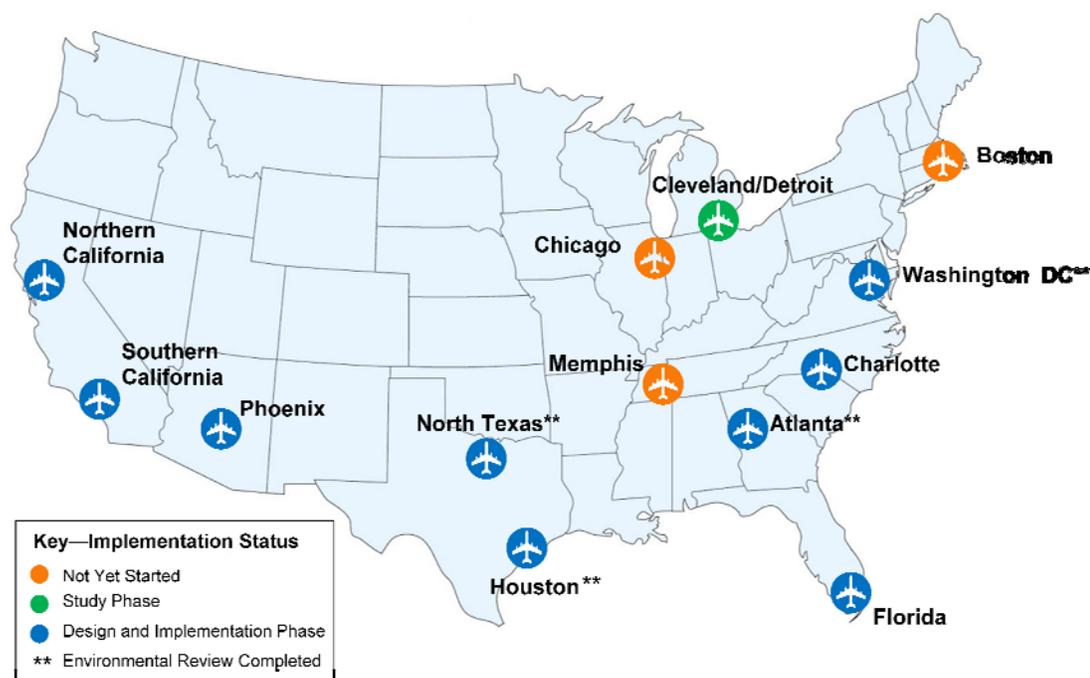
Key PBN Projects Are Underway, but Implementation Is Limited Due to Delays and Uncertain Benefits

FAA is working to implement two key PBN initiatives—metroplex and Greener Skies. However, according to FAA, both initiatives have experienced delays due to several factors, such as procedure design issues and work stoppages due to furloughs and the Government shutdown, and have not realized their intended benefits of optimizing the use of PBN procedures.

⁸ High-value PBN routes and procedures are those that provide measurable benefits to airspace users, such as shorter flight paths improved on-time aircraft arrival rates, and greater fuel savings.

In response to a Government-industry task force recommendation,⁹ in 2010 FAA launched its metroplex initiative—a 7-year effort to improve the flow of traffic at congested airports in 13 major metropolitan areas. As of April 2014, FAA was in the study or design and implementation phase at 10 of the 13 metroplex locations. However, to date, Houston is the only metroplex site that FAA has completed, with new flight procedures launched in May 2014. Delays at metroplex sites range from 2 months to over 1 year. Figure 3 shows the implementation status of each of the 13 sites.

Figure 3. Metroplex Implementation Sites and Their Status, as of April 2014



Source: OIG based on FAA data

Note: FAA's Metroplex program includes study teams and design and implementation teams. Study teams provide a front-end strategic look at each major metroplex. Using study team results, design and implementation teams provide a systematic approach to the design, evaluation, and implementation of PBN-optimized airspace and procedures.

To accelerate implementation, FAA limited the metroplex initiative to airspace redesign and procedures that can be implemented for the majority of NAS users without (1) additional equipage of aircraft, (2) improvements to automation systems for controllers, and (3) extensive environmental reviews. FAA took this approach because most aircraft flying in the NAS today are equipped with RNAV.

⁹ In September 2009, a Government-industry task force recommended that FAA implement more efficient RNAV and RNP procedures and accelerate deployment of new flight procedures by resolving longstanding approval and certification issues.

However, this approach limits benefits for aircraft that are already equipped with more advanced avionics and capable of flying RNP. According to MITRE, about 50 percent of all active Part 121 aircraft and over 70 percent of major airlines' aircraft are equipped with RNP. These airspace users would like more, not fewer, advanced PBN procedures at metroplex sites—especially procedures that allow for curved rather than linear runway approaches, which are more precise and efficient. FAA study teams have proposed only a limited number of RNP procedures at metroplex locations. The limited number of RNP procedures is concerning to airlines that have made, or are planning to make, significant investments to equip their aircraft with RNP capabilities.

As we reported in 2012,¹⁰ industry representatives also expressed concerns that FAA did not integrate other related initiatives, including improving airport surface operations such as aircraft operations on taxiways and at gates, further limiting metroplex benefits. FAA has not developed a plan with milestones for a more integrated metroplex approach as we recommended and as envisioned by airspace users.¹¹

According to FAA, several factors have hindered its efforts to fully implement the metroplex initiative, including sequestration,¹² delays due to implementing the Agency's En Route Automation Modernization¹³ (ERAM) system, and the challenges of working with air carriers. For example, FAA has delayed the completion of three sites—Cleveland/Detroit, Boston, and Memphis—from 2016 to 2017 due to resource issues and has stopped work at three locations—Atlanta, Washington DC, and Florida—due to ERAM deployment.

FAA's "Greener Skies Over Seattle" initiative¹⁴ has experienced similar delays. If implemented as envisioned, the project will allow both RNP-equipped aircraft and less advanced aircraft to land concurrently in Seattle—using, respectively, curved and straight-in paths. Dual approaches would reduce flight miles and fuel burn for equipped aircraft, as well as increase airspace efficiency. The first phase of the Greener Skies initiative focused on a new set of PBN procedures, some of which were implemented in the Seattle metroplex in March 2013 after 4 years of development. Publication of the remaining procedures was delayed until August

¹⁰ *Challenges With Implementing Near-Term NextGen Capabilities at Congested Airports Could Delay Benefits* (OIG Report No. AV-2012-167), Aug. 1, 2012.

¹¹ A September 2013 NAC report on NextGen priorities reiterated the need for a more integrated approach to implementing NextGen initiatives.

¹² As a result of the Budget Control Act of 2011, automatic spending cuts across the Government became mandatory.

¹³ ERAM is a multibillion dollar system for processing flight data at facilities that manage high-altitude traffic typically above 10,000 feet where aircraft reach their cruising altitudes and fly as direct a route as possible between their departure and destination points.

¹⁴ Greener Skies is a collaborative project between FAA, airlines, the Port of Seattle, and Boeing to develop new PBN procedures at the Seattle-Tacoma International Airport (Sea-Tac) and take advantage of equipment onboard today's aircraft. The project plans to add 27 new procedures to expand the use of Optimized Profile Descents, RNAV, and RNP.

2013 because they did not account for differences in airlines' onboard flight systems, preventing some airlines from being able to use the procedures. The Agency also has a second phase of ongoing safety studies to establish new air traffic control separation standards, which will allow greater use of RNP approaches not only in Seattle but at all airports. FAA plans to apply lessons learned from its Greener Skies initiative to effectively implement PBN NAS-wide and reduce the development timeframe at other locations. However, it remains to be seen whether this model can be applied NAS-wide.

Preliminary FAA Data Show Moderate Use of PBN Procedures at Some Airports, but NAS-Wide Use Is Low

Although RNAV and RNP procedures have the potential to bring significant benefits to airspace users, such as greater fuel savings, the procedures can only provide these benefits if aircraft operators actually use them. Preliminary data show RNP overall use is low.

Since 2009, we and many airspace users have expressed concern with FAA's inability to track the use of PBN procedures and determine benefits.¹⁵ In December 2010, we recommended that FAA perform cost-benefit analyses in close coordination with stakeholders before and after implementing RNP procedures so that consensus could be reached regarding the potential and actual benefits of the procedures.¹⁶ Likewise, airspace users have repeatedly emphasized the need for quality flight procedures that have measurable benefits.

In response, FAA tasked the MITRE Corporation¹⁷ with developing a computerized PBN Dashboard that will allow FAA to readily monitor and track PBN use and assess PBN benefits before and after implementation. In May 2013, FAA posted the first public PBN Dashboard usage data for calendar year 2012 on the Agency's Web site. MITRE has since been working to provide more detail on procedures and performance metrics, refining data, and increasing analytical functionality.¹⁸ These data provide a valuable opportunity to determine how often and what kind of procedures are in use across the NAS.

FAA has implemented over 100 RNP approach procedures at 24 of the "Core 30" airports—generally those that have the most air traffic.¹⁹ As of August 2013, 14 had curved RNP approaches—which, unlike straight-in RNP approaches, can be

¹⁵ *Challenges in Implementing Performance-Based Navigation in the U.S. Air Transportation System* (OIG Testimony No. CC-2009-086), July 29, 2009.

¹⁶ *FAA Needs To Implement More Efficient Performance-Based Navigation Procedures and Clarify the Role of Third Parties* (OIG Report No. AV-2011-025), Dec. 10, 2010.

¹⁷ MITRE is a not-for-profit company that operates multiple federally funded research and development centers.

¹⁸ In addition to the public dashboard, MITRE developed two additional PBN dashboards internal to FAA that provide the more detailed procedure information, performance metrics, and analytical capabilities.

¹⁹ FAA defines the Core 30 airports as the 29 large hub airports and Memphis International Airport. For the purposes of our analyses, we focused on the Core 30 airports because these are the key airports FAA is tracking and many of these are metroplex locations.

distinguished from existing flight procedures and measured. For these 14 core airports, only about 2 percent of eligible²⁰ airline flights have used the curved RNP approach (see table 1). For all airports tracked by the PBN Dashboard, only about 4 percent of eligible flights have used RNP procedures.

Table 1. Percentage of Eligible Flights That Used Curved RNP Approaches at Core Airports (September 2012 to August 2013)

Core 30 Airports With Curved RNP Approaches	Eligible for RNP	Executed RNP	Percentage of Eligible Flights That Executed RNP
Baltimore Washington International	24,461	188	1%
Chicago Midway International	1,614	502	31%
Denver International	18,681	62	0%
Fort Lauderdale International	3,240	3	0%
Hartsfield-Jackson Atlanta International	6,510	37	1%
John F. Kennedy International	29,907	307	1%
LaGuardia International	15,950	76	1%
Memphis International	9	0	0%
Minneapolis/St. Paul International	310	0	0%
Newark Liberty International	3,112	10	0%
Reagan National	8,908	1,395	16%
San Francisco International	11,212	23	0%
Seattle-Tacoma International	25,601	289	1%
Washington Dulles International	2,098	0	0%
Core 30 Total	151,613	2,892	2%
NAS Wide Total	325,324	12,120	4%

Source: OIG based on FAA data

Use of RNAV arrival and departure procedures is much higher than the use of RNP, in part because more aircraft are equipped to use RNAV. At the Core 30 airports, 26 have at least 1 arrival procedure, and 23 have at least 1 departure procedure. Overall use of arrival procedures is about 51 percent, ranging from a high of 86 percent at Phoenix to less than 1 percent at Los Angeles; overall use of

²⁰ Eligible airline flights as defined by MITRE are ones in which (1) the aircraft is estimated to be RNP capable based on the airline and aircraft type using a database with proprietary data and (2) the flight is in a position to start the procedure.

departure procedures is about 30 percent, ranging from 79 percent at Atlanta to 1 percent at Phoenix.²¹

FAA Has Not Resolved Key Obstacles To Implementing PBN Procedures

According to FAA and MITRE representatives, several complex issues contribute to low use of PBN procedures, including mixed aircraft equipage, outdated air traffic controller policies, insufficient controller training, a lack of controller automation tools, and weather conditions. Representatives from Airlines for America (A4A)²²—the largest trade association that represents major air carriers—identified similar impediments to PBN implementation.

A March 2012 FAA report detailed the results of its study on such obstacles to PBN use.²³ For example:

- **Outdated Policies and Procedures**—Many of FAA’s existing rules and procedures do not accommodate the capabilities of advanced navigation equipment onboard aircraft. Notably, FAA’s air traffic controller handbook²⁴ has not been updated to provide procedures for controllers to safely manage RNAV/RNP operations in a mixed-equipage environment. FAA formed a Steering Committee in July 2012 to complete a multi-phased approach to revise the handbook. FAA expects to complete most of its planned handbook changes by 2015, but will not complete one²⁵ until 2017.
- **Insufficient Training**—FAA’s NextGen-related training often consists of briefings rather than comprehensive training on RNAV and RNP. Because of the lack of awareness and training, controllers are reluctant to clear pilots to use PBN procedures. According to National Air Traffic Controller Association officials, training on new RNAV and RNP procedures should include simulator training to be effective.
- **Lack of Air Traffic Automation**—FAA remains in the beginning stages of developing automated decision-making tools to help controllers manage air carriers that operate with differing capabilities and procedures and optimize the full use of the procedures. Controller automation tools, such as Traffic

²¹ The RNAV data represents the time period of January 2012 to April 2013.

²² According to A4A, its members and affiliates transport more than 90 percent of U.S. airline passenger and cargo traffic.

²³ FAA, *Obstacles to Performance Based Navigation Implementation*, Mar, 1, 2012.

²⁴ FAA Order JO 7110.65U prescribes air traffic control procedures and phraseology for use by persons providing air traffic control services.

²⁵ The planned change scheduled for 2017 relates to departure separation for parallel runways.

Management Advisor (TMA),²⁶ can enhance and maximize the effectiveness and use of new PBN procedures, particularly when controllers are managing aircraft with different types of equipment. While TMA is operational at all 20 air route traffic control centers, select terminal approach control facilities, and airport control towers,²⁷ the extent to which these facilities use TMA varies due to a lack of national controller training and local operating procedures.

As we reported in 2012, removing these obstacles is critical to securing industry support and continued investment in new systems. Representatives of A4A and 7 of their 11 member carriers we spoke with were all concerned about FAA's progress in implementing PBN procedures. Industry representatives stated that slow progress has affected the airlines' pace of equipping with advanced avionics and subsequently slowed the return on investment for those carriers that have equipped. They further stated that FAA needs to demonstrate the benefits of new procedures to help make the business case for equipage.

To address these concerns, FAA assembled a PBN Action Team tasked with developing specific remedies and incremental action steps. Additionally, FAA tasked RTCA to evaluate the potential obstacles to PBN use and provide specific remedies and incremental action steps to remove them in the near term. RTCA's results, published in June 2013,²⁸ are consistent with our findings. Specifically, RTCA identified outdated air traffic policies, insufficient training, and lack of controller automation tools as three of its top five obstacles to PBN implementation and use.²⁹ According to an FAA official, the Agency has shifted its efforts from the PBN Action Team's work to responding to the RTCA reports on obstacles to PBN.³⁰ However, FAA has not determined how and when the Agency plans to follow up on its internal report on these obstacles.

²⁶ Traffic Management Advisor (TMA) is a comprehensive automated tool for planning efficient flight trajectories. TMA has the ability to sequence and schedule aircraft to maximize airport and terminal airspace capabilities without compromising safety.

²⁷ FAA is implementing a new system, called the Time-Based Flow Management (TBFM) system.

²⁸ RTCA, *Recommendation for Increased Utilization of Performance Based Navigation (PBN) in the National Airspace System (NAS)*, June 2013.

²⁹ The other two are (1) procedure design (that is, the need to define the problem being solved and the operational goal of PBN procedures) and (2) the lengthy environmental review process.

³⁰ RTCA issued a second report in response to FAA's request to examine industry barriers to PBN. RTCA, *Addendum to Recommendations for Increased Utilization of Performance Based Navigation (PBN) in the National Airspace System (NAS) – Industry Barriers*, February 2014.

FAA'S PROGRESS IN IMPLEMENTING NAV LEAN RECOMMENDATIONS HAS NOT MET STAKEHOLDERS' EXPECTATIONS

While FAA has implemented some NAV Lean recommendations, the full benefits of streamlined instrument flight procedure development processes will not be realized until the project's completion, which is currently scheduled for September 2015. Consequently, FAA has not yet met airspace users' demand for a streamlined flight procedures process.

FAA's NAV Lean initiative aims to address problems in FAA's procedure development, such as a lack of an expedited process for approving minor procedure revisions, inconsistent interpretation of environmental policies and guidance, and data discrepancies across diverse databases. FAA originally planned to fully implement all 21 NAV Lean recommendations by 2016 but expedited its timeline to 2015. However, to date, FAA has completed just nine recommendations, with only about 1 year remaining. The nine completed recommendations represent new policy and process changes for areas pertaining to procedure amendments, life cycle development, environmental concerns, safety, criteria, and database standardization, as shown in table 2. (See exhibit C for a full list of the NAV Lean recommendations and their expected completion dates.)

Table 2. FAA Actions Completed To Address NAV Lean Recommendations

Completed NAV Lean Recommendations	FAA Actions	Date Completed
Establish process to allow abbreviated amendments for RNAV arrivals (Recommendation 4).	Published revised guidance identifying requirements and processes for abbreviated amendments.	9/27/2013
Establish standardized databases with custodianship and data stewards to maintain data integrity (Recommendation 5).	Published planning documents identifying database standardization processes and key stakeholders responsible for data ownership. FAA does not plan to implement these databases until September 2015.	6/28/2013
Standardize data precision, resolution, and rounding values. (Recommendation 9).	Revised guidance to assign responsibility to the Shared Service Organization for establishing and maintaining the FAA Enterprise Data Architecture.	1/9/2014
Issue interim guidance for use of focused approach to environmental reviews (Recommendation 11).	Issued interim guidance for streamlined environmental reviews which provides a quicker, more efficient process.	6/1/2011
Modify guidance to define responsible Federal officials for environmental work (Recommendation 14).	Modified two guidance documents clarifying the responsibility of Federal officials for environmental work.	4/3/2014

Completed NAV Lean Recommendations	FAA Actions	Date Completed
Establish U.S. Instrument Flight Procedures Panel (US-IFPP) as focal point for criteria changes and new requests (Recommendation 15).	Established US-IFPP as the focal point for procedure design criteria changes—such as airspeed and bank angle—to improve coordination across FAA and with airspace users.	1/28/2013
Publish guidance on a standardized Safety Management System (SMS) Process for implementing instrument flight procedures (Recommendation 16).	Issued new guidance on a standardized SMS process for implementing instrument flight procedures.	2/7/2014
Issue interim guidance for Safety Risk Management compliance for procedure development and implementation (Recommendation 17).	Issued safety review guidance for PBN procedures. (Conventional procedures already have guidance in place.)	11/26/2012
Amend FAA guidance to define the life cycle policy for procedure development, including items such as environmental reviews and minor amendments (Recommendation 19).	Revised guidance that defined the life cycle policy for procedure development.	1/9/2014

Source: OIG analysis of FAA data

FAA has begun work on 11 of the 12 remaining recommendations and plans to complete all 12 by September 2015. However, FAA faces significant challenges in meeting this deadline. According to FAA documents, it takes on average 2 years to publish a new procedure. While FAA plans to decrease this time by more than 40 percent—citing strong support from senior Agency officials—FAA officials acknowledge that completion of most recommendations will require integrating efforts from various Agency lines of business and keeping the program funded to meet all deadlines. Specific areas of concern include the following:

- **Environmental Reviews**—FAA has already experienced nearly a year delay with ongoing efforts to standardize management environmental specialist training to ensure consistent compliance for all flight procedures. According to FAA, a shortage of funds needed to initiate a contract has delayed this effort.
- **Defining Requirements**—At the time of our audit, FAA had not defined requirements, schedules, or both for 11 NAV Lean recommendations, increasing the risk of further delays. For example, the initiative to consolidate databases relies on multiple organizations and contractors. However, because of the complexity of this project, FAA did not have the ability to manage the technical details—requirements, development, and verification—at the onset of the project. In addition, FAA had yet to define requirements for providing a Web-based system for flight procedures that airlines and FAA can access.

Conceptually, the system will capture carriers' requests for flight procedures, help ensure new flight procedure processes are followed, and enable stakeholders and managers to track the progress of each request. According to FAA, the Agency has made recent progress in defining the requirements and schedules for most of these remaining 11 recommendations, but has not yet defined all requirements and schedules.

- **Uncertain Costs**—FAA originally estimated NAV Lean would cost \$19 million. However, FAA program officials said that those estimates were unreliable because the Agency was still in the process of defining the technical requirements, schedules, and costs for each recommendation. FAA has since requested \$52 million for NAV Lean for fiscal years 2013 to 2015, but FAA program officials are uncertain about the level of funding they will receive. NAV Lean representatives we spoke with said that funding is a critical issue that will need to be addressed if the program is expected to be completed within the 2015 timeframe.
- **Undetermined Benefits**—FAA has not established a process to continually measure the benefits of its NAV Lean initiatives to ensure improvements achieve desired outcomes. The NAV Lean report stated that implementing all 21 recommendations would reduce the processing time for new flight procedures by more than 40 percent. While FAA has begun to measure the time reduction for some of its NAV Lean initiatives, it has yet to develop a comprehensive methodology to measure the impact on the overall processing time. Some recommendations will only impact certain types of flight procedures. For example, the Agency established a shortened process for revising flight procedures capable of reducing the time from 2 years to just over 100 days, but the process only pertains to RNAV arrivals and requires additional work to automate. In addition, FAA plans to implement a quality assurance program that eliminates redundant data entry and procedure design work; however, this program will be available only for RNAV arrivals.

CONCLUSION

PBN procedures such as RNAV and RNP are key to achieving NextGen's successful implementation and realizing its expected benefits—to enhance safety, reduce delays, save fuel, and minimize aviation's environmental impact, while increasing NAS capacity. FAA recognizes the risks involved in executing a complex and highly integrated project such as NAV Lean and is modifying plans to mitigate those risks on a continuous basis. However, until FAA overcomes the many implementation barriers and streamlines new flight procedures, the aviation industry will likely remain hesitant to equip with new avionics.

RECOMMENDATIONS

To help mitigate barriers to PBN implementation and expedite the development of new procedures, we recommend that FAA:

1. Complete an action plan to address the Agency's report on "Obstacles to Performance Based Navigation Implementation" and develop milestones for when these solutions can be implemented.
2. Establish firm requirements and schedules for all NAV Lean initiatives that will provide a basis and justification for future funding requests.
3. Establish a process to measure the benefits of the NAV Lean initiatives on an ongoing basis to determine whether NAV Lean is achieving the desired outcomes.

AGENCY COMMENTS AND OFFICE OF INSPECTOR GENERAL RESPONSE

We provided a draft of this report to FAA on May 1, 2014. The Agency did not provide us with a written response to the report or our recommendations. Throughout the review, we discussed our findings and proposed recommendations with FAA representatives. Where appropriate, we incorporated FAA's comments and input received during our meetings with the Agency. However, until we receive the Agency's written response, our recommendations will remain open and unresolved.

ACTIONS REQUIRED

In accordance with Department of Transportation Order 8000.1C, a written response to this report and our recommendations is required. If you concur with the findings 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. Please provide your written response within 30 calendar days.

We appreciate the courtesies and cooperation of FAA representatives during this audit. If you have any questions concerning this report, please call me at (202) 366-0500 or Robin Koch, Program Director, at (404) 562-3770.

#

cc: DOT Audit Liaison, M-1
FAA Audit Liaison, AAE-100

EXHIBIT A. SCOPE AND METHODOLOGY

We conducted this audit between May 2012 and May 2014 in accordance with generally accepted Government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives. Our audit objectives were to assess (1) FAA's progress in providing high-value PBN routes and procedures, and (2) the degree to which the NAV Lean Project meets demand for improved flight procedure development processes.

To assess FAA's progress in providing high-value PBN procedures, we analyzed MITRE's PBN usage data used in the PBN Dashboard to determine how often and where PBN procedures are used. Our review of high-value PBN focused on RNAV arrival and departure procedures and RNP approach procedures. To evaluate usage, we analyzed data we obtained from MITRE's dashboard system for the time period January 2012 to April 2013 and from September 2012 to August 2013. We computed the percentage of flights that were equipped and flew RNAV arrival and departure procedures by dividing the number of flights that flew at least 30 percent of a route³¹ using an RNAV departure/arrival procedure by the total number of flights for every departure/arrival airport that had RNAV departure/arrival procedures. We computed the percentage of flights that were equipped and flew RNP approaches by dividing the number of flights that flew the RNP path by the total number of flights that were equipped to fly RNP and arrived at the airport close to where the RNP approach begins.³²

We reviewed FAA's draft PBN report to Congress in response to Section 213 of the FAA Modernization and Reform Act of 2012. We reviewed FAA databases containing information on procedures FAA had developed or is planning to develop. Further, we met with representatives for Airlines for America, the National Business Aviation Association, the Regional Airline Association, and individual airlines to determine their views on FAA's progress with providing high-value PBN procedures and the extent to which they are using the procedures. We also attended NAC meetings to get updates on progress and industry's perspective on FAA programs. We identified the barriers to implementing and using high-value procedures by reviewing FAA's March 2012 report, *Obstacles to Performance Based Navigation Implementation*; the NAC's June 2013 report on *Recommendations for Increased Utilization of PBN in the NAS*; our previous work; and interviews with airlines and FAA staff. Finally, we examined FAA programs seeking to implement high-value PBN procedures, such as Metroplex

³¹ MITRE and FAA determined the 30 percent threshold.

³² MITRE defined RNP eligible flights.

and the Greener Skies Over Seattle project. To conduct that work we met with FAA headquarters and field officials, air traffic controllers involved in the projects, and lead carriers at those airports including Atlanta, Seattle, Houston, and Dallas. We also reviewed Metroplex Study Team Reports and other documentation.

To assess the degree to which the NAV Lean Project is meeting the demand for streamlined flight procedure production process, we analyzed the actions taken to address the NAV Lean recommendations, including analyzing proposed milestones, and project tracking documentation. To determine what the project was expected to accomplish, by when, and for how much we reviewed the September 2010 Navigation Procedures Project Final Report, the June 2011 Navigation Procedures Implementation Plan, and the 2013 NAS Lifecycle Planning Project Level Agreement. We also met with some of the original project participants to get a better understanding of their intent and whether the current implementation would accomplish the original goals. To determine the progress of FAA's streamlining efforts, we attended NAV Lean Quarterly Program Reviews and reviewed numerous project tracking documents. We met with the NAV Lean program manager and staff to learn about the challenges facing the program and mitigation strategies being employed to overcome them. We also met with airline and FAA program offices to learn what their expectations were for the project and determine whether it would provide improvements.

The scope of work on internal controls was limited to gaining an understanding of the PBN usage data that was published by FAA and MITRE and how FAA is tracking implementation of the NAV Lean recommendations. MITRE is continually improving the data collection for the PBN Dashboard, and FAA conducted beta-testing on the data it received from MITRE. For NAV Lean, FAA produced an implementation plan for the recommendations and created a program manager position with staff to track and implement the recommendations. The program manager put into place multiple internal controls, including a program tracking tool, quarterly review meetings, identifying program risks, and mitigations for those risks. No significant deficiencies were found during our examination of these controls.

EXHIBIT B. ORGANIZATIONS VISITED OR CONTACTED

FAA Headquarters, Washington DC

- Air Traffic Organization
 - PBN Policy and Support Group
 - Mission Support Services
- MITRE Corporation, McLean, VA

FAA Field Facilities

- Atlanta Terminal Radar Approach Control, Peachtree City, GA
- Central Service Center, Fort Worth, TX
- FAA Northwest Mountain Regional Office, Renton, WA
- FAA Southern Regional Office, College Park, GA
- FAA Western Service Center, Renton, WA
- Fort Worth Air Route Traffic Control Center, Fort Worth, TX
- Houston Air Route Traffic Control Center, Houston, TX
- Houston Terminal Radar Approach Control, Houston, TX
- Mike Monroney Aeronautical Center, Oklahoma City, OK
 - Flight Inspection Services
 - Aeronautical Navigation Products
 - Flight Standards Service
- Seattle Air Route Traffic Control Center, Auburn, WA
- Seattle Terminal Radar Approach Control, Burien, WA
- United Certificate Management Office, Houston, TX

Aviation Stakeholders

- Airlines for America (A4A), Washington, DC
- Alaska Airlines, Seattle, WA
- American Airlines, Fort Worth, TX
- Delta Airlines, Atlanta, GA
- Communication Navigation Surveillance (CNS) Taskforce
- Federal Express, Memphis, TN
- GE Aviation PBN Services, Renton, WA
- National Air Traffic Controllers Association (NATCA), Washington, DC
- National Business Aviation Association (NBAA), Washington, DC
- NextGen Advisory Committee (NAC)
- Port of Seattle, Seattle, WA
- Regional Airline Association (RAA), Washington, DC
- RTCA Inc., Washington, DC
- Southwest Airlines, Dallas, TX
- United Airlines, Chicago, IL
- United Parcel Service, Atlanta, GA

EXHIBIT C. NAV LEAN ISSUE AREAS AND RECOMMENDATIONS

Recommendation by Issue Area	Estimated Completion
<i>Minor Amendments of instrument Flight Procedures</i>	
1 Expedite the processing for minor revisions of instrument flight procedures	11/01/2014
<i>Procedure Design Automation</i>	
2 Approve the electronic transfer of procedure design information.	3/30/2015
3 Implement a "Direct to quality assurance" process for procedures developed using the automated system.	1/02/2015
4 Establish an abbreviated amendment process.	Completed
<i>Database Standardization</i>	
5 Establish a standardized set of databases and maintain data integrity.	Completed
6 Provide access to, and mandate use of, a single set of data for all instrument flight procedure service providers.	9/30/2015
<i>Data Transfers</i>	
7 Allow electronic transfer of data.	9/30/2015
8 Standardize software and data formats.	5/31/2015
9 Standardize data precision, resolution, and rounding values.	Completed
<i>Focused Environmental Assessments</i>	
10 Provide guidance on a focused approach to environmental assessments and use of radar track data for noise analysis	9/30/2014
11 Issue interim guidance for a focused approach to environmental assessments.	Completed
12 Enhance environmental assessment screening tools to make them more user-friendly, efficient, and comprehensive.	6/30/2014
<i>Environmental Policy</i>	
13 Standardize management and environmental specialist training.	5/30/2014
14 Modify guidance to define responsible federal officials for environmental work.	Completed
<i>Criteria</i>	
15 Designate the United States Instrument Flight Procedures Panel as the focal point for criteria changes and new requests.	Completed
<i>Safety Management System Policy</i>	
16 Standardize the Safety Management System process.	Completed
17 Provide interim guidance for Safety Risk Management compliance for instrument flight procedure development and implementation.	Completed
<i>Web Portal</i>	
18 Establish and implement a Web-based request and access portal.	9/30/2014
19 Amend guidance to define life cycle policy for instrument flight procedure development.	Completed
20 Develop an outreach/communication plan to educate users on use of the instrument flight procedure portal.	9/30/2015
21 Establish a Web-based operations approval portal	6/01/2015

EXHIBIT D. MAJOR CONTRIBUTORS TO THIS REPORT

<u>Name</u>	<u>Title</u>
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