Office of Inspector General
Audit Report

FAA'S APPROACH TO SWIM HAS LED TO COST AND SCHEDULE UNCERTAINTY AND NO CLEAR PATH FOR ACHIEVING NEXTGEN GOALS

Federal Aviation Administration
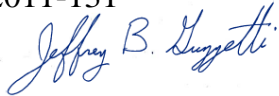
Report Number: AV-2011-131
Date Issued: June 15, 2011

Memorandum

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

Subject: <u>ACTION</u>: FAA's Approach to SWIM Has Led to Cost and Schedule Uncertainty and No Clear Path for Achieving NextGen Goals
Federal Aviation Administration
Report Number AV-2011-131

Date: June 15, 2011

From: Jeffrey B. Guzzetti
Assistant Inspector General
for Aviation and Special Program Audits

Reply to
Attn. of: JA-10

To: Federal Aviation Administrator

The Federal Aviation Administration's (FAA) successful transition to its Next Generation Air Transportation System (NextGen) depends on developing and implementing the System Wide Information Management (SWIM) program. FAA plans to spend about $284 million through 2015 to implement the first of three stages of SWIM. As envisioned, SWIM will form the basis for a secure network that manages and shares information more efficiently among all air traffic systems that will comprise NextGen. Key benefits expected from SWIM are streamlined data communications and real-time information that will improve air traffic management, enhance airspace capacity, reduce flight delays, and decrease costs for FAA and aviation users.

We initiated this audit because FAA identified SWIM as a key transformational program[1] for NextGen. Our audit objectives were to (1) determine the development and implementation status of SWIM and (2) assess the risks facing SWIM's successful deployment. We conducted this audit in accordance with government auditing standards prescribed by the Comptroller General of the United States. Exhibit A details our audit scope and methodology.

RESULTS IN BRIEF

FAA is still in the early stages of developing SWIM but has increased the costs for the program's first of three segments by more than $100 million and delayed its

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[1] We have an ongoing review of FAA's Transformational Programs; SWIM is one of six of those capital programs that FAA is developing and implementing.

completion by at least 2 years. Undefined requirements among the seven programs that will serve as implementation platforms for SWIM are driving these cost increases and schedule delays. Five of the program offices have not finalized their own system requirements, much less their plans to implement SWIM capabilities. For example, SWIM is intended to enable data sharing with the En Route Automation Modernization Program (ERAM)—the primary NextGen tool for processing flight data in the National Airspace System (NAS). However, FAA does not plan to fully integrate SWIM capabilities with ERAM for another 4 years. FAA also has yet to develop an implementation strategy for the two remaining SWIM segments and is considering other alternatives given the cost and schedule slips experienced to date.

SWIM will likely remain at risk of further cost increases and schedule delays because FAA has not established clear lines of accountability for overseeing how SWIM is developed and managed. Rather than pursue an overarching SWIM infrastructure, FAA decided it could best achieve SWIM's diverse benefits and save development costs by delegating significant responsibility and funding to the seven NAS program offices to design and implement SWIM. However, in doing so, FAA also left the SWIM Program Office with no authority over the other program offices' costs, schedules, and requirements related to SWIM. Each program office determines when and how SWIM software will be upgraded on its system with little or no input from the SWIM Program Office. Because the SWIM Program Office is not filling the typical role of setting long-term programmatic priorities, it will be difficult for FAA to develop an end-state transition strategy for SWIM and ensure that SWIM aligns with NextGen goals such as reducing aviation costs. Without a consistent vision of SWIM's requirements and clearly defined program priorities, the true cost and timeline to deploy SWIM and the realization of expected benefits is unknown.

Our recommendations to FAA focus on actions needed to effectively implement SWIM and address program challenges and risks.

BACKGROUND

FAA began developing and implementing SWIM in June 2007. SWIM is software that will provide FAA with a more effective process for sharing air traffic information to support current and future NAS programs. FAA plans to implement SWIM in three segments but has only approved funding (i.e., baselined) for the first segment.

Segment 1 (originally planned between 2009 and 2013): FAA expects this segment to provide users with more air traffic management system information sharing, including airport operational status, weather information, flight data, status of special use airspace, and airspace restrictions. FAA is still defining

Segment 1 requirements. Rather than developing a separate SWIM infrastructure, FAA is developing and implementing SWIM capabilities within seven FAA systems that comprise Segment 1, as shown in table 1.

Table 1. Seven NAS Programs Implementing SWIM Capabilities

Air Traffic Management Systems
• **En Route Automation Modernization (ERAM):** The SWIM ERAM service will provide flight data and updates to airspace users for filed/active flight plans, and adapted arrival and departure route status. Capabilities for five of the seven systems are planning to utilize ERAM for support.
• **Traffic Flow Management System (TFMS):** The SWIM TFM service will provide a means for airspace users to subscribe to information on traffic flow constraints, such as ground delays, and ground stops.
• **Terminal Data Distribution System (TDDS):** The SWIM TDDS service will consolidate data from four terminal systems that provide information such as pre-departure clearance data to controllers and visibility of runway conditions to pilots.
• **Aeronautical Information Management (AIM) /Special Use Airspace Management System (SAMS):** This SWIM service will improve the current Special Use Airspace (SUA) process by providing better knowledge of when airspace used jointly by FAA and the military is safe for civilian aircraft to enter.
Weather Systems
• **Integrated Terminal Weather System (ITWS):** The SWIM ITWS service provides a real-time picture of aviation-impacting weather near airports (wind shear, lightning, storm cells) with a 1-hour weather forecast.
• **Corridor Integrated Weather System (CIWS):** The SWIM CIWS service provides weather-avoidance routing/re-routing and automated 2-hour weather forecast.
• **Weather Message Switching Center Replacement (WMSCR):** The SWIM WMSCR service adds a new capability to automatically distribute pilot reports of crucial weather observations by pilots to en route controllers.

Source: SWIM Final Program Requirements, Segment 1, May 23, 2007.

Segment 2 (between 2012 through 2016): FAA expects this segment to provide services to support NAS-wide flight planning activities; improved flight arrival, surface, and departure flow; and restricted and regulated airspace capabilities. Additionally, this segment will provide NextGen users with universal access to aviation weather data (in latitude, longitude, altitude, and time). The SWIM Program Office is currently conducting the Segment 2 investment analysis to determine cost, schedule, and performance parameters. A final investment decision is planned for September 2012.

Segment 3 (between 2016 through 2019): FAA expects this segment to allow for enhanced communications and surveillance to reduce separation between aircraft in the oceanic air traffic environment and improve airport surface traffic

management. In addition, this segment will provide more timely and informed decision-making based on shared situational awareness between airspace users.

SWIM IS EXPERIENCING SIGNIFICANT COST INCREASES AND SCHEDULE DELAYS

Cost estimates for Segment 1 of SWIM have increased significantly while estimated cost savings have decreased. Further, FAA has no executable strategy to finish deploying SWIM and achieve user benefits for this segment. When FAA made its final investment decision in July 2009, the estimated cost to complete Segment 1 had increased by approximately $105 million since 2007 (from about $179 million to about $284 million). FAA has also reduced the expected cost savings for Segment 1 by approximately $168 million and delayed completion from 2013 to 2015. Further delays are likely as the seven NAS program offices implementing SWIM have yet to fully define their specific program or SWIM requirements. Table 2 shows the increase in estimated cost to complete Segment 1.

Table 2. SWIM Annual Cost Estimates for Segment 1
(Facilities and Equipment Funds - Dollars in Millions)

FAA's Estimated Cost to Complete	2009	2010	2011	2012	2013	2014	2015	Total
June 2007	$46.3	$58.3	$42.2	$25.2	$6.9			**$178.9***
July 2009	$39.7	$58.3	$84.5	$42.8	$35.9	$15.0	$7.3	**$283.5**
Total Cost Variance	**$-6.6**	**0**	**$42.3**	**$17.6**	**$29**	**$15.0**	**$7.3**	**$104.6**

Source: OIG analysis of FAA's Joint Resources Council SWIM documents (*Total does not compare to Table 4 due to rounding).
Note: FAA provided cost estimates to complete SWIM in 2007 and 2009.   However, in 2007, the Agency only baselined cost estimates for the first 2 years, and in 2009 all costs estimates were baselined.

NAS Program Offices' Undefined Requirements Have Delayed SWIM Implementation for Segment 1 and Increased Development Costs

FAA is at least 4 years away from finalizing requirements to fully realize SWIM capabilities; many of these requirements depend on the successful development and implementation of other NAS systems. Until the seven NAS programs needed to implement SWIM have defined requirements, delays with SWIM's overall development will continue. For example, a critical component of SWIM's success is the ERAM program, as four of the other NAS programs implementing SWIM are planning to use ERAM for support. Without ERAM, the more efficient flight data management envisioned for SWIM will not be possible; therefore, defining and completing ERAM modernization requirements must be a top priority. Because of its central role, the ERAM program has received funding from the

SWIM Program Office to modernize and enhance ERAM flight data processing and external interfaces with terminal air traffic control (ATC) and the Traffic Flow Management (TFM) systems (see exhibits B and C for a detailed list of SWIM capabilities enabled through all seven systems and cost and schedule status).

Table 3 provides examples of requirements for the five NAS programs that must be finalized to implement SWIM (see exhibit D for a complete list of the challenges all seven programs must overcome to implement SWIM capabilities).

Table 3. Requirements That NAS Program Offices Must Finalize To Implement SWIM Capabilities

FAA Systems	Challenges to Finalizing Requirements
ERAM	FAA is 4 years away from finalizing requirements to fully implement SWIM/ERAM capabilities. For example, FAA has yet to finalize requirements to replace two key interfaces that share flight data with airspace users and terminal and tower facilities. FAA does not plan to complete this activity until FY 2014. FAA also does not plan to start the final phase of exchanging SWIM-compliant information with the TFM and terminal facilities or complete SWIM/ERAM upgrades for the 22 en route facilities until FY 2015.
TDDS	FAA is undertaking a major development effort to implement SWIM terminal capabilities on a new system known as the Terminal Data Distribution System (TDDS). It is uncertain when FAA will deploy TDDS to the 38 planned sites for Segment 1 because the Agency has yet to establish a contract agreement and fully define all requirements.
TFM	FAA has yet to develop requirements for a new TFM service to provide NAS users with information from terminal facilities because of its dependence on TDDS, which has yet to be developed. This service is not expected to be implemented until FY 2014.
SAMS	FAA has not established firm requirements to upgrade ERAM with SWIM's capability to exchange Special Use Airspace data with other Air Traffic Management systems. FAA does not plan to implement this capability until FY 2014.
WMSCR	FAA has not established firm requirements to upgrade ERAM with the interface to record Pilot Reports and send them to the WMSCR system. FAA does not plan to implement this capability until 2015.

Source: OIG analysis of SWIM Implementing Program documentation

As a result of the changing requirements with these programs, SWIM Segment 1 development costs have increased significantly over original estimates. For example, the estimated costs to upgrade ERAM with SWIM increased by 85 percent, from $63.4 million to $117.7 million. Likewise, costs for TDDS more than doubled, from $16.5 million to $33.9 million.[2]   Congress has specifically

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[2] When upgraded with SWIM, ERAM is expected to provide flight data and updates to clients for filed/active flight plans, and adapted arrival and departure route status. TDDS is expected to consolidate data feeds from four terminal systems that provide information such as pre-departure clearance data to controllers and greater visibility of runway conditions to pilots.

expressed concern over how much money will be directed to the other program offices to support SWIM.[3] In fiscal year (FY) 2009, of the $41 million requested for SWIM, FAA redirected $27.6 million to the seven NAS programs to implement SWIM capabilities for their respective systems. Table 4 outlines the increases in cost estimates for six of the seven NAS programs to implement SWIM capabilities.

Table 4. SWIM Segment 1 Program Cost Variances

NAS Programs Implementing SWIM Capabilities	Estimated Cost (Dollars in Millions)		Percent Cost Growth
	2007	2009	
Terminal Data Distribution System (TDDS)	$16.5	$33.9	105.5%
Weather Message Switching Center Replacement (WMSCR)	$6.5	$12.8	96.9%
En Route Automation Modernization (ERAM)	$63.4	$117.7	85.6%
Traffic Flow Management (TFM)	$19.8	$29.2	47.5%
Corridor Integrated Weather System (CIWS)	$0.8	$0.9	12.5%
Integrated Terminal Weather System (ITWS)	$3.0	$3.2	6.7%
Aeronautical Information Management (AIM)	$8.5	$7.1	-16.5%
SWIM Program Office	$60.5	$78.7	30.1%
TOTAL	**$179.0***	**$283.5**	**58.4%**

Source: OIG analysis of FAA's Joint Resources Council SWIM documents (*Total does not compare to Table 2 due to rounding).

Many of these technologies are likely to see further cost increases with continued SWIM schedule delays. FAA originally planned to field SWIM segments in 4-year increments but has already extended completion for Segment 1 from 4 years to 6 years. Segment 1 capabilities originally planned for deployment in 2013 are now slated for 2015. Until FAA fully defines and finalizes requirements for the programs implementing SWIM, the program's cost and schedule will remain uncertain.

FAA HAS NOT ESTABLISHED CLEAR AUTHORITY FOR MITIGATING RISKS AND SUCCESSFULLY IMPLEMENTING SWIM

SWIM will likely remain at risk of further delays and cost increases because the SWIM Program Office has no authority over the seven NAS program offices'

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[3] Committee on Appropriations, U.S. Senate, Committee Report 110-418, July 14, 2008.

costs, schedules, and requirements for implementing SWIM. In deciding upon a decentralized approach to implement SWIM, FAA recognized that transitioning to a SWIM-enabled environment all at once would not be operationally practical, affordable, or provide a guaranteed level of safety for mission-critical systems with high-availability requirements. A decentralized approach is not necessarily cause for concern, but combined with evolving requirements, no clear end state, and unclear lines of accountability, it can significantly increase risks to the program's successful implementation. Because the SWIM Program Office is not filling the typical role of setting long-term programmatic priorities, it will be difficult for FAA to develop an end-state transition strategy for SWIM; ensure that SWIM aligns with NextGen goals as promised; and address data integrity, performance, and security issues.

SWIM Program Office Has No Authority Over SWIM Implementation, Cost, and Schedule

The SWIM Program Office has relied on Program Level Agreements (PLA) with the seven NAS program offices to document and establish funding sources, design parameters, and implementation dates for developing capabilities. However, these PLAs have been ineffective tools for controlling SWIM development costs and schedules. FAA officials believed that this approach would save on initial development costs by building out the SWIM infrastructure through the seven NAS systems. Yet, SWIM program officials admitted they have no authority over when SWIM capabilities will be implemented. A primary reason is that the seven NAS program offices responsible for developing SWIM individually manage when and how their SWIM software is deployed. The SWIM Program Office could not justify the escalating development costs associated with six of the seven programs.

Further, FAA did not establish PLAs with any of the program offices for Segment 1 deployment activities through the end of Segment 1 from 2012 through 2015 for the majority of the systems involved. While the PLA process has limitations, FAA did not use them to gain commitment from the NAS program offices on schedule goals that could be achieved. As a result, in addition to driving their own costs, the NAS program offices do not provide deployment schedules, and their requirements are constantly changing. Our work has shown that this approach has significant risks. As we stated in September 2008, implementing SWIM in an incremental approach could leave the program with no clear end state and less cost visibility into what it would take to complete the program.[4]

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[4] OIG Testimony Number CC-2008-118, "Status of FAA's Effort To Develop the Next Generation Air Transportation System," September 11, 2008. OIG reports and testimonies are available on our website: www.oig.dot.gov.

FAA Does Not Have SWIM End-State Plans

Without a more centralized perspective on implementing SWIM, FAA lacks an actionable roadmap to transition the NAS to SWIM through its end state. Specifically, FAA has not developed an overall architectural design that identifies all the NAS systems that will require SWIM technology. In 2007, Congress expressed specific concerns about this aspect of the program, stating that the value of SWIM lies in its overall architecture rather than in its connectivity to disparate systems. Congress directed FAA to explain how it will ensure connectivity between SWIM and other systems.[5] FAA submitted its report to Congress in January 2008; however, it did not sufficiently explain how FAA would ensure connectivity and integration with existing and planned air traffic systems.

According to FAA, SWIM connectivity to other systems becomes critical as more air traffic programs beyond the seven Segment 1 systems are upgraded with SWIM, because system complexity will increase. Overly complex systems will eventually limit the number of cost-efficient capabilities, which will ultimately impede user acceptance—a key component of achieving a successful end-state for new technology. However, FAA has not planned how users such as airlines, airline operating centers, or other agencies will upgrade their respective systems with SWIM capabilities for exchanging data so they can be compatible and begin using the new capabilities SWIM will offer. Industry experts noted that migrating legacy systems and operational environments to a SWIM-based infrastructure will typically be a gradual and painstaking process presenting planning/lifecycle challenges.

SWIM Lacks Alignment with NextGen Goals

FAA's NAS Enterprise Architecture[6] roadmap identifies numerous SWIM initiatives required to achieve NextGen goals, including reducing aviation costs (FAA's and industry stakeholders'), expanding capacity, improving collaborative decision making, and increasing system predictability. With the exception of reducing aviation costs, these NextGen goals are associated with SWIM capabilities slated for Segments 2 and 3. However, SWIM program officials have yet to finalize the requirements to achieve them or define expected benefits for FAA and aviation users. Moreover, according to SWIM planning documents, aviation users will not realize key NextGen benefits in Segment 1; rather, only FAA cost savings realized by deployment of SWIM capabilities are planned.

Reducing Aviation Costs: The SWIM implementation plan states that a key objective of the SWIM program is to help reduce FAA infrastructure costs by

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[5] Committee on Appropriations, U.S. Senate, Committee Report 110-131, July 16, 2007.

[6] An Enterprise Architecture describes the "current architecture" and "target architecture" to include the rules and standards and systems life cycle information to optimize and maintain the environment which the agency wishes to create and maintain by managing its information technology portfolio.

reducing the number and types of interfaces, systems, and potentially facilities that make up the NAS. Additionally, new systems will develop SWIM-compliant interfaces, saving future development costs. Table 5 outlines FAA's planned SWIM cost savings per year.

Table 5. SWIM Projected Annual Cost Savings (Dollars in Millions)

FAA's Projected Cost Savings	FY09	FY10	FY11	FY12	FY13	FY14	FY15	Total
June 2007	$88.4	$87.1	$86.0	$87.9	$83.6	$13.5	$13.3	**$459.8**
July 2009	$55.5	$55.1	$52.4	$51.7	$51.8	$12.9	$12.8	**$292.2**
Decrease	**$32.9**	**$32.0**	**$33.6**	**$36.2**	**$31.8**	**$0.6**	**$0.5**	**$167.6**

Source: SWIM Final Investment Decision Briefings (June 2007 and July 2009).

FAA has already reduced the expected cost savings benefits by $168 million (from $459.8 million to $292.2 million) through 2015, the end of Segment 1, because 2 additional years will be required to complete Segment 1. Moreover, FAA could not support its reported annual cost savings of about $55 million for FY 2009 and FY 2010. One of the assumptions associated with these cost savings was that ERAM and TFM program offices would agree to stop work on a capability planned for ERAM Release 1 to support the exchange of Special-Use Airspace (SUA) data. This is because, as planned, SWIM would provide the same capability at the same time. However, FAA's original assumptions are no longer valid because the new interface for the SWIM SUA capability will not be deployed until 2014, at least 4 years later than originally planned.

Expanding System Capacity: FAA's SWIM implementation plan also states that the program will enable information to be readily shared and used by all NAS participants. With more widespread use of better data, SWIM will improve strategic planning and flight trajectory management to allow better use of existing capacity in the en route (high altitude) environment. FAA's NAS Enterprise Architecture states that FAA is planning to initiate trajectory-based operations, which will provide interactive flight planning during Segment 2 of the SWIM program. However, FAA has yet to define requirements or establish a transition plan for when SWIM will provide this new capability. FAA is not planning to approve a final Segment 2 performance baseline until September 2012.

Improving Collaborative Decision Making: A key NextGen and SWIM goal is to enable collaborative decision making, which means that once all airspace users have access to the same information, they can efficiently make real-time decisions and quickly reach agreements. However, FAA's NAS Enterprise Architecture states that the Agency is not planning to implement the full collaborative decision making capability for SWIM until Segment 3 of the program. Requirements for this capability also have not been defined.

Increasing Predictability: SWIM is expected to improve coordination to allow transition from tactical conflict management to strategic operations and make flight schedules more reliable. Also, SWIM is expected to provide the potential to increase automated information exchanges between systems (e.g., ERAM and TFM) for the purposes of supporting and disseminating decisions rather than relying on current manual processes. A planned benefit of SWIM is to ensure consistent decision making based on the same data. However, FAA's NAS Enterprise Architecture did not have any information outlining when the Agency would achieve this NextGen objective through SWIM.

Performance Issues with Data Integrity, Security, and Routing

While the SWIM software has a number of security directory services and system management capabilities, by itself, the software does not supply all the needed data integrity or security features. To provide these would require an Enterprise Service Bus (ESB[7]) or general framework for security. FAA is not using an ESB for Segment 1 of SWIM but is considering using one during the transition to Segment 2. Industry experts caution that FAA's plan to provide a secure information web through SWIM may not be successful without a central ESB capability for NAS-wide message exchange.

Other security risks could be introduced to the program with the SWIM Program Office's plans to use FAA's Telecommunication Infrastructure (FTI) to route information between NAS systems and external users. FTI uses Internet Protocol Security controls such as Virtual Private Networks to create authorized connections between external systems and FTI. FAA has not yet developed a similar protocol to ensure that those programs implementing SWIM technology and aviation users meet all the requirements necessary to protect the NAS systems. Using SWIM technology can expose an organization to security risks that can compromise existing network-based internal controls. Web service-enabled networks such as FTI are more vulnerable to internal and external attacks. For example, in May 2009, we reported that Web applications used in supporting ATC systems operations that are not properly secured can create security risks.[8]

CONCLUSION

The guiding tenet of FAA's vision for NextGen is transitioning from air traffic control to air traffic management to increase the capacity and efficiency of the Nation's aviation system. This will require revolutionizing communication across the NAS, while effectively planning and overseeing the significant investments required. Because SWIM is a key component of this plan, FAA must take steps

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[7] ESB services provide a common backbone upon which global information is transacted and managed securely.

[8] OIG Report Number F1-2009-049, "Review of Web Applications Security and Intrusion Detection in Air Traffic Control Systems," May 4, 2009.

now to establish clear accountability and authority for SWIM's implementation. Otherwise, the program will be left without an overall blueprint or achievable end state. These steps are critical to mitigate risks of further cost increases and schedule delays and obtain promised benefits for NAS users.

RECOMMENDATIONS

We recommend that FAA:

1. Finalize SWIM requirements for Segment 1 and establish firm cost and schedule commitments.

2. Provide the SWIM Program Office with the proper authority to ensure SWIM capabilities will be implemented within the established schedule.

3. Strengthen the PLA process so the SWIM Program Office can have sufficient authority to enforce SWIM's Segment 1 implementation.

4. Define requirements through SWIM's end-state by:

   a. developing an overall architectural design for the SWIM program identifying all the NAS systems that will be required to implement SWIM technology.

   b. defining their respective costs and schedules for implementing planned capabilities.

5. Align SWIM implementation strategy with the Agency's NextGen goals, develop a realistic plan that coordinates the two, and define when planned NextGen benefits will be realized.

6. Follow up with NAS program offices and users implementing SWIM technology to determine whether they are meeting all the requirements necessary to protect NAS systems from exposure to security risks.

AGENCY COMMENTS AND OFFICE OF INSPECTOR GENERAL RESPONSE

We discussed the results of our review with FAA's Senior Vice President for NextGen and Operations Planning, and SWIM Program Manager and provided FAA with our draft report on April 15, 2011. We received the Agency's formal response on May 12, 2011. FAA's complete response is included as an appendix to this report. In its response, FAA concurred with all six of our recommendations.

FAA's planned actions meet the intent of our first recommendation. FAA stated that PLAs are typically updated annually, but we are requesting that FAA provide us with target action dates for when the PLAs are finalized so that we can track the Agency's progress.

For recommendations 2 and 3, FAA stated that the SWIM Program Office was given more authority to ensure SWIM capabilities will be implemented within the established schedule through FAA's Joint Resources Council (JRC) process. FAA also stated that the Deputy Administrator will assume direct oversight responsibility for NextGen activities and that differences between the SWIM Program Office and other programs regarding SWIM implementation will be adjudicated at this level. While this is a step in the right direction, it is unclear to us how the JRC process and direct oversight of the Deputy Administrator for NextGen activities will sufficiently strengthen the PLA process itself. The intent of our recommendations was that FAA provide the SWIM program office or another FAA entity with greater authority to effectively manage requirements, cost, and implementation schedules by improving controls over PLAs. Accordingly, we are requesting that FAA provide us with more details and completion dates for its planned actions for recommendations 2 and 3.

For recommendations 4, 5, and 6, FAA stated that it would complete actions to address our concerns by September 30, 2012, in preparation for a Final Investment Decision for Segment 2 of SWIM. FAA also indicated that cost, schedule, requirements, and an overall architecture design for Segment 3 of SWIM will be finalized in preparation for a Final Investment Decision on September 30, 2014. Accordingly, we consider these recommendations resolved but open pending completion of planned actions.

ACTIONS REQUIRED

FAA's proposed actions for recommendations 4, 5, and 6 are responsive, and we consider them addressed but open pending completion of the planned actions. For recommendation 1, we are requesting that FAA provide us with target dates for

updating PLAs annually. For recommendations 2 and 3, we are requesting that FAA provide us more details on how it plans to strengthen the PLA process.

We appreciate the courtesies and cooperation of FAA and various stakeholder representatives during this audit. If you have any questions concerning this report, please contact me at (202) 366-0500 or Kevin Dorsey, Program Director, at (202) 366-1518.

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cc: FAA Deputy Administrator
     FAA Chief of Staff
     FAA Director, Audit and Evaluation
     Anthony Williams, AAE-001
     Martin Gertel, M-1

EXHIBIT A. SCOPE AND METHODOLOGY

We conducted this performance audit in accordance with Generally Accepted Government Auditing Standards as prescribed by the Comptroller General of the United States. 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. We conducted this review between September 2008 and April 2011.

To assess FAA's efforts to develop and implement Segment 1 of the SWIM program we identified the cost, schedule, and performance issues associated with the program and identified the risks associated with FAA's decision to develop SWIM using a decentralized approach for Segment 1 and a centralized approach to transition into Segment 2. We examined the Program Level Agreements that placed the authority to develop and implement SWIM capabilities under the control of the Implementation Programs.

We interviewed FAA program officials representing the seven FAA systems implementing SWIM capabilities. We also met with NextGen program officials from the Office of Requirements and Governance and the Office of Evolution and Coordination.

We conducted site visits at the Volpe National Transportation Systems Center in Cambridge, Massachusetts to observe the Integrated Terminal Weather System (ITWS) working prototype developed by VOLPE to distribute live weather data with an advance forecasting notice time of 1 hour. We observed real time ITWS weather demonstrations developed as a Service Oriented Architecture (SOA)-based prototype to provide interoperable services to allow different applications to exchange data with one another using an industry standard format. We visited and interviewed the staff at William J. Hughes Technical Center in Atlantic City, NJ to assess their support resources for the SWIM program. We also visited the two facilities at the Tech Center for SWIM the SWIM Prototyping and Support Facility to gain an understanding of the Hardware and Software necessary to support the SWIM prototyping and evaluation activities, and the SWIM Integration Facility which releases versions of the service container software maintained in the SWIM Commercial off-the-Shelf (COTS) products repository.

EXHIBIT B. SWIM PLANNED CAPABILITIES

NAS PROGRAMS	CAPABILITIES	SWIM SERVICES
Traffic Flow Management (TFM)	Flow Information Publication	Provide a means for airspace users to subscribe to information on traffic flow constraints, such as ground delays and ground stops.
	Runway Visual Range	Provide runway visibility data used to report approximate distance a pilot is able to see down a runway.
	Reroute Data Exchange	Provide aircraft reroutes for congested airspace, severe weather, facility outages, or emergencies.
En Route Automated Modernization (ERAM)	Flight Data Publication	Provide flight data and updates to airspace users for filed/active flight plans, and adapted arrival and departure route status.
Terminal Data Distribution System (TDDS)	Terminal Data Distribution	Consolidate data feeds from four terminal systems that provide information such as pre-departure clearance data to controllers and greater visibility of runway conditions to pilots.
Aeronautical Information Management/Special Use Airspace (SUA)	SUA Automated Data Exchange	Improve the current Special Use Airspace (SUA) process by providing better knowledge of when a SUA is active or inactive, i.e., unsafe or safe for civilian aircraft to enter.
Weather Message Switching Center Replacement System (WMSCR)	Pilot Reports (PIREP) Data Publication	Provide a new capability to automatically distribute weather-related pilot observations to controllers to enhance safety and capacity.
Integrated Terminal Weather System (ITWS)	ITWS Publication	Provide real-time picture of weather near airports (wind shear, lightning, storm cells) with a 1-hour weather forecast.
Corridor Integrated Weather System (CIWS)	CIWS Publication	Provide weather avoidance routing/re-routing and an automated 2-hour weather forecast.

Source: SWIM Final Program Requirements Segment 1 (May 23, 2007), and other FAA sources.

EXHIBIT C. COST AND SCHEDULE STATUS OF SEVEN NAS PROGRAMS IMPLEMENTING SWIM CAPABILITIES

NAS Programs	No. of Systems Upgraded with SWIM Capabilities	SWIM Services		SWIM Funded
		Initially Operational	Fully Operational	Cost Estimate (in millions)
Air Traffic Management				
En Route Automation Modernization (ERAM)	22	FY 2012	FY 2015	$ 117.7
Traffic Flow Management System (TFMS)	2	FY 2011	FY 2014	$ 29.2
Terminal Data Distribution System (TDDS)	38	FY 2012	FY 2015	$ 33.9
Special Use Airspace (SUA)	2	FY 2010	FY 2014	$ 7.1
Weather				
Weather Message Switching Center Replacement (WMSCR)	3	FY 2012	FY 2015	$ 12.8
Integrated Terminal Weather System (ITWS)	1	FY 2011	FY 2011	$ 3.2
Corridor Integrated Weather System (CIWS)	1	FY 2011	FY 2011	$ 0.9

Source: OIG analysis of SWIM planning and funding documents.

Exhibit C. Cost and Schedule Status of Seven NAS Programs Implementing SWIM Capabilities

EXHIBIT D. NAS PROGRAMS CHALLENGES IMPLEMENTING SWIM CAPABILITIES

NAS PROGRAMS	CHALLENGES IMPLEMENTING SWIM SERVICES
En Route Automated Modernization (ERAM)	<u>Major modernization efforts required to successfully implement SWIM/ERAM capabilities:</u> We found FAA has considerable development work that will be required over the next 4 years before all of the SWIM/ERAM capabilities are implemented. For example, ERAM program officials have only completed requirements to develop an interface with TFM. This will establish a standard SWIM interface to implement the capability to exchange pre-departure and rerouting information between the TFM and En Route domains once a flight plan has been filed. The SWIM reroute interface will automate what is currently a manual process. However, the FAA is not planning to start operating this capability until FY 2012. Moreover, in the FAA En Route environment there are two key interfaces that share flight data (e.g., the filed flight plan and the current state of the flight) today that will be replaced in SWIM Segment 1. The Host Air Traffic Management Data Distribution System (HADDS) provides a general purpose message-based interface for sharing flight data with airspace users, and Flight Data Input/Output (FDIO) which provides a point-to-point data interface with terminal and tower facilities. FAA is currently planning to complete the HADDS and FDIO replacement by FY 2014, however, the agency has yet to finalize requirements for this key activity. Finally, FAA is not planning to complete SWIM/ERAM upgrades for the 22 En Route facilities and start the final phase of exchanging SWIM compliant information with the TFM and terminal facilities until FY 2015. However, until requirements are finalized considerable uncertainty exists with respect to when these capabilities will be implemented.

NAS PROGRAMS	CHALLENGES IMPLEMENTING SWIM SERVICES
Terminal Data Distribution System (TDDS)	Major development effort required to achieve SWIM terminal capabilities: FAA is currently undertaking a major development effort to implement SWIM terminal capabilities. FAA needed to develop a new system known as the Terminal Data Distribution System (TDDS) to more effectively exchange terminal data with the En Route and TFM facilities which is currently exclusive to the terminal facilities. FAA has a contract with Raytheon to develop the TDDS system, and current plans are to complete development in FY 2012. The TDDS is currently planned to be deployed at large Terminal Radar Approach Control (TRACONs) and major air traffic control tower facilities. The TDDS will consolidate data feeds from four terminal systems that provide information such as pre-departure clearance data to controllers and greater visibility of runway conditions data to pilots. However, uncertainty exists regarding when FAA will deploy TDDS to the 38 planned sites for Segment 1, because the Agency has yet to establish a contract agreement and fully define all requirements. Consequently, until TDDS is developed and deployed, considerable uncertainty exists regarding when SWIM terminal capabilities will be implemented.
Traffic Flow Management (TFM)	Modernization work required to achieve SWIM TFM capabilities: The initial capability that SWIM/TFM will provide is aircraft reroute information formatted in accordance with SWIM standards. This information will be sent to ERAM from TFM and is planned for completion by FY 2011. The TFM program will also develop new standards to support a service which describes current and planned traffic flow constraints in the NAS, but is not planned for completion until FY 2013. The TFM system will also provide a new service to airspace users through the distribution of data collected from terminal facilities. However, requirements for this capability have yet to be defined because of its dependence on a new terminal program to modernize equipment controllers rely on to manage traffic in the vicinity of airports, which has yet to be developed. Moreover, this service is not expected to be implemented until FY 2014.
Aeronautical Information Management/Special Use Airspace (SUA)	Requirements to complete SWIM SUA capabilities: The SWIM SUA capability will provide a standard data entry user interface to accommodate the creation of digital designs of SUA assigned areas. The SWIM SUA capability will also ensure schedules and status are digitally managed in the NAS, and changes in SUA status are captured and distributed as they are made. While FAA is planning to initially start operating the SWIM SUA capability in Fiscal Year 2010, another 3 years will pass before this key flight data is accessible by other users in the NAS. We found that FAA is not planning to upgrade ERAM with SWIM capability to exchange SUA data with other air traffic management systems until FY 2014. We also note that ERAM and SWIM program officials have yet to establish PLAs or any firm requirements to meet this planned milestone date.

Exhibit D. NAS Programs Challenges Implementing SWIM Capabilities

Weather Message Switching Center Replacement System (WMSCR)	Requirements to complete SWIM WMSCR capabilities: The SWIM WMSCR portion adds a new capability to automatically distribute pilot reports (PIREPs) of crucial weather observations by pilots to En Route controllers. Although WMSCR program officials reported that 3 WMSCR facilities will be upgraded with SWIM by FY2012, another 3 years will pass before this crucial weather data will be distributed to the wider NAS community. WMSCR can only redistribute the data after it receives the information from ERAM. However, FAA is not planning to upgrade ERAM with the interface to record PIREPs and send the automatic PIREPs to the WMSCR system until 2015. Moreover, ERAM and SWIM program officials have yet to establish PLAs or any firm requirements to meet this planned milestone date.
Integrated Terminal Weather System (ITWS)	Funding concerns to implement SWIM ITWS capabilities: ITWS promotes common situational awareness among all users, which is crucial to the collaborative decision making process necessary to reduce weather-related delays. FAA performed demonstrations with SWIM/ITWS capabilities in October 2008 and plans to publish 31 products by FY 2011. ITWS program officials are concerned because they will have to fund and support both SWIM/ITWS and the existing ITWS services until all users upgrade with SWIM.
Corridor Integrated Weather System (CIWS)	Users upgrading to implement SWIM CIWS capabilities: CIWS will work with SWIM to allow traffic managers to collaborate with dispatchers on routes to avoid during severe weather conditions; it will also help to avoid en route delays, which saves airline fuel costs. While the CIWS prototype was deployed in 2010, FAA officials could not tell us when or if Airline Operating Centers, the primary users of CIWS weather data, would upgrade their systems to utilize the SWIM data.

Source: OIG analysis of SWIM Implementing Program documentation.

Exhibit D. NAS Programs Challenges Implementing SWIM Capabilities

EXHIBIT E. ACTIVITIES VISITED OR CONTACTED

Federal Aviation Administration (FAA):

Headquarters

- System Wide Information Management Program Office   Washington, DC
- Evolution and Coordination   Washington, DC
- Requirements and Governance   Washington, DC

System Wide Information Management Implementing Programs

- Aeronautical Information Management   Washington, DC
- Corridor Integrated Weather System   Washington, DC
- En Route Automation Modernization   Washington, DC
- Integrated Terminal Weather System   Washington, DC
- Terminal Data Distribution System   Washington, DC
- Traffic Flow Management System   Washington, DC
- Weather Message Switching Center Replacement   Washington, DC

William J. Hughes Technical Center   Atlantic City, NJ

Volpe National Transportation Systems Center   Cambridge, MA

EXHIBIT F. MAJOR CONTRIBUTORS TO THIS REPORT

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Andrea Nossaman	Writer/Editor

APPENDIX. AGENCY COMMENTS

Federal Aviation Administration

Memorandum

Date: MAY 1 2 2011

To: Jeffery B. Guzzetti, Assistant Inspector General for Aviation and Special
                 Program Audits

From: Clay Foushee, Director, Audit and Evaluations, AAE-1   MFH fu CF

Subject: OIG Draft Report: FAA's Approach to SWIM Has Led to Cost and
                 Schedule Uncertainty and No Clear Path for Achieving NextGen Goals
                 Federal Aviation Administration

The System Wide Information Management (SWIM) program is an advanced technology
program designed to facilitate greater sharing of Air Traffic Management (ATM) system
information such as airport operational status, flight data, weather information, status of
special use airspace, and National Air Space (NAS) restrictions. SWIM supports current
and future NAS programs by providing a flexible and secure information management
architecture for sharing NAS information. The primary objective of SWIM is to improve
the Federal Aviation Administration's (FAA) ability to manage the efficient flow of
information. The SWIM program is an integral part of the Next Generation Air
Transportation System (NextGen) that requires FAA programs to provide more
streamlined communications and efficient operations.

Some of SWIM's accomplishments over the past two years include:

- Corridor Integrated Weather System (CIWS) capability operational September 27,
  2010; 15 CIWS products available.
- Integrated Terminal Weather System (ITWS) capability operational January 25;
  30 ITWS products available.
- Aeronautical Information Management/Special Use Airspace capability:
  completed initial operating capability (IOC) December 16, 2010.
- Joint Resource Council (JRC) Segment 2 Authorization to Proceed (ATP)
  November 17, 2010.
- SWIMposiums held Sept 2009, September 2010.
- NAS Service Registry/Repository (NSRR) operational July 2010.

The following is provided in response to the OIG's recommendation:

Recommendation 1: Finalize SWIM requirements for Segment 1 and establish firm cost and schedule commitments.

FAA Response: Concur. FAA agrees that finalized requirements are necessary for firm cost and schedule commitments by SWIM implementing programs (SIPs). Program Level Agreements (PLAs) between SWIM and SIPs are updated annually. Each year, PLAs are modified to include milestones that must be achieved by the SIP in order to meet SWIM cost and schedule commitments.

Recommendation 2: Provide the SWIM Program Office with the proper authority to ensure SWIM capabilities will be implemented within the established schedule.

FAA Response: Concur. With the SWIM Segment 2 JRC decision on November 17, 2010, SWIM was given more authority. SWIM is now part of the JRC process and without approval from the SWIM program office, a program can be stopped from proceeding to its next JRC milestone.   SWIM also has been integrated into the Enterprise Architecture Board and Technical Review Board.

As of April 14, 2011, the Deputy Administrator will assume direct oversight responsibility for the NextGen activities. Differences between SWIM and the SIPs regarding SWIM implementation will be adjudicated at this level.

Recommendation 3: Strengthen the PLA process so the SWIM Program Office can have sufficient authority to enforce SWIM's Segment 1 implementation.

FAA Response: Concur. FAA agrees that the Program Level Agreement (PLA) process needs to embody sufficient authority to enforce Segment 1 implementation. Since the initial versions were written in 2008, PLAs have continued to evolve in order to strengthen SIP accountability for Segment 1 implementation. Differences between SWIM and the SIPs regarding SWIM implementation will be adjudicated as described in the response to Recommendation 2.

Recommendation 4: Define Requirements through SWIM's end state by:

a. developing an overall architectural design for the SWIM program identifying all the NAS systems that will be required to implement SWIM technology

FAA Response: Concur. The SWIM Program Office works closely with NextGen and Operations Planning (AJP) to ensure that the evolution of SWIM, represented by three Segment Implementations in the NAS Enterprise Architecture roadmaps and System Views, is consistent with achievable SWIM program capabilities. Since January 13, 2009, SWIM has been conducting service-oriented architecture (SOA) suitability assessments of programs before their JRC investment decisions. This process identifies NAS systems that need to include SWIM technology.

Appendix. Agency Comments

Requirements and architecture for SWIM Segment 2 will be finalized in preparation for a Final Investment Decision (FID) on September 30, 2012. Requirements and architecture for SWIM Segment 3 will be finalized in preparation for a Final Investment Decision (FID) on September 30, 2014.

b. defining their respective costs and schedules for implementing planned capabilities.

FAA Response: Concur. Costs and schedules for SWIM Segment 2 will be finalized in preparation for a Final Investment Decision (FID) on September 30, 2012. Costs and schedules for SWIM Segment 3 will be finalized in preparation for a Final Investment Decision (FID) on September 30, 2014.

Recommendation 5: Align SWIM implementation strategy with the Agency's NextGen goals, develop a realistic plan that coordinates the two, and define when planned NextGen benefits will be realized.

FAA Response: Concur. SWIM implementation strategy will be aligned with NextGen goals and defined in more detail in preparation for a Final Investment Decision (FID) on September 30, 2012.

Recommendation 6: Follow up with NAS program offices and users implementing SWIM technology to determine whether they are meeting all the requirements necessary to protect NAS systems from exposure to security risks.

FAA Response: Concur. SWIM is prototyping an identity and key management (IKM) capability using VeriSign-provided security certificates to ensure that only authorized users have access to NAS systems. These security requirements will be finalized in preparation for a Segment 2 Final Investment Decision (FID) on September 30, 2012.

Appendix. Agency Comments