Expediting Implementation of Air Traffic Management System Improvements

April 6, 2000
Washington, D.C.

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Cosponsored by
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and
Transportation Research Board

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Acknowledgments

The Committee on Airfield and Airspace Capacity and Delay (A1J05), the Transportation Research Board committee which sponsored the Symposium on Expediting the Implementation of Air Traffic Management Technologies, would like to express its appreciation and gratitude to the organizing committee of this activity. TRB would like to acknowledge all the effort and dedication of the Symposium Organizing Committee in making this activity happen and their contribution to its success:

- Joseph H. Sinnott, Organizing Committee Chair, Senior Principal Staff, The MITRE Corporation's Center for Advanced Aviation System Development (MITRE/CAASD);
- Robert H. Cormier, Senior Engineer, MITRE/CAASD;
- Robert L. Humbertson, Project Team Manager, MITRE/CAASD;
- Kara J. MacWilliams, Lead Staff, MITRE/CAASD; and
- Margaret C. Tower, Senior Engineer, MITRE/CAASD.

The TRB Sponsoring Committee would also like to thank the direction and support provided the organizing committee by Dr. Agam Sinha, Director of Air Transportation Systems, MITRE/CAASD. The Committee would like to acknowledge all assistance and continuous support by the TRB Aviation Section staff Joseph A. Breen and Nancy Doten to the organizing committee that ensured the success of this symposium.

Dr. Saleh A. Mumayiz
Chairman
TRB Committee on Airfield and
Airspace Capacity and Delay (A1J05

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Introduction

A viation stakeholders across the community agree on one point: it often takes a long time to implement improvements to the air traffic management (ATM) system. While some progress has been made on how to implement ATM system changes more expeditiously, many challenges remain. In the words of one FAA executive, "We need to make technology work for us rather than working for technology."

The coordination of government and industry investments in new technologies represents a unique and multifaceted complex challenge. Decisions are often reached by consensus from a large number of diverse parties across the community in both the public and private sectors. These decisions are often complex and interdependent from technological, performance, political, financial, and implementation perspectives. Circumstances can often change making it difficult to maintain consensus and to make progress toward implementation. Understandably, aviation industry executives are reluctant to invest in new technologies without firm, long-term government commitments, and correspondingly, the government cannot often make such firm long-term commitments in the face of uncertain budgets and fragile community consensus. All of these factors and many others, no doubt, contribute to the problem.

The primary objective of this symposium, Expediting the Implementation of Air Traffic Management System Improvements, was to bring together key government and industry stakeholders to identify:

- The steps involved in implementing ATM system improvements (including those that are often less visible but that are an integral part of implementation),
- Steps that can be taken to achieve more rapid implementation of ATM system improvements, and
- Actions that specific stakeholders can take to implement these steps

The symposium featured formal presentations, panel discussions, and opportunities for informal discussions, all designed to foster a constructive exchange of ideas. The scope of the improvements included, principally, ATM system hardware and software changes, from mission need approval through completion of implementation at all sites. Thus, communications, navigation, and surveillance system improvements and purely procedural or airspace changes were excluded to keep the scope of the symposium more focused.

An important consideration for the symposium was that attendees should leave with a better understanding of the problems that hamper the implementation of ATM system improvements, and most importantly, the actions they can take to help overcome them.

WELCOME

Dr. Saleh A. Mumayiz, as the Chairman of the TRB Committee on Airfield and Airspace Capacity and Delay (A1J05), welcomed the attendees on behalf of TRB and the organizing committee. Dr. Mumayiz addressed a few administrative and logistical details, and closed by noting that he hoped that the symposium would be interesting and informative.

SYMPOSIUM INTRODUCTION

Mr. Joseph Sinnott of The MITRE Corporation's Center for Advanced Aviation System Development (MITRE/CAASD) led the committee that organized the symposium and offered a few opening remarks to set the stage for the day.

Mr. Sinnott acknowledged that the organizing committee spent quite some time in trying to develop a good symposium: one that addresses an important topic and would be valuable to attendees. When planning first began, key stakeholders in the aviation community were consulted to identify important topics that would be worth addressing. A few topics were identified and this one was selected largely because there is certainly a clear need to address it and because other candidate topics are often addressed in other forums.

Mr. Sinnott noted that all of the participants agree that it takes too long to field ATM system improvements. Mr. Sinnott stated "The objective of the symposium is to take this opportunity to try to explore potentially viable solutions. This symposium offers a unique opportunity; the National Academy of Sciences is a different venue that may afford us the opportunity to think more broadly and impartially about this important topic. In addition, most of the participants have invested a considerable part of their professional careers in getting ATM system improvements into the field. How can we find ways to expedite implementation?"

In developing the symposium, the organizers identified a substantial number of organizations that either play a significant role or have a significant stake in the implementation of system improvements. Not all organizations that have a role or a stake in implementing improvements could be represented in the presentations and panel discussions. The point is that there are many players with diverse interests involved, and that by itself adds to the complexity of the problem.

The objective was, in part; to identify some concrete, specific, and practical ways to reduce the time required to field improvements. There is no shortage of tough questions:

- Requirements: Does an improvement really need to perform like that? In what way?
- Consensus: What constitutes consensus? Who must agree? What happens if consensus cannot be reached?
- Approval: Who approves an improvement?

There probably are no easy answers, and no one in this forum was expecting any to emerge from the discussions. The FAA and the aviation community are currently engaged in implementing some initiatives that are not easy to contend with even now. Some of those initiatives have had some measure of success, and some are too new to fully evaluate. Thus, the participants were encouraged not to think purely in easy and simplistic terms.

These thoughts and insights provided a good platform for the symposium's presentations and the ensuing discussion.

OVERVIEW OF SYMPOSIUM SESSIONS

The symposium consisted of three principal sessions convened to address various issues and topics related to understanding and expediting implementation of ATM system improvements.

- The first session, What's Involved in Implementing Improvements?, featured FAA presentations and described the steps and challenges facing the FAA and the community at large in implementing ATM system improvements. The objective was to help symposium participants understand the various activities involved in fielding improvements, the time required to initiate and complete them, and the circumstances that can complicate or extend them. This session identified, based on examples drawn from recent experience, some of the successes, challenges, and problems encountered and the corresponding implications for the time required to implement improvements.
- The second session, What Can be Learned from Recent Government and Industry Experience?, featured presentations from both the FAA and other organizations. The presentations focused on the experience and lessons learned of various organizations with large-scale implementation programs and the recent actions they have taken to speed implementation. Parallels were drawn where possible between their experience and the challenges facing the FAA.
- The third session, What Are the Opportunities and Constraints in Speeding Implementation?, featured a panel discussion on the activities where considerable time has often been spent, and on the opportunities and constraints associated with reducing the time required to complete these activities. The topics included FAA and industry perspectives on operational implications, system development, investment decisions, acquisition, technology insertion, regulation, certification, and workforce issues. The session also identified priorities among possible actions identified in the previous sessions.

CIRCULAR CONTENT

This TRB Circular documents the proceedings of this symposium and includes summaries of the three sessions outlined above, speaker presentations, the symposium agenda, and a list of the symposium participants.

What's Involved in Implementing Improvements?

STEVEN ZAIDMAN

Moderator, Associate Administrator for Research and Acquisitions
Federal Aviation Administration

T he first morning session, What's Involved in Implementing Improvements?, featured FAA presentations describing what is required to implement air traffic management (ATM) system changes, indicating which activities require the most time and why. The presentations addressed most of the various perspectives associated with implementing improvements, including research, requirements development, acquisition, regulation and certification, transition, implementation and integration, air traffic operations, facilities and operational support, and hardware and software infrastructure. The objective was to help symposium participants gain a better understanding of the various activities involved in fielding improvements, the time required to complete those activities, and the circumstances that can complicate or extend them.

Mr. Zaidman set the stage with a presentation of issues for the panelists and audience to consider. The following paragraphs summarize Mr. Zaidman's remarks.

FAA Is Unique

Mr. Zaidman emphasized that the FAA is unique in government in that it is both the provider of a service and the customer of that service. Often the same people are involved on the producer side and the marketplace or user side. For that reason, one has to multiply the time expected to implement an ATM system improvement by almost two.

Operations Concepts

Mr. Zaidman stressed the importance of clearly defined operations concepts to drive requirements. He explained that it often takes a long time (about 6 years) to field a new capability when one does not start off with a clear understanding of what the system is going to do and how it is going to be used. Beginning with a well-defined operations concept can significantly reduce the time needed to develop and field a new capability (e.g., about 2 years total rather than 6 years). Requirements reap results when one has to fit a system into a real operating environment that was not understood at the beginning.

Specifications

Mr. Zaidman compared the ease of tailoring a "thin" specification that everyone can understand versus trying to adopt some "thick" specification developed for another program and attempting to use it as is in a different project.

Human Adaptation

Mr. Zaidman explained that successful human adaptation/human factor results when time and resources are invested early in the program life cycle to plan and prototype the computer–human interface (CHI). It is important to attain early buy-in from operators and maintainers so that they are not surprised with a poorly designed CHI late in the program. Human adaptation should be developed in one or two iterations up-front (it is nearly impossible to get it completely right the first time) to thereby get it done in half the time, versus having to do an extensive redesign late in the program.

National Airspace System Interfaces

National Airspace System (NAS) interfaces are important but too many developers claim that interfaces are "not my problem." A good architecture and clearly understood interfaces are important to success. People and programs cannot operate in a vacuum.

Software Development

In software development, the FAA is actually better than many other technical organizations. However, FAA failures are in the public eye, versus the many failures in private industry that do not become public knowledge. Software development is a big issue for everyone.

Procedures Development

Procedures development, including air traffic control, flight, and maintenance procedures, needs to be performed in parallel or ahead of systems acquisition. Mr. Zaidman explained that the community needs to fully understand the operating environment and how the system is going to work within it. Today, we often have to develop many operational work-arounds late in the program, which takes time. Doing more procedures development up-front would save time. Generally, the FAA underestimates the technical complexity and, even more important, the operational complexity of ATM system improvements.

Logistics, Training, Certification, Scheduling

Mr. Zaidman emphasized the importance of logistics support, training of the workforce (including everyone who touches or operates the system), certification (which is a little different on the ground than in the air), and scheduling (which tends to be underestimated). He cited the role of logistics, training, and certification in helping one to get to the field with something that is better and cheaper.

Organizational Structure

Mr. Zaidman addressed the layering of the FAA organizational structure and the extent to which it could be streamlined to gain efficiency in the review and approval process.

Decision Making

The programs that seem to work smoothly are those where someone makes a decision—it may not always be perfect, but it is a decision. It drives program managers crazy if there is no clear decision-making process in a program. That is the kiss of death for a program because you wind up churning and spinning.

Trust

Trust issues are endemic to most organizations. This includes trust between organizations as well as trust between collective bargaining units and management. The programs that work are those that bring the users on board early. You get their trust and buy-in rather than just saying, "Here it is." Successful programs are able to overcome "trust barriers" and develop a good relationship with users.

Why Things Take So Long

FAA requirements are more stringent than commercial requirements. Commercial off-the-shelf (COTS) products often cannot fulfill FAA requirements. Also, development, production and testing time are not well understood by Congress or the Inspector General (IG). Oversight from Congress, the IG, and the Government Accounting Office tends to lengthen the acquisition process.

International Standards

The next generation communications systems require that international standards be in place so one airplane can talk to another airplane from a different country. International standards are a big investment early in the program life cycle.

Jack Kies
Manager of Tactical Operations, FAA ATM Operations Perspective

Mr. Kies discussed the advantages of the collaborative model of software development. Collaborative software development involves all the affected players, and automatically gives all parties ownership. Ownership is the key tenet of the collaborative model. The collaborative group responsible for software development at the command center includes NAS operators, traffic managers, and contractors.

The steps of the collaborative development model are:

- Problem identification,
- Idea generation,
- Explore solutions, and
- Consensus.

In problem identification, air traffic stakeholders quickly recognize and adjust to "symptoms." Frequently, that is a problem because addressing symptoms rather than problems causes additional problems downstream. Group discussions lead to better understanding of the problems, their sources, and their impacts.

Mr. Kies explained that idea generation from all the members of the collective brain trust participating in a collaborative effort provides a much greater and much more sound foundation to problem identification and ultimately problem solving.

In terms of exploring solutions, a group-developed list of solutions to problems is far more profound than an individual effort. Air traffic controllers have a great deal of experience in local decision making and local problem solving. However, at the system level, local problem solving is detrimental. Consensus has to be reached on the best approach.

The timing of the solution is absolutely important. We cannot afford to introduce new technology inconsistent with the people's ability to assimilate that technology and exercise it.

"Build a little, test a little" is an important element of collaborative development. Evolving technology demands that we first build a strong foundation on top of which we can build up and out. Evolving products is part of that same paradigm in that we do not want to aim at building the final product or the finished product necessarily because the way our technology and goals change, we do not have a final target. We must commit to constant evolution.

The proximity of players is another very important element in the collaborative process. Placing users and developers in close proximity to one another provides a sense of what is needed and what is important.

Mr. Kies discussed the Flight Schedule Monitor (FSM) as an example of a collaborative development success story. FSM was developed by many people collaborating over a long period of time. It was rapidly prototyped in the command center and integrated into the existing hardware infrastructure. FSM is the foundation for many initiatives in the enhanced traffic management system. Out of FSM came many of the technological advances and tools we are using today—not just in the command center, but at customer sites out in the airline operations centers and elsewhere. Ground stop tools, ground delay programs, and arrival delay tools are examples.

Mr. Kies indicated that there have been many lessons learned. For example, the timing of the introduction of new technology is absolutely critical. The controllers who are going to use it, after they have bought into the fact that they want to use it, will exercise the technology and develop a degree of familiarity so that when a tough situation arises, they are ready to use the technology. That is a tough lesson to learn. For example, we have learned that when you introduce new technology in the middle of a severe weather season with expectations that the air traffic controllers are going to use it, it is not going to happen. When the pressure is on, they go back to what they know how to do the best. New technologies are not among those tools they are going to use if they have not yet become familiar with them.

Mr. Kies went on to express the idea that we have to commit to reviewing the products, not only from the controller's perspective but also from the customer's perspective. Everybody has to have a vote on how good something is performing. What do we need to do to augment it? What about it is serving our collective needs? We are all in business to serve one another to one degree or another and if we can commit to understanding that conceptually, then we will commit to reviewing the needs of the system.

Mr. Kies talked about a recent success involving the Spring 2000 initiative. He said that MITRE staff who participated in the process were able to introduce a measure of expertise when it was most needed to support electronic data transfer and utilization of web technology.

James Washington
Director, Air Traffic System Requirements Service
FAA Requirements Development Perspective

Mr. Washington explained that requirements are a fundamental piece of the acquisition process, and are often blamed for why things take so long. Air Traffic System Requirements Service (ARS) serves as the "middleman" to coordinate the involvement of many participants in the requirements process.

Why does the fielding of ATM system improvements take so long? Mr. Washington followed that rhetorical question with another, "Compared to what?" He indicated that we need to acknowledge that our activities require making multimillion-dollar investments and identifying improvements to a complex legacy system that helps us manage throughput of tens of millions of flights on a daily basis. It encompasses the national system in an international network which is the most significant that anyone could imagine. The question "It takes so long to get there, compared to what?" also needs to be related to the quality of what we produce in the acquisition process. The problem is not necessarily why does it take us so long to get there, as much as it is addressing the sliding scale of time versus quality.

Mr. Washington offered that integration issues and human factors issues pose the most challenges.

Mr. Washington presented a graphical depiction of the acquisition process, from identifying a mission need to fielding and periodically reviewing the performance of improvements to the NAS. An operations concept should drive how we describe the NAS architecture, which also ought to drive how we define a mission need. The mission need should define what the gap is between our existing capability in the system as compared to a new capability—a new decision tool or a new functionality, which allows us to run traffic more safely and more efficiently than we do today. This also, in turn, ought to drive how we define a specific requirement that gets introduced into the acquisition process. Mission analysis is where industry typically gets involved. The Radio Technical Commission for Aeronautics group focusing on 03-05 concepts for Free Flight Phase 2 (FFP2) is a good example.

Early involvement of principle stakeholders, including both union and management field personnel, is critical to early requirements planning. Early involvement of stakeholders can address human factors requirements, operational and maintenance requirements, and interface requirements. ARS looks to both air traffic and airways facilities (AF) to help in the process of getting early workforce involvement, as well as determining what the concept of operations is and translating it to system requirements.

Investment analysis looks at the expected benefits as compared to the costs for fielding a system improvement. We need to consider both government and industry or economic factors that come into play when we address what benefits really are as

compared to what we think it is going to cost to achieve them. Investment analysis is an important input to the budget process.

ARS forms partnerships with the Office of Air Traffic Systems Development (AUA) and others to support the processes involved from contract award to fielding to last site operational readiness demonstration.

Mr. Washington explained how the FAA Acquisition Executive Advisory Board (FAB) was established to tailor the Acquisition Management System to enhance both mission and investment analyses. Also, the FAB is developing an expedited process for Service Life Extension and Technology Refresh. The cochairs are Joann Kansier and Mike Harrison.

There are several lessons from the Free Flight Phase 1 (FFP1) program that address the transformation of requirements to capabilities. These lessons include how to better focus program execution to meet customer needs, how to transition from research and development to production, and how to formulate and gather data for operational and engineering metrics. For FFP2, the FAA will need to understand how the program will be integrated, how the system will evolve, and how technology transfer will be carried out.

Portfolio management is gaining notice in the FAA as a means to address the mix of projects necessary and sufficient to deliver benefits to the end-user. There are no stand-alone, stovepipe projects.

Mr. Washington summarized by emphasizing that we know what our acquisition process is. We have made improvements to the process. We have learned how to do acquisition better. The FFP1 Program Office is a key example of where we are doing the most creative work in the acquisition world. What is really going to cause us to make improvements is for requirements to be embraced in the acquisition context, rather than simply being something that the operators identify up-front and hand-off to the developers so that we march down the road on two different paths.

Mr. Washington then explained that testing needs to be done based on an accurate description or an updated version of the requirements. If testing occurs on the wrong set of requirements, then we get approval where potentially we are going to go down the wrong road and have a piece of equipment that does not quite meet the test once it is fielded.

Mr. Washington emphasized that integration issues, human factors, and workforce suitability all need to be addressed. We can continue with integrated product teams. We can go back to matrix management. We can provide service portfolios. But, the bottom line is that even though we all like to be decision makers, we really need to focus on the need for consensus building. That is what it's all about in terms of having the right stakeholders involved in the process early. The more we work on building consensus around not just schedule and cost and performance, but workforce suitability, the less we will have to have decisions coming down that cause us to react and figure out what to do real-time.

Raymond Long
Deputy Program Director, Airways Operational Support
FAA Facility Operations Perspective

Mr. Long provided a brief overview of the Airway Operational Support (AOS) organization. AOS is a second-level engineering service organization that provides engineering and field support throughout the NAS. AOS has 1,200 personnel, half FAA and half contractors. AOS has 30 field sites, including 1 at each center plus 10 terminal sites. AOS has an agency at headquarters, four divisions at the William J. Hughes Technical Center, one division at the Mike Monroney Aeronautical Center in Oklahoma City, and a group at the command center.

AOS works with AF personnel, as well as customers and stakeholders, to try to deliver the right requirements to the field. That is a complex problem.

According to Mr. Long, key site testing is critical. That is the first true test of how systems will operate in the field. Much work needs to be completed before you get to the field. It is that ability to develop strong, repeatable processes to deliver quality products where the agency is struggling. Once we get to the key site, the agency is good at fixing the legacy systems so that they will interoperate with new systems, which is the primary role of AOS.

Mr. Long explained how the FAA has adopted the integrated capability maturity model (iCMM). AOS has a number of systems that have reached iCMM level 2, including DART, Display Systems Replacement (DSR), and Common Advanced Radar Tracking System (ARTS). The FAA has a goal of achieving iCMM level 2 with the host system by 2001. iCMM offers a strong, repeatable, and documentable process for the FAA to develop systems, deliver them to the field, and have them work properly the first time. iCMM helps various FAA organizations to work together and avoid stovepipes.

FAA is placing great emphasis on serving the customer. AOS recently went through a process of clarifying its mission and identifying who its customers are.

Year 2000 (Y2K) was a true success story in the FAA and demonstrated that the agency is communicating better internally and working better collaboratively with industry. FAA has learned from past failures and is moving forward.

AOS has to work within many constraints, including limited budget and hiring freezes. Upgrading systems is all the more challenging because of those constraints.

Prioritization of what fixes go into what software release is also a challenge for AOS. Each stakeholder has their own set of priorities. AOS has a better process in place for identifying requirements and priorities earlier, but challenges still remain.

In terms of lab capabilities, the FAA does not have the ability to fully mimic a site. When the FAA completes a software enhancement and is about to release it into the field, it does not have a comprehensive lab anywhere where it can take a center and duplicate 20 or 30 sectors. That is why key site testing is so important. FAA needs to commit to develop, at the technical center, a site where it can mimic the facilities in the field.

COTS software presents a particular set of problems in terms of configuration management. The problems are made more challenging when one considers the many hardware configurations that exist at the circuit board level and the modifications that have to be made to software to operate under those various hardware configurations.

Mr. Long stressed that the costs of maintaining systems in the field are increasing. Many FAA systems are over 30 years old and it is often difficult and costly to obtain replacement components. It is complex and difficult for AOS to maintain legacy systems and help deploy new equipment; iCMM will help meet those challenges.

AOS is improving in defining its customer requirements, understanding those requirements, and making sure they are met.

Mr. Long summarized by stating that the AOS focus is on maintaining the NAS and ensuring that the systems that are being deployed are maintainable. This has been a problem in the past. Maintaining legacy systems is a challenge. FAA discovered through the Y2K project and is learning through FFP1 that its employees can be successful. FAA can manage large technical programs and deliver capabilities under budget and on schedule. FAA is learning from past failures—not just building on its successes. That is the key to the agency being successful.

William Voss
Director, Office of Air Traffic Systems Development
FAA HW/SW Infrastructure and Applications Perspective

Mr. Voss explained that his organization, the Office of Air Traffic Systems Development (AUA), is responsible for implementation of the new NAS infrastructure.

Mr. Voss emphasized the importance of the research community understanding the details of how the infrastructure is rapidly changing. The FAA has been moving forward with incremental infrastructure improvements, and the research community now must pay attention to how the infrastructure is evolving so that research efforts can be better integrated. For example, in the en route environment, DSR implementation is nearing completion early and under budget, something that many would not have predicted the FAA was capable of doing. In the terminal facilities, Standard Terminal Automation Replacement System still has about 200,000 source lines of code to develop, but it is under control and not as risky as it was a year ago. Also, the last ARTS IIE will be installed by the end of May. Many large terminal facilities have ARTS IIIEs and advanced color displays.

There are many weather programs underway. The Integrated Terminal Weather System is under development and will improve weather-related decision making. The Weather and Radar Processor is nearing completion, addressing human factors and acceptance issues. The Operational and Supportability Implementation System is back on track for the flight service stations. Research programs are underway to generate products incrementally for the field users and transfer technologies to industry. In the oceanic area, source selection activities are underway for new automation systems. A new version of the Enhanced Traffic Management System has been released. It facilitates future enhancements.

Mr. Voss' next point was that many COTS products have become integral parts of the NAS infrastructure, and that presents a particular set of problems. For example, there are 180 COTS software products used in the en route environment. FAA does not have control over the evolution of these COTS products; the software vendor does. The vendor can decide to stop supporting a product, and that dictates the technical refresh cycle of when the FAA has to replace the product. That has implications for those who are trying to deploy new capabilities on top of the existing infrastructure. Open systems and

software standards have improved the infrastructure, but with COTS, FAA does not have as much control as it used to.

Mr. Voss explained that FAA is developing application program interfaces for DSR, and in the terminal environment, so that the research community will have an easier time integrating with the infrastructure. Collaborative work across research and acquisition organizations is underway to build better interfaces between the research and the infrastructure. Also, more high-fidelity integration work is being pursued at the tech center. It is critical that FAA be able to integrate research ideas early into the infrastructure environment so that problems can be shaken out.

Mr. Voss indicated the primary problem associated with stovepipe research and development approaches: duplicate efforts. For example, there was no conscious decision to develop multiple trajectory models, but that has been the result. Fielding multiple variations of a capability has significant maintainability cost implications when one considers all of the lines of code, in different languages, with different release cycles, plus all of the underlying COTS products.

Introduction of new technology cannot overwhelm operations, given limited operations budgets.

In summary, AUA focuses on integration and adaptation. They basically try to keep up with what the research community is doing. AUA is trying to work through the challenges with the research community. For example, how do you implement something in the COTS non-developmental item environment? How do you deal with the budget constraints? How do you not overwhelm operations in order to introduce the new technology? AUA is also trying to keep up with the refresh cycles and the realization that FAA is no longer the market driver in many technologies as it was in the past. All of these considerations change the way to best approach everything, including research and development (R&D).

Gilbert Devey
Director, Office of Acquisitions, FAA Acquisition Perspective

Mr. Devey provided an overview of acquisition process performance measures, indicating that acquisition reform has been successful in reducing the amount of time required for important steps of the acquisition process.

In late 1995, the U.S. Department of Transportation Appropriations Bill directed the FAA to create a new acquisition management system (AMS). In the three years since AMS was implemented, FAA has demonstrated some fairly significant and dramatic reductions in cycle time. In fiscal year 1995, before AMS, it typically took about 51 days from an investment decision before we actually issued a solicitation. Then it took about 106 days to go through the competitive acquisition process and award a contract. In 1997, the first year when FAA was fully under AMS, you can see a fairly dramatic reduction in the cycle time. It took about 30 days after an investment decision to issue a solicitation. From the time we issued the solicitation, it took about 57 days on average to award a contract.

For fiscal year 1998, there has been continuous improvement in terms of reduced cycle times. From the perspective of creating a solicitation and conducting procurement, FAA has been able to demonstrate some fairly significant reductions in cycle times.

Mr. Devey also emphasized that FAA has demonstrated that it is promoting more competition. In 1995, 66 percent of our actions were awarded competitively; in 1997, about 63 percent; and in 1998, the last year we had data for, about 70 percent of the actions. With increased competition, FAA is able to get best value in its contract awards. FAA is also able to trade off costs for technical performance, use contractor past performance as a significant evaluation factor, and select better contractors overall.

The FAA and the contractor community face the challenge of having a stable and sustained agreement on requirements. Also, FAA must get customer acceptance of what it is creating and trying to deliver. If the operator does not accept what we deliver, then we have another challenge. A lot of times this can slow down implementation and increase costs. We have a challenge with the conservatism of the air traffic controller workforce. Safety is foremost on their mind.

Mr. Devey explained that contractor performance is another challenge. We have some contractors that do an excellent job, and in some cases they deliver on time and under cost. But, we also have some other challenges with contractors who have not been able to deliver on time. We have had a number of cost growths. It is certainly not the contractors' fault completely. The FAA has a responsibility in that as well.

Mr. Devey posited budget as the next challenge. We need to have a commitment for long-term stable budgets. Disruptions to contractors and development and delivery times have to be eliminated. FAA needs a sustained budget on a long-term basis, and that is not just facilities and equipment—that is also operations and R&D, because they are all tied together.

Finally, FAA needs to do a better job convincing Congress as well as our customers that we actually do deliver systems.

Margaret Gilligan
Deputy Associate Administrator for Regulation and Certification
FAA Regulation and Certification Perspective

Ms. Gilligan explained that aviation safety is the key focus for regulation and certification. FAA's Regulation and Certification Perspective (AVR) looks for ways to increase safety margins and reduce risks in the NAS while promoting the efficiency and capacity goals of the FAA. Contrary to what many believe, safety goals are not in conflict with efficiency and capacity goals.

To ensure safe and timely introduction of products, AVR makes determinations about the safety of systems as they affect the operating environment, making sure systems are well analyzed, well documented, and well integrated.

AVR focuses on system elements (communications, navigation, and surveillance) rather than services, such as ATM. Ms. Gilligan acknowledged that, in the future, AVR also may have to adopt a services focus. AVR has the responsibility to make sure that supporting guidance, procedures, and regulatory changes are in place to introduce new equipment into the system and achieve the desired level of safety.

Equipment has to be affordable and offer user benefits. Ms. Gilligan explained that past experiences involving the mandating of equipage were not successful.

The FAA safety goal is ambitious: an 80 percent reduction in the commercial fatal accident rate by 2007. That is one of the cornerstones of AVR's participation in NAS

modernization. AVR must constantly assess whether a given technology will contribute to that goal.

AVR must communicate clearly with those who operate in the NAS environment, including designers, producers, integrators, and operators (both the airlines and individual pilots). AVR has done that successfully on the aircraft side for many years. AVR sets equipment standards through Technical Standards Orders (TSOs), which support the approval process for design and production of the technology. TSOs are done in partnership with the designers and the producers. AVR also has to improve installations, because installations differ depending on aircraft. AVR establishes the bases for supplemental type certifications. That process, while having some room for improvement, is nonetheless well understood by the FAA and the applicants.

On the operating side, aircraft certification and flight standards are well integrated. Operational policy is issued through advisory circulars to inform industry about a technology and inform them about what they need to do to operate it. Operating rules are changed if needed.

Where AVR is looking to improve its performance is in the role of coordination between aircraft systems and ground systems. AVR understands that it must play a role in setting requirements to ensure capability between airborne and ground systems. Safety issues must be taken into account early. AVR and air traffic system implementers have each addressed safety from different perspectives, and they need to understand each other better. AVR wants to be a better participant in the acquisition process.

Where is AVR going? These are the key areas: AVR needs to refine the safety assessment process. AVR also needs to clarify what it means in terms of regulation and certification. According to Ms. Gilligan, AVR needs to adapt some of the processes that it uses for failure modes analysis and other tools that it has used in aircraft certification to be certain that it is getting the same level of safety enhancements or risk modifications in the ground-based systems. AVR believes it needs to see better end-to-end analysis and that it understands second and third level implications of new technologies, both on the ground and in the aircraft.

Ms. Gilligan acknowledged that AVR knows that it must enhance its role in terms of acquisition sponsorship, and she is committed to facilitate that in two primary ways. First, AVR needs to enhance its own understanding of the acquisition process and understand better where it can play a role and help programs be successful. Second, AVR also needs to increase its resource commitment to the acquisition process. She explained that it is not an easy thing to do given budget constraints, but it is a commitment that AVR has made nevertheless.

Finally, AVR believes that it needs a much clearer operational plan that works hand-in-hand with the architecture. AVR needs to have a better time line for when it needs to be looking at regulatory or procedural changes. It needs to let the operators play a bigger role in helping to set that scheme. That may affect some of the architecture decisions, but the end result will be a better, more integrated process.

Robert Long
Program Director, NAS Transition and Integration,
FAA Transition, Implementation, and Integration Perspective

Mr. Long began his presentation by indicating how providing a more efficient and effective air traffic service is a joint effort of AF. Implementing products and ensuring that they stay on-line to provide service to customers is the AF focus.

NAS Transition and Integration, headed by Long, and NAS Implementation (ANI), headed by Jack Nager, are two AF organizations that ensure that hardware and software upgrades are introduced into a stable platform. These organizations deal with plants and structures, which are aging. Elements such as lightening protection, grounding/bonding/ shielding, and commercial and emergency power are examples of facilities infrastructure that affect the NAS. Also, telecommunications technology is constantly changing, and AF's NAS Operations organization has to keep up with the changes.

Security of facilities is a growing challenge. AF has to address both physical security of facilities, equipment, and personnel, as well as data security. Facilities safety is also a concern that has implications when new systems are deployed.

Configuration management is one of the main concerns. It is very difficult for a product team or other organization to plan for deploying something when they know they are going to 400 locations and they don't know if all 400 are the same, or maybe 200 are one way but the other 200 are each individual. AF is addressing configuration management not just at the software release level, but at the level of the entire facility, e.g., considering the amount of space available for future expansions.

To support implementation activities, ANI is working with the regions to plan a standardized approach to site preparation for NAS equipment implementation. This planning addresses site adaptation and engineering, which includes environmental and community considerations. AF is also working with its past partners to address training, staffing, needed skills, and how to deal with changes in the work environment brought about by implementation of new capabilities.

AF has to handle emergencies that arise on a daily basis when equipment fails and has to be restored quickly or when other unsafe conditions need to be addressed.

AF is also involved in responding to changes in demands and performance, e.g., consolidating facilities, building larger control towers to address issues at local airports, or consolidating Terminal Radar Approach Control Facilities, all to make the system more efficient and effective and to consolidate resources.

AF continues to address a large number of requests for growth in the area of Instrument Landing Systems and transitioning to the Global Positioning System. AF has the constant challenge to add more like systems and other equipment to the NAS.

Field maintenance support is a very fluid situation and is transitioning to a more software-based activity.

System performance analysis occurs on a daily basis, looking for trends and deterioration of various services in the NAS.

AF is involved in the end of the life cycle of various things, including equipment, buildings, and structures. These are some things that although they do not impede us in how we get a new service in place, they are the final things that we must do to conclude a modernization project. More and more, AF is looking at hazardous material control and

mitigation. Buildings that we have out there today are 40- to 50-year-old facilities that used asbestos. They used lead paint. They have radon problems. All these types of issues must be addressed and mitigated.

Mr. Long explained environmental due diligence audits, which are required when we leave a site or when we close something down. Also, AF has processes to make sure that it acquires environmentally clean property for new facilities.

In summary, Mr. Long stressed that AF has the challenge to "put the wrappings on" implementation and NAS modernization. In his opinion, AF does an outstanding job, and the FAA, as a whole, is improving. There is much better communication between organizations, e.g., working with the product teams.

SESSION WRAP-UP

Steven Zaidman
Moderator

With public demand increasing, FAA is at a "hair trigger" in providing services in terms of what the flying public is willing to tolerate. For example, with an outage or a severe weather situation, the public is vocal in letting the FAA hear about it. Against the backdrop of increasing demand and increasing expectations for reliable, quality air traffic service, FAA is in a situation where it has to rely on some old equipment and facilities. The technology is very complex. Also, because of the saturation on the system, FAA has increasing challenges on the procedural aspects. Given an operations budget that is decreasing and decreasing numbers of qualified personnel, it is challenging to meet rising expectations. And in this conference we are considering how to do it faster and better.

QUESTION-AND-ANSWER SESSION

Comment: Researchers need to put the research in a form that is implementable. NASA, MITRE, CSC, Lockheed–Martin, and others have begun to meet and discuss what needs to be done to improve the implementation of technology. The participant, in reference to Mr. Voss' presentation, also acknowledged that there are too many trajectory models.

Answer: One panelist responded that he is excited about research community meetings to improve technology implementation. The research community needs to do more to get the research to a more ready, more "plug-and-play" level. FAA and vendors who are responsible for developing a lot of the infrastructure need to get involved earlier in the research efforts.

The contract that NASA–Ames put in place recently—the ATMSDI contract—is a positive step. Through either some great foresight or good fortune, I think we have vendors available to NASA now on those contracts who would know a lot about the infrastructure where these systems can be employed.

The area of trajectory models is probably one of the places where it is hardest to gain consensus. Everybody can agree that you ought to have a consolidation of

communication protocols or communication layers or monitor control, but many have pride of ownership in the area of trajectory models. It is encouraging that NASA and MITRE have been meeting. There needs to be agreement on what the progression of the technology looks like, particularly in the en route domain.

The architecture does a very good job of describing things at the top level, but what is needed is the development of more of the tactical architecture for the en route domain.

Answer: Another panelist explained that he appreciated the identification of the crux of the issue: speeding research tools to implementation. Technology transfer is a stumbling block. A common understanding of the operations concept and how is it that we anticipate using a particular decision tool or improvement to the system is needed.

Comment: A participant observed that there has been a lot of discussion about requirements and about the stability requirements. ARS has recognized that at the time when requirement documents are written, there often is not a clear understanding of what is needed. In working with Automatic Dependent Surveillance–Broadcast, instead of starting to write requirements documents, ARS has been writing Requirements Evaluation Plans (REP). A REP outlines the questions that need to be answered in order to be able to write the requirement. The participant stated their desire to work with the research community to identify such requirement questions in the future.

Comment: A participant addressed the need for leadership in the area of standards. He also called for caution in the pursuit of "faster, better, cheaper." He then emphasized the importance of aviation to our culture. He applauded FAA efforts in the area of collaboration.

Question: A participant commented on the difficulties in the acquisition process and successes in collaboration and asked whether government–industry partnerships (e.g., the approach taken with the Local Area Augmentation System) are working.

Answer: Partnerships are working fine, but with some caveats. FAA did not get the funding it requested. Industry is taking a big financial and marketing risk

Comment: We need to create a vehicle to get the avionics side involved in the system design earlier so that developments can be done in parallel. Sequential or serial activities take longer. The participant challenged the group to determine how to bring the ground automation and the avionics segments together. The same kind of automation and decision-support tools are in development for equipage on board the aircraft, and they need to be consistent with the ground systems.

Answer: Regulation and Certification needs to be the bridge between the products that are going to be in the airplane and the products that FAA is going to field on the ground. We need to enhance how we can bring those two together. There are many forums where some of that exchange of information already occurs, but we have not formalized it.

What Can Be Learned from Recent Government and Industry Experience?

DAVID TRAYNHAM
Moderator
Assistant Administrator for Policy, Planning and International Aviation, FAA

The second session, What Can be Learned from Recent Government and Industry Experience?, featured presentations focusing on the experience of the FAA and other organizations in implementing large-scale changes and on actions organizations have taken to speed implementation.

With all the activity and growth that is occurring, it is not surprising that some have begun to question whether existing and planned capacity improvements to the National Airspace System (NAS) will be sufficient to sustain future air traffic demands.

The objective of this session was to understand the various activities involved in fielding improvements, the time required to complete them, and the circumstances that can complicate or extend them.

Belva Martin
Assistant Director, Transportation Issues, General Accounting Office

Ms. Martin presented a brief overview of the FAA's Air Traffic Control (ATC) modernization experiences. Over the past 18 years, Congress has appropriated almost $30 billion through 2000 for the ATC modernization program, the bulk of which is associated with hundreds of ongoing projects. In terms of the need for reform, ATC modernization has historically experienced cost overruns, delays, and performance problems. In the mid-1990's, FAA attributed some of those problems to burdensome federal acquisition regulations. The FAA basically sought the opportunity from Congress to write its own ticket, so to speak. In November 1995, Congress did exempt the FAA from most of those procurement rules and directed the agency to develop and implement a new acquisition management system (AMS).

In April 1996, when the FAA implemented the AMS, it established three broad goals:

- Implement a procurement system to provide flexibility in selecting contractors and managing projects;
- Implement an investment management system that spans the entire life cycle; and
- Reform the organization and the culture to support the new way of doing business.

Procurement System

In a July 1999 review, Booz-Allen and Hamilton found that the FAA had indeed met one of its goals, which was to award contracts 50 percent quicker than it had in the past. In

addition, the FAA is awarding a greater percentage of its contracts competitively, and has awarded more contracts based on best value. Thus, the procurement area is one area where the FAA has achieved most of the goals it set forth and can be commended.

Investment Management System

A General Accounting Office (GAO) report issued in April of 1999 on the FAA's investment management system found a number of strengths. In particular, it focuses not only on acquisition but also on deployment and maintenance. There are also a number of important policies and procedures for selecting and controlling projects (e.g., mission analysis, investment analysis, Joint Resources Council reviews). Another strength is that the system establishes processes for scoring and ranking projects based on established criteria.

According to Ms. Martin, the investment management process also has a number of weaknesses. The major one is that the FAA does not manage the modernization programs as a complete portfolio and that there is limited oversight of operational projects. The second is that the system does not require post-implementation evaluations of completed or canceled projects, though the FAA is taking steps to rectify this. Also, due to the lack of a cost accounting system, decision makers cannot put a lot of confidence in the cost information used to select and control projects. In addition, the implementation of some projects does not comply with critical aspects of AMS policy.

Organizational and Cultural Reform

One of the major strengths in this area is the focus on the integrated team approach; however, the integrated team approach has not been fully implemented. Another area where improvement is needed is the tendency to be more focused on the vertical organization than on a team approach, which may be causing some of the delays in delivering systems.

In summary, Ms. Martin indicated that the FAA has made progress toward the three major goals of the AMS, but improvement is still needed. The FAA reduced the time it takes to award contracts. Much has been done with the investment management system, but more work is needed, as some of the major acquisitions are still experiencing problems in meeting cost, schedule, and performance parameters. In terms of the organization and cultural reform, the right concept is there, but there is still work to be done to ensure a fully functioning integrated team approach.

There are four things that the community can do to assist the FAA. One is to possibly help the agency prioritize the recommendations from internal and external reviews; put the focus on those with the highest pay-off. Second, develop an action plan to implement the recommendations, including assigning responsibility. The third step would be to develop performance goals and hold individuals accountable. The fourth is to look for ways to use the flexibility provided by AMS to help expedite the implementation of the system. There are a number of opportunities within AMS to do things a little bit differently, with the ultimate goal being to implement systems in a more timely manner.

Charles Keegan
Director, Free Flight Phase 1, FAA

Mr. Keegan discussed the consensus among many stakeholders that serves as the context for Free Flight Phase 1 (FFP1) improvements. FFP1 represents a historic agreement, a consensus among the community—suppliers, customers, airlines, industry groups, the FAA, and other government organizations. Together, the stakeholders developed a plan to stem the increasing problem of system congestion. The single most important element of success is consensus. If we are not together, stated Mr. Keegan, nothing will happen. The worst thing that could happen is to start down the path together and split off.

The status of FFP1 is best seen in the impact of what the FAA has delivered and what the FAA is doing. That is what the customer base really cares about. Collaborative decision making has resulted in the avoidance of over 5.8 million minutes of delay. Surface Movement Advisor has enabled airlines to avoid three to five costly diversions during inclement weather. Savings attributable to the User Request Evaluation Tool (URET) represent nearly $1 million per month payback at two prototype sites. Traffic Management Advisor resulted in a 5 percent traffic increase in Dallas/Fort Worth, where it is fully operational. Passive Final Approach Spacing Tool adds two additional aircraft per rush at Dallas/Fort Worth.

Mr. Keegan characterized the path from technology to research to acquisition to fielding a new capability at site as a series of bridges. We need to build smaller and cheaper bridges; big bridges are very difficult processes to deal with. From an industrial engineering perspective, we can and need to build them smaller so people can use them and get benefits every day.

There are a lot of dynamics in research and customer expectations are extremely high. The research itself almost has to deliver some capability. Once you see the demo, everybody wants it and it always looks like it is plug-n-play. The transition from research to production should be just that—there needs to be more thought, more production-oriented thought in the research. Mr. Keegan observed that if research is marketed in the same manner in which production systems are, that is the expectation. We let the aviation community down when we can't deliver. Government and industry alike have this problem and collectively we're addressing it.

We have a process called spiral development—build a little, test a little. Production needs to work with research to take small steps to go from research into actual play. It ultimately has to be done in system domain engineering. When you start a prototype that has tremendous impact, you have to think that if it works, people may demand it all the time. With URET, we had it working with about five people in five sectors and then that grew to every sector to multiple facilities, 16 hours a day, 5 days a week, to 22 hours a day, 7 days a week. It is our fault that we have to shut down those 2 hours. They can't get enough of the tool. We can't serve the customers enough. But, we are a prototype and it is a big deal to operate on that kind of a schedule. So, the worst thing and the best thing that can happen in research is that it works.

Mr. Keegan stated the need to set the balance for research. Research should not be continued beyond where we know what to do and that it can be produced. We need to have metrics and know what to measure to keep our research focused on the problem we are trying to address. Too often we spin off into never-never land looking for the answer.

Research and development (R&D) is as complicated as it looks. There is one thing to remember with spiral development—configuration control between research and production. FFP1 is about focused execution. We need to define what we are going after, understand it, and turn around the speed of research. System engineering becomes important because if it does work, we might have to build two, and they might need to talk to each other. FFP1 is a good example of how spiral development works. Our unions, both from Air Traffic and Airway Facilities workforces, are believers. We must uphold our commitment to ensure build a little, test a little, deploy a little continues, and we don't fall into the trap where continued planned improvements get wiped from our budgets.

We need to make integrated versus distributed decisions smartly. It is nice to have everything accomplished all in one box. Although synchronization may be difficult, we need to think about non-integrated systems to be distributed on their own schedule to limit the risk of other programs interfering and to provide customers that they need.

There need to be processes, standards, and other tools to focus research on the problem, stay there, and manage community expectations of time frames, capabilities, and deliveries. We need to ensure that it still works and that it works with the future NAS. It is also important to understand the maintenance responsibilities involved in the transition from research to operational capability.

We have to stick with the operational concepts and tremendous work going on now with the Radio Technical Commission for Aeronautics (RTCA) to bring all the concepts together. Research isn't ready to go until you can get in a live environment with somebody using it. When this happens, it is probably good enough to start spiraling into production. If somebody in a live environment hasn't used it, it is not ready, regardless of what the marketing says.

We are still learning about technology transfer every day. We have had a lot of experience of late, and it always takes longer than we thought. It is just not a set of documentation rolled over. It takes hands-on handholding, and a lot of time, effort, and a great deal of money to make that technology transfer happen.

In summary, Mr. Keegan indicated that we have everything in place to take research and technology and put it into operation to help our customers and the aviation community. The drive and focus must be clear and we need to meet our customers' demands. Our challenge is to not throw out our own schedules and ideas, but to take our customer expectations and turn that into our program plan. This is where we need to focus on awarding contracts quickly and to the right people, measuring ourselves, and reporting that we are doing the right thing in accordance with what our customers have asked for.

Neil Planzer
Executive Director, Department of Defense Policy Board on Federal Aviation

Mr. Planzer discussed three primary topics. First, he talked about operational concepts and requirement failures in the past. Next, he presented a success model and failure model within the FAA. Finally, he discussed leadership and managing change and how that affects how we have gotten to where we are in the NAS. Mr. Planzer reminded the audience that where you are influences how you look at things. He stated that his view

has changed over the past several years and that he looks at the FAA with more objectivity than before.

According to Mr. Planzer, the Advanced Automation System's (AAS's) failure was in the inability to hold the requirements stable during changes of different phases of the Agency. We had, in that environment, requirements that not only were irrational, but also were generated by an operating community for reasons that were not clear to anybody. The success of Display Systems Replacement (DSR) is the result of the failure of AAS. But the truth is, it is the success of AAS. DSR is a stripping off of the unnecessary requirements. It became stable because it was designed and implemented during the life cycle of one administration that got burnt at AAS and insisted there would be no requirements changes once they were established —none.

Standard Terminal Automation Replacement System (STARS) is an outgrowth of the Terminal Automation System (TAS). With TAS, the FAA also did the big bang. Every day that program got new requirements from the operating organization, every single day. We constantly took half-steps to the wall. The appearance is that you were moving closer. The reality is that you never got to the wall. When STARS came out as a concept, it included facilities like Boston which had a requirement set far less than Denver. You couldn't hold the stability of STARS requirement like you did at the DSR because the administration had changed. The leadership thought differently than the one that went through the previous experience. So, the new administration, for all the right reasons, redid the failure points of the old one because they changed the requirements.

Next, Mr. Planzer discussed operations concepts and how those affect complex problems with simple answers and simple problems with complex answers. Mr. Planzer pointed out that we are transitioning from a terrestrial-based NAS to a NAS that depends on satellites in space. We need a transition, and the FAA said we're doing it without a backup, well maybe some backup, oh, we've got to have a backup, and now what backup do we use. You are two-thirds into your development and nobody understands the transition. Your movement technologically is airborne command and control to ground based. There are no operational concepts or planning documents that show the transition to a system that is shared between the ground based and airborne command and control. That is a failure of an operations concept and a failure of a requirement process.

From Mr. Planzer's new perspective outside of the FAA, success models in the FAA are when you bust development out of the bureaucracy, or when you extract it from failure and recapture it. FFP1 is a success because it is not burdened with bureaucratic development. It is the build a little, test a little, spiral development, but it did not start that way. Where success came from is when you took FFP1 and busted it out of the bureaucracy, because if you did not do that you were put out there with an end development that said in 1 year we are going to have free flight, which was insanity. You put it into RTCA or into anything, and a group got together and they took reality into consideration, and they changed it from a "do today" to a philosophical concept that has long-term transition. And, the demands by the user were prioritized and balanced against what could be done. Not one of the programs was developed for FFP1; they all existed prior to FFP1. But you took them because they weren't the priorities of the NAS. You packaged them, gave them leadership, funding, and visibility, and they were doable in the time frame chosen. The success model is there.

Mr. Planzer talked about what is needed to improve. Part of it is reform. You've got acquisition reform and if you cut down your acquisition time, let's say by half, you cut it down from 200 days to 100 days. Well, for programs that are slipping 7–8 years, that doesn't mean a whole lot. That is not where your problem is.

You have personnel reform. Is the workforce happier today than it was before personnel reform? When you did that you have taken away some of the masking issues. It is forcing you to look back at the core problem. It wasn't the acquisition and it wasn't the personnel.

Does anybody think the system will work well without a clear understanding of what its operations dollars are? It is halfway there. Now that works okay unless you are jumping off a building and you're halfway down and everything seems to be going okay. You need to make sure as an industry that the movement continues the right way.

Tim Fehr
Vice President, Airplane Systems, Boeing Commercial Airplanes Group

Mr. Fehr indicated that we have a much different system now than we will in the future. The transition is the problem. Right now, we've got it down as long as a miracle occurs and gets us from where we are today to where we want to be. In the absence of this, you need a plan, and more importantly, the commitment to execute the plan. Commitment is built around consensus because it takes a lot of folks to make it happen.

There is no point launching a plan that says the FAA is going to end up with a drastically different culture at the end unless everybody has bought into a reason to do so. According to Mr. Fehr, we have to plan relative to today's culture. The people's requirements and needs are going to do that, because when all is said and done, it is the people who are going to implement it.

Mr. Fehr indicated that there are certain business realities we must pay attention to. There is not an unlimited source of funds, people, or capability to do everything. You must take all these into play in plan development. Once you have a plan, you enter what we call our Plan Do Check Act Cycle, which is the important part of program execution.

Mr. Fehr presented a multistep process for developing a plan for improvement. The first step in developing the plan is developing a shared vision of success. Without that, each arm that has to participate is likely to head in a different direction. You have to understand your starting point and then develop a portfolio of proposals or projects to accomplish the goal. We do this using a situation target proposal activity and there is never a single alternative for a situation or target. We ask the five Ys—what are five different ways we might be able to accomplish what needs to be done. When you lock on one, the first thing you find out is (a) you don't have a back-up plan, and (b) that first idea was probably kind of half-baked anyway and will have to be modified downstream. If you ask the five Ys, you usually come up with a better long-term answer.

After we have enough alternatives, we select evaluation criteria. We look at the benefits, investment required, risk and mitigation activities, and probability of success. Select and schedule the preferred set of projects. Then, apply more constraints and reschedule. Next, test that plan against the outcomes and how it fits relative to the vision.

In the planning process, it is important to commit the resources to get it done. Put them in place, and set up the right teams. We used a lot of integrated project teams

(IPTs). We have airline customers and FAA representatives on the IPTs. Then we used analysis and integration teams or a system program office and program management office to glue it all together. The key aspect is the multidisciplinary make-up—customers and suppliers on the team.

We do detailed plans—tier four and five level. We have tried multiple times with a good tier two or three, but it never works. You earn your value at the tier four and five levels where it all comes together. You identify risk mitigation activities and know your critical path. You've got a really integrated network of all the activities that could take place and know how they fit together. Then you have to measure yourself with key metrics.

Once this is done, you implement the plan. Our experience has been that if we really do the detailed work up front, the detailed planning and coordination and involvement of all of the people, implementation is the easy part. Where we don't do that, we get an opportunity to re-set three or four times, which is a huge waste. The worst experience is when you get to the end and have something the customer doesn't want.

When we launch a new airplane program, we are kind of betting the net worth of the company. If you do this, you better have a pretty good idea that you are going to get a pay-off on your investment, so we really have to make that investment up front. In a way, in terms of mass modernization, we are betting the net worth of the aviation community.

Once you have a plan, you have not just a team that is executing it, but you have the entire stakeholder group, including the executives of the corporation, who need to remain engaged. If you don't stay engaged, you can't provide corrective action when necessary. You have to take proper action as you execute the plan. You need project assistance from all over the corporation and from outside the corporation. On the 777 program, we got to the point that I had people managing a subcontractor's plant in England because that was the way to be successful. We had to provide capability that didn't exist then. If you're not willing to commit those resources or are not willing to be involved to that extent, if you want to let the supplier fail, your project will fail. That is an unacceptable answer.

So, where do we start? First, we need a vision. We talk about safety, capacity, and efficiency and I think the year 2016. In the safety area, we have to get to where we have an accident rate that is less than 0.5 per million aircraft departures, with a goal of zero fatal accidents. If you don't get to that kind of an accident rate—less than one-half per million aircraft departures, you are having a major accident every week.

Capacity—by 2016, the projection is that the world transport fleet will be about 30,000 aircraft. We've got to be able to handle that with an average delay of less than 1 minute per flight to sustain economical, viable systems. The real goal would be never get to where that average exceeds 2 minutes.

Finally, efficiency—if we can get to the point where it is less than $500,000 per jet transport in the worldwide fleet, we might have an affordable system. Alternatively, say the cost to operate and maintain the NAS is less than one cent per passenger-mile. One cent doesn't sound like a lot, but when multiplied by passenger-miles, it is fundamental. Mr. Fehr concluded that his vision is just a starting point for thinking in terms of what we can coalesce on and what a plan ought to be for modernization.

PUBLIC UTILITY

Daniel Mehan
Assistant Administrator/CIO, Office of Information Services, FAA

Mr. Mehan was at AT&T from 1967 to 1998 and for the first 15 years, before the government-imposed breakup of AT&T, he was a monopolist. For the last 15 years, he was in a competitive environment. Mr. Mehan ran the small business product house from 1987 to 1992, over a period when AT&T was transitioning from being a monopoly to competitive market. In his presentation, he shared some of what he learned as AT&T evolved from a more protected environment into the wilds of competition.

Mr. Mehan learned that you had to have absolute clarity and alignment around your objectives. The objectives had to be a small set and clear and aligned. There were three questions to ask yourself every night before you went to bed. Would the shareholder invest again? Would the customer buy again? Would the employee join again? Those were the three questions and you had to focus on those. That was your mission.

In a lot of businesses and in a lot of our world, you can get distracted and start meandering off. Focus helped us in a number of ways, even in discussions with corporate. In the early 90s, we were bringing out a cordless unit for the business environment that didn't have quite the quality of sound of a hard-wired one. We still thought it was a good business decision. Corporate came in and said—we think you may tarnish the AT&T image. Now, that can be a real complex discussion. We said let's take a set of customers and give them this wireless and explain up front that it has some great advantages of mobility, etc., but by the way, there are some environments in which it won't work as well, but, by the way, if anything happens, we will react quickly.

So, we took the number of customers that the statisticians told us and the results were interesting. We compared the customers who had hard-wired facilities and what they thought of AT&T with the wireless customers. Of course, the wireless customers had a higher complaint rate than the other customers. But, they knew in advance and we responded quickly. We asked each set of customers their opinion of AT&T at the end. The wireless customers we had taken care of had a higher opinion of AT&T than the customers who never had a problem. It has never ceased to amaze me how customers or any constituent base will react to responsiveness. The corporate folks left the field of battle in terms of not marketing cordless because we had a very clear metric. They came in and said you will tarnish the image. We had a very simple experiment that said, no we won't. That ended the discussions. Clarity and focus on what you want to do is imperative.

Second, you always want all your constituencies represented, but the challenge is to do so without big meetings, large teams, and efforts so cumbersome that you can't move. Over time, we kept the constituencies involved, but the working teams got smaller and smaller. You had key representatives; you had people representing viewpoints. Basically you found smaller rooms and smaller tables so you could engage and drive to get things done. We in the FAA have larger rooms and teams than I experienced in the late 80s. It is always something you have to work through to try to get more focus on what you're doing.

The third thing is that we would take more risks as we got together as a team, trusted one another, and had clarity about what we wanted to do. We got better at differentiating what could "cost the ranch" and what would just be an irritating delay. We found that at

most about 20 percent of what you do can cost you the ranch and 80 percent won't. It may upset management and will upset some folks, but if you get real trust as a team and real clarity with your management on what you're doing, you can ride that through. If you won't take risks, you're not going to move as quickly as you need to, particularly in the age we're entering.

A fourth thing is your budget. Nobody can free you from it. It is very important to have absolute clarity about who is going to spend what part of any buck you have. I used to tell people that for every dollar of revenue, you get to spend 90 cents. We would get clarity around how much we would use for R&D, marketing and sales, service, etc. It puts a discipline around your conversation that permits you to make headway.

We also learned not to become too wedded to process, or at least not to the specific process you thought was going to get you where you wanted to go. You always have to test whether it is getting you where you thought you were going to go, and if not, make course corrections. The instructions you get when you go out of the box may need to get modified, based on what happened along the way. So, always keep your sights on where you want to go and where you need to wind up. Don't become fixated on a plan or a process, however good it is. Always stay focused on the end result.

The last thing we found was that over time if we made things too complex, we confused ourselves. When you're committed to getting something done and you have clarity about it, you need to drive to that conclusion even when something outside your control is in the way. For example, if some other group or some other IPT could maybe hinder results, you have to make that part of your domain because you need to drive to the end result regardless of circumstances. You must be absolutely, positively committed to that end result.

We got better between 1987 and 1992 and competition helped us get better. But, the recipe wasn't any different than it is here. The recipe is to focus on a vital few, have absolute clarity and complete alignment, and drive relentlessly to where you need to go, regardless of what gets in the way. That is what we need to do to achieve what we're after in the FAA.

PRIVATIZED ATS PROVIDERS

Sidney Koslow
Vice President of Engineering, NAV CANADA

Mr. Koslow explained how NAV CANADA took over the equivalent of the FAA's non-regulatory role in Canada about 3½ years ago. It is a non-share capital company regulated by the government. One hundred percent of expenses are covered by fee for service. Driving the company is a board of directors representing the stakeholders—the airlines, general aviation, unions, government, and the people at large.

A major difference from the United States is oversight. The United States has Congress, the GAO, the Inspector General, the Department of Transportation, and the White House. It is a great pyramid with which the FAA must contend. It is upside down and managers are balancing this huge thing on top of them. The idea is to turn it around and put key managers at the top of the pyramid.

Mr. Koslow described how NAV CANADA had a program that was not going well and stopped contractor payment. That shocked the contractor because he wasn't getting paid, had nobody to complain to, and had to deal with the substance of the matter. The board of directors is more of a policy board and would not entertain complaints. In addition, management was aligned. The issue could be dealt with without the threat of the confusion that is caused by multiple agendas and appeal layers which results in delays and creates difficulty in moving forward.

NAV CANADA management goes to the board for its budget including capital (facilities and equipment) and defends its funding recommendations. There is a quarterly process to track and report progress. There is serious accountability and little tolerance for lack of results. The idea is to be responsive to the customer and produce results. The environment in which they function drives how people operate and react. One should avoid stovepipes and situations where individuals do things without corporate buy-in. Lack of corporate cohesion and sign-up is quite detrimental.

Whenever we talk about something as complicated as air traffic management (ATM) we must remind our audience and ourselves that it is rocket science. We have a system that is people and technology intensive. The ATM problem is serious and difficult. There is often a false starting premise that the requirements are known. In fact, the requirements are often unknowable. What if we were going to implement the Internet 15 years ago and decided to specify it? How far would we have gotten? There is no way the details could have been specified. Of course, we would also say—let's develop the Internet and, oh, by the way, let's do it with a fixed-price contract and here are the terms and conditions and gee, we can't make any commitments beyond the 30th of September because that is the end of the fiscal year. The problem is not a natural for the kinds of processes we sometimes impose.

Learn and change as you go along. It is literally impossible to know everything up front and to build and accept the specified system. You can't test quality into a product. You must start out with a quality process. Learning does not stop when the design is over. It really begins when it is fielded and people attempt to use it. If processes and systems are so rigid that we cannot learn and adapt, consequences will not be pleasant.

Big is not beautiful. We have learned that with any number of projects; AAS is a classic example. Not only was the project itself huge, the amount of overhead was simply enormous. A lot can be addressed through spiral development and build a little, test a little. Our equivalent of AAS is a very big project that will cost about $1 billion dollars and has been going on for 8 or 9 years. About 3 years ago, we had a project office of 125 people and the contractor was doing a lot of design work. Now we are doing a lot of testing and our program office has gone from 125 to 40 people even though the level of activity in the office has increased. The idea of decreasing overhead and making things happen is awfully important. We do not need hundreds of people to do everything. Big is not only not beautiful—it is often not controllable.

Sometimes we get involved in processes, contracting, justifications, and budgets and forget the problem, which is to get a useful system fielded. That is the end game and we should never forget it. The buying group and the using group need to do a lot themselves. They must have internal capability and cannot contract out their thinking. They must bring understanding and confidence as well as money to the table.

It is crazy not to have standard hardware. Nobody should be inventing any hardware you can't buy off-the-shelf. NAV CANADA will adapt an idea from anybody. There are lots of good ideas that have been developed for the FAA; not enough have been implemented.

Lots of planning gets done with people looking out 5–10 years. Once there is some notion of the goal, move and do something. Then look up and see where the goal is now from where you are, and push again. The idea is to make something happen. The best plan is not going to be how it works out in the real world anyway. Get on with it.

A couple of obvious things—time is important, probably more so than money. An on-time project is probably reasonably within budget and a multiyears late project almost always has a blown budget. If you can meet your schedule, the situation is likely under control. We can't be tolerant of systems that slip for years; that is the road to disaster. We spend a lot of time and money on cost benefit studies and look at all the fine points. Then we have a project slip 3 years and cost more. Nothing will be cost beneficial if schedules are blown. We have a fascination with money; however, finance does not equal management. Sometimes people are so fascinated with the financial aspect they forget the real job, which is to get something in the field that works and is useful. Training and procedures cannot be an afterthought, they have to be part of the development process and are absolutely essential to be truly successful. We also talk about spiral models. Shiny new systems may not be accepted right away and it is beneficial to think about introducing it in pieces as well.

Last, Mr. Koslow stressed that stakeholders must be involved in the process early on. By definition, nobody in the headquarters office is a stakeholder in my view. Controllers, maintenance people, airlines, general aviation, regional aviation, etc., are the stakeholders.

QUESTION-AND-ANSWER SESSION

Question: Are the three criteria of safety, capacity, and efficiency the right criteria for us to think about as we think about improving the system?

Answer: That is the way we look at the system, in terms of evaluating what we have to do. We can't divorce the three. So, it is how do you solve a multivariate problem.

Comment: Safety and security are givens and are almost conditions that need to be met. Efficiency is one we need to understand better, even what the metrics are in addition to how we are going to measure them. I include capacity because that drives the revenue, the denominator. We're still grappling with efficiency some in terms of how do we get capacity or predictability and flexibility in the capacity that we deliver. How do we measure the effectiveness of what we do in terms of expenses as a function of industry revenue, expenses as a function of savings to the carriers, expenses as a function of consumer surplus? The FAA has started to play with some metrics.

Comment: From a near-term practical sense, we are attacking that head on. The agency has a set of metrics under air traffic systems (ATS). We have goals set for safety and security as well as efficiency. We have broken efficiency down into another layer of detail; to how many passengers per plane per threshold landing that we can get. We've

done this collaboratively within the community we serve. We have not had easy goals, but goals that really stretch us and force us to maintain an operation that is as good as we can possibly have. A lot of the research we have pushes the envelope in a lot of the metrics areas. One of the challenges is how do you measure all the data that there is, and so we've tried to have some practical bounds with that, along with a community to be able to service in that area.

Comment: The definition of ATC, starting at about 1959, has been the safe, orderly, expeditious movement of traffic. Metrics need to be integrated. The ATS has, as its least common denominator, the air traffic controller in this case, been trading off safety for capacity with every single decision. Capacity gives way to safety. When safety is maintained, more come in. When the airlines pose and pressure a hub-and-spoke beyond its point of diminishing return, it is forcing the ATS to lessen the trade-off between safety and capacity. I don't think anybody would argue that an airline operation flying today is unsafe. It is the safest form of transportation. The integration of metrics is more consequential and I would tell you the metric of security is an entirely different one. It sits out there by itself and should not be included in the trade-off between the other three.

Question: We heard a lot about the acquisition process. I would like to know if the FAA, in their contracts, puts in the clause—there seems to be a need to address incentives for completing contracts on schedule. Are there penalty clauses in the contracts as well, or is this just when a contractor doesn't perform, then we just give them more money and extend the program? What is the mechanism to see that a contractor will perform on a contract?

Answer: Having been on the receiving end, I can assure you there are penalties.

Comment: There are a number of contract vehicles and methodologies that we use. We have been very creative at using various things in order to get the job done. Do they always work? No. So, we have a set of incentives and, in appropriate cases, we have a number of penalties. We execute those and in the contracting world this gets to be very complicated.

In FFP1, we think we have the right set of vehicles, although there is always somebody that can complain about it to get the job done with both incentives and penalties. In DSR, we had the right vehicle to get the job done.

Comment: There are award fees. It is the difference between the theory and a textbook acquisition and the real world. The real world is that in some areas there is only a handful of people that really are experts in delivering a product. Every day we struggle—we, being the FAA and our team, to keep these people on the job and not to go across the street to a dot.com firm and be hired in a second. So, it is consistent funding and incentivizing people to work for FAA, because they can make a lot more across the street. That is the reality. None of the textbooks say that, but that is, in fact, when you have 2 percent unemployment nationwide and less than that in the tech business, that is all we deal with. So, the other scenario is we are angry and we are not going to pay them and we're going to cut them.

So, we pay them $50 million a year and withhold $5 million. Who are we hurting? Ourselves. We may feel good and we say we withheld payment and are going to decrease

the payment. But, if you really look at the prize, are you going to get a system out there any faster—I would argue, no. It sounds good in sound bites, but the reality is I have to hold a core team of people together. So, it makes good business sense not to pay them incentive and award fees. But, I think it makes worse business sense to force them to go to their shareholders and say, we're not making any money, and in fact, we are losing money because their board of directors is going to take them right off this project. That is the balance in the real world.

Comment: There is a precious resource out there that can design new systems and make them happen. The environment does not always make it conducive to retain those resources. We struggle with the same thing and in the Washington, D.C., area, a lot of our people are going off to the Internet companies, all these wonderful software developers that we need to make sure that we don't have these problems. It has to be balanced.

But, I also think that contracts that do have both incentives and penalties are powerful vehicles. You want that. We have incentive clauses. We have cost sharing to a point. We have a fixed-price ceiling in it. We also have penalty clauses if we are late to the site.

It is a balance and when you sign these contracts, depending on how tough the terms are, you are going to get a much higher price to begin with. That is the other challenge you have because you are going to try to protect yourself.

The other thing is that when there are problems, you all get a lot of help. If you have a red program, you get a lot of corporate help and they look at your resources and they look at other things, and then they may, at one point, decide the business is too tough to be in.

Comment: I have penalty clauses, but I pay you if I don't. With my incentive clauses I get on my side, I also have a penalty that I pay you if I'm late for a certain period of time. So, it is both. At a certain point in time, I'm not making any money any longer and I'm paying for all the costs that go above that ceiling price. So, I think they can be used in balance, but it is hard. It is always balance and putting the right incentives in place and getting a good price to begin with up front.

Comment: I think one of the difficulties is that we end up playing these games of how much can I make the other side bleed if they don't perform properly. What we're really trying to do is to manage getting something new built that hasn't ever been done before. There is a responsibility on the part of the buyer to ask for something that is reasonable and that is defined well enough so that at least we can get a reasonable start, and to pay for the service that we get. There is a responsibility on the part of industry to perform up to a reasonable standard and to give good value for money.

Unfortunately, we can probably all agree to that and then we get into the contractual clauses—how do we punish people if they act improperly, and we pay almost no time to how do we encourage people to act properly, and how do we make it a reasonable gain? If we ask for something that is not possible, we will probably get some response to that, but in the end, everybody is going to be less than happy. We need to find a way—if it is really true that these projects are difficult to do, and we don't know everything we are going to need to get these things into the field, to be a little more inventive about how we build the relationships between each other and not allow other people to dictate. Certainly there are legal aspects, the contractual aspects; you have to have contracts, you have to

have a legal basis. But, we have to remember what the problem is. I think we need to tailor them a little bit more so that they are friendlier to the problem. Otherwise, we do get into these kinds of discussions where nobody is the winner.

Comment: Another really powerful contract tool is that on our schedule incentives as well as our cost incentives, he required us to share 25 percent of that with our employees. That is a bonus that you're going to get on successful completion of the program. So, I think it is another creative mechanism. It has to be mutual and I think that a lot of the success we've had over the last couple of years is because we have worked mutually with the FAA on getting our programs to the field and understanding the problems and solving them.

Question: I listened to all the good stuff from AT&T and it is all right on the clarity of vision, focus, where you're going—the need to have a clarity of objectives that everyone can relate to. How do you think the FAA is doing in that area? Can you articulate those objectives to us? That is one of the things that I think with all the different groups it is hard to get people to put away their organizational objectives and make the overall objectives the key.

Answer: At the very high level, the strategic objectives, the strategic plan, are pretty good in terms of the broad set. We have to do a better job of driving down the objectives and accountabilities so that we can better decide what our core competencies are, what the solution is that we need to work in the long term, and decide where we are going to place our bets so that we can do it and provide more stability. We still have the realities of Congress. We still have realities of how the budget gets done. But, I think that is more where we have to focus.

   The other thing I think is this: while our communication with the industry is much better, I think we have to continue to work that. One thing that strikes me, coming to FAA from AT&T, was when we solved the problem of what is the product, how do we sell it, what's the volume, how do we build product, network, or whatever it is, we solved it in total. We had control of the marketing plans, the pricing plans, the things that would drive demand, as well as the resources to build the product to do the network. Even with better communication in the industry, you still have some degree of blind man's bluff, in a sense, between the folks who are driving some of the capacity and the folks who are driving some of the programs. I don't know if that is a criticism, but to me it is a challenge in the industry to say, how do we get better with one another about understanding volume dependence, action/reaction better across that divide? In industry, you were more solving the whole equation. Now, you've got different folks pushing different levers. There will always be some difference there because of the nature of the industry. But, I think that is one of the challenges for us to get that dialogue to be better and better.

Comment: If I could just add the need for clarity and focus and goals. Some of the people who are here from the FAA management board may recall an exercise we had several months ago when at the board meeting we were talking about how we get our goals communicated to the lower level of supervisors and employees out there. Eventually, the discussion turned to—take out a piece of paper and write down what our

top five goals are. It was a little bit of a trick question because we all know the three goals—safety, efficiency and security. But, there were a lot of different answers as to what the next two were. So, it was an interesting exercise and it helped us focus and get clear on what we were doing.

Question: The FAA was successful in removing the requirement for seven-nines from the STARS and DSR programs. How do we remove this from some of the current programs such as Local Area Augmentation System and make sure it doesn't creep into other programs and make them very expensive or potentially kill them?

Answer: First of all, I think one of the problems with the seven-nines reliability is that when you have a system that gives you this reliability, it doesn't mean that every segment has to give you seven-nines reliability. When you're looking at the standard that the approaches are going to be required for in the Wide Area Augmentation System, you are exceeding standards that are acceptable today.

Right now, I think that the segments that they are holding to standards that are unachievable are being done out of trying to manage it to pass standards in an aggregate, not segments of a wide systemic view. So, if you want certain reliability in the NAS, it doesn't mean every piece of equipment in the NAS has to have it. That should be built into the standards. So, I think it is first an internal review and if that fails, then the users need to push back on the standard. If the safety is necessary, it has to be explainable because no one wants a diminished level of safety. If you can't explain it, then it's wrong. I would even offer in certain areas they have standards that are so difficult, if not impossible, to achieve, that the failure of having an achievable system is lowering the standard of safety because the system they would put in would be safer than the system you have today. It is the gap between the two. I think pushing on them is the important thing to do.

Comment: I think the level and readiness of technology as it is picked up into a big system is a key to success. NASA has all sorts of examples where we have had incredible successes. We also have had a large number of examples of failures or cost overruns or whatever. Almost always underlying those failures is the fact that in those cases we are too aggressive in assuming technology is going to be ready before it was, and the result was you have a huge army planning a program for which the pieces aren't there.

A wonderful example of that was the national aerospace plane, where we embarked on a program that was going to generate something to fly from New York to Tokyo in a couple of hours, 3 or so hours. Somebody went and convinced the president that was doable. They provided him a vial of material that was the world's total supply that was going to be the composite fuselage. We were going to go from this vial to acres and acres of the thing in just a couple of years. Well, the project was doomed to failure. The taxpayers paid—actually the Department of Defense took it over so they got the black eye. But, the fact is that was one of many, many examples I had seen where we pushed the envelope too hard.

The places where NASA has been really successful is where all the pieces were ready, the technology was ready, and you had to put it together. I think in a lot of these systems we collectively will succeed or not depending on the technology leap that goes from the prototype to the fielded system.

Comment: As we were going through our years of maturing in bringing products to market and we did roughly halve the cycle time of products to market, one of the things we learned was not to build invention into a strict development program. So, you have invention and some exploratory development, and you have things you have mock-up models of etc. We tried to discipline ourselves not to work into the schedule what would be a true invention, but rather to work into the schedule things that were applications of technologies that we knew.

The other piece was making sure that the human interface was ready. Another problem was making sure our sales and service people were ready for the technology so that there was a blend when it came in. That comes back to looking at the whole system and making sure you have a vision of the whole that you're trying to accomplish.

Comment: One of the truly brilliant things that the FAA has done in the last 10 years has been to take a collection of things which have been in development for some time and give it the name FFP1. All of those things were being done. They were in some stage of development. Personally I'm not sure what they have to do with free flight, at least as originally defined. But, giving them that name was absolutely brilliant and it feeds into the notion of do what you can do. I think in general that for ATM systems, that right now there are lots of things, and a lot of them are in the free flight program I think, that are on the shelf. Technology is not the issue. We know that things are developed. All we have to do is package them and actually do them. I think the name is a stroke of genius.

What Are the Opportunities and Constraints in Speeding Implementation?

PETER CHALLAN
Moderator, Deputy Associate Administrator for Air Traffic Services, FAA

The morning sessions were comprised of a series of prepared presentations on specifically requested topics by key members of the aviation community who have particularly relevant perspectives on what it takes to implement system improvements. The format of the afternoon session was a panel discussion among a broad cross section of representatives from the FAA, the user community, and other organizations involved in National Airspace System (NAS) modernization. The panel discussions were largely extemporaneous and less formal, and consequently, the summary, which follows, was written to try to capture the tone and character of these discussions.

We have the chance to do something different in the deployment of systems and in getting information to the controller out on the floor where the actions will be effective. We are faced with three key questions that I would like us to try to address:

- How do you get new technology out to the floor better, cleaner, quicker, and smarter?
- What is the overall approach for how we ensure that as we build toward the future, we don't have to go back and rip it apart later?
- How do we look at the safety aspects of all of the different enhancements we are implementing in a really vibrant operational concept?

Steven Zaidman
Associate Administrator for Research and Acquisitions, FAA

How do you get it to the floor? I think we should ask ourselves in FAA the appropriate questions like, are we better off with it, than without it? Even if it is not the ultimate answer, are you making an improvement? If the answer is yes, then we have to say, why not do it? We often don't ask ourselves the right questions. Too often we ask ourselves all the wrong questions, like the negative questions in FAA. What are the problematic implications if we have it? I think those are the wrong questions. The answer is, if you had this in place, what would the system be like? Would it be better than it is today?

With regard to the safety aspects, I also agree that this involves some risk. But, FAA is a very risk-averse organization, and we have zero tolerance. Except, we have little or no hard data to know whether something is more safe or less safe when we make implementation decisions. I believe that we need to take on the risk in a smart way because I think it is safer. We talked today about runway incursions and the role of technology. I think it's safer to field runway incursion technologies that aren't totally nailed down, whether it is the Airport Movement Area Safety System (AMASS) or the Airport Surface Detection Equipment, and to try them on the belief that

it is likely to be safer if we implement them than if we do nothing and study it ad infinitum. I think we can make a compelling case, and I think we can do all the analysis, but first we need to have a philosophical and logical basis for risk management and then ask ourselves the question, is safety likely to be enhanced if we do this?

We are also talking about putting weather on the controller's display. That gets into the question of roles. Is it my job to separate aircraft from aircraft or aircraft from weather? I would suggest that the answer should be the following: if you don't want to use weather, you don't have to use it. Thus, you don't have to have weather. In the FAA, it is a binary answer many times, either yes or no; there's rarely any discretion. When we look at weather on a display, what is wrong with telling the controller, if you don't want to use it, don't. You don't use it now. If you had it, maybe it would be helpful at times and maybe not at others.

Regarding how we should deal with safety, we have to have the courage to ask what the safety consequences may be, and you have to have courage to make a decision. Sometimes it is going to be wrong, and sometimes it is going to be right. Without a decision, there is no action and stagnation.

Maureen Woods
Deputy Director, Air Traffic Service, FAA

From an Air Traffic Service standpoint, we want the enhanced tools that are going to allow us to provide the efficiency and capacity that you, as our customers, demand. However, we want to have confidence in those tools: that they will really work when they hit the glass.

There's a lot of discussion around efficiency and capacity, and it was interesting that Peter brought up the topic of safety. We just make an assumption about safety, and the controllers make it work day in and day out. Certainly, we use traffic flow management to help us maintain that safety level in the system, but as the system increases in capacity and in demand, we must look at how we balance getting more efficiency out of the system without compromising safety. Also, procedural development is something we certainly have to look at.

Michael Fanfalone
President, Professional Airways Systems Specialists

What Professional Airways System Specialists (PASS) brings to the table is something fairly unique. We represent 10,000 employees of the FAA; that's 20 percent of the workforce. Our workforce is unique in that it is, perhaps, the most diverse. We represent folks in the NAS Implementation organization who do the construction oversight and installation of new systems structures. We represent the electronics technicians and specialists who troubleshoot, maintain, and certify the NAS itself. We represent, through Aviation System Standards (AVN), the FAA folks who write procedures, develop approaches, and do flight checks. Through Peggy Gilligan's organization, Regulation and Certification (AVR), we do the safety oversight surveillance of manufacturing as well as air carrier, cargo, and general aviation. So, the upside is we get an opportunity to see the NAS and the FAA from head to

toe. That's also the downside. We see it from head to toe. What is it that we are trying to accomplish? I think modernization is more than concrete. It is more than structures. It is more than hardware. For us, it is internal. It is a cultural shift.

Our folks, to really get engaged in modernizing, have to see themselves in the future. I'm not sure we are very clear on where they fit in tomorrow's environment. All they know is the status quo. I think everyone in this room would argue the status quo is not acceptable. I don't think we have the luxury of spending years in planning and group dynamics and group development. We have to begin to act.

So, that is a real challenge for us: to move our workforce mentally, if not intellectually, into tomorrow's environment.

Margaret Gilligan
Deputy Associate Administrator for Regulation and Certification, FAA

I would like to address the safety perspective. As I spoke this morning, that is where we see ourselves playing a role in NAS modernization. I have to disagree ever so slightly and very respectfully with Mr. Zaidman. While I'm not by any means suggesting that we want to study things to death, we believe there are, in fact, ways to do risk assessments, to do failure modes analyses, to understand what the risks are that are being introduced, and to mitigate those risks appropriately. It is not always by changing the technology, but it is, as so many things in aviation, it is through the redundancies within the system. Unless we do all of that, we are not confident that, in fact, we are addressing the safety elements that new technologies might introduce.

Our experience in aircraft and product design, development, and manufacture tells us that, in fact, you can do those kinds of assessments. You can understand the risks. You can, in fact, design around them or put procedures in place to do training or to take other actions to address risks, as long as you understand them. This notion that safety is an impediment is always very troublesome to the standards setting organization because from our perspective progress is always about risk mitigation and safety enhancement. How do we widen the margins of safety, making sure they aren't so wide that they interfere with other things we can reasonably accomplish like capacity and efficiency? How do we understand the risks that we have introduced, or will introduce, into the system, and how do we mitigate those? How do we understand them at second and third levels of potential risk intervention?

We have a lot of things underway in our programs to try to address these concerns, and I think we haven't played as active a role as we should in NAS modernization because we never quite understood a role for ourselves. Now, as NAS modernization has come to involve our product line as much as it involves the air traffic product line, we are beginning to understand the role that we have to play and the skills we can apply to help address the safety element. There are ways to ensure that we understand the safety risk and ways to make knowing decisions about whether or not that risk is acceptable. This is something we can do in better collaboration both internal to the FAA and with industry as well. Boeing is probably the primary example of the ability to understand complex systems within systems, the

integration of risk management in their development, and the mitigation of risks. I think there are lots of other models that we can draw on.

As I said this morning, we need to look at developing the operational plan that goes along with the architecture. That, to a large extent, will tell the operating community where and how they need to do these assessments and how we need to integrate that operating plan with the technologies coming from the FAA for the ground-based system. It is very easily said, but very hard to do. I don't, for a moment, suggest that next week we will have our operational plan. But, the industry has been clamoring for an operational piece to go along with the architecture, and I believe that we at AVR can provide some leadership. So, we will be looking at how we can pull that together.

Amr ElSawy
Vice President and General Manager, MITRE/CAASD

Let me start by addressing the first question: how do you get the systems fielded? Before I do that, I want to make a confession. There were no written requirements for Collaborative Routing Coordination Tools (CRCT). What there was for CRCT was a very important aspect of the requirements process and that was a real serious discussion with the champion, Jack Kies and his staff, on what his problems really were. Sid Koslow mentioned that this afternoon, that, I think, is the key. It is key to making advancements in the system. If, in fact, we are able to understand what problem they are trying to solve, we are able to do a much better job at developing the tools and the capabilities to do that. So, the first task is really understanding the problem. The second is getting a champion. The third step is getting all systems accepted at the local level. It doesn't mean anything for a system to be accepted at headquarters alone, and it doesn't mean anything for a system to be accepted at the technical center alone.

It is really important for the field facilities to participate in the modernization process. So, my recommendation is that as we identify specific problems in specific facilities, we put these tools and capabilities there as soon as possible. I know that Bob Rosen from NASA is here, and he and I have had this conversation many, many times. Our teams, in trying to do the technology transfer and trying to do the research and understanding, go through an incredible metamorphosis, if you will, when they are in a facility. Many controllers are looking for ways to do their job differently. The only way you capture that is to have a real dialogue between those people and either the research and development teams or the people who develop procedural changes. So, I would say that one way to accelerate deployment is to allow for more distributed deployment of these capabilities across the board, and to essentially work with the champions on specific problems across the board. This means that it's going to get a little uncomfortable because the notion of control is not going to be there; the system will evolve, and many capabilities will be developed along the way. You can't help but think that is precisely how the Internet developed. That is why we are getting the acceleration in capabilities. Running air traffic control is not, however, like the Internet, although there are some similarities in the development and deployment approaches and in the ways to deploy capabilities faster. Champions, understanding the problem, and getting access at a local level are critical.

In terms of getting the information from a collaborative tool like CRCT or User Request Evaluation Tool or anything else to the cockpit, our first challenge is to make sure that Controller Pilot Data Link Communications Phase 1 is implemented on time. There should be no excuses. We ought to get that done. The technology has been around forever, and we ought to make that happen very quickly.

On runway safety, there has been too much focus put on AMASS and the radar. I don't believe the radar is going to solve the runway incursion problem by itself. The surface environment is, by definition, a very noisy environment. It is not great for radars. We have to figure out ways to accelerate other technologies to help, like using multilateration or doing Automatic Dependent Surveillance-Broadcast (ADS-B) on the surface with Wide Area Augmentation System- (WAAS)-based accuracy. Those are all things that we can do now and that will help.

If you look at WAAS capabilities and its accuracy, there are many other applications that can, in fact, improve safety. We ought to be pretty adamant about getting those things out fast.

In terms of commitments, we're pretty committed at The MITRE Corporation's Center for Advanced Aviation System Development (MITRE/CAASD), as are all the people here, to technology transfer. We are learning how to do it. We want to do it faster. We are pretty committed to accelerating the development of the tools and not waiting until it is perfect to get it out in the field. I think we learn a lot, and we end up changing it a hundred times before it actually gets accepted. I think that Charlie Keegan said it earlier today. The system is not accepted or a system is not really tested until it is in daily use. I think that ought to be an integral part of our deployment strategy.

Harold Disbrow
Deputy Director, Operational Requirements, U.S. Air Force

In the area of requirements, acquisition, and technology, the Air Force, and I think the Department of Defense in general, has many things in common with the FAA. We deal with the same sort of difficulties in recognizing technology, transitioning technology, etc.

We recognize in Air Force requirements that there are really two methods by which systems come to the attention of the acquisition community. One of them is through the requirements pull, and that is a deliberate requirements process. That is part of the modernization planning process fed by the long-range planning process. But, there is also a technology push method that presents great ideas, and in some cases not so great ideas, that are of benefit to the user. In this case, a system sounds like a technology push program because it was not part of the deliberate requirements process. There are no requirements for the system. It is a system presented to the government that may or may not help operations. I think in the case of such a system, a number of the questions we have discussed ought to be answered before it is delivered to the doorstep of an operator without an understanding of its likely impact. From a corporate point of view though, is it technology push or is it impulse buying? In one case, you may have some warning, and you can blend it into your modernization plan. In other cases, it shows up all of a sudden; someone thinks it is a great

idea, and it is in your budget before you know what happened. So, what's the impact on your deliberate modernization plan, and what goes away when this gets funded? Does it represent savings or does it kill a competing program, one that your agency has already decided is worth funding and now is not? So, from a systems point of view, what is the operational impact of what goes away when you bring this system on? Is it the right time? Is it the right piece of equipment?

I would also like to comment about some of the remarks that were made about whether or not you can really know if it is right until it is in the operators' hands. There is a certain acceptable level of maturity for systems before you give them to the operator. At least in the Air Force, we have learned the hard way a number of times that operators already have a full-time job. System development is not one of them. System testing is not one of them. Operator input is important, but there is a minimum acceptable level of maturity before you put it into the field. Otherwise, you detract from the operation while they try to get it right for you. That is a safety issue for us in that before it goes into a cockpit or down a tube, we need to have a minimum level of development on it, and then operators can help you make the small changes that are necessary. When the F-15E was delivered, it was about a 90 percent solution. It was one of the best fighter aircraft ever built. It was a first-class cockpit fighter. It was software intensive. It was delivered on time, and there wasn't a whole lot that we needed to do to the F-15E, but operator input continued over the years as we improved the system and gave it more capabilities. Nevertheless, it was a good product when it was first acquired.

So, I think there is a minimum level of development and trying to make the operational community part of the test community too early can have a down side. Operator input is certainly important, but so is maintaining current operations.

Robert Frenzel
Senior Vice President, Aviation Safety and Operations, Air Transport Association

I think that "build a little, test a little" is how you get it to the floor and in use. However, you can never forget about how an improvement may impact the overall system. You can't just develop things in isolation and assume they won't impact some other area. That is the whole point of the operational concept. You must have an idea about what you want to see at the end of the day. You may not have a crystal clear view, but you need to know where you're headed. In other words, you have to begin with the end in mind: what do I want that operational concept to look like? That's why I think it is very important for both the users and the providers of this service to have a vision about what that technology is ultimately designed to achieve.

I think it is very important, especially in the certification area, that people remain completely neutral and allow the certification process on its face to deal with whether a piece of equipment can be used for a specific purpose.

We can put all the equipment in place, but if we don't have the procedures, charts, and the other things that we need, we can't fly. We can't operate. Controllers cannot operate these new pieces of equipment without specific procedures in place to show them how to do that. We cannot lose sight of that either.

Safety is very important and can never be overlooked. I don't think we assume safety. We assume that we will take whatever actions are necessary to ensure that there is an acceptable level of safety. It is not assumed. We are not saying that safety is going to take care of itself. We have to design the system operationally for efficiency and capacity. With all due respect to my brother over there about hubs, there is a lot of discussion about capacity constraints and congestion caused by hubs. That is like the Post Office saying we can't deliver the mail on time because we have too much mail. You have to design the system to handle that capacity. What we are trying to do is one of two things:

We can either work with the current system, increasing capacity in some respect, but that is going to be very difficult because of the political realities, or

We can change how the system itself operates. We may have to readjust manning. We may have to readjust sectorization—the whole air space reassessment that we're doing.

As for runway incursions, the number of aircraft that are landing or taking off probably isn't the issue. Typically, the aircraft landing or taking off isn't the aircraft that causes the incursion. Often times, incursions are caused by people violating clearances by crossing active runways. How should we, in fact, define an incursion? If we only count an incursion when an aircraft is on final, then we are not addressing when someone crosses an active runway without a clearance at other times, whether it is a vehicle or an aircraft. If you get so used to what happens at a particular airport, you can become complacent no matter what airport it is, and you can get used to driving across some runways, sometimes when you're not supposed to. Who knows when something can happen. So, we have to look at how to change that behavior. That is certainly part of the runway incursion problem.

Peter Challan
Moderator, Deputy Associate Administrator for Air Traffic Services, FAA

I think that unless we as a community address this pretty clearly for ourselves, it will be addressed for us by others. I feel that very strongly, and I have a hint that the National Transportation Safety Board in the next several weeks will be issuing some recommendations concerning runway safety. You all are going to think they are pretty dramatic at some locations because it is going to include no taxi into position and hold. Another one is probably going to be positive clearance for every runway crossing. If you think we all have congestion on ground control now at certain locations, we will have some controller workload situations with a positive clearance at every runway. So, I'm going to encourage us as a community to address runway incursions aggressively. Automation is probably one of the answers in addition to awareness, education, and training. I think that unless we as a community start to do something pretty quickly and pretty dramatically, we are going to have some solutions imposed on us that we can't live with well as a community.

David Traynham
Assistant Administrator for Policy, Planning and International Aviation, FAA

The president signed into law the FAA authorization bill, and it is a good bill for the FAA and the aviation system. It will present us with some opportunities that we did not have before in terms of managing the system and in terms of funding some aspects of the system.

An opportunity for fielding improvements faster has to do with how we are funded. The legislation that was passed continues to keep us in the annual appropriations process and, as I see it, that is a very big constraint on speedy implementation of these programs.

So, what we need to have, and it is what the administration and the National Civil Aviation Review Commission proposed, was a cost-based user fee supported system for the aviation system. So, we missed an opportunity in Congress on that point.

Moving more toward leasing of equipment, long-term leasing, and service leasing of equipment would enable us to become more customer-like and less inventor-like at the FAA. So, those sorts of things are opportunities that at this point remain constraints because of Congress not acting on those concepts. But, we will continue to work on them as we get some things like our cost accounting system into place. I think the arguments for cost-based user fees will grow stronger and will seem like a natural thing to do at some point.

QUESTION-AND-ANSWER SESSION

Comment: The user community feels that there is a need for more participation from FAA in a lot of the activities that are going on in the Radio Technical Commission for Aerpnautics (RTCA), especially from the air traffic and Certification offices. There are people within program areas that are fairly active in RTCA. However, FAA representatives need to be a little more involved earlier on, so that the architecture and other things can be developed with certification in mind to make sure that happens. The same thing is true for air traffic. From an operational standpoint, we have very good participation from the National Air Traffic Controllers Association (NATCA) from their different representatives and I think the same thing about PASS and some of the others. But, I think there could be a little bit more participation from your air traffic organization.

Comment: One change for the positive from the way the FAA has historically made NAS implementation decisions is the increase in collaboration with the users. We had to get consensus with the user groups to be successful with Congress. Another sign of progress is the emerging relationship between FAA and NASA. Also, better communication should come out of the information exchange activities that are now going on at the command center such as collaborative decision making and spring/summer 2000. Important progress is being made with this group. Without this information exchange, we can't have successful free flight.

There are a lot of us in the airline industry who are full partners in this discussion about safety. I've been the chief safety officer at Northwest now for about 10 years. Every airline has a chief safety officer. We have a safety council at Air Transport Association. If we are going to start thinking about reducing separation standards in en route, terminal, final

approach, who in the FAA has the responsibility for that now? Consider the assumptions for increased capacity used, for example, in the Russ Chew capacity studies. They assume reduction in separation by 50 percent when you read the fine print. I think he raised the right question. Who is going to make that happen and how? I think it is a real safety issue that we have to worry about. I would propose that we put together some kind of a separation standards team if we don't have one already. This is obviously one of those inherently governmental responsibilities.

On the subject of runway incursions, FAA is doing the right thing by going out and asking users at the meetings you're holding right now. There is a CAASD team also, and we are working closely with them. I believe that hardware may not be the solution. Since Northwest's runway incursion in Dallas, we have changed our cockpit procedures. As an example, in the terminal area, we have recently required that all of our checklist items be completed before you get into the terminal area. We no longer have pilots doing the final approach items over the final approach fix inbound. We've also redesigned all of our checklist items on the ground to include a positive indication when you cross a runway: Captain, we are cleared to cross 18, right? This is just like we do with altitude, where we learned years ago to do that. We have to have some kind of procedural change. We've shared this with CAASD, so it will be in the final report on runway incursions to be shared with the rest of industry.

Comment: The administrator deserves a lot of credit for the work she has done on collaborative efforts among the unions, industry, and the agency, as well as between the agency and Congress. I think she has set the tone for that. That has carried over to the command center exercise working with industry in collaborative decision making and all its facets. At the senior management level, there is commitment to tearing down the internal stovepipes. Although the lower you go in the agency, the harder and thicker the stovepipes are, but at least for the first time that I've been with the agency, at least at the higher levels, the stovepipes are harder and harder to find. I think that is one of the reasons why FAA in recent years has been more successful than in the past because there is less turf.

Comment: On separation standards, since most of this issue also related to aircraft equipage, the FAA Flight Standards Office has the lead on it. Much of that work is also done in international settings. There are teams, and there is a lot of work being done. Reduction of separation standards is more difficult domestically, not only in terms of technology and volume, but in terms of politics. There is a pretty clear process for working on separation standards changes, and Flight Standards has the technical lead working with FAA's AAT and AVN offices.

Comment: I think a lot of the things we look at are not actually reducing separation standards, but getting to the current standards. If we were to get to the current standards, it would be a 50 percent reduction in separation.

Comment: On the topic of separation standards, there are still too many stovepiped organizations at the FAA. I've been working on a project for 2 years which has been extremely frustrating for this reason.

As far as volume and runway incursions are concerned, I would suggest that they do not happen at high volume. Let's start giving pilots and controllers immunity to find out what has really being going on.

Regarding separation standards, let's take a look at that operational concept that is out there, because frankly, what we're striving for initially is the existing standards. Let's take the Operational Error Deviation Program and make it a positive tool, and if the controllers' perception is wrong, let's just change that perception. That is based on their experience. They have a perception that it has been vindictive, and it is not a very positive program. So, let's make the thing positive because we are on the right track. We're a maturing group and a maturing industry, and it is time for some changes.

Regarding surveillance and ADS-B, the operational concept on surveillance identifies ADS-B as the last line of defense. Having surveillance today based on the controllers' ability to look at a display and then find the time and all the rest to get that message to the pilot is a flawed system. The last line of defense is the pilot. So, let's just keep working on that. It is time to change some of these paradigms. It is time to act.

Comment: I'd like to respond to the immunity part of that last comment. We have entered into an agreement with NATCA to try to get at some of the causal factors of what is going on in the environment when some of these things occur, whether it is operational errors or runway incursions. They are working with us on that. We haven't defined it totally, but we're trying to get at that very thing and who knows where it will lead. It is certainly a challenge for us as we start looking at immunity, but that is a step in the right direction.

Comment: I think you all know that in the runway safety program, we are also looking at particular runway incursions to determine whether there is value in getting additional detail, and in those cases, we will offer those pilots what we call enforcement consideration; that is, we will consider that they have taken part and that it is likely that they will get nothing more than administrative action. When we define it as a result of alcohol or drugs, then that is a different set of circumstances. But, barring that kind of outcome, the whole point is to try to better understand the causes that lead to the error, so we can understand how to improve the training and other initiatives which, from an operating standpoint, we believe are far more important than AMASS even.

Comment: The objective isn't enforcement. The objective isn't an administrative paper trail. The objective is safety, and the quality of service to the customer. That is the objective. We are not going to get it unless we join together.

Comment: I would like to talk a little bit about safety, and I think there are two key things said today that talked about safety. One was that if we get rid of all the infrastructure errors and the airplane errors, that doesn't really solve the problem. It is the human errors that really are the problem. I think Peggy Gilligan hit on the key to preventing human errors, and that's

redundancy. The only way we are going to get to a safe system is to have that redundancy. People are going to make mistakes; I can guarantee it, whether it is operational errors, runway incursions, or taxiing down the wrong runway, people are going to make mistakes. The only way we are going to catch those mistakes is if we have redundancy. So, the key is getting surveillance in the cockpit, ADS-B, so that we have a three-way redundant system instead of a one point of failure system now. All the nines in the world don't help when you have a human in the equation, because they take it all away with probably a 0.01 error rate. So, we have to get that redundancy, or we are not going to eliminate runway incursions and operational errors. The only way to do it is to provide the information to the cockpit so the cockpit can, as somebody said, become the final line of defense. But, I think it can be more than that. I think it can be a cooperative or collaborative air traffic management system that really cannot only improve the capacity and the efficiency, but also greatly increase the safety.

Comment: There is some on-going work being done to look out beyond Free Flight Phase 2. Back in March of last year, the administrator, along with Dan Golden from NASA, had a challenge session with industry. Out of that came a challenge by industry to say we would like to work with you collaboratively to understand where we are going in the future so that we have a road map. Based upon that challenge, we have had some preliminary meetings.

Summary of Observations

Over the course of the day, there were more than a dozen presentations and a panel discussion with 10 panelists. All of the participants are respected members of the Air Traffic Management (ATM) system community. Most of them brought considerable knowledge in specific areas that are key to expediting ATM system improvement. Others brought knowledge and experience from other areas that are related or may be transferable to the evolution of the ATM system.

Collectively, the participants brought a broad perspective on various considerations. Some of the observations are critically important in specific areas or at specific points during development and implementation, while others reflect important principles that are broadly relevant. Nearly all of the points the participants made are worth noting in one context or another, and thus, summarizing and distilling them is a difficult task. These ideas and considerations were reviewed and distilled in light of the comments of the participants collectively, and consequently, some comments have been reframed somewhat and combined with those from other participants.

The key points from the symposium have been distilled and have been organized under the following categories:

- Structuring improvement implementation
- Managing improvement implementation
- Managing requirements
- Technical and engineering matters
- Implementation of team perspectives

STRUCTURING IMPROVEMENT IMPLEMENTATION

Most of the presentations and discussions focused on actions that can be taken to improve the structure and management of implementation efforts. The first two categories of comments address these two topics. However, the distinction cannot be crisply defined between what constitutes structuring an implementation effort and what is more a matter of managing the effort once it is underway. Some of the comments apply more to structuring an effort than managing it and vice versa, depending on the context. Thus, some of the items listed in this section and the next could easily be switched between the two categories.

- Use incremental implementation approaches:
    - Do it gradually, not as a "big bang" and
    - Big isn't beautiful, it's hard and often unmanageable.
- Develop a clear strategy for financing the effort.
- Commit resources clearly.
- Establish the teams clearly and develop detailed tactical plans.
- Use integrated multidisciplinary teams, including customers and suppliers.

- Develop realistic, objective, committed plans:
    - Understand the problem context, including any overarching policies, the people who will carry out the plan, stakeholder needs, and business constraints;
    - Consider alternative solutions to address the needs, including their relationship to various aspects of the problem context;
    - Clearly understand the criteria for evaluating and selecting improvements; and
    - Get and use reliable data describing the cost of the improvement (capital and operating costs, costs to FAA and users).
- Understand the performance of existing systems in order
    - To understand the frame of reference of various stakeholders, and
    - To understand the current operations, including what works well and what does not.
- Assess early on whether the need should be met inside the organization or by an outside entity.
- Eliminate "stovepipe" implementations (i.e., implementations where the relationship with other programs is not considered).
- Provide close oversight to the project: schedule compliance, expenditures, issues/problems/concerns, corrective actions.
- Identify risks and risk mitigation activities and revise plans to incorporate them.
- Take corrective action early and decisively.
- Recognize that all parties affect the outcome: "If you're willing to let a supplier fail, you will fail."

MANAGING IMPROVEMENT IMPLEMENTATION

As noted in the previous section, most of the presentations and discussions focused on actions that can be taken to improve the structure and management of implementation efforts, and the distinction between them is not black and white. Thus, some of the items listed here may also be relevant in structuring efforts and comments listed above may also apply to managing implementation efforts.

- Assess the maturity of the technology under consideration and research needs before committing to the solution.
- Exploit technology transfer wherever practical, from research, through initial operational use, to production.
- Integrate early when costs are lower, approaches are more flexible, and investments to date are lower.
- Consider training and procedures early.
- Focus execution efforts on what really matters and do not become distracted by peripheral or less important matters.
- Collaborate in order to obtain a broad contribution to the effort and ownership of solutions:

- Understand and challenge the stated needs and the proposed requirements, solutions, and approaches;
- Involve all stakeholders: controllers, traffic managers, implementers, maintenance/support, airspace users, contractors/suppliers;
- Involve staff at affected Air Route Traffic Control Centers, Terminal Radar Approach Control Facilities, and other sites early;
- "Manage" the expectations of stakeholders (e.g., speed of implementation, results to be expected, level of effort required to implement it, …); and
- Do not oversell the solution to win early project approvals.
- Coordinate implementation schedules with stakeholders
  - To ensure that they are ready for implementation, and
  - To ensure that other actions seemingly unrelated to the improvement do not conflict (e.g., actions that may require the attention of key staff).
- Exploit the flexibility that is available in acquisition management to capitalize on opportunities and to overcome problems or constraints.
  - Develop and use metrics specifically for each of the following purposes:
    - Assess alternative solutions before one is selected;
    - Measure progress during development;
    - Refine the improvement during implementation; and
    - Document actual payoff after implementation and to aid future improvement decision making.
  - Develop and use metrics to measure both
    - Operational improvement (i.e., the "payoff" to the end customer) and
    - Engineering performance (i.e., system/equipment performance).
  - Improve existing processes continuously—"It's a learning experience":
    - Learn from past successes (and failures);
    - Learn from the current effort in order
      - To capitalize on project specific opportunities (e.g., organizational positions and relationships), and
      - To overcome project specific problems;
    - Implement new ways of managing projects; and
    - Do not be unduly constrained to existing administrative processes; they can be modified if warranted.
  - Perform post-implementation evaluations in order
    - To understand the actual "payoff" that resulted from the improvements;
    - To understand key factors that affect the implementation of the improvement; and
    - To understand what other changes occurred as the improvement was implemented, whether they were coincidental or caused by the improvement.
  - Share the knowledge gained and lessons learned during the project and afterward.

MANAGING REQUIREMENTS

A number of participants noted that problems had surfaced in the past because requirements were not well defined, understood, or challenged.

- Understand customer needs clearly.
- Understand operator (air traffic controller) and support (maintenance technician) needs.
- Understand expected operational impacts and benefits.
- Understand and challenge needs, solutions, requirements, and approaches to ensure that the right problem is being addressed in an appropriate way.
- Avoid the common false premise: the requirements are (or can be) known early.
- Maintain focus on the problem being addressed throughout the program (i.e., do not forget the problem).

TECHNICAL AND ENGINEERING MATTERS

Several points were made during the presentations and discussions that focused on some of the technical aspects of the design and fielding of improvements.

- Use standard, open, commercially available hardware and software with documented standards.
- Use common standards.
- Design for integrity, inter-operability, extensibility, and portability.
- Consider integrated versus distributed approaches.
- Maximize reuse from research to production to the extent possible.
- Decouple platforms and applications.
- Develop a platform (e.g., a laboratory) to support
  – Research and development and
  – Pre-implementation testing.
- Be proactive in considering sustainment and life-cycle support.
- Understand and resolve system interdependencies.
- Consider operations cost and support implications both for specific improvements and on overall budget levels.
- Consider the cost and likely success of the logistics and maintenance of obsolete legacy systems.

IMPLEMENTATION OF TEAM PERSPECTIVES

A number of comments were made that seem to relate more to the perspectives, culture, or outlook of the people involved in implementing improvements. These notions differ from the changes noted earlier, which focus on the aspects of project implementation that are most

often considered: implementation process management and technical concerns. For that very reason then, it is probably most important to address some of the softer aspects of management which nevertheless can have a profound impact on project execution and success.

- **Do something!**—A successful project means getting something accomplished and not simply following a prescribed process. It is often more important to make progress in the right direction than to have a detailed, comprehensive, coordinated long-term plan. The details of the plan will change, but the overall direction will not. Always drive in that direction and check periodically to ensure consistency with the overall plans and objectives.
- **Time is important!**—It is often too easy to incur even well-intended delays (e.g., to coordinate with specific stakeholders, to address a technical issue carefully and collaboratively with key stakeholders). These delays can result from specific decisions, or more often, can creep in insidiously as the attention of key players is diverted from getting to completion. Such delays usually add to project costs, can add to the project's complexity as implementation schedules overlap with other interdependent projects, and often delay meeting the needs that the project is designed to address, which can amount to hundreds of thousand of dollars per day in cost savings!
- **Results count!**—Getting it implemented, solving the problem, meeting the needs, and accruing benefits, all in measurable and documented terms, is what it is all about. A good plan or process is not enough.
- **It's a challenge!**—Implementing ATM system improvements really is difficult, and it really does require the best we have to offer. While we need to strive for accomplishments, we also need to recognize that this is a difficult endeavor and we should not unduly castigate ourselves when we come up short.
- **Commit to executing the plan!**—Once the plan is developed, all of the key players must be clearly and unequivocally committed to accomplishing it. This commitment, of course, does not begin once the plan is developed.
- **Perform, perform, perform!**—Once the plan is developed, the job is mostly about execution. It is critically important to build a culture that is focused on performing and delivering as the core value.

APPENDIX

Speaker Presentations

Click here to see Joe Sinnott's presentation.

Click here to see Belva Martin's presentation.

APPENDIX

Symposium Agenda

Start   End

8:00   8:15   Registration and Coffee

8:15   8:30   **Introduction to Symposium**

Welcome: Saleh Mumayiz, Chairman of the TRB Committee on
Airfield and Airspace Capacity and Delay (A1J05)

Introduction: Joseph Sinnott, MITRE/CAASD

8:30   10:30   **What's Involved in Implementing Improvements?**

Framing the Problem: Why Does It Take So Long to Implement
ATM System Improvements and What Are the Implications?
Speaker: Steven Zaidman, Associate Administrator for Research
and Acquisitions, FAA

Presentations:

ATM Operations Perspective: Jack Kies, Manager of Tactical
Operations, FAA

Requirements Development Perspective: James Washington,
Director, Air Traffic System Requirements Service, FAA

Facility Operations Perspective: Raymond Long, Deputy Program
Director, Operational Support, FAA

HW/SW Infrastructure and Applications Perspective: William
Voss, Director, Office of Air Traffic Systems Development,
FAA

Acquisition Perspective: Gilbert Devey, Director, Office of
Acquisitions, FAA

Regulation and Certification Perspective: Margaret Gilligan,
Deputy Associate Administrator for Regulation and
Certification, FAA

> Transition, Implementation, and Integration Perspective: Robert Long, Program Director, NAS Transition and Integration, FAA
>
> Question-and-Answer Followup

10:30   10:45   Break

10:45   12:15   **What Can Be Learned from Recent Government and Industry Experience?**

> *Moderator:* David Traynham, Assistant Administrator for Policy, Planning and International Aviation, FAA

Recent Government Experience

Presentations:

> FAA Acquisition Reform: Belva Martin, Assistant Director, Transportation Issues, GAO
>
> Free Flight Phase 1: Charles Keegan, Director, Free Fight Phase 1, FAA
>
> DOD: Neil Planzer, Executive Director, Department of Defense Policy Board on Federal Aviation, DOD

Experience from Outside FAA

Presentations:

> Airframe Manufacturers: Tim Fehr, Vice President, Airplane Systems, Boeing Commercial Airplanes Group
>
> Public Utility: Daniel Mehan, Assistant Administrator/CIO, Office of Information Services, FAA
>
> Privatized ATS Providers: Sidney Koslow, Vice President of Engineering, NAV CANADA
>
> Question-and-Answer Session

12:15   1:15   Lunch

| 1:15 | 3:30 | **What Are the Opportunities and Constraints in Speeding Implementation?** |

Moderator: Peter Challan, Deputy Associate Administrator for Air Traffic Services, FAA

Panel Discussion:

Steven Zaidman, Associate Administrator for Research and Acquisitions, FAA

Maureen Woods, Deputy Director, Air Traffic Service, FAA

Gilbert Devey, Director, Office of Acquisitions, FAA

Margaret Gilligan, Deputy Associate Administrator for Regulation and Certification, FAA

David Traynham, Assistant Administrator for Policy, Planning and International Aviation, FAA

Michael McNally, President, National Air Traffic Controllers Association

Michael Fanfalone, President, Professional Airways Systems Specialists

Robert Frenzel, Senior Vice President, Aviation Safety and Operations, Air Transport Association

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| 3:30 | 4:45 | **Summary and Wrap Up** |

Moderator: Steven Zaidman, Associate Administrator for Research and Acquisitions, FAA

Assisted by Panelists and Session Moderators

APPENDIX

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