

# **National Airspace System Stakeholder Needs**

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## **Preface**

This report documents research undertaken by the National Center of Excellence for Aviation Operations Research, under Federal Aviation Administration Research Grant Number 96-C-001. This document has not been reviewed by the Federal Aviation Administration (FAA). Any opinions expressed herein do not necessarily reflect those of the FAA or the U.S. Department of Transportation.

This document consists of the NAS Stakeholder Needs survey, and is to be considered an adjunct to the Air Traffic Management Concept Baseline Definition report. This document is included as part of Boeing's submission under NEXTOR Contract #DTFA03-97-00004, Subagreement #SA1636JB.

## **Executive Summary**

This document is one of three deliverables of the AATT program's Milestone 1, ATM Concept Baseline Definition. The objective of the NAS stakeholder needs task of the ATM Concept Baseline Definition Project is to understand the needs of each of the various NAS stakeholders for the modernization of the NAS, to determine the prioritization of these needs, and to identify common and diverse needs among the various NAS stakeholders. The identification of common and diverse needs will help to provide insight into AATT program research.

The NAS stakeholders' needs task was started in the beginning of May 1997. This task was a building block for the ATM Concept Baseline Definition Project. Faced with only five months in which to complete the entire project, the project team members (NASA Ames, Boeing, MIT, and Berkeley) agreed that the best way to gather the needs of the various NAS stakeholders was to conduct face-to-face interviews with high level representatives of the stakeholder organizations.

The interviews were conducted during three trips to the Washington, DC area. After each of the trips, interview notes were compiled and a needs matrix was developed for each stakeholder based on the interview notes. The notes and needs matrix for each stakeholder were sent to each stakeholder for review and comment. The notes and needs matrix for each stakeholder were used to determine each stakeholder's primary needs for the future NAS as well as common and diverse needs among the NAS stakeholders.

The stakeholders interviewed were all familiar with the various industry initiatives. They had all participated in RTCA Task Force 3 on Free Flight Implementation and were also knowledgeable with the technology and implementation issues. They were generally in agreement with the Task Force 3 report. However, they presented different detailed solutions to some of the technology and implementation issues.

All of the stakeholders interviewed acknowledged that the demand for air travel will continue to increase. They agreed that the demand on the terminal area will also increase. A majority of the stakeholders stated that the need to increase capacity in the terminal area is their number one priority. Once that is accomplished, the next priority will be to squeeze as much efficiency as possible out of the terminal area. If that is the case, several of the stakeholders acknowledged that, in order to maximize capacity and efficiency in the terminal area and thus, fit more aircraft in the same amount of airspace, separations will need to be reduced. This has safety implications, especially in the terminal area. Thus, stakeholders identified a need for research into capacity and safety issues, especially in the terminal area.

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## Acronyms

AATT	Advanced Air Transportation Technology
ADF	Airline Dispatchers Federation
ADS-B	Automatic Dependent Surveillance-Broadcast
AERA	Automated En Route ATC
AGL	Above Ground Level
ALPA	Air Line Pilots Association
AOC	Airline Operational Control
AOPA	Aircraft Owners and Pilots Association
ASIST	Aviation Safety Investment Strategy Team
ATA	Air Transport Association
ATC	Air Traffic Control
ATM	Air Traffic Management
CDM	Collaborative Decision Making
CFIT	Controlled Flight Into Terrain
CTAS	Center-TRACON Automation System
DGPS	Differential Global Positioning System
DME	Distance Measuring Equipment
DOD	Department of Defense
DOT	Department of Transportation
DSR	Display System Replacement
EATCHIP	European Air Traffic Control Harmonization and Integration Programme
EGPWS	Enhanced Ground Proximity Warning System
ELVIRA	Extremely Low Visibility Instrument Rotorcraft Approaches
ETMS	Enhanced Traffic Management System
FAA	Federal Aviation Administration
GAMA	General Aviation Manufacturers Association
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
GPWS	Ground Proximity Warning System
HAI	Helicopter Association International
ILS	Instrument Landing System
IMC	Instrument Meteorological Conditions
KIAS	Knots Indicated Air Speed
LAAS	Local Area Augmentation System
LAHSO	Land and Hold Short Operations
NAS	National Airspace System
NASA	National Aeronautics and Space Administration
NATCA	National Air Traffic Controllers Association
NBAA	National Business Aviation Association
NDB	Non-Directional Beacon
NOTAM	Notice to Airmen

NRP	National Route Program
PRM	Precision Runway Monitor
RAA	Regional Airline Association
RNAV	Area Navigation
RNP	Required Navigation Performance
RVSM	Reduced Vertical Separation Minima
SIDS	Standard Instrument Departures
STARS	Standard Approach Procedures
SUA	Special Use Airspace
TCAS	Traffic Alert and Collision Avoidance System
TMU	Traffic Management Unit
TRACON	Terminal Radar Approach Control
VHF	Very High Frequency
VMC	Visual Meteorological Conditions
VOR	Very High Frequency Omnidirectional Range
WAAS	Wide Area Augmentation System

## **1 Introduction**

This section describes how this document fits into the Advanced Air Transportation Technology (AATT) program, the objective of this task as part of the Air Traffic Management (ATM) Concept Baseline Definition Project, how this task was conducted, and provides an overview of this document.

### **1.1 Context**

This document is one of three deliverables of the AATT program's Milestone 1, ATM Concept Baseline Definition. As described in the statement of work, the ATM Concept Baseline Definition is a "task that will define and document the probable evolution of the National Airspace System (NAS) through the year 2015, based on current documents and on-going work by the Federal Aviation Administration (FAA), the National Aeronautics and Space Administration (NASA), and industry."

### **1.2 Objectives**

The objective of the ATM Concept Baseline Definition Project is to provide part of a road map to guide AATT program research and includes:

- Understanding National Airspace System (NAS) stakeholder expectations with respect to safety, capacity, and productivity
- Identifying primary modernization drivers and constraints
- Establishing a probable baseline operational concept for 2015 and transition paths
- Providing insight for AATT program planning that is "robust" with respect to NAS modernization uncertainty

The objective of the NAS stakeholder needs task of the ATM Concept Baseline Definition Project is to understand the needs of each of the various NAS stakeholders for the modernization of the NAS, to determine the prioritization of these needs, and to identify common and diverse needs among the various NAS stakeholders. The identification of common and diverse needs will help to provide insight into AATT program research.

### **1.3 Scope**

The NAS stakeholders' needs task was started in the beginning of May 1997. This task was a building block for the ATM Concept Baseline Definition Project. Faced with only five months in which to complete the entire project, the project team members (NASA Ames, Boeing, MIT, and Berkeley) agreed that the best way to gather the needs of the various NAS stakeholders was to conduct face-to-face interviews with high level representatives of the organizations that represent the identified stakeholders. The individuals that were interviewed are active in industry initiatives in Washington, DC, represent their organizations on the Free Flight Steering Committee, were already familiar with the AATT program, and were knowledgeable on other industry technology and research initiatives.

The interviews were conducted during three trips to the Washington, DC area. After each of the trips, interview notes were compiled for each stakeholder interviewed and a needs matrix was developed for each stakeholder based on the interview notes. The notes and needs matrix for each stakeholder was sent to each stakeholder for review and comment. The notes and needs matrix for each stakeholder were used to determine their primary needs for the future NAS. They were also used to determine common and diverse needs among the NAS stakeholders.

#### **1.4 Report Overview**

Section 2 of this document presents summaries of the needs of the individual stakeholders, as well as summaries of the common and diverse stakeholder needs presented by category, including capacity, safety, and efficiency. Section 3 of this document describes the stakeholder organizations that were included in the survey process, how the survey process and interviews were conducted, and benefits and limitations of the survey process. Section 4 of this document presents conclusions derived from the NAS stakeholders' needs survey. Appendix A presents the individual stakeholder interview notes that were collected for this project. Appendix B presents the individual stakeholder needs matrices that were collected for this project.

## **2 NAS Stakeholder Needs Summary**

This section includes a summary of individual stakeholder needs, common stakeholder needs, diverse stakeholder needs, and special stakeholder considerations.

### **2.1 Individual Stakeholder Needs**

This section reviews the top level needs for each stakeholder, in order of importance. It is important to note that during the interviews stakeholders discussed both “needs” such as capacity, efficiency, and safety, as well as “solutions” to those needs, such as technology, procedures, and automation. The interview notes for each stakeholder are presented in Appendix A and the needs matrices for each stakeholder are presented in Appendix B. Stakeholder needs for which NASA has no influence, such as changes to FAA management or procurement processes, have not been included here, but may be found in each stakeholder’s complete interview notes in Appendix A.

#### **2.1.1 System Users**

This section presents a summary of the needs of the various system users, the Air Transport Association (ATA), the Regional Airline Association (RAA), the National Business Aviation Association (NBAA), the General Aviation Manufacturers Association (GAMA), the Aircraft Owners and Pilots Association (AOPA), the Helicopter Association International (HAI), and the Department of Defense (DOD).

##### **2.1.1.1 Air Transport Association (ATA)**

The ATA’s priority is for more capacity and efficiency in the terminal area. As such, they expressed the need for:

- Airspace redesign to allow for more flexibility and a reduction of airspace restrictions, allow aircraft to be able to share the same airspace, and enable FMS-equipped aircraft to operate more efficiently instead of having to fly standard procedures
- Reduction in separation standards and research into the detection of wake vortices to enable a reduction in wake vortex separation standards
- Exchange of the same weather information among ATC service providers and system users
- Research into the prediction, detection, and removal of icing
- Research on the interaction between flight crews and ATC
- Research on tools to help the pilot in situational awareness

##### **2.1.1.2 Regional Airline Association (RAA)**

The RAA’s priority is on increased capacity in the terminal area. Regional airlines operate one half the fleet in the NAS and conduct two-thirds of total daily departures. For example, a typical regional aircraft will conduct approximately eight daily departures. As a result, RAA members have a greater dependency on the terminal area and are much more vulnerable to problems in the terminal area. As such, they expressed a need for:

- More runways at the hub and spoke
- Controller cross-training

- Airspace redesign to eliminate some of the airspace restrictions that are in use today
- More GPS procedures
- Access to the current, transition, and future ATM systems

#### **2.1.1.3 National Business Aviation Association (NBAA)**

The NBAA's members typically operate out of reliever airports. As such, they expressed the need for:

- Maintaining reliever airports and their associated airport arrival rates
- Access to the airports that they serve and instrument procedures for those airports in terms of providing access to those airports
- Better airspace coordination between hub airports and the extended terminal area
- Global interoperability

#### **2.1.1.4 General Aviation Manufacturers Association (GAMA)**

GAMA's first priority is safety. As such, GAMA expressed the need for:

- Research and installation of the right technology in the cockpit to help the pilot make better decisions
- Automation tools to help the controller better sequence the mix of traffic so that GA can continue to operate independently of airline traffic
- Maintaining airport infrastructure and only one ATM system rather than two systems that do not encourage users to equip
- Certification of software and hardware, airframe and avionics

#### **2.1.1.5 Aircraft Owners and Pilots Association (AOPA)**

AOPA expressed the need for:

- Weather information for planning purposes and in the cockpit for safety
- Access to airspace in congested areas by fitting the GA traffic through corridors between large jet traffic streams. (Airspace redesign and the development of terminal area procedures to take advantage of GA area navigation (RNAV) is necessary for this to become a reality.)
- Development of new TERPS criteria that incorporate the Required Navigation Performance (RNP) concept
- More procedures to enable approaches in lower weather minima into more airports using GPS-based navigation
- Access to airports, both GA and reliever, preferably away from large jet operations
- Information sharing between ATC and ground operations so that they work together as a team
- More automation tools for the controller such as conflict probe
- Better situational awareness for the GA pilot
- Surveillance in low altitude

### **2.1.1.6 Helicopter Association International (HAI)**

The HAI envisions that their members will be able to alleviate some of the capacity shortfall in congested terminal areas with the integration of helicopters and tiltrotors into the NAS. As such, they expressed the need for:

- Redesign of the NAS to incorporate the unique handling and operational characteristics of helicopters and civil tiltrotors
- Complete access for helicopters to the IFR system, including a helicopter-specific IFR route structure derived from GPS
- Development of new TERPS criteria that take advantage of the unique handling and operational characteristics of helicopters and civil tiltrotors
- Low cost weather reporting system that would enable helicopters to file IFR flight plans
- More GPS approaches to more airports
- Low altitude surveillance coverage
- Research into the prediction, detection, and removal of icing.

### **2.1.1.7 Department of Defense (DOD)**

The DOD does not have the same needs as the other users of the NAS because they do not usually fly in congested areas of the US. However, DOD expressed the need for:

- Unimpeded global access to the current, transition, and future NAS — DOD needs to be able to go anywhere, at any time
- The FAA to state requirements clearly and consistently, not change direction in mid-stream in terms of what to equip, when it will happen, how it will happen, how much it will cost, and what will be the penalties associated with non-compliance
- Preservation of Special Use Airspace (SUA) and its availability to DOD

## **2.1.2 Service Providers**

This section presents a summary of the needs of the various service providers, including the FAA, the Airports Council International - North America (ACI-NA), and the DOD.

### **2.1.2.1 Federal Aviation Administration (FAA)**

The needs of the FAA may be found throughout the accompanying document, ATM Concept Baseline Definition, but specifically in Section 3 (The ATM System Functional Structure) and Section 5 (Available and Emerging Technology).

### **2.1.2.2 Airports Council International - North America (ACI-NA)**

The Airports Council International - North America (ACI-NA) expressed terminal area capacity and efficiency as the top priority and expressed the need for:

- Development of new TERPS criteria, making use of the RNP concept, to allow a reduction in separation standards
- Development of new procedures to take advantage of new technology
- Research to reduce wake vortex separations
- More runways

- Development of consistent safety criteria
- Data collection, modeling, and end to end system analysis
- Collaborative Decision Making
- Exchange of real time data between ATC service providers and system users

### **2.1.2.3 Department of Defense**

The Department of Defense is not only a user in the NAS, but also a service provider by providing ATC services for their military aircraft. DOD expressed the need to achieve interoperability with the FAA, by equipping DOD air traffic control (ATC) facilities with the same equipment as that used by the FAA in their facilities.

### **2.1.3 Labor Organizations**

This section presents a summary of the needs of the labor organizations, the Air Line Pilots Association (ALPA) and the National Air Traffic Controllers Association (NATCA).

#### **2.1.3.1 Air Line Pilots Association (ALPA)**

ALPA feels strongly that the first priority should be terminal area capacity. According to ALPA, the biggest safety concerns are also in the terminal area. They expressed the need for:

- More runways
- Human factors research associated with new procedures and training in the terminal area, e.g., shared responsibility between air traffic controller and pilot
- Data collection, modeling, and analysis
- More and better weather information in the cockpit
- Changes in procedures to take advantage of new technology
- Research on wake vortex and requirements for a wake vortex system that enable reduction of wake vortex separations
- Airspace redesign
- Better coordination/communication between FAA facilities and between ATC service providers and system users
- Collaborative Decision Making
- Situational awareness for the pilot

#### **2.1.3.2 National Air Traffic Controllers Association (NATCA)**

NATCA's first priority is safety, then capacity and efficiency. As such, NATCA expressed the need for:

- More human factors research before technology is implemented in the field
- More air traffic controllers
- More coordination between FAA facilities and between ATC service providers and system users
- Airspace redesign for more flexibility
- Additional airport marking and lighting for low visibility operations
- More frequencies

- Additional functionality to enable controllers to better predict aircraft climbs, descents, and turns
- Replacement of outdated equipment

#### 2.1.4 Professional Organizations

This section presents a summary of the needs of the Airline Dispatchers Federation (ADF).

##### 2.1.4.1 Airline Dispatchers Federation (ADF)

ADF’s priority is efficiency for the airline. As such, they expressed the need for:

- Exchange of real time information between ATC service providers and system users
- NAS-wide information system available to all users in single data base
- Automatic schedule updates from airline operational centers (AOCs) to FAA
- Collaborative Decision Making
- Better communication links between TFM units and system users
- Inclusion of all users, with varying levels of automation, in NAS-wide information system
- Exchange of same weather information

#### 2.2 Common Stakeholder Needs

The needs, as stated by the stakeholders, were categorized and tallied in order to come up with priorities. As mentioned in Section 2.1, during the interviews many of the statements made by the stakeholders were actually solutions, such as technology, procedures, and automation, rather than needs, such as the need to increased capacity, safety, or efficiency. Results of the tally of stakeholder needs are presented in Table 2.1 and in Figure 2.1. However, in Sections 2.2 and 2.3, both common and diverse stakeholder needs are discussed.

Table 2.1 Tally of Stakeholder Needs

Need Category	Tally
Capacity	28
Efficiency	28
Safety	22
Affordability	11
Access	6

Source: Stakeholder interviews, May - August, 1997.

##### 2.2.1 Capacity

The need for more capacity and efficiency was the highest priority expressed by a majority of the stakeholders.

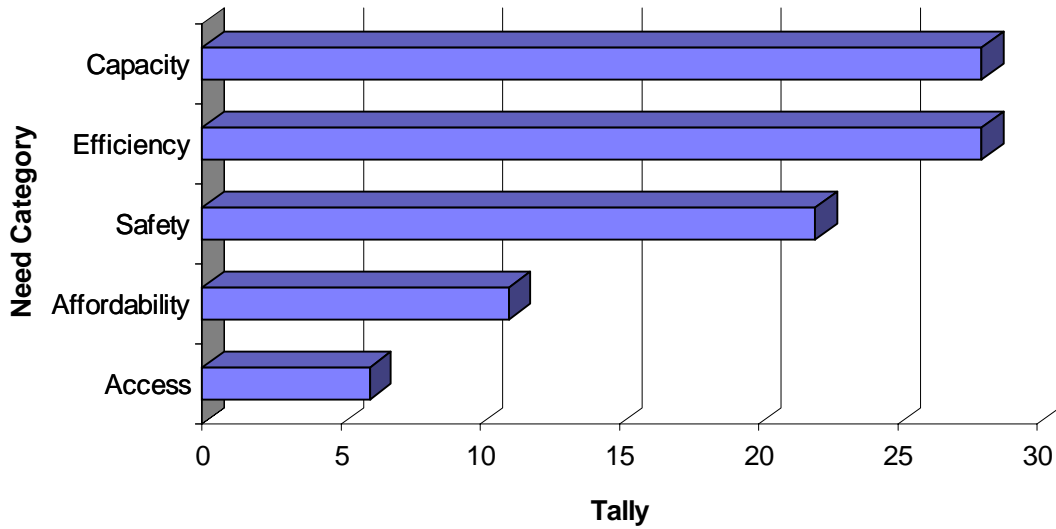


Figure 2.1 Tally of Stakeholder Needs by Category

### 2.2.1.1 Terminal Area

Specifically, the terminal area was considered to be the area in need of the greatest capacity gains by eight of the eleven stakeholders interviewed (ACI-NA, ALPA, AOPA, ATA, GAMA, HAI, NBAA, and RAA).

### 2.2.1.2 Airline Scheduling Practices

AOPA, ALPA and ACI feel that airlines could alleviate some of the problem by changing their scheduling practices; however, they recognize that this is an economic issue but have noted that some airlines have taken the step.

### 2.2.1.3 More Runways

In acknowledging the terminal area as the operational area for the greatest capacity needs, seven of the stakeholders interviewed specifically expressed a need for more runways (ACI-NA, ALPA, HAI, NATCA, NBAA, and RAA). ALPA and RAA both believe that adding more runways is the key to solving terminal area congestion problems, reinforcing NBAA and AOPA desires for more access to airport runways and facilities, and noting that they are willing to use reliever airports. ALPA also suggested the use of reliever airports but were not specific as to who should use them. The need to solve the noise and environmental problems that get in the way of building new runways was only specifically mentioned by two of the stakeholders interviewed (ACI-NA, NBAA).

Although noise and environmental problems were not specifically referred to by the other stakeholders, many of them admitted that adding more runways is one of the most difficult problems facing the industry in alleviating the terminal capacity problem. The reason for this may be due to many factors, including the lack of available land, lack of money, and the undesirability of the nearby communities for increased operations due to noise and environmental considerations.

#### **2.2.1.4 Requirements for Separation Standards**

The need for changes to the requirements for the reduction of separation standards was expressed by seven of the eleven stakeholders interviewed as another factor to alleviate the terminal capacity problem (ACI-NA, ALPA, ATA, HAI, NATCA, and RAA).

#### **2.2.1.5 Wake Vortex Separation Standards**

The need to reduce wake vortex separation standards was mentioned by four of the stakeholders interviewed (ACI-NA, ALPA, ATA, and NATCA). Wake turbulence concerns are likely to continue to drive separation minima, particularly in the terminal area. ACI, ATA and ALPA advocate the pursuit of innovative methods of wake avoidance either by procedural means or through detection of the disturbances. RAA and ATA stated that changes to approach weight categories affected approximately half the regional fleet, resulting in increases in longitudinal spacing and, hence, reductions in approach capacity affecting all users.

### **2.2.2 Efficiency**

According to the stakeholders interviewed, specific needs that related to efficiency received the same tally as those that related to capacity.

#### **2.2.2.1 Collaborative Decision Making**

Collaborative Decision Making (CDM) was expressed as a need by six of the eleven stakeholders interviewed (ACI-NA, ADF, ALPA, NATCA, NBAA, and RAA). ALPA feels that the concept of CDM between airlines and Central Flow Management is good, believing that it will lead to more efficient use of airspace. ACI-NA agrees, stating that provision of NAS status and airport configuration data will allow operators to plan more effectively. The FAA also agrees that the concept of CDM will result in a benefit, but there is a need for research to be carried out to ensure that problems solved by CDM are not simply moved from one sector to another. ALPA and ATA agree that more research is required in the area of air traffic controller and pilot interaction.

#### **2.2.2.2 Exchange of Real Time Information**

The need to exchange real time operational information between system users and ATC service providers was also expressed by six of the eleven stakeholders interviewed (ACI-NA, ADF, ALPA, AOPA, ATA, and NATCA). Many stakeholders would welcome flexible use of Special Use Airspace, but AOPA and ATA are skeptical about the system's ability to provide an adequate flow of information concerning SUA status.

#### **2.2.2.3 Automation Tools for Air Traffic Controller Productivity**

Six of the eleven stakeholders expressed a need for automation tools to enable the controller to accommodate and better sequence the mix of traffic in the terminal area (ADF, ALPA, ATA, GAMA, NATCA, and RAA). Air traffic controller workload and productivity concerns a number of users. ATA and AOPA recognize the need for tools to help controllers sequence mixed traffic streams. NATCA, ATA and AOPA stated that controllers should be provided with tools to enhance separation predictions. NATCA and

ATA also stated that, unless a redesign incorporating dynamic sector boundaries is achieved, controller workload will increase.

#### **2.2.2.4 Airspace Redesign**

The need for airspace redesign was expressed by five of the eleven stakeholders interviewed (AOPA, ATA, HAI, NBAA, and RAA).

#### **2.2.2.5 Exchange of Same Weather Information**

If the new airspace system's flexibility is to offer advantages, AOPA, ALPA, ATA and HAI agree that users must have access to up-to-date, accurate weather information. The exchange of the same weather information by system users and ATC service providers was expressed as a need by five of the stakeholders interviewed (ADF, ALPA, AOPA, ATA, and HAI). This need was determined to be both an efficiency and a safety need. Therefore, half of the points were allocated to efficiency and half to safety.

#### **2.2.2.6 Surface Guidance**

The need for more surface guidance was expressed as a need by two of the stakeholders (ALPA, NBAA). This need was determined to be both an efficiency and a safety need. Thus, half of the points were allocated to efficiency and half to safety.

### **2.2.3 Safety**

All stakeholders acknowledged that there will be traffic growth in the future system. As demand increases, there will be a need for greater capacity. Once the system has achieved as much capacity as is feasible, the users will adapt so as to squeeze as much efficiency out of the system as possible. With a greater number of aircraft occupying the same amount of airspace, the separations between aircraft will have to be reduced and aircraft will have to operate closer to one another than they do today, especially in the terminal area. This has safety implications. The need for more safety consideration in the terminal area was expressed by three of the stakeholders interviewed (ALPA, GAMA, and NATCA).

#### **2.2.3.1 Human Factors Research**

The need for more human factors research was expressed by eight stakeholders interviewed (ACI-NA, ALPA, AOPA, ATA, GAMA, HAI, and NATCA). NATCA stated that the FAA is not applying human factors precepts to any new ground infrastructure technology programs, and that tower systems are not integrated. ACI-NA agreed and cited examples of inappropriately conceived sub-systems and poorly integrated implementations. ADF also agreed, stating that the Enhanced Traffic Management System (ETMS), the system used by Traffic Flow Management to predict the need for intervention to prevent congestion, has poor human factors design resulting in airlines' unwillingness to update their information. Another human factors concern was heard from both DOD and HAI. Both organizations represent the interests of single pilot operations in complex aircraft and both are concerned that workload will be excessive if pilot responsibilities are to be increased.

#### **2.2.3.2 Surveillance and Communication in Low Altitude**

The need for surveillance and communications in low altitude was expressed by two of the stakeholders (AOPA and HAI).

### **2.2.3.3 Cockpit Display of Traffic Information**

The pilot's need to have a traffic information display in the cockpit was expressed by two of the stakeholders (ALPA, HAI).

### **2.2.3.4 Icing**

The need for more research into the prediction, detection, and removal of icing was expressed by two of the stakeholders (ATA and HAI).

### **2.2.3.5 Exchange of Same Weather Information**

As mentioned in Section 2.2.2.5, the exchange of the same weather information by system users and ATC service providers was expressed as a need by 5 of the stakeholders interviewed (ADF, ALPA, AOPA, ATA, and HAI).

### **2.2.3.6 Surface Guidance**

As mentioned in Section 2.2.2.6, the need for more surface guidance was expressed as a need by two of the stakeholders (ALPA, NBAA).

## **2.2.4 Affordability**

The issue of affordability includes the transferring of costs from the service providers to the users of the system and the issue of global interoperability.

### **2.2.4.1 Cost Transfer to Users**

Stakeholders acknowledged that federal funding for airports and the NAS infrastructure is declining. The FAA, in an attempt to reduce its operating and maintenance costs, is transferring more and more of these costs to the users. This is especially true for the reliever and GA airports. GAMA is concerned that decreasing Airport Improvement Program funds and the transfer of responsibility for funding improvements, like airport lights, to the airports themselves will limit enhancements in airport access for GA. Some of the cost transfers are being borne by the users in terms of avionics equipage in order to be able to operate in the system. The need to keep down as many of the costs borne by the users was expressed as a need by eight of the eleven stakeholders interviewed (ACI-NA, AOPA, ATA, DOD, GAMA, HAI, NBAA, and RAA).

### **2.2.4.2 Global Interoperability**

The need for global interoperability was expressed by three of the eleven stakeholders (ATA, DOD, and NBAA). Global interoperability is considered a cost issue in the sense that if the user does not equip (because of cost), the user cannot operate in that airspace. NBAA, GAMA, and DOD share concerns over the diverse global development paths which have been postulated and the escalation in cost which compliance with a multiplicity of requirements will generate. DOD stated that once a requirement is mandated, they equip their fleet because they need to be able to operate anywhere, at any time. However, it may take them ten to twelve years to fully equip their fleet due to budget constraints.

NBAA, however, has some members who can afford to and will equip quickly in order to be able to operate globally. DOD, AOPA, GAMA, RAA, and HAI are all concerned over the cost of new equipment required for compliance with domestic requirements.

## **2.2.5 Procedures**

Procedures includes the development of new TERPS criteria, the development of new procedures for existing technology, and the development of new procedures for new technology.

### **2.2.5.1 Development of New TERPS Criteria**

Many of the stakeholders acknowledged that the current NAS was developed many years ago and that separation criteria and procedure development has not kept up with current technology. HAI believe that congestion problems can be eased by changing archaic separation standards which, RTCA pointed out, were designed on the basis of technology in use long ago. The need to develop new TERPS criteria to take advantage of the performance characteristics of today's aircraft and current communications, navigation, and surveillance technology, was expressed by two of the stakeholders interviewed (ACI-NA and HAI). ACI-NA observed that the difficulties experienced with the revision of TERPS criteria are likely to limit the operational benefits of satellite-based approach procedures. ATA agreed, stating that the TERPS criteria revision process is the major barrier to rapid development of new procedures.

### **2.2.5.2 New Procedures for Existing Technology**

ACI-NA and ATA recognize that full benefit has still to be derived from existing technology; therefore, procedures should be developed to take advantage of current capabilities.

### **2.2.5.3 New Procedures for New Technology**

The need for new procedures to take advantage of new technology was expressed by four of the stakeholders interviewed (ACI-NA, ATA, GAMA, and NBAA). The need for more GPS approach procedures to more airports was expressed by three of the stakeholders (AOPA, HAI, and RAA). RAA does not believe that GPS approaches being developed by the FAA economize on airspace usage (and, therefore, increase terminal area capacity) because they are simply overlays of existing procedures. They further believe that contractors could develop more efficient procedures quicker and cheaper than current processes allow, but the knowledge of experienced controllers should be included at the local level when airspace is redesigned. RTCA agrees that new procedures are needed and also promotes the use of contractors to carry out the development quickly. AOPA further feels that the low activity airports which they prefer to use will receive low priority on DGPS equipage. HAI would also benefit from DGPS approaches and approach lighting; if these facilities were provided for approaches to helipads, all users might benefit from removal of rotorcraft from arrival streams.

### **2.2.6 Access**

The need for access to the current, transition, and future NAS was expressed as a need by six of the eleven stakeholders (AOPA, ATA, DOD, HAI, NBAA, and RAA). RAA and DOD want to ensure that, whatever changes are made to system architecture, their access to it will not be limited; both must be able to operate in the new environment. HAI and AOPA also want continued access to all airspace, including congested airspace and in IFR.

## **2.3 Diverse Stakeholder Needs**

Just as there was agreement over some issues, there were also diverse opinions among stakeholders. These are presented below.

### **2.3.1 Capacity**

Although eight of the eleven stakeholders expressed a need for more runways, they differ as to where the new runways should be located. ACI-NA, ALPA, NATCA, and RAA expressed a need for more runways at major airports. In addition, HAI expressed a need for more helipads at the major airports. ALPA, NBAA, and RAA expressed a need for more runways at reliever airports and NBAA expressed a need for more runways at GA airports.

Although ALPA and RAA believe that the best solution to terminal area congestion is the addition of more runways, ATA pointed out that work associated with runway construction will affect the ability of operators to conduct efficient surface operations for a considerable period.

### **2.3.2 Efficiency**

Although many of the stakeholders stated a need for efficiency, there was a difference of opinion in terms of airspace redesign, airspace restrictions, the exchange of real time information, and system architecture.

#### **2.3.2.1 Airspace Redesign**

NATCA does not believe that the current airspace structure is designed to accommodate Free Flight operations. They state that the redesign process will be costly. ALPA disagrees, stating that they doubt that there is a real problem with airspace design, and that a change would be a waste of resources.

NATCA does not believe that Free Flight will be practical for routes into congested areas since ATC must start to sequence the aircraft so far out. However, ACI-NA recognize that a limitation on user preferred routing in the terminal area is likely to negate en route efficiency gains.

Although five stakeholders expressed a need for airspace redesign, the specifics of this airspace redesign took on different flavors depending on the stakeholder. ATA expressed a need to redesign the airspace to allow for more flexibility in routing in arrival procedures, departure procedures, and en route, to allow aircraft to share the same

airspace, a reduction of airspace restrictions, and to enable FMS-equipped aircraft to operate more efficiently instead of having to fly standard procedures.

HAI expressed a need for airspace redesign to incorporate the unique handling and operational characteristics of helicopters as well as civil tiltrotors. When the current NAS and ATC systems were developed back in the 1940s, they were designed with only commercial and fixed-wing general aviation aircraft in mind. The helicopter and the civil tiltrotor need to be incorporated into the future system.

AOPA expressed a need for airspace redesign to be able to fit the GA traffic through corridors between large jets streams in congested areas and the development of terminal area procedures to take advantage of GA RNAV. NBAA expressed the need for airspace design to enable better coordination between hub and reliever airports.

### **2.3.2.2 Airspace Restrictions**

RAA expressed the need to eliminate some of the airspace restrictions in use today. The restrictions they would like to see eliminated first are the requirements for filing a National Route Program (NRP) route (the distance requirement of 200 nm from each endpoint and the altitude requirement of at or above flight level 290). Regional airlines usually fly segments less than 400 nm and at much lower altitudes than FL 290. Thus, they are prohibited from taking advantage of the NRP. Since they do not file an NRP route, regional airlines are usually sequenced and mixed in behind aircraft that operate much slower than most RAA aircraft are capable of operating. RAA expressed a need to eliminate some of the static agreements between centers that restrict regional airlines to operate at or below 10,000 ft. If they were allowed to operate above 10,000 ft on short legs, RAA members could increase their airspeeds above 250 KIAS, and contribute to the efficiency of the NAS.

The other restriction that RAA would like to see changed is the Edict Program in which aircraft are held on the ground to alleviate some of the congestion in the system. RAA feels that the problem with this program is that because RAA members fly short haul flights, they are usually the ones that are given the “ground stop” and held on the ground, their passengers usually missing their connecting flights as a result, making it very costly for the regional operators. ATA also expressed a need to eliminate airspace restrictions such as flying at 250 kts below 10,000 ft.

### **2.3.2.3 Exchange of Real Time Information**

While many stakeholders would welcome flexible use of SUA, it is important to the military to preserve its ability to use SUA whenever it is needed. Lack of access to SUA by the military could limit training and affect readiness.

DOD professes to pass information on inactive SUA to the FAA. AOPA and ATA are skeptical about the availability or use made of the information while ALPA does not believe that DOD has the funding to set up communication paths.

#### **2.3.2.4 System Architecture**

NBAA and GAMA believe that a political mandate is needed to implement a modern, advanced ATM system. HAI, on the other hand, feels that the industry should take the initiative for change away from the regulatory authorities. ACI-NA suggested that a scaled-down version of the GPS Wide Area Augmentation System (WAAS) would be adequate for en route navigation. However, RAA no longer supports WAAS, preferring that all airports be equipped with Differential GPS.

#### **2.3.3 Safety**

While many of the stakeholders interviewed expressed the need for more human factors research, the specifics of the research differed among the various stakeholders. For example, ATA expressed a need for more research into flight crew/ATC controller interaction, ALPA for more research into the human factors aspects of shared responsibility between the pilot and controller, and human factors issues associated with new procedures such as closely spaced parallels and land and hold short operations. GAMA expressed a need for more research to help the pilot make better decisions, HAI expressed a need for more research to reduce pilot workload, and both HAI and DOD expressed a need to integrate any new technology in the cockpit with existing technology. NATCA stressed that the human factors research needs to be done before new technology is implemented in the field. Many times the new technology is fielded before all the human factors research is completed and the controllers are expected to work it into the existing system.

While NATCA, ACI-NA, and ADF advocate human factors improvements in ground systems, ALPA and ATA suggested that pilot and air traffic controller interaction should be examined. AOPA criticized Ground Proximity Warning Systems (GPWS) and Traffic Alert and Collision Avoidance Systems (TCAS) designs because they are optimized for transport category aircraft use (although this may not really be a human factors issue).

### **2.4 Special Stakeholder Considerations**

This section presents some special considerations that were not included previously. However, they are worth noting and are presented here.

#### **2.4.1 Economic Driver Considerations**

NBAA believes that transportation is a driver for economic development and, as such, a healthy transportation infrastructure needs to be maintained to ensure a sound economy. The future of civil aviation must be ensured for national economic purposes, for the needs of both the nation's transportation system and the health of the high tech industry. We need to maintain our competitive status in the aviation business and not give it up to other countries; we do not want to be driven technologically by businesses in other countries. Once we lose the ATC lead in the world, it will be difficult or impossible to get it back.

As expressed by NBAA, NAS modernization is a prerequisite for a sound national economy and a top level political mandate is needed to modernize the NAS. Now is the time to make the transition to a more collaborative decision making system. The industry needs to change now from the current manual, labor intensive, tightly controlled ground-based ATC system to a more automated air-based system that includes distributed decision making. System users should be active in dictating the NAS architecture.

#### **2.4.2 Department of Defense Considerations**

DOD needs unimpeded access to airspace for national security purposes. As such, they will equip their fleet in order to be able to operate anywhere, at any time. Their request of the modernization effort is for the FAA to let them know what to equip with, when it will happen, how it will happen, how much it will cost, and what the penalties associated with non-compliance will be. They need the FAA to state it clearly and consistently, and not change direction in mid-stream. As they commented during the interview, they believed the FAA when the FAA said that they were going to an MLS-based precision landing system. As such, they have the largest MLS-equipped fleet in the world. It was costly and they do not want to repeat the same scenario.

#### **2.4.3 Rotorcraft Considerations**

When the NAS was developed in the 1940s, the system was developed with fixed wing aircraft in mind. Rotorcraft were not included as part of the system. The system has evolved and rotorcraft are an integral part of the current system. As such, they have unique handling and operational characteristics that should be taken advantage of in designing the future system so that they can off-load some of the capacity shortfalls envisioned in the future.

### **3 NAS Stakeholder Needs Survey**

This section describes survey participants, the survey process, and provides an assessment of the process.

#### **3.1 Survey Participants**

The NAS stakeholders that participated in this survey were divided into four categories: (1) system users, (2) service providers, (3) labor organizations, and (4) professional organizations.

##### **3.1.1 System Users**

System users represent the wide variety of users of the NAS, from the major airlines to the owners and operators of general aviation aircraft to owners and operators of rotorcraft. This category includes the Air Transport Association (ATA), Regional Airline Association (RAA), National Business Aviation Association (NBAA), General Aviation Manufacturers Association (GAMA), Aircraft Owners and Pilots Association (AOPA), Helicopter Association International (HAI), and Department of Defense (DOD).

The ATA represents the major air carriers that operate in the NAS. The RAA represents the regional carriers that feed the major air carriers as part of the hub and spoke system. The NBAA represents businesses that own at least one or more aircraft and use it for business purposes. They also represent corporate general aviation, the high end of GA. GAMA represents the manufacturers and suppliers of GA aircraft. AOPA represents all GA pilots. HAI represents the owners and operators of rotorcraft, including helicopters and civil tiltrotors. The DOD represents the various military services. Although they do not typically operate at the same airports used by civilian operators, they do use the same airspace and have some of the same concerns as the other users of the system.

##### **3.1.2 Service Providers**

Service providers are the providers of air traffic management services. They include the Federal Aviation Administration (FAA), Airports Council International - North America (ACI-NA), and the Department of Defense (DOD).

The FAA is the primary provider of air traffic management in the continental US. ACI-NA represents the major air carrier airports in the US. The DOD is both a system user and service provider in that they provide ATM services to their military aircraft.

##### **3.1.3 Labor Organizations**

In this category are the Air Line Pilots Association (ALPA), representing the pilots of the major and regional airlines, and the National Air Traffic Controller Association (NATCA), representing the air traffic controllers.

### **3.1.4 Professional Organizations**

The Airline Dispatchers Federation (ADF), representing the airline dispatchers that work at the Airline Operations Centers, is the only professional organization considered in this category.

### **3.2 Survey Process**

The FAA/NASA/NEXTOR team identified the NAS stakeholders to be considered in the survey during initial meetings in May 1997. The survey of NAS stakeholders was conducted over a four month period. Each NAS stakeholder was first contacted by phone, during which a description of the project was provided and an explanation of the need for stakeholder input. To facilitate that input, a face-to-face interview was requested, and an interview arranged. A package of information was then sent containing a letter describing the project and a table that would be used to facilitate discussion during the interview. The table listed phase of flight (from gate to gate) and then had room for descriptions of operational deficiencies. Alongside each operational deficiency the stakeholder could provide the technical or operational cause of that deficiency, the benefit mechanism (safety, capacity, or efficiency) if that deficiency were removed, and prioritization of that stakeholder need.

The interviews were conducted over a series of three trips to the Washington, DC area. Each interview lasted between one and three hours and was conducted between two Boeing interviewers and anywhere from one to four stakeholder interviewees. A briefing was provided to the stakeholders.

The briefing first described the AATT program and the role of this task, ATM Concept Baseline Definition, in meeting Milestone 1 of the AATT program. The interviewers described the Constraints Model approach that was developed as part of the CNS/ATM Focused Team (C/AFT), in order to get the interviewees thinking about technical or operational deficiencies in the current system. The Boeing interviewers reviewed the various phases of flight and the factors that might constrain throughput for each phase of flight. The interviewees were then asked to describe what they saw as the biggest problems in the current system and their needs for the future system.

The Boeing interviewers listened and took notes during the interviews. After each interview, the interviewers formalized the notes and converted the notes into a needs matrix for each stakeholder. A draft copy of each stakeholder's notes and accompanying matrix were then sent to each stakeholder for review and edit. Each stakeholder was also asked to prioritize their needs in order of importance, with "1" being their most important need for the future NAS.

### **3.3 Survey Process Assessment**

In hindsight, there were both advantages and disadvantages of carrying out the survey process as described above. The benefits and limitations are discussed below.

### **3.3.1 Benefits**

The stakeholders that participated in this study were all familiar with the various industry initiatives such as the AATT program, Free Flight, and Flight 2000. As such, much time was saved in the interview process by not having to educate the stakeholders as to how this study fits in with other industry activities. All of the stakeholders had participated in the Free Flight Steering Committee and were accustomed to thinking about high level needs, missions, and objectives. Therefore, they were quite familiar with and willing to provide the information requested.

### **3.3.2 Limitations**

The stakeholders' sophisticated knowledge of technology and industry initiatives allowed them to discuss their detailed short term needs such as airspace redesign, conflict detection and resolution, Center-TRACON Automation System (CTAS), and Automatic Dependent Surveillance-Broadcast (ADS-B). The system modernization process between now and the year 2015, is however, very uncertain, as presented in Section 6 of the ATM Concept Baseline Definition document. Therefore, the stakeholders interviewed were able to specify detailed short term needs and only high level long term needs.

The interviews were conducted such that stakeholders were specifically asked for deficiencies in the current system in order to get them to focus on their needs for the future system. Therefore, stakeholders did not identify what is working well in the current system.

A draft copy of the interview notes and needs matrix for each stakeholder was provided to each stakeholder for comment and review. At this time, each stakeholder was asked to prioritize the needs listed in the matrix. Several of the stakeholders were able to provide this, others were not.

## **4 Conclusions**

The stakeholders interviewed were all familiar with the various industry initiatives. They had all participated in RTCA Task Force 3 on Free Flight Implementation and were also knowledgeable with technology and implementation issues. They were generally in agreement with the Task Force 3 report. However, they presented different detailed solutions to some of the technology and implementation issues.

All of the stakeholders interviewed acknowledged that the demand for air travel will continue to increase. They agreed that the demand on the terminal area will also increase. A majority of the stakeholders stated that the need to increase capacity in the terminal area is their number one priority. Once that is accomplished, the next priority will be to squeeze as much efficiency as possible out of the terminal area. If that is the case, several of the stakeholders acknowledged that, in order to maximize capacity and efficiency in the terminal area and thus, fit more aircraft in the same amount of airspace, separations will need to be reduced. This has safety implications, especially in the terminal area. Thus,

stakeholders identified a need for research into capacity and safety issues, especially in the terminal area.

## **Appendix A. NAS Stakeholder Interview Notes**

This appendix contains the interview notes of each of the stakeholders that were interviewed as part of this study. They are presented in the following order:

### **System Users**

- Regional Airline Association (RAA)
- National Business Aviation Association (NBAA)
- General Aviation Manufacturers Association (GAMA)
- Aircraft Owners and Pilots Association (AOPA)
- Helicopter Association International (HAI)
- Department of Defense (DOD)

### **Service Providers**

- Airports Council International-North America (ACI-NA)

### **Labor Organizations**

- Air Line Pilots Association (ALPA)
- National Air Traffic Controllers Association (NATCA)

The Air Transport Association (ATA) and the Airline Dispatchers Federation (ADF) were not interviewed. The ATA submitted their matrix as a response, and the ADF information was elicited from their participation in RTCA committee activities. Consequently, notes for these two organizations are not provided.

## **Regional Airline Association (RAA)**

**Steve Rayborn, Manager**, ATC Communications, Comair

**Walt Coleman, President**, Regional Airline Association

The regional airlines are growing at a faster rate than many of the major carriers. One of the factors responsible for this growth rate is a result of many of the RAA members terminating the use of turboprop aircraft and incorporating turbojets into their operations. Historically, the flying public preferred to fly on turbojet aircraft rather than turboprop. This preference has intensified in recent years. As a result of this preference, many RAA members have met the demand of the flying public by terminating the use of the turboprop aircraft and implementing regional jets into their operations. By making this equipment transition, the RAA has been able to capture a market of travelers who, in the past, preferred to travel by automobile rather than by air.

Several regional carriers are billion dollar companies that operate with fleets of 100 or more aircraft. Most regional carriers operate their aircraft in the middle high altitude range that lies approximately 4,000-6,000 ft below where the third tier major carrier jets operate. One of the reasons many of the RAA aircraft operate in this airspace is because they can't get acceptance into air traffic controlled NRPs. According to ATC's requirements to be filed into the NRP, the flight must be filed at or above flight level 290 and the distance must be a minimum of 400 miles. The NRP gives certain flights that meet the requirements the availability to file their flight plans from a Standard Instrument Departure (SID) for 200 miles directly to a Standard Instrument Arrival (STAR) that exists approximately 200 miles from the arriving airport.

As a result of these restrictions, an RAA carrier has never been able to file a turboprop aircraft into the NRP system. The RAA members would like to see the NRP's minimum requirements be reduced from 200 miles from each endpoint to a much lower number and the minimum altitude requirements lowered to accommodate short leg, low altitude operations.

RAA members' operations and the altitudes they fly at have a very low impact on the NAS. As a result of not being able to fit into the NRP system, they are sometimes sequenced and mixed in behind arriving traffic that is often much slower than most RAA aircraft are capable of operating. At times, this sequencing begins at distances of 80 or more miles from the arriving field and often results in extensive holding which costs RAA carriers big money. A large percentage of RAA aircraft are not given ATC clearances to operate airspeeds of 250 kts below 10,000 ft. The RAA believes that they are not asked or assigned to fly at these speeds by ATC because they simply aren't aware that the equipment is capable of performing at these airspeeds. Some airports and ATC centers are more knowledgeable about the RAA operations than others. Most facilities know the capabilities of the turboprops and do a much better job sequencing them than some others. The RAA feels that, with a little additional training for some of the air traffic controllers

regarding the operational capabilities of regional turboprops, they can reduce delays and save money as a result of not having to be slowed down and instructed to hold.

On many of the RAA's short segment flights they are restricted to operate at 10,000 ft or below due to static agreements that exist between ATC centers. The RAA feels that if they could operate above 10,000 ft on short legs, they could increase their airspeeds above 250 KIAS, reduce delays, and, as a result, make the entire system more efficient.

The RAA is continuously adding more airplanes to the National Airspace System. As a result of these additional aircraft, airspace is bound to get tighter in high traffic areas. Through the use of technology and modern avionics they will have the ability to place aircraft closer to one another in the air and add more airplanes to the system. With the use of these new modern instruments they will also more than likely be able to generate more faith in the ATC system.

The most efficient technologically advanced instrument system currently available is the Global Positioning System, also known as GPS. Through the use of GPS, a controller will be able to work more aircraft in tighter airspace and have the ability to pinpoint their location. As a result of this technology, controllers will be able to reduce their workloads significantly by letting the Flight Management Systems fly the airplanes, leaving them to just manage the airspace.

Many of the air traffic problems that carriers face today are institutional issues on the part of the FAA. One of the most common problems is training. It is easy to identify the differences in proficiency levels between controllers at different centers. One solution to this problem would be to implement a controller cross-training program between air traffic control centers. By conducting such a training program, air traffic control could increase the efficiency of the whole NAS by at least 15%. The FAA should close the barriers of disinformation and inconsistent knowledge among centers. Instead of addressing these issues, the FAA is ignoring the fact that efficiency and management problems do exist. One such example of a common problem that exists between centers is airspace holding.

The priorities of the RAA are to develop and plan for more runways at the hub and spoke airports. When you add more concrete and expand airport facilities, you immediately reduce the complexity of the airspace system.

One program that air traffic control uses to manage air traffic congestion is the "Edict Program." The Edict Program is a system that air traffic control uses when they are working highly congested air routes. Air traffic control can only accommodate so many airplanes in some sectors of controlled airspace. ATC will activate their Edict Program where they will institute pre-departure clearances and ground stops which means that no one leaves the gates or the airports. If an aircraft is already pushed away from the gate, it will be held until the air congestion is thinned out. The Edict Program and other holding procedures that are currently used by ATC are not good for RAA members. When RAA aircraft are delayed and given ground stops, this causes a great inconvenience to the passengers and a financial loss to the regional carriers. Passengers often miss connecting

flights due to these all too frequent delays and many times, as a result, the RAA members have to put passengers up in hotels.

Another possible solution to these problems might be to close all the ATC centers and operate from the ATC Command Center in Herndon.

RAA members are increasing the number of regional jets and the routes they are utilizing throughout the US. GPS instrumentation would allow ATC to put more airplanes in less airspace. Shooting approaches using GPS instrumentation utilizes less airspace than today's navaids that consist of ILS, VOR, and NDB facilities. Through GPS, the FAA can retire the use of today's navaids, therefore reducing the amount of airspace necessary for aircraft to shoot instrument approaches.

GPS instrumentation would become an immediate asset to the entire NAS by reducing airborne and ground delays that would, in turn, save the airlines. GPS would be a valuable tool for ATC by enabling better control of air traffic, thus reducing their workload.

There are contractors and consultants available that can redesign airspace and develop new instrument procedures utilizing the newest and most technologically advanced instrumentation. The problem with getting these contractors hired to do the job is the FAA and their institutional resistance to change.

The Regional Airline Association would like to see GPS Category I approaches available at all the airports they operate in and out of.

Although GPS is a very cost-efficient tool, there are variables regarding the system that need to be researched. For example, the RAA would like to have a study conducted regarding the use of a lighting system with GPS approaches. If GPS instrumentation gets you down to the precision of one meter in range, why would you need a guidance lighting system? By the time you would reach your decision point, the lighting system would already be behind you.

The RAA have approximately 2,127 passenger aircraft and 12,200 departures per day. There are currently 109 regional carriers in the airline business. The major airlines have approximately 18,000 daily departures. The RAA operators have 1/2 the fleet and 2/3 the number of daily departures in the system. As a result of operating such a large number of aircraft in the national airspace system, they have a greater dependency on the terminal system and are much more vulnerable to problems in the terminal area.

## **National Business Aviation Association (NBAA)**

**John W. Olcott**, President

**Robert P. Blouin**, Vice President, Operations

**E.H. "Moe" Haupt**, Senior Manager, Airport and Environmental Services

**David W. Almy**, Vice President, Communications

The National Business Aviation Association represents operators of general aviation aircraft that are used for business purposes. The average company flies one aircraft and has medium sales activity on the order of a total of \$800 million/year.

NBAA is very interested in an advanced ATM system and considers modernization of the NAS a fundamental prerequisite for a sound national economy. Their members operate into and out of a variety of smaller airports. Not only do their members fly their own airplanes, but they purchase approximately \$10 billion worth of airline tickets each year. NBAA strongly supports NASA's AATT program and budget since NASA has a lot of the technology expertise that is required to work the problems facing the system in the long term.

The industry is trying to institute a major architectural change in the aviation system that will take us from a manual, labor intensive, tightly controlled system to a system that is more automatic and more distributed in decision making. A radical change like this has never been done without a top-level political mandate. This change is, in some ways, analogous to the task of being first to put a man on the moon.

NBAA strongly urges Boeing, at the highest corporate level, to work toward a political mandate to implement a modernized and advanced ATM. This would ensure the future of civil aviation for national economic purposes, from the standpoints of both a strong national transportation system and the health of high technology industry. Transportation and economic development are tied together; the economy will suffer if a healthy transportation infrastructure isn't maintained.

The communications revolution has increased the need to meet face to face and attendance at business meetings is on the rise. We, as a nation, need to maintain our competitive status in the aviation business, and not give it up to other countries. We do not want to be driven technologically by businesses in other countries.

Our measure of success will not be the number of accidents, but given an accident rate, how efficiently we can run the system.

The system users should dictate the NAS architecture. We're not going to get anywhere with Free Flight or Flight 2000 until the administration recognizes the need to fund such a system, just like they did with NASA putting a man on the moon. This is a national goal and it should be on Boeing's agenda to make this a presidential mandate. What happens if Europe dictates EATCHIP for the US? In order to get things moving, there has to be a

political mandate. The Chairman of Boeing should be talking with the President of the US. If we continue to do what we're doing, we're going to continue to get what we have now.

We should embrace Free Flight at the philosophical level. The exception may be the controller community. About 80% of the current controller workforce will retire in the next 10 years. Now is the time to transition to the collaborative decision making process and transfer from a ground-based to a more air-based system. Conversion to Free Flight should be a government mandate. The FAA should have the same role as NASA has, reporting directly to the President. For FAA currently to get to the President they have to go through the DOT. The management structure within the FAA must be fixed first, and the FAA to be made as independent as possible. Then look to funding to help build the infrastructure. Look at what NASA Administrator Goldin has done. He can go directly to the President to get the funding that NASA needs even though the nation won't see a payoff from that for the next 20 years.

We could throw billions of dollars at the current FAA and nothing would change. We're at the crossroads regarding our economy. Once we lose the ATC lead in the world, it will be impossible to get it back. Technically, Free Flight is the way to go. Jack Olcott is on the FAA R,E&D Advisory Committee as well as the RTCA Free Flight Steering Committee. Bob Blouin is on the board of RTCA. NBAA is aware of the FAA's NAS Architecture 3.0. The system's obsolescence is well documented. We can't let the opportunity pass to replace the obsolescent equipment and change the basis of controller training.

NBAA members are not heavy users of the major airport hubs throughout the US. They do not fly banks like the airlines. Business aviation serves 10 times the number of places than those that have airline service. NBAA members are not competitors to the airlines, but rather complementary to their operations. NBAA has 8,000 individual entities flying 11,000 aircraft. When a new technology comes along, such as TCAS II, most of the companies make a decision to equip one aircraft. They can put the equipment in faster and utilize it to get benefits from it faster than the airlines. They can integrate faster into a technologically advanced ATC system than the other users. NBAA members can be equipped within six months of a decision, once there is a clear economic case for the investment. They were the first ones to take advantage of the NRP program. They are a resource that can take advantage of technology advances. About  $\frac{3}{4}$  of members are equipped with GPS, half of which is approach-capable. American Airlines is just starting to put them into their MD-80's, and the other airlines are still further behind. NBAA members are equipping with RVSM. NBAA's high-end members are going to be equipped, and the others have decided to live with the economic penalty of not equipping due to the cost of compliance.

Economic modeling is very difficult to do, and the evaluation of benefits is a very complex problem. "TravelSense" is a tool that allows the user to evaluate the alternative of using air carrier transportation vs. corporate aircraft. This computer software is proving extremely valuable for customers to justify to management the investment in a corporate aircraft. It clearly shows the benefits of operating business aircraft, by accounting for all

the time saved using the business aircraft. The business aircraft provides the opportunity to save the CEO's time because he uses the time on the aircraft very effectively, as if he had a second office. The software allows an evaluation of the CEO's time along with other costs. David Almy is the technical contact for the software package.

The economic drivers for the airports are extremely powerful. Airports are the fundamental pieces in the system and every one of those pieces is important. The government must take partial responsibility for the capital investment required for the system, due to its importance for the nation's economy.

Unless we do something about airports and the arrival rates, access, noise, and slots, we won't have a future aviation system. Instrument procedures are important in the issue of access to a sufficient number of airports.

Looking at the airport itself, the airport surface is critical. Access to airports is the key issue. In studies of the top five airports the NBAA has found that their traffic percentage is about 4%. It is the coordination between the hub airports and the extended terminal area that is important to the association. They need access to the reliever airports. When the local authority contemplates closing an airport, NBAA tries to turn that around. For example, when they closed Meigs Field, NBAA worked to help open it again. They are very sensitive to airport closures, because it is very difficult to get new airports approved and built.

About 60% of NBAA members own a single airplane. A company that is starting out and needs to grow may purchase an aircraft as a key tool to stimulate growth, and may later upgrade the aircraft. Thus, it's the aviation infrastructure that helps the business grow. The small aircraft is a powerful tool and if the airports aren't there, the utility of the tool is decreased. If you can't get into an airport because of the procedures, configuration, etc., then the aircraft is not as useful. We need to look at the total system and ensure that all components are healthy. As we lose airports, we lose our training grounds, because the GA and business aviation sector is increasingly the pool of trained pilots for air carrier operations.

NBAA has members who are interested in working in pilot programs, trials, and certification. They are willing to be involved. Some of their members include large companies that have a fleet of aircraft that are willing to equip quickly. They have utilization of aircraft out of many different airports, so there is a lot of operational flexibility.

Illinois and New Jersey have published economic impact studies due to aviation, that demonstrate the importance of the system on the overall economy.

NBAA members are taking part in the international arena more and more. It's not usually the case for members to play catch-up. Usually, they're the first ones to equip.

Honeywell and Rockwell-Collins were right in there with corporate GA aircraft with TCAS equipment. We should let the user drive the technology; not the other way around. NBAA recommends talking with GAMA and RAA. They get good feedback from their respective users. Ron Swanda from GAMA could provide the Boeing interviewers with valuable insight.

Users have to be part of the airport, both for departure and approach operations. For all investment decisions, if it's not cost effective it's not going to go into the field. If the wrong things are mandated, the cost of business aircraft operations will become prohibitive, and the sector will suffer, along with economic growth. Any system that is developed should go out to the whole industry; don't leave any component out of the planning. NBAA is eager to participate and should be considered as a valuable resource available for active participation in the modernization plan.

## **General Aviation Manufacturers Association (GAMA)**

**Ronald Swanda**, Vice President, Operations

**Kris Estes**, Manager, Technical Affairs and Operations

One of the things GAMA is worried about the most is funding for the FAA, institutional issues, how taxes are collected to pay for the whole system, etc. The industry needs to work on these issues together and build some consensus before we look at what the operational concept for the future system will be.

GAMA represents the manufacturers and one of their major issues is the infrastructure. They tend to be more conservative on the safety side. They don't want to compromise safety for efficiency. Most of the problems have to do with the pilot. GAMA members' pilots are diversified and represent a wide range of capabilities. How can we get the pilots to make better decisions? What role can technology play to help the pilot make better decisions? Any changes that we make in the cockpit have to be cost effective. Training for the pilots is not mandatory. There is always the pressure to manufacture new avionics. GAMA supports the AGATE program. The goal of the program is to put technology in the cockpit that will help the pilot and perhaps automate some of his functions. One of the biggest problems is that pilots fly into weather that they are not certified for. One of the goals of the project is to add technical capability in the cockpit, to enable the pilot to become IFR certified in half the time that it takes today . The question is, though, at what point do you compromise safety by automating some of the pilot's functions? GAMA doesn't want to compromise safety and doesn't want to compromise certification standards.

GAMA's number one concern is safety and putting technology in the cockpit to help the pilot and hopefully reduce the number of accidents. Their number two concern is capacity. How can they help the controller so that they can continue to operate independently of the airline traffic? The goal is to help the controller better sequence the traffic. They want to operate in a non-interference mode. GAMA's number three concern is airport infrastructure. Money to airports in the AIP program is decreasing every year.

Also, more and more of the cost of equipment such as airport lighting and GPS receivers on the ground are being transferred to airports. The problem is that the airports into which they operate don't have that kind of money. For example, many accidents happen when pilots misread the charts when they are below the glideslope. GAMA wants some form of vertical guidance, either through WAAS or GPS that will allow pilots to do that.

GAMA is also concerned about transition issues. An example is the FAA maintaining two infrastructures and the cost of maintaining two infrastructures. If you maintain two systems, are the users going to transition? The manufacturers would rather want the FAA to say that everyone has to equip by a certain date. But, they've been burned in the past. The date always shifts. The users, however, don't feel the same way. They don't want to have to spend the money. Many will equip when they absolutely have to. Maybe when the

majority of the users in a certain region equip, the FAA should give a definite transition date.

GAMA thinks that the time frame for Flight 2000 is totally out of the ballpark. There is no way to equip all those aircraft in such a short period of time. You can't just put a black box in the aircraft, you also have to worry about the system integration issues. GAMA is uncomfortable with some of the technology decisions of Flight 2000. ADS-B as an interim solution is OK. However, there is opposition to doing anything else with the Mode S Squitter. Some of GAMA's members are not happy with the VHF. Some members see some promise with the use of the technology coming out of Iridium. Right now it doesn't have any aviation applications, but perhaps pilots can piggyback onto it. From what they've heard from the FAA, the pilots can rely on WAAS for en route navigation. GAMA doesn't think you should try to get CAT I approaches with WAAS. The FAA has not done a good job on communicating the research on WAAS. Maybe you can use LAAS for CAT I.

The GAMA interviewees went out to Oakland Center to see the FANS-1 implementation. The FAA part of it doesn't work. However, ADS on board the aircraft does work. If we have to change the specifications for WAAS for the satellites, there will be cost overruns.

Another problem the industry is facing is software certification. It is always a mess. It is something new. The FAA always makes the most conservative decisions. Then they change their mind at the last minute. Certification is a big issue both in airframe and in avionics.

The international arena is headed in a different direction. Another problem for GAMA is RVSM in domestic airspace. GAMA has lots of aircraft that won't be certified. The problem is bigger than in the North Atlantic. The FAA has never considered that the aircraft could have precise horizontal navigation to compensate for the vertical separation. GAMA is trying to get the FAA to think in terms of a new paradigm. Maybe with GPS we will be able to do without RVSM in domestic airspace. If we switch to RVSM in domestic airspace, not only will it be expensive for GAMA, but it will also be expensive for the airlines. They worry that the FAA will do the same thing in domestic airspace as was done with RVSM; the only reason to buy the equipment is so that you won't be kept out. It's a cost avoidance issue. There doesn't seem to be a capacity problem in en route. They don't need the vertical navigation precision en route.

It seems to GAMA that the concept development is a moving target. In terms of Flight 2000, there is skepticism because of the unrealistic time frames involved. When the final report comes out, people will be skeptical. Plus, they never had a say in it. There is a lack of understanding of the real world on the part of the FAA. In Flight 2000 they assumed that the cost of the avionics included the installation costs. Sometimes, that can be just as much as the cost of the avionics! The other problem is the fact that they will maintain the

old system in addition to the new system. GAMA definitely endorses the idea of a beta test for the NAS. However, the implementation got side-tracked.

Safety is the number one problem. That also includes weather which includes the issue of precision and non precision approaches.

## **Aircraft Owners and Pilots Association (AOPA)**

**Douglas S. Helton**, Vice President, Regulatory Policy

**Martin W. Shuey**, Vice President, Air Traffic Control

The items in the Free Flight plan are not specific about the details of how they improve the system. This makes it difficult to evaluate benefits and side effects to the various users.

It is important to distinguish between ATC delay and delay caused by maintenance and other ground operations, that are run by the airlines themselves.

Information sharing between ATC and ground operations needs to be improved, so that they work together as a team. This might reduce ground delays caused by non-ATC airport operations issues.

FAA program management is not well coordinated and programs compete for funding. There needs to be a substantial reform of the entire procurement and program management organization to ensure that the tight budget is invested wisely.

AOPA members are about 50% private aircraft owners for recreational use; the other 50% derive some income from their aircraft. Thus, money is very tight for any equipage on GA airplanes; owners' investment decisions involve such comparisons as equipping the airplane or with new tires for the family car.

On the topic of prioritization of ATM improvements: AOPA operates VFR mostly, but through different airspace classes near terminal areas. Their priorities are as follows:

1. Weather information, for safety.
2. Access to airspace in congested areas.
3. Airports, access to facilities and runways, preferably away from large jet operators.

GA pilots are losing airports to real estate development as a result of pressures of population growth; they have more trouble defending their airports from public pressure. Funding for airport facilities is a more difficult problem for them also. Primarily they need a landing strip, conveniently located to their eventual destination to alleviate ground transportation difficulty. New airport construction today has become just about impossible.

Access to airspace is also a problem. Airspace design in terminal areas often does not take advantage of GA RNAV ability to allow them to fit through corridors between large jet traffic streams. Getting changes in airspace design and terminal area procedures is very difficult.

Also needed are approaches in lower weather into more airports, using GPS-based navigation. GPS helps tremendously in the en route area to be able to navigate independent of VOR stations.

There already is a lot of off airway routing in VFR. From the IFR standpoint, the biggest bottleneck is in the terminal area. Most of this is caused by airline scheduling. 99% of the day there is no problem going into the reliever airport. The terminal area is where the controller needs the biggest relief, since AOPA pilots go to the reliever airport and the air carriers go to the major airport. The controller needs to sequence both, so he needs tools to do that more efficiently.

What about airline scheduling? Yes, the scheduling causes delays, but the efficiency that the airlines gain from the hubbing concept is substantial. When congestion reaches a certain point, though, the airlines will have to modify their operations, which adds cost. United has already spaced out their schedule. American has made a decision not to do that. To United, it has helped them a great deal to spread out their schedule. If there is a capacity constraint, the system adapts.

A substantial efficiency for handling of VFR flights could be gained if the VFR flight plan was transmitted from the Flight Service Station to the ATC TRACON and Host computers. The first controller the VFR pilot talks to has to get all the information that was filed by voice. So, instead, the pilot files an IFR flight plan, then tells the first controller he talks to that he's decided to go VFR. Now the pilot is getting service from the FAA, without having to tie up the controller's time reading the flight plan over the radio. They need every flight plan filed, to make future operations safe and efficient. But, if they go to the user fee concept, this goes out the window because there will be a lot of opposition from GA pilots to sharing the information.

In the planning stage, weather information is currently the biggest problem. In the existing system, weather for flight planning is more important, for the go/no go decision. That really impacts the safe utility of AOPA aircraft. The FAA is very conservative in their weather reporting, they almost never state that visual flight is recommended. Thus, it often happens that you cancel your flight because of weather and decide to drive, but the weather is clear all the way there. There is also a problem with how the weather data is presented; graphical weather maps provide increased understanding of the entire weather situation and enhances understanding of the verbal weather forecast.

Other flight information that would be useful is navigation system status, especially GPS, to know what operating capability will be throughout the whole flight plan. The NOTAM system is a mess. Data is not shared between airports, because they don't have the capacity to put all the NOTAMs in each local system. The system should be national, accessible to all users at all locations. We need a data network and the right graphical user interface. OASIS, the flight service station software that is planned for installation, will help with the NOTAMS. It is a real FAA program, funded, and is currently within six months of contract award. Current plans call for the replacement of 61 automated flight service stations.

The weather and NOTAM information could also be shared during flight. Using data link, the data could be displayed in the cockpit. Many pilots start out flying in VMC and subsequently encounter IMC — this is the biggest cause of accidents for GA. Often this is due to a lack of adequate weather information, for both planning and en route updates. The airlines could ultimately make use of such a system to help their pilots circumnavigate convective activity attenuated by airborne weather radar or otherwise not visible (turbulence). The data link infrastructure isn't there right now to be able to share that information.

In the area of departures, AOPA pilots get indirectly impacted by controller workload caused by the added workload of the air carriers. You can cut down a lot of the delays by allowing the GA population that are equipped (75% are RNAV equipped) not to have to fly over the VORs. Airspace design does not take into account RNAV capability.

Terminal areas become obstacles to AOPA pilots that they have to fly around. A lot of the routes are constrained by ground-based nav aids. There is ample space between the jet arrival and departure airways in the terminal areas to fit in GA traffic on RNAV routes. The airspace design is predicated on the flow patterns into the carrier airports and the design does not take into account transient aircraft. In the northeast, you might want a north-south RNAV GA route and another one east-west. The major flow patterns are based on 300 ft per nm climb gradient, which is the lowest common denominator. TERPS criteria are outdated, and have not incorporated the RNP concept yet, which requires an airspace redesign. It will be a difficult transition to get to RNP-based operations, because none of the certification ever done has been RNP-based. Europe is trying to implement it too quickly, and many users will be left behind without the proper certification to operate.

In en route operations, SUA is another obstacle for the GA pilot. The difficulty seems to be primarily lack of information sharing. In many instances, the airspace is available but ATC doesn't know it's available or isn't telling. It's a workload issue. For the GA pilot getting airspace for 20 minutes would be great. The strategic planning aspect needs to be worked also, but the person controlling the airspace should be able to tell the controller on position that the airspace is available. The information should go directly to the user – the flight crew.

There are already a lot of communication links available, but the community is not using them very well. MITRE is looking at ADS-B and weather information. They are using frequencies used for DME. VHF frequency might be the better way to go, but they aren't available. There is a lot of noise on the Mode S frequency (1090 MHz), which require high power transmissions from transponders and TCAS to overcome. This increases the cost and complexity of the system. FAA, supported by the airlines, required GA to equip with transponders several years ago. Now they want GA to equip with a new black box to do ADS-B. ADS-B is not high on the priority list for most GA pilots and aircraft owners. GPS and then weather in the cockpit are their priorities in terms of avionics.

When transitioning to a new system, it is vital to keep avionics costs down, or else the user will just not equip. There is a segment of the GA community that wants weather data in the cockpit. If you can tack on traffic information in the cockpit, you might be able to sell it to a larger number of users. Digital communications is something the FAA is looking at. There will be resistance to requirements for new radios, particularly since January 1997 effectively marked the conclusion of the transition from 360 channel to 720 channel communication radios. AOPA members are not eager to do that again. If the FAA can package it with things that the GA community does see a real need for, this resistance can be overcome in the long term. Weather over data link is one such need. However, aircraft owners have a limited amount of discretionary income, so FAA must prioritize its modernization efforts, and implement transition schedules that are affordable by low-end GA and carry them out sequentially rather than in parallel.

The certification of equipment needs to be looked at in a whole new way, particularly from the point of view of managing risk and liability. The current system isn't working. GA pilots have difficulty filing direct routes because the FAA Host computer doesn't have the same navigation data base as the GA airplanes. We need to have the same data base on the ground and in the cockpit. The pilot does not know where the sector boundaries are, which is what the controllers use to base their conflict avoidance on. The controller asks for nav points because they don't have that in their data base.

Regarding conflict probe: The FAA just decided to implement URET, which is written in an outdated programming language. It will take approximately 40 months to totally rewrite the software. NASA's UPR uses C++ programming language compatible with all CTAS functions. What the FAA should have done is use what they learned from the URET probe and apply it to improve and implement the UPR probe. The human factors aspects need to be worked more as well. Conflict probe will provide controllers with the ability to separate aircraft long before there is a conflict. In the future, controllers will have to think more strategically rather than tactically, but they need the automation and data in an easily usable form. UPR provided one such tool which helped the controller prioritize tasks so that no time was spent fixing projected problems that had little chance of actually materializing. More work needs to be done to make the system fail-safe so controllers can safely take over should the automation fail.

The only provider for navigation database information is Jeppesen. The cost for this service represents a significant economic barrier in the transition to satellite navigation, and will ultimately compromise safety. Most aircraft owners are simply not willing to bear significant additional costs to maintain software for their avionics. Many GA users can't afford a \$500/year cost for the navigation data base. It's also partly a matter of principle. The FAA currently collects, stores, and maintains this information. This work is funded in part by the taxes levied on GA. FAA provides this information to Jeppesen for a nominal fee, which then sells it to the users. AOPA members ask, "Why should the GA pilot pay for government information they are already paying for?" The basic data base product should be available online directly to end users through the Internet, or an Internet tool, e.g. OASIS. FAA could use NOAA to do the same thing that Jeppesen does, which

is control the data quality. The FAA will ultimately have to provide this data to its controllers once they have a computer system that will handle it. It would not take a great deal of resources to provide this to the pilot community. Ultimately, the updates could be broadcast via data link, and could even be incorporated into the WAAS so that the avionics would update themselves when they were turned on. The precedent set with the navigation data base is going to affect the other data bases that will be coming online. The terrain data base will be next.

In the future, electronic charts could be printed in the cockpit for the current trip. The course could be overlaid on the chart. The charts don't need to be reproduced every time the data base is updated.

Technology is often applied as the "easy" fix to a symptom of a problem rather than the cause. An example is Enhanced Ground Proximity Warning Systems (EGPWS) which is being considered to prevent controlled flight into terrain (CFIT) accidents. Not only is this system very expensive, but it will provide warnings too late in many situations, particularly for lower performance aircraft. The underlying cause for most CFIT accidents is lack of situational awareness. Better position information that comes with GPS avionics provides the needed situational awareness for most of GA.

The approach phase of operations brings up the issue of access. FAA policy for prioritizing GPS approach development disqualifies the airports that don't have high activity levels. These are the airports used almost exclusively by general aviation. Since general aviation aircraft represent the vast majority of the aircraft that must transition to GPS, any incentives that accelerate the transition through voluntary equipage should be pursued aggressively. More emphasis should be placed on developing GPS approaches for these airports to increase user benefits and encourage equipage. That would also help spread out the traffic to more airports. This is also a safety issue. Pilots are resourceful when using the system. If they want to fly to a non-IFR airport in poor weather they will fly an approach to a nearby IFR airport, call off the approach once they are below the clouds and fly VFR to the destination airport. This creates an environment where the risk of CFIT accidents is greater.

When flying into airports without surveillance, procedural separation is used. Usually the procedure is "one-in one-out." This is a minor issue compared with some others. For an airport without surveillance that means no surveillance below 2500 feet (en route radar coverage). Right now, ATC won't allow another aircraft to come into the airport until the preceding pilot lets them know that he is on the ground, and meanwhile the controller keeps the next aircraft in the air 19 miles away. Also, even if the pilot waiting is on the ground ready for departure, and sees the other aircraft clear the runway, he still has to wait for that pilot to call ATC to close his IFR flight plan before they will release aircraft waiting to depart. There are probably ways to alleviate this problem by changing procedures (let pilots coordinate and notify ATC of position and intent) rather than trying to use expensive technology (ADS-B and associated ground infrastructure) to fix the problem.

On ADS-B, some in the industry insist that there needs to be positive identification of aircraft in the message. If GA pilots not part of the system, why should they provide positive identification? Anonymity is better for GA, especially if flying VFR. The information is already there if flying IFR. Aircraft type is less of an issue from the aspect of anonymity, but anytime you put aircraft specific information into the avionics, it complicates record keeping and increases cost and hassle when changes are made. Positive identification is a much bigger issue. There is fear of misuse of ID information by the government and third parties on the ground (phantom controllers, anti-airport/noise advocates, Department of Interior, competitors, user fees, etc.) An ADS system should be able to randomly select a differentiating code to serve as an aircraft ID for VFR operations when the avionics are turned on. They could automatically reselect a random ID in those extremely rare cases where two aircraft with identical IDs encounter each other.

## **Helicopter Association International (HAI)**

**Glenn Rizner**, VP Operations

**Richard M. Wright**, Director, Safety & Flight Operations

**Bill Sanderson**, Director, Heliports & Technical Programs

**Scott DiBiasio**, Staff Assistant, Operations

In 1997, the White House Commission on Aviation Safety - the Gore Commission - recognized the impending problems associated with the National Airspace System and recommended a goal of reducing aviation accidents by five-fold in the next ten years and by ten-fold in next twenty years.

The FAA, NASA, and industry have recognized that now is the time to undertake a comprehensive redesign of the NAS if the Gore Commission's goals are to be met. When the current NAS and ATC systems were developed in the 1940's, primitive equipment and technology was in use. In addition, the NAS and ATC were designed with only commercial airline and fixed-wing GA traffic in mind. Since that time, helicopter technology has greatly evolved. More helicopters are now equipped and certified for IFR flight. Although helicopters were practically excluded from participation in the NAS, there is now a need for helicopters to participate fully. In addition, with the advent of the tiltrotor, an additional category of aircraft needs to be considered for acceptance into the NAS. Each of these three categories of aircraft - airplanes, helicopters, and tiltrotors (powered-lift) - have unique handling and operational characteristics. Any redesign of the NAS must incorporate the need for rotorcraft to operate in the system. These changes will require regulatory, operational, and technological innovation.

One of the major goals of HAI in any redesign of the NAS is complete access for helicopters to the IFR system. The current IFR system was designed specifically for airplanes and does not take into account the unique handling characteristics of helicopters. Helicopters fly at much lower airspeeds, require less airspace to maneuver, and require less territory to takeoff and land. In order for helicopters to make most effective use of the IFR system and to have the least impact on commercial and fixed-wing aircraft, changes need to be made in the departure, en route, and terminal areas.

Changes to the en route IFR structure must include a helicopter-specific IFR route structure, derived from the GPS. This route structure must be high enough to avoid creating disturbances in noise sensitive areas, yet low enough to avoid commercial aircraft. Helicopters are most efficient when they operate between 1,500 AGL to 6,000 feet AGL. However, with the current capabilities of surveillance, this type of system is not possible, and helicopters often fly outside of radar coverage. New satellite-based technologies are emerging that will allow helicopters to be under positive control throughout the entire flight.

A helicopter-specific IFR route system, such as the one described above, is already being developed along the East Coast of the United States, from New York to North Carolina. The IFR helicopter routes were developed based on GPS. They were also developed to

have the least impact on fixed-wing traffic. When flying these routes, helicopters are under radar coverage at all times, ensuring that adequate separation is maintained from other aircraft. These routes were test flown under VFR in the summer of 1996 with tremendous success. Currently, HAI and the developers of the routes are working with other users of the airspace (i.e, the military), and many of the air traffic control facilities, to garner final approval.

In addition to an IFR route structure based on GPS, other technological innovations will have significant impacts on helicopters operating in the IFR environment. VHF data link capabilities now allow air traffic to be aware of all other traffic operating in a sector. It is also possible to have weather overlaid on a single VHF data link display so that not only are aircraft aware of other aircraft, but they can also avoid areas of significant weather and the boundaries of controlled airspace. This type of system was demonstrated effectively in the summer of 1996, when the Heli-Star project successfully incorporated helicopter technology into the Atlanta Olympics. Over 110 helicopters were able to operate in the relatively confined areas of downtown Atlanta with complete awareness of other traffic operating in the area. This allowed unrestricted operation in the Temporary Flight Restriction area, and in the Atlanta Class B airspace. With the VHF data link information, air traffic controllers were relieved from constant control of aircraft operating in this area, often operating in very close proximity to one another. This type of precision system could have the effect of reducing both horizontal and vertical separation requirements, allowing more aircraft to safely operate in the same amount of airspace.

A system such as this (as well as some regulatory change, discussed below) would also be ideal for implementation in the Gulf of Mexico. In the Gulf, there are between 5,500 and 9,500 flights each day. VFR flight is possible for 8 to 10 months of the year, but for the other 2 to 4 months, operations are virtually grounded by the lack of the ability to fly IFR. The Gulf of Mexico does not currently have an effective ATC system, and the cost of implementation of present day technology has been measured to be too great. However, a system such as VHF data link, installed on all aircraft operating in that locale, would eliminate the need for an ATC system, and would allow aircraft to operate IFR with full awareness of all other traffic. In addition, weather information uploaded directly to the cockpit via data link is consistent with the FAA's desire to shutdown many Flight Service Stations.

However, this technology needs to be developed with two key elements in mind. First, it must be cost effective so that all users of the system can participate. The flow of the system breaks down if an aircraft does not have the appropriate equipage. Certainly different versions of this equipment can be produced with different levels of users in mind. Low-cost units, that have limited features, can be produced for general aviation users, while more expensive, "top-of-the-line" units can be produced for corporate and commercial users. Secondly, this technology needs to be "user-friendly." This type of information cannot distract the pilot from performing other flying, communication, and planning procedures. This will be particularly important in the area of single-pilot operations. Recently, the FAA released a rule that will allow single-engine commercial

operations in instrument conditions. The workload on a pilot in this type of situation is significant and future technologies must keep this type of operation in mind.

The problems of helicopters operating in the IFR environment do not end in the en route structure, however. Current technology, regulations, and TERPS criteria do not take into account the unique handling characteristics of helicopters in the terminal area. TERPS criteria were originally developed specifically for airplanes. For instance, in the event of a missed approach, airplanes must climb to high altitudes and complete a full go-around of the airport. On the other hand, helicopters and tiltrotors in the future may be able to come to a hover at a point in space, discover that they will miss the approach, and do a 180 degree turn to execute a missed approach. The unique handling capabilities of rotorcraft/tiltrotors will allow helicopters to use much less airspace for approach and missed approach.

In addition, helicopters do not need to fit comfortably into the IFR arrival stream that was developed specifically for airplanes. Airplanes must fly long approaches that allow them to lose altitude, reduce their speed, and configure for landing. Helicopters, on the other hand, fly at lower airspeeds and can slow to a hover at the point of intended landing. Fitting helicopters into this arrival stream often requires significant spacing increases, sometimes resulting in delays for other aircraft. Because helicopters do not need to make approaches to runways, they should be able to make instrument approaches to an airport or heliport from almost any direction, away from the arrival stream of other aircraft. We do not currently have the capabilities described above because the number of GPS approaches to a point-in-space are limited. HAI believes that the number of GPS approaches could be increased significantly if the FAA design and approval process was streamlined. Better yet, many private firms have the capability to rapidly design these types of approaches to FAA standards. The role of the FAA in this process would be to approve the design criteria and to test fly the route, significantly reducing the implementation period.

However, even if design changes were made in the en route and arrival arenas, significant modifications need to be made to the regulations. During the past 10 years there have been specific recommendations from within the FAA, from industry, and from joint efforts of the agency and industry regarding regulatory changes for the purpose of safely expanding helicopter access to the IFR system. A prime example is the Extremely Low Visibility Instrument Rotorcraft Approaches Workshop (ELVIRA) that resulted in a list of "Ten Most Wanted" changes. The first item on the list of 10 is "Rotorcraft Specific Rules for alternate minima and determining requirements for an alternate when filing an IFR plan."

According to the ELVIRA report of December 1993, current IFR restrictions force helicopter operators to fly under VFR in marginal weather. In its ELVIRA "Operational Concept Development" Final Report (March 1994), the FAA noted that the current regulations result in a "severe penalty in the productivity of helicopters operating under IFR." The FAA observed that, "with certain weather conditions it is often impossible for

the helicopter operator to gain access to the current IFR system, while VFR flight is allowed. . . . “ For instance, currently, 14 CFR § 91.169 requires that, unless otherwise authorized by air traffic control, each person filing an IFR flight plan must include, among other things, an alternate airport designation unless the exception in § 91.169(b) is met; this exception specifies that a person need not designate an alternate airport on an IFR flight plan if 14 CFR part 97 prescribes a standard instrument approach procedure for the first airport of intended landing and, for at least one hour before and one hour after the estimated time of arrival at that airport, weather reports or forecasts indicate that the ceiling will be 2,000 feet above the airport elevation and the visibility will be at least three miles.

In addition, § 91.169(c) states that unless otherwise authorized by the Administrator, no person may include an alternate airport in an IFR flight plan unless current weather forecasts indicate that at the estimated time of arrival at the alternate airport the ceiling and visibility will be at or above the following weather minimums: at airports for which an instrument approach procedure has been published in part 97, the alternate minimums specified in that procedure; or, if none are specified, for precision approach procedures, a ceiling of 600 feet and visibility of 2 statute miles; for nonprecision approach procedures, a ceiling of 800 feet and visibility of 2 statute miles. A person who cannot comply with § 91.169 may not file an IFR flight plan and may fly only under VFR.

These rules were issued to provide safe landing weather minimums in IFR conditions for airplanes operating under IFR. Other than the distinction in § 91.167 concerning the amount of fuel a helicopter must carry versus the fuel an airplane must carry, flight planning requirements, including alternate airport weather minimums, are the same for airplanes and helicopters even though the operating characteristics of these different categories of aircraft are quite different.

For these reasons, the FAA should act swiftly to amend 14 CFR §§ 91.167(b) and 91.169(b) and (c) pertaining to flight plan requirements for flight by helicopters under IFR by revising: (1) the destination airport criteria for specifying an alternate airport, and (2) the weather minimums necessary to designate an alternate airport on a flight plan. This change enhances safety because current rules force helicopters to operate under VFR in marginal weather conditions. This proposal would enhance helicopter access to the IFR system, thereby enhancing the safety of helicopter operations in marginal weather.

Even if the regulatory requirements for filing IFR flight plans were changed, it would still be nearly impossible for helicopters to file IFR flight plans due to the lack of readily available, accurate weather information. Many heliports, and almost all temporary landing zones, do not have accurate weather reporting information. In order to be able to file an IFR flight plan, operators must receive a weather report from a station located in the vicinity of the departure point, the first point of intended landing, and the alternate airport. Currently, this is nearly impossible and helicopters are denied access to the IFR system. Low-cost weather reporting stations need to be developed so that they can be implemented quickly and cost-effectively so that more helicopters can legally file IFR

flight plans.

The last category of improvements that needs to be made to better facilitate helicopter operation in the IFR environment are changes to the helicopters themselves. The advancements made in the development and certification of helicopters for flight in IMC have been very successful. However, one area where development is lacking is in the area of icing. Very few helicopters are properly equipped for flight into known icing conditions. Deicing equipment for rotor systems is very expensive and not readily available. More development needs to take place in the detection and removal of ice on helicopters.

In addition, there needs to be more accurate forecasting of icing conditions. Currently, very few helicopters can file an IFR flight plan for flight into known icing conditions. However, the forecast of icing conditions is not always accurate and can be made more location specific. Often we find that a certain area is forecast to have icing conditions and, once aloft, no icing conditions are present. Therefore, more cost effective ice removal equipment and more accurate forecasts of icing conditions would enhance the operational capabilities of helicopters in the IFR environment.

As stated above, the number one priority of HAI in a redesign of the NAS is helicopter access to the IFR system. This will require not only operational changes, but will require regulatory change as well. Helicopter operation in the IFR environment is currently stymied by:

1. The lack of helicopter-specific IFR route structure in which helicopters operate under air traffic surveillance and remain out of the way of fixed-wing aircraft. This problem is solved through actions such as the development of IFR charts such as the one under development on the East Coast of the United States. In addition, data link upload of weather and traffic information to the cockpit would make helicopter operation in the IFR environment safer and more effective.
2. The terminal area criteria must be changed to incorporate the uniquely different handling characteristics of helicopters when compared with fixed-wing aircraft. In addition, streamlining the approval process for GPS point-in-space approaches would facilitate simultaneous helicopter/fixed-wing operation in the terminal environment.
3. Current regulations make it difficult for helicopters to legally operate in the IFR environment. Regulatory changes to the alternate airport requirements, as well as changes in the weather observation requirements would facilitate easier operation in the IFR environment.
4. Lastly, any changes that are made need to be done in a cost-effective manner that does not significantly increase pilot or air traffic controller workload.

It is HAI's belief that incorporation of helicopter traffic into the IFR environment will significantly reduce the number of accidents caused by scud-running and inadvertent VFR flight into instrument conditions. In this way, the rotorcraft community will play a significant part in the Gore Commission's goal of significantly reducing aviation accidents, even in the face of greatly increased traffic. Through groups such as the Aviation Safety Investment Strategy Team (ASIST) and the Advanced Air Transportation Technology (AATT) program, strategies, technologies, and programs are being developed to further enhance the prospect for a safe and effective National Airspace System for the 21<sup>st</sup> Century.

## Department of Defense (DOD)

**Frank Colson**, Associate Director of Operations, USAF

**Major Joseph Anatra**, Military Assistant, Policy Board on Federal Aviation

The Department of Defense operates approximately 15,000 aircraft ranging from pre-707 to the advanced F-22 fighter with 10,000 fixed-wing aircraft and 5,000 helicopters. Five thousand are transport aircraft. The Air Force alone has 600 KC-135s. The military is faced with an enormous problem of integrating anything new, especially in terms of cost and the time that it takes to integrate new systems into existing flight decks. Crew workload is a big issue, especially with new technology and especially on the single pilot aircraft. There is limited room to put anything new into the cockpit of some of the smaller aircraft — if they put anything else on board, it means they need to take something out. The Free Flight initiative grew out of a very different concept that was being advocated by the FAA in connection with the centralized flow control system, which involved complete 4D control of aircraft from gate to gate. The users revolted because in fact such a concept is not practically feasible due to all the uncertainties in performing the total operation. Prior to Free Flight, the system mission was to provide **safe capacity**. The Free Flight mission is for the system to provide **safe, efficient capacity**.

The desire of DOD is unimpeded access to the NAS. DOD must preserve its Special Use Airspace as technology drives increased capacity. DOD demand for capacity has not increased. Their concern is compliance and the penalties associated with not equipping. For example, with RVSM, DOD had to comply in order to fly in RVSM airspace. They don't have the same requirements as other users of the NAS, and they don't usually fly in the highly congested CONUS areas. The capacity of the system has to grow and it will only grow with new technology.

DOD needs to understand where the future ATC system is going. They want to have a say in the new technology in order to minimize costs. They want to know what they need to equip with, when it will happen, how it will happen, how much it will cost, and what the penalties associated with not complying will be. Also, they need to know this clearly and need the message to be consistent. The system providers can't be changing direction mid-stream. A perfect example is MLS. DOD believed the FAA when they said they were going to MLS as the next generation precision approach system. Consequently, DOD has more MLS-equipped aircraft than the rest of the world combined. They would like to have some say in the decision making process that identifies new ATC technology. DOD cannot be excluded from efficient access to the airspace during the transition period. They have more airplanes than any of the commercial carriers; however, their aircraft are not used as much as commercial aircraft. Also, they tend to make equipment on their aircraft homogeneous. It is imperative that as the system evolves, that it be a global system, because DOD's aircraft have to operate globally. An international architecture is very important. They need to be able to go anywhere, any time, unrestricted — unrestricted global reach.

DOD consumes SUA volumetrically, not linearly like civil aircraft. An important factor is the preservation of SUA and its availability to DOD. They need to have sterile or controlled SUA to fulfill mission requirements. Losing any SUA could severely degrade the ability to fight and win.

It takes DOD a long time to implement changes because of the budget process. They need as much lead time as possible. For example, to retrofit their aircraft takes about 10 years plus the added lead time to get it into the budget process (two years). Anytime they have to put anything into the fleet, the cost starts out at about \$1 billion and goes up from there. In doing business case analyses in terms of the compliance issue, the cost to is the inability to perform the mission. In terms of compliance, they don't do something until it becomes a requirement. Otherwise, it is too costly. With RVSM in the North Atlantic, it cost \$4.5 million to equip their aircraft.

The system as it is today meets DOD's needs and requirements. They are not the demanders of increased system capacity. Their issue in the future system is one of compliance and the fear that growing capacity for the future system will come out of SUA and therefore constrain military operations. DOD's ability to acquire and redefine new airspace is becoming increasingly difficult. In terms of real-time airspace management, they provide FAA Central Flow Control with a schedule of military activity. They activate the airspace according to the schedule. When finished with the airspace, they return it to the FAA. The FAA's ability to reuse that airspace in the most efficient manner is questionable. For example, sometimes, DOD is not able to predict six to eight hours in advance when they will or will not need some airspace, especially when involved in R&D missions. Sometimes they know they won't need SUA for two hours of an eight hour scheduled block, for example. However, if a flight has already left Atlanta going towards the west coast, the FAA is reluctant to redirect flights through that airspace for that short a period of time. Perhaps with collaborative decision making advances may be possible.

In their effort to achieve interoperability with the FAA, DOD's long term plan is to equip their ATC facilities with the same equipment the FAA uses to equip their facilities. This provides the possibility that DOD can offload some of the burden off the FAA for providing ATC services. It also allows for economy in acquisition and speedier changes to maintain consistent operations.

## **Airports Council International - North America (ACI-NA)**

**Richard Marchi**, Senior Vice President, Technical and Environmental Affairs

The FAA system procurement process is primarily driven by FAA costs and budget limitation, and not by user benefits. There is a lack of understanding of airline costs within the FAA, which contributes to the problem. Another problem is the organization of NAS improvements into “project-specific” structures, mainly dedicated to delivering “things” rather than operational improvements. Individual program offices compete within FAA for money and attention. Delivered products (hardware/software) do not have the approved procedures needed to place into operational service. A change in organization to focus on delivering operational improvements rather than “things” would help.

The WAAS program is currently a big issue. The benefit to system users seems very marginal, and the price for the system is escalating rapidly. Users keep hearing that WAAS will not deliver a stand-alone CAT I capability. If major airports will require LAAS for CAT II/III, why not just use LAAS for all landing aids, leaving a scaled back WAAS for sole-means en route navigation?

Procedures development is a big issue for improving capacity and efficiency in terminal areas. In particular, it is currently very difficult to revise TERPS criteria and this slows procedures development. This is at the heart of the problem of increasing capacity in the terminal areas. The increased technical performance and precision of GNSS technologies will not deliver operational capability improvements without changes to TERPS criteria which allow smaller separations, closer spacings, etc. which recognize the increased navigation and surveillance precision available with local differential augmentation, ADS-B, CDTI, etc.

Wake vortex is one of the major issues in terminal area separation standards, and thus capacity/safety. Mix of large and small aircraft is the biggest issue. The industry should look into the idea of a dual threshold operation, where small aircraft following a large one come in on a 4.5° glideslope and land further down the runway than the large one on the 3° glideslope. Current procedures would allow VFR spacing under IMC if the dual threshold/ high glide path idea were developed. Currently it would require dual ILS equipment which is not very feasible. In the future NAS both approaches could be supported with DGPS. A related problem which would need to be solved is FAA's current marking and signing criteria which only recognize one threshold. This is a minor point, but indicative of the lack of a systems approach to delivering operational capability. The FAA certification process is inefficient and suffers from inconsistency in safety criteria across the various operations. A big problem is that the FAA does not have enough data to measure the safety of the current systems and operations, and therefore is overly conservative when establishing safety criteria for new systems.

Regarding ADS-B as it relates to the planned decommissioning of radar systems, the FAA does not have a credible transition plan. There is continued investment in and reliance on

current radar technology, then a "big bang" switch to ADS-B to replace radar. This is not realistic. GA users are a politically powerful lobby and will be slow to equip with GNSS-based ADS-B equipment. The proposed NAS won't work without universal equipage, yet there is no consideration of available "bridge" technologies to facilitate a transition to universal equipage. For instance, one solution to this might be to transition to dissemination of traffic information to all users in terminal areas using Mode S during the period while ADS-B equipage is taking place and the traffic is still mixed. This is very similar to the proposed substitution of Traffic Information System for TCAS being proposed by UPS.

Multilateration using Mode C is another form of surveillance capability that doesn't require any on board avionics beyond the current Mode C or Mode S transponders and should also be looked at as a potential transition tool. Users would not gain the benefit of high precision vertical navigation without ADS-B, but could be tracked with high horizontal precision and coarse altitude information.

Collaborative Decision Making is an important issue. Users need to have real-time information on NAS system status, including runway configurations and airport capacity, to better plan their operations.

User preferred routes in the en route area will have a major impact on operations in terminal areas. Efficiency gains in en route can be lost in the terminal area if the system operation is not worked end to end.

Noise and environmental issues are among the most difficult problems in terms of increasing airport capacity and efficiency. Ultimately, new capacity will come from a small number of new runways and a large number of new procedures supported by the new technologies, IF the procedural and operational approvals can be developed concurrently with the hard/software.

Airline scheduling practices, especially for hub operations, put an enormous capacity demand at peak hours on hub airports, but most of the time demand is considerably lower. Thus, the hub concept induces some delay into the system that is unavoidable, i.e. a compromise between the efficiency gained through the hubbing concept and some inefficiency in flight delays.

There are substantial issues with new larger airplanes on the drawing boards, and their surface movement. The standards for surface clearances are set using a very conservative deterministic approach - a probabilistic approach should be adopted along the lines of the RNP concept.

## **Air Line Pilots Association (ALPA)**

**John O'Brien**, Director, Engineering and Air Safety

**Robert Striegel**, Staff Engineer, Engineering and Air Safety (ATC & Engineering)

**E. Fretwell**, Manager, Engineering and Air Safety (Safety and Operations)

The RTCA Task Force 3 report is still the statement of user needs for the system. A prioritized list of user needs were given to the Flight 2000 project recently. CTAS and conflict probe are not on the list, they are in the pipeline and doing them for Flight 2000 would simply delay their implementation where they are needed.

Four primary things emphasized by the Free Flight Select committee were CTAS, conflict probe, NOW applications, and Flight 2000. This was recently decided by the Free Flight Select Committee.

NASA has consensus from the industry on the fact that they should be working human factors. There is controversy about specific system and software development — MITRE thinks that they have a claim on that. The trouble is that NASA and MITRE aren't working together. Where is the interface?

John O'Brien would like Boeing to talk with Dave Watrous of RTCA and fill him in on what Boeing is doing. He has input into the RTCA Board and the Free Flight Select Committee. John O'Brien would also like Boeing to keep track of the committees, activities, and different things going on and keep track of the reports coming out of all these activities.

The number one problem in the system today is terminal area capacity. That is also where the biggest safety problems are. One of the best solutions needed is additional runways. However, that is the toughest problem because it would take so much money to get that done. Plus, NASA isn't in the business of building more runways. Other ways of getting more runways would be reliever airports and wayports.

In the same category as new runways, and also needed, is change in airline scheduling practices. Some of the marketing is false because of the hub and spoke system. Schedules may not necessarily reflect when people want to fly, but because of the hub and spoke system, schedules have evolved that way.

Two things needed from an ATC sense are more runways and changes to airline scheduling practices; however, from an economic sense, one can't do it because it represents a huge cost impact to the airlines.

Terminal area capacity is the biggest payoff area, most challenging, and the biggest safety concern. If we look at what is happening today in the terminal area (intersecting runways, closely spaced parallels, reducing spacing, etc.) these changes in procedures have the greatest safety consequences. ALPA doesn't feel that all of the safety concerns are being

addressed. Land and hold short operations (LAHSO) are a big concern. Some of the promised technology has not come on line as quickly as predicted or promised (e.g., CTAS) and throughput has increased. ALPA is concerned about the safety. Training is desperately needed.

NASA should concentrate on human factors and training in the terminal area. That is key. No other organization can do a better job on human factors than NASA. Areas to be emphasized are procedural things, software/hardware, shared responsibilities between pilot and controller. No one has defined what human factors work in the shared responsibility area needs to be. Langley did some work on CDTI in the 70's. At some point in time, you need to bring the air traffic controller into the picture. Last Friday at the Free Flight Select Committee, CDTI came up in Flight 2000. It's on the list but no one knew what they meant by it. We need CDTI but how will it be used? If we want to get capacity on a clear day for a bad weather day, perhaps give the pilot all the information he needs so that he can do the separation. Why does good weather day work so well? Because the pilot does the separation. Bill Cotton and Jack Howell were big proponents of CDTI as an independent backup like TCAS. We are now trying to get capacity enhancements out of the technique. What kind of information does the pilot need to do his job in separation? How would he use that information? The need and use of a CDTI display is greater in the terminal airspace than en route. Applications are envisioned to use it for traffic sequencing and for following the preceding aircraft on final. NASA has been the leader in human factors in the past, and could have a big influence with a careful look at this issue. This work needs to be done. It has been left out before; hopefully, it won't be left out again. There isn't the same business drive behind the human factors and so it is easy to leave it out of the picture.

There is a lack of good data in the area of data gathering and model development. FAA uses NASA reports for one thing but not others. Closely spaced runways – there is nothing out there on paper that tells us of blunders. We need a good reporting system and then something that helps with defining data for blunders. There may be blunders out there, but there is no data on it. Deviations are a big concern, and increasing number of operations increases the risks. The FAA doesn't take into account the increase in number of operations in the future. They do the analysis for current traffic levels, but don't take future increase into account. Data gathering and model development is one of the critical elements and the FAA needs to be part of it. Recent efforts where data was done as an afterthought were TCAS — after the program or the concept has been implemented. Concerted effort now to do that could be beneficial before some of these operational concepts that have been developed are implemented. Good data recorders are needed as well as pre-application/implementation evaluation phase data collection.

In the area of weather, there needs to be more and better weather information in the cockpit. Predictive wind shear technology is on the horizon. This was mentioned in the Free Flight Select Committee last Friday and also that NASA would play a role. All of this is part of situational awareness and assumes data link capability. There will be a consensus on the part of industry, not a unanimous decision.

Concerning wake vortex, there were two studies done at Langley focused in the terminal area: in-trail awareness, and following traffic in an effort to achieve VFR capacity in instrument conditions. Wake vortex would have to be brought into the equation. The goal was to try to give the pilot as much information as he needs in the cockpit so that he can do in IFR what he does in VFR. Look at the PRM operation – the controller would not accept those reduced separations without better radar. Maybe the display in the cockpit is easier to do than the wake vortex issue. Maybe you only reduce wake vortex at airports that have special sensors on the ground. The key to the wake vortex problem is getting good information at altitude in the terminal area. ALPA doesn't want the wake vortex rules changed without wake turbulence research data to support the change. No one is doing any research now. If we are going to increase capacity in the terminal area, a wake vortex detection system is needed. What are the requirements of a wake vortex system so that you can do something about it? Trying to reduce space by a quarter mile or eighth of a mile won't really increase airport capacity. Spend time on the larger issues that will increase IFR capacity to VFR capacity.

Concerning a planning and safety tool, the terminal area is our most critical area (terminal airspace and operations on the surface). For en route applications, below FL290, CDTI and other things will be necessary if only to be the backup monitor. TCAS now fulfills that role but it's not a planning tool. We need a planning and safety tool. Awareness of what is going on, more than what we have on TCAS. You need to know how wide a radius you need to be able to specify the requirement.

On the subject of airspace: The multiple efforts going on are incredible. FAA just asked RTCA to set up a special committee on airspace and airspace review. FAA says that they need to make their sectors more efficient. Can eliminate some of the centers – maybe New York and Cleveland. Sectorization – maybe the airspace doesn't need fixing. It would be a waste of resources. Special Use Airspace (SUA) is a coordination problem. When DOD gives up some airspace for a while, they need to be able to get the SUA back, requiring a quick decision. There needs to be good coordination procedures, communication, quick decisions. There is no good communication system between DOD and FAA. It is also a budget issue between FAA and DOD and the Pentagon has no money to set up a coordination system.

Concerning traffic mix: Different kinds of airplanes in the traffic mix need to be accommodated in the terminal area. Runway configurations make a difference. When you have to mix in a Cessna 172 into the air carrier flow, capacity goes down. They have to take the general aviation guys into account.

Central flow in Herndon is where collaborative decision making between the FAA and the airlines is being implemented. Airline scheduling is the biggest problem. 40 airplanes arrive in the first 10 minutes – making a non-hub airport appear like a hub, i.e., SFO. CDM works on a daily basis, dealing with today's planned traffic. Collaborative decision making

will eliminate slots that go unused because of lack of information exchange between the FAA and users.

In the areas of airport surface operations/situational awareness/human factors: Another constraint in the airport is taxiway configuration and taxiing — in-ground lighting would help. We don't have that here in the US. However, in-ground lighting is used in London. It would be location specific. In today's world, we're getting along. But, if you're going to be increasing capacity, you won't be able to handle that much traffic in low visibility operations if you can't taxi. The cost of low visibility operations won't make putting in in-ground lighting cost effective since the occurrence of low visibility operations is not that high. A bigger problem is the lack of adequate taxiways and high speed turnoffs, as well as gate access. Some say that CDTI is the solution. However, the pilot will need a 35 inch screen to be able to get all the information he needs. That's why the human factors is so important. We're going to all these displays, but someone needs to look at how they're designed, built, how they will be used. Another example on the use of CDTI is the AILS program sponsored by NASA. They are saying that they can get down to 1200 ft separation. But, what are they relying on – information to pilot in the cockpit and system in the aircraft that notifies the pilot that something is going wrong. What are you doing to the pilot? The equipment is only one portion of the equation. It is a costly venture to go into human factors research. Additionally, as you move more responsibility into the cockpit, what happens with the liability issue, who pays when there is an accident? Who is held responsible? Controllers and pilots need the same type of information. Pilots need better information in the cockpit in the terminal area. For example, in Los Angeles you may have five miles visibility but you can't see the runway because of the haze. In en route, you want to use CDTI that tells you that you are five miles behind the other airplane. It is a better way for the air traffic controller to control the distances behind airplanes so that they don't waste space and don't get into trouble. Airport specific solutions are a real problem.

In the FAA structure and management, there is no cooperation between managers in Air Traffic and Flight Standards. Flight Standards are on one end and Air Traffic is on the other end. For example, with LAHSO, Flight Standards and Air Traffic are not agreeing on numbers and risk. Pilots won't buy into it. Better cooperation between Air Traffic and Flight Standards is needed.

## **National Air Traffic Controllers Association (NATCA)**

**Mike McNally**, Executive Vice President

NATCA is very concerned about safety issues. Promotion of aviation used to be the prime focus for the FAA. The new HR bill took aviation out and inserted safety as the primary focus of the FAA. We want safety and health of the aviation system to improve. NATCA looks at things from a safety perspective before considering capacity and efficiency. Strategic planning is very important, but long term planning by the FAA is lacking. There are too many entities going in different directions. Thus, no real direction. Also, no focused leadership within the FAA. There are competing entities within Air Traffic in terms of strategic planning, organizations that are fighting each other rather than working in a collaborative environment. Free Flight lacks technology answers as well as airspace redesign answers. As it is being approached today, Free Flight is a free for all. Safety will be adversely impacted.

There is a major human factors piece but there are no real human factors studies being done by FAA for any of the technology projects coming on board. National route program is a perfect example. Human factors studies receive only superficial consideration. It is not reality when it hits the operational environment. National civil aviation review system is dealing with the staffing of the system which is less than what it should be. There is no focus. There is no human factors research that is looking at staffing levels which are far short of where they need to be right now or in the future. Future technology does not decrease the controller workload at all.

There is lack of cooperative planning between the controllers and the airlines and also between the controllers and the GA pilots. There is no communication between the en route center and approach control. There is no communication between flight service station and en route. Pilots don't usually get the flight plans that they want — they get the one that the computer in the center has in it. Most of the emphasis in the development of Free Flight is from the pilot point of view. This is a very serious safety concern. Airspace is not designed for that. It is a very fixed airspace structure, dependent on VORs and wind patterns. Airspace is not dynamic and not designed for that type of a system. It will be a very costly task to redesign the airspace.

The role of RTCA is to make Free Flight a reality. Airspace review is another piece of it. They've recognized that the airspace is a big piece of it, so they've created another committee. Free Flight flights are usually riding the boundaries between sectors. If the aircraft weren't in my sector, I wouldn't pay attention to them. But, since they are on the boundary, now I have to pay attention to them, and try to sequence them in. This increases my workload. Without dynamic sector boundaries (aircraft will try to capture the winds), we will find ourselves in an increasing workload situation. With the staffing problem too, you start impacting safety. The last major airspace redesign was the Expanded East Coast Plan, more than 10 years ago. We used to do airborne holding. With fuel prices going up,

we went to ground stop measure. Now, airlines want to revert back to airborne holding because the customer would prefer to be in the air than hold on the ground.

La Guardia and San Francisco are prime examples of airports without enough concrete. Runway marking and signage are always problems. Lights for low visibility operations are needed. ASDE is in place now, but it doesn't always work: there is ground clutter, and the display is so small. Just the size of the screen itself is impractical. There is no integration of systems in the tower — they are all stand-alone. They should be logical in their placement because it takes the controller away from the window, which is where he needs to be. There is much more research being done for the cockpit and pilots than for controllers. Because there isn't research being done for the controller, the controllers will do things the old fashioned way because it's busier and they can't be bothered. Controllers then do more verification with communication as a result. You know there are scheduling problems when you arrive at DFW and you have to wait for an hour on the ground to get to the gate.

A big portion of the deficiencies are a result of flow control. It is supposed to relieve the pressures on the controllers. However, controllers don't understand what the flow control program does. The FAA TMU coordinator group which is responsible for increasing efficiency does not have the backing of the controllers. It boils down to separate entities within the FAA. Traffic Management is a separate unit. Controllers don't understand what the traffic management units do and so they resist it. There is no transfer of knowledge between TMUs and controllers. TMUs just establish restrictions; other than that, they don't do anything. They just establish the flow rates. They do a lot during the severe weather using the severe weather avoidance program. They work very hard during that time. Every facility has their own unit and it's all coordinated through central flow. There is no scientific method based on their experience working as controllers. If that whole traffic management piece were to become part of the controller function, that would work. Right now, controllers concentrate on safety. If they aren't busy, they are willing to give users what they want. The controller can't do more if they aren't given better tools and more information. The relationship between controllers and TMUs is getting worse, not better.

There is a distinct lack of understanding on industry's part – you staff the firehouse in case there's a fire. That's the same thing that happens with the ATC system. You staff for the anticipated weather. The en route environment system today is maxed out with the way the airspace system is designed today. Airspace-wise, you run out of room. There is a maximum that the system can handle, under current and future technology. The whole en route system hasn't changed since the 70's. We went from the broadband system to a digital system — no additional functionality has been added. There are a lot of frequency problems. A lot of facilities used to have spare frequencies but that is no longer the case. These days, several sectors have only one frequency that they can share. A lot of this is financially driven. By not having so many frequencies, you don't have to maintain them and you save money. Safety – you can't measure the loss of a life. The priorities today are on the gadgets, the wow's.

There is very much a lack of focus in the FAA. Some of these are acceptable inefficiencies; some of these are acceptable realities. Equipment outages. Flight 2000 is another political maneuver to make Free Flight a reality. They think that once Hawaii and Alaska are in, there will be such a demand that everyone will want to be in it.

The controller has a five mile ring, the “snitch factor”. Controllers are put through a grueling process if they violate it. That drives their psyche. They won’t shoot for five, instead they’ll shoot for seven or eight. You’ve got everything to lose if you go to 4.8 miles — there’s no incentive to increase the efficiency. Probably the separation standards could be improved. The rules need to be changed regarding how a controller operates. There are no incentives for doing better. Controllers should have a better prediction ability (climb and descent). A lot of uncertainty in climb and descent when they get to altitude. Turning is another issue. Airlines have different operating procedures and you don’t know how they are going to react to your commands. Controllers need more tools that increase their functionality. Data link and voice would eliminate some of the frequency congestion. AERA was a great idea. If you gave controllers all the tools, they might not even have to use all of them. Although managers of these programs are controllers, there is a severe lack of asking the working controllers what they want. FAA headquarters is driven by dollars; the controllers are driven by safety. Controllers want to bring technology on board, but they haven’t been through the training or asked what they would want or need. DSR is coming on board – it’s already been built and controllers don’t like it. Functionality is the same as it is today for DSR, with no additional functionality; just now it is more data intensive. In the new DSR, the assistant position isn’t working because he gets in the way of the controller.

The sector suite design was very nice. They thought they had an open pocketbook. Now they are going with buying off the shelf. It’s back-handed. Any new pieces are now an add-on to the system and cost a lot more.

The congestion is so severe and the equipment is so outdated, that the data blocks are superimposed over one another (ARTS-III system). So, instead of having color to distinguish the data blocks, controllers deal with it by increasing the separation between arrivals on closely spaced parallels. The equipment needs to be lightning quick and cannot be so that it takes your eyes off the scope. Data link will work well, but, where is the display going to be? Will the controllers have to take their eyes off the display to work with it? If so, they will reach for the mike.

Free Flight is an answer to some of the delays caused by the fixed airspace structure. Any procedure designed today is to manage the system. In the early 80’s we would run the planes a lot faster with less procedures than they do today. It was a lot more efficient. When the snitch patch came in, that slowed the system. Traffic management slowed the system. Added procedures slowed the system. Dynamic airspace would help. Conflict probe would help. Today they have conflict alert – if you are at the same altitude. Controllers like UPR; FAA picked URET. Controllers like CTAS, as well.

The New York area, with three airports, doesn't have the airspace to maneuver. It is a complex terminal area with three interacting airports. Every airplane is not just an object in the sky – it's a three mile ring or a five mile ring, plus, it has altitude. Even if you have reliever airports and more concrete, the congestion then gets shifted into the air. If La Guardia could add a runway, you could add capacity to a point, but in the TRACON and center environment, you have to start lining them up to the runway. Even on parallel runways, some of the runways are not spaced far enough apart and you have to stagger the arrivals.

Anywhere in the vicinity between Chicago and New York, the concept of Free Flight will not be feasible. It won't work point to point. Even if you have the National Route Program that begins sequencing at 200 miles away, maybe you will be able to shorten it to 150 or 100, but at some point you need to start lining them up. Before instituting NRP, the FAA didn't do any modeling. Controllers are making it work. As the situation worsens, controllers won't use it and will just put the aircraft on a route. The whole Northeast Corridor, the Chicago area, all the congested areas of the country are where the FAA and the users want more efficiencies. But, the FAA isn't able to institute the NRP there because, at some point, you need to line them up. For example, if everyone is going to La Guardia so that they are all at the same point at the same time, you need to put them into a hold. There is a saturation point. Can the system be more efficient? Yes, but you get to a point of diminishing returns. Pilots feel like they are a part of the system.

Controllers don't feel like they are part of the system. FAA Headquarters says that they know what the controllers want but they don't really represent the controllers. Oceanic control is a completely separate entity within the NAS. That part of the system is in the dark ages. Major efficiencies can be added. Separations over the ocean are more like 60 or 100 miles.

Mr. McNally invited Boeing to talk with other controllers such as TRACON or tower controllers to get their point of view. Boeing should coordinate with Adele Humphreys for the next trip.

## **Appendix B. NAS Stakeholder Needs Matrices**

This appendix contains the needs matrices of each of the stakeholders that participated in this study. They are presented in the following order:

### **System Users**

- Air Transport Association (ATA)
- Regional Airline Association (RAA)
- National Business Aviation Association (NBAA)
- General Aviation Manufacturers Association (GAMA)
- Aircraft Owners and Pilots Association (AOPA)
- Helicopter Association International (HAI)
- Department of Defense (DOD)

### **Service Providers**

- Airports Council International (ACI-NA)

### **Labor Organizations**

- Air Line Pilots Association (ALPA)
- National Air Traffic Controllers Association (NATCA)

### **Professional Organizations**

- Airline Dispatchers Federation (ADF)

The matrices are presented in the following manner:

The first column provides the phase of flight for which the need is stated, e.g., strategic planning, planning and dispatch, gate, apron, taxi-out, initial departure, TMA departure, en route, TMA approach, final approach, and taxi-in.

The second column presents the name of the stakeholder that expressed that need, e.g., ATA, RAA, NBAA, GAMA, AOPA, HAI, DOD, ACI-NA, ALPA, NATCA, and ADF. The third column presents the need or operational deficiency or constraint, e.g., insufficient capacity and efficiency, insufficient airspace capacity, etc.

The fourth, fifth, sixth, and seventh columns represent the benefit mechanisms that would be achieved if that need were met or if that operational deficiency or constraint were removed. These benefit mechanisms are “S” for safety, “C” for capacity, “E” for efficiency, and “Other Performance Objectives” such as access and affordability.

The eighth column presents the technical or operational cause of that operational deficiency or constraint presented in column three.

The ninth column presents a potential solution to eliminating the technical or operational cause provided in the previous column.

The tenth column presents, for each stakeholder, a prioritization of their stated needs. Many stakeholders did not provide this information.

**Table B-1  
ATA Needs Matrix**

<b>Operational Phase</b>	<b>Org.</b>	<b>Operational Deficiency Description</b>	<b>S</b>	<b>C</b>	<b>E</b>	<b>Other Perf. Obj.</b>	<b>Technical/Operational Causes (Across the System)</b>	<b>Potential Solution</b>	<b>Prioritization (1=most important)</b>
Strategic Planning	ATA	Inefficient routings and fuel usage.		x	x		Lack of real time SUA information to users by FAA results in inefficient routings and fuel usage.		2
Strategic Planning	ATA	Insufficient airport and airspace capacity.		x	x		Inability for users to fly optimized trajectories and operate at desired times.		1
Strategic Planning	ATA	Insufficient airspace capacity.	x	x	x		Lack of user input in airspace design. Current airspace structure constricts FMS equipped aircraft into standard operating procedures that are inefficient.		2
Strategic Planning	ATA	Lack of human factors research.	x				Research on the complex interaction of flight crews with ground controllers taking into account cockpit technologies and the aircraft.		3
Planning and Dispatch	ATA	Insufficient airport capacity because aircraft may need to be deiced more than once during winter weather conditions.	x		x		Research on new technology to predict and prevent icing on aircraft.		2
Planning and Dispatch	ATA	Insufficient capacity and efficiency.	x	x	x		Lack of same real time weather information to dispatchers, controllers, and pilots.		4
Gate	ATA	Insufficient capacity and efficiency.		x	x		Lack of ability to exchange critical flight information among airlines, ATC, and airport operators. Current automation systems such as SMA need to be brought on line to make NAS more efficient.		5
Gate	ATA	Insufficient capacity and efficiency.		x	x		Lack of real time information to users to predict surface events that impact operational decisions. Users need real time data to help them increase the efficiency of ground movement operations.		2
Apron	ATA	Insufficient capacity and efficiency.	x	x	x		Lack of real time data to tower controllers for tower visibility and awareness to predict surface events that impact operations.		2
Apron	ATA	Insufficient capacity and efficiency.		x	x		Lack of real time information to users to predict surface events that impact operational decisions. Users need real time data to help them increase the efficiency of ground movement operations.		2
Taxi-out	ATA	Insufficient capacity and efficiency.	x	x	x		Inefficient taxi routes due to airport construction.		3

**Table B-1  
ATA Needs Matrix**

Operational Phase	Org.	Operational Deficiency Description	S	C	E	Other Perf. Obj.	Technical/Operational Causes (Across the System)	Potential Solution	Prioritization (1=most important)
Taxi-out	ATA	Insufficient capacity and efficiency.		x	x		Lack of real time data to controllers to aid in runway load balancing.		4
Taxi-out	ATA	Insufficient capacity and efficiency.	x	x	x		Lack of real time data to controllers, pilots, and dispatchers to predict surface events that impact operational decision making.		3
Taxi-out	ATA	Insufficient capacity and efficiency.	x	x	x		Taxi delays due to frequency congestion and inefficient taxi routes.		3
Initial Departure	ATA	Insufficient capacity and efficiency.		x	x		Lack of procedures that take advantage of new technology that may allow more efficient use of airspace on initial departure.		4
Initial Departure	ATA	Insufficient capacity and efficiency.	x	x			Need for detection of wake vortices to allow for reduction of separation criteria to increase capacity in terminal area.		2
TMA Departure (Vectors, SIDS)	ATA	Insufficient capacity and efficiency.		x	x		Lack of new procedures that take advantage of variations in aircraft performance characteristics.		3
TMA Departure (Vectors, SIDS)	ATA	Insufficient capacity and efficiency.		x	x		Lack of procedures that allow aircraft that are capable of exceeding 250 kts below 10,000 ft to do so to expedite air traffic from terminal to en route environment.		3
TMA Departure (Vectors, SIDS)	ATA	Insufficient capacity and efficiency.		x	x		Lack of variable routings or trajectories on departure procedures for aircraft that require them to proceed over the same fix regardless of destination.		1
TMA Departure (Vectors, SIDS)	ATA	Insufficient capacity and efficiency.		x	x		Separate departure routings for turboprop aircraft not always needed. New turboprops can maintain same speeds as turbojets.		2
En Route	ATA	Inefficient airspace routings.		x	x		Airspace redesign to allow for dynamic resectorization.		1
En Route	ATA	Insufficient capacity and efficiency.		x	x		Lack of automation tools for conflict detection and resolution for controllers.		2
En Route	ATA	Insufficient capacity and efficiency.		x	x		Lack of automation tools such as DA to help controllers sequence mix of aircraft at the feeder gates by issuing cruise and descent speed advisories, top of descent points, and heading advisories.		3

**Table B-1  
ATA Needs Matrix**

Operational Phase	Org.	Operational Deficiency Description	S	C	E	Other Perf. Obj.	Technical/Operational Causes (Across the System)	Potential Solution	Prioritization (1=most important)
En Route	ATA	Insufficient capacity and efficiency.		x	x		Need for more efficient airspace design; need for new procedures that take advantage of new technology for reducing separation between aircraft.		1
En Route	ATA	Lack of research on unrestricted routing or Free Flight.	x	x	x		Research on the ability of aircraft to safely share same airspace.		1
TMA Approach (STAR)	ATA	Insufficient capacity and efficiency.		x	x		Lack of automation tools such as TMA to help controllers sequence mix of traffic so that it flows efficiently from feeder gates to final approach.		3
TMA Approach (STAR)	ATA	Insufficient capacity and efficiency.		x	x		Lack of new procedures that take advantage of FMS procedures that are fuel efficient.		2
TMA Approach (STAR)	ATA	Insufficient capacity and efficiency.		x	x		Lack of new procedures that take advantage of variations in aircraft performance characteristics.		3
TMA Approach (STAR)	ATA	Insufficient capacity and efficiency.		x	x		Lack of variable routings or trajectories on arrival procedures for aircraft that require them to proceed over the same fix regardless of destination.		1
TMA Approach (STAR)	ATA	Insufficient capacity and efficiency.		x	x		Need for additional airborne and ground clearances for aircraft between controller and pilot such as Pre-Departure Clearances (PDC).		3
TMA Approach (STAR)	ATA	Insufficient capacity and efficiency.		x	x		Separate arrival routings for turboprop aircraft not always needed. New turboprops can maintain same speeds as turbojets.		4
Final Approach	ATA	Insufficient capacity and efficiency.		x	x		Effectiveness of FMS equipped aircraft to perform standard missed approach procedures is limited due to current standardized procedures.		3
Final Approach	ATA	Insufficient capacity and efficiency.		x	x		Inefficient changes in aircraft weight groupings from large to small category have caused increase in separation standards.		1
Final Approach	ATA	Insufficient capacity and efficiency.	x		x		Lack of FAA to limit construction of antenna towers and other obstacles near airports.		5

**Table B-1  
ATA Needs Matrix**

<b>Operational Phase</b>	<b>Org.</b>	<b>Operational Deficiency Description</b>	<b>S</b>	<b>C</b>	<b>E</b>	<b>Other Perf. Obj.</b>	<b>Technical/Operational Causes (Across the System)</b>	<b>Potential Solution</b>	<b>Prioritization (1=most important)</b>
Final Approach	ATA	Insufficient capacity and efficiency.		x	x		Lack of real time information system to report planned and unplanned events that restrict aircraft movements such as runway closures or equipment outages.		2
Final Approach	ATA	Insufficient capacity and efficiency.		x	x		Large variability in skill levels of ATC specialists. Need for automated tool such as FAST to help sequence mix of traffic.		2
Final Approach	ATA	Insufficient capacity and efficiency.		x	x		Need for automated tool to help controllers assign runways to aircraft.		1
Final Approach	ATA	Insufficient capacity and efficiency.	x	x			Need for detection of wake vortices to allow for reduction of separation criteria to increase capacity in terminal area.		1
Final Approach	ATA	Insufficient capacity and efficiency.		x	x		Need for systems such as PRM that provide independent simultaneous approach capability at more airports.		2
Final Approach	ATA	Lack of tools for situational awareness in the cockpit.	x				Research on tools in the cockpit to aid the pilot in situational awareness to help prevent collisions with other aircraft and terrain and sensors to detect weather hazards.		3

**Table B-2  
RAA Needs Matrix**

Operational Phase	Org.	Operational Deficiency Description	S	C	E	Other Perf. Obj.	Technical/Operational Causes (Across the System)	Potential Solution	Prioritization (1=most important)
Strategic Planning	RAA	Insufficient capacity and efficiency.	x	x	x		200 nm restriction on NRP endpoints.	Reduce 200 nm restriction.	
Strategic Planning	RAA	Insufficient capacity and efficiency.	x	x	x		Regional aircraft not sequenced as efficiently as possible with other aircraft due to lack of knowledge of aircraft performance capabilities.	Controller training; decision support tools for controllers.	
Strategic Planning	RAA	Insufficient capacity and efficiency.	x	x	x		Static agreements between facilities that do not allow regional aircraft to fly above 10,000 ft.	Collaborative reworking of static agreements between facilities.	
Strategic Planning	RAA	Insufficient capacity and efficiency.	x	x	x		Need for airspace redesign and development of procedures that take advantage of new technology.	Hire contractors to redesign airspace and develop new procedures. Reduce barriers between regions and facilities.	3
Strategic Planning	RAA	Lack of communication between FAA headquarters and the field and between facilities.	x	x	x		Institutional.	CDM	
Strategic Planning	RAA	Insufficient capacity and efficiency.	x	x	x		Different skill levels between controllers at different facilities.	Controller cross-training.	2
Strategic Planning	RAA	Unimpeded access to current, transition, and future ATC system.	x			Access	Future direction of ATC system unclear.		
Strategic Planning	RAA	Users are unable to plan avionics investment.	x			Access	FAA does not provide the procedures (benefits) to encourage users to equip.		
Strategic Planning	RAA	Inability of some users to equip.	x	x	x	Afford	Lack of funding. Avionics need to be cost-effective.	FAA and NASA to work together to develop funding mechanism.	
Final Approach	RAA	Insufficient capacity and efficiency.	x	x	x	Afford	Need for new runways at hub airports.		1

**Table B-3  
NBAA Needs Matrix**

Operational Phase	Org.	Operational Deficiency Description	S	C	E	Other Perf. Obj.	Technical/Operational Causes (Across the System)	Potential Solution	Prioritization (1=most important)
Strategic Planning	NBAA	Implementation of technology (FAA) too slow	x	x	x		Management problems, certification process .		1
Strategic Planning	NBAA	Insufficient number of runways in system.		x		Afford	Public resistance to air traffic noise and environmental issues.		3
Strategic Planning	NBAA	Insufficient number of runways in system.		x		Afford	Economics		3
Strategic Planning	NBAA	Lack of long term planning/direction	x	x	x		Lack of leadership at FAA.		1
Strategic Planning	NBAA	Lack of global international architecture			x	Afford	Lack of consensus among international ATC service providers.	Coordinated Regional Planning	2
Strategic Planning	NBAA	Unimpeded global access to current, transition, and future ATC system			x	Access	Future direction of international ATC service providers unclear.		2
Strategic Planning	NBAA	Unimpeded access to reliever and non-hub airports			x	Access	Economics; lack of FAA funding for airport improvements.		1
Strategic Planning	NBAA	Insufficient capacity and efficiency.		x	x		Lack of collaborative decision making		2
Planning and Dispatch	NBAA	Inefficient decision making in central flow management process.		x			Lack of infrastructure for sharing operational data between FAA and users.	CDM implementation.	3
Initial Departure	NBAA	Insufficient capacity and efficiency.		x	x		Public resistance to air traffic noise and environmental issues. Wake vortex separation rules.		3
Initial Departure	NBAA	Insufficient capacity and efficiency.	x	x	x		Need for increased coordination between hub airports and extended terminal area		2
TMA Departure (vectors, SID)	NBAA	Insufficient capacity and efficiency.		x	x		Noise and environmental.		2
En Route	NBAA	Insufficient route efficiency.		x	x		Need to redefine airspace from fixed to dynamic structure, more procedures.		3
En Route	NBAA	Insufficient route efficiency.		x	x		Need to transition from ground-based to air-based ATC system		3
Final Approach	NBAA	Insufficient capacity and efficiency.		x	x		Wake vortex separation rules.	Revise procedures, i.e., smaller aircraft on steeper glideslope and land short.	3
Final Approach	NBAA	Insufficient capacity in IMC.		x			Lack of instrument approach capability at reliever and non-hub airports.	Approach procedures using satellite navigation.	3
Final Approach	NBAA	Insufficient capacity.		x		Afford	Lack of reliever and non-hub runways and airport facilities.	Build and maintain more reliever and non-hub airport runways and facilities.	3

**Table B-3  
NBAA Needs Matrix**

<b>Operational Phase</b>	<b>Org.</b>	<b>Operational Deficiency Description</b>	<b>S</b>	<b>C</b>	<b>E</b>	<b>Other Perf. Obj.</b>	<b>Technical/Operational Causes (Across the System)</b>	<b>Potential Solution</b>	<b>Prioritization (1=most important)</b>
Final Approach	NBAA	Insufficient capacity.		x			Poor coordination between hub airports and extended terminal area		2
Final Approach	NBAA	Insufficient capacity.	x	x	x		Need for new procedures that incorporate new technology.		3

**Table B-4  
GAMA Needs Matrix**

<b>Operational Phase</b>	<b>Org.</b>	<b>Operational Deficiency Description</b>	<b>S</b>	<b>C</b>	<b>E</b>	<b>Other Perf. Obj.</b>	<b>Technical/Operational Causes (Across the System)</b>	<b>Potential Solution</b>	<b>Prioritization (1=most important)</b>
Strategic Planning	GAMA	Lack of funding for the FAA.	x	x	x	Afford	Political process.		1
Strategic Planning	GAMA	Cost of infrastructure being transferred to airports and ultimately to users.		x		Afford	Political process.		4
Strategic Planning	GAMA	Lack of human factors research to (1) help the non air carrier pilot make better decisions, (2) automate some of the non air carrier pilot functions.	x			Afford	Funding issues.		2
Strategic Planning	GAMA	Insufficient capacity and efficiency.		x	x		Decision support tools for the controller to help sequence the mix of traffic so that general aviation can operate independently of air carrier operations.		3
Strategic Planning	GAMA	FAA lacks a clear transition plan to system modernization		x	x	Afford	Lack of understanding of the cost of maintaining two systems, user costs, system integration issues, and software certification process.		
Strategic Planning	GAMA	Users are unable to plan avionics investment.		x	x		FAA direction not clear and concise.		
Strategic Planning	GAMA	Lack of creative solutions by FAA using current technology, i.e. using alternatives for vertical separation.		x	x		Requires paradigm shift.		
Strategic Planning	GAMA	FAA implements procedural improvements to NAS without analyzing end-to-end system impact.		x	x		Lack of long term planning, e.g. instituting RVSM in domestic airspace.		

**Table B-5  
AOPA Needs Matrix**

Operational Phase	Org.	Operational Deficiency Description	S	C	E	Other Perf. Obj.	Technical/Operational Causes (Across the System)	Potential Solution	Prioritization (1=most important)
Strategic Planning	AOPA	Implementation of technology (FAA) too slow	x	x	x		Management problems, certification process .		
Strategic Planning	AOPA	Terminal area procedure development too slow.	x	x	x		Application of safety criteria and reliable safety data are lacking or inconsistent	Apply RNP concept to procedure development and separation criteria.	
Strategic Planning	AOPA	ADS-B effects are misguided.				Privacy	Positive identification of aircraft unacceptable to GA users.	Identify aircraft type only in message.	
Strategic Planning	AOPA	Airline scheduling creates peaks.		x			Hub strategy.	Spread schedules in time.	
Strategic Planning	AOPA	FAA procurement process is poorly coordinated.	x	x	x		Programs compete for funds, without incentives for sound investment principles.	Management reform.	
Strategic Planning	AOPA	Free Flight plan lacks consensus among users.	x	x	x		Plan lacks detail on operational enhancements.	Develop the details and evaluate economic basis for all users.	
Strategic Planning	AOPA	Inefficient use of data communications channels and existing equipment investment.	x	x	x	Afford	FAA lacks understanding of user avionics cost impact.	Coordinate with user on infrastructure investment decisions.	
Strategic Planning	AOPA	Insufficient knowledge of system performance.	x	x	x		Performance data lacks detail on causes of delay and inefficiency.	Collect and publish using good metrics.	
Strategic Planning	AOPA	Insufficient capacity and efficiency.		x	x		Lack of data sharing among users and providers at non-controlled airports.		
Planning and Dispatch	AOPA	ATC does not receive VFR flight plans from FSS.	x		x		Lack of infrastructure for sharing operational data between FAA facilities	Implement flight plan data transfer FSS to ATC facilities.	
Planning and Dispatch	AOPA	Lack of NAS status information.	x		x		NAS-wide information infrastructure insufficient.	Information network and status data collection and dissemination.	
Planning and Dispatch	AOPA	Lack of weather information.	x				FSS weather data format and presentation poor.	More and better graphical weather data for flight planning.	
Planning and Dispatch	AOPA	Lack of weather information.	x				Poor in-flight weather data.	Weather data through data link and cockpit display.	
Planning and Dispatch	AOPA	Difficult to keep up to date on navigation data base and charts.	x				Charts published on paper.	Make charts available electronically to FSS or cockpit.	
TMA Departure (vectors, SID)	AOPA	Insufficient capacity and efficiency.		x	x		Inflexible route structures with congestion over nav aids.	Implement RNAV procedures for GA aircraft to smaller airports.	
En Route	AOPA	Insufficient capacity and efficiency.		x	x		Inflexible route structures with congestion over nav aids.		
En Route	AOPA	Insufficient route efficiency.			x		Ground and air have incompatible nav data bases.	Same nav data base ground and air, supplied free of charge by FAA.	

**Table B-5  
AOPA Needs Matrix**

<b>Operational Phase</b>	<b>Org.</b>	<b>Operational Deficiency Description</b>	<b>S</b>	<b>C</b>	<b>E</b>	<b>Other Perf. Obj.</b>	<b>Technical/Operational Causes (Across the System)</b>	<b>Potential Solution</b>	<b>Prioritization (1=most important)</b>
En Route	AOPA	Insufficient route efficiency.			x		Underutilized SUA.	Lack of data exchange DOD, FAA and users.	
En Route	AOPA	Insufficient route efficiency.			x		Lack of controller automation and tool integration	Implement conflict probe by combining advantages of URET and UPR.	
En Route and TMA	AOPA	Controlled Flight into Terrain too frequent.	x				Lack of situation awareness by pilot.	Terrain data in cockpit.	
TMA Approach (STAR)	AOPA	Insufficient capacity and efficiency.		x	x		Inflexible route structures with congestion over nav aids.		
Final Approach	AOPA	Insufficient capacity in IMC.		x		Access	Lack of instrument approach capability at GA airports.	Approach procedures using satellite navigation.	
Final Approach	AOPA	Insufficient capacity.		x		Access	Lack of GA runways and airport facilities.	Build and maintain more GA runways and facilities.	
Final Approach	AOPA	Insufficient capacity.		x			Poor sequencing efficiency for mixed traffic in terminal areas.	Implement sequencing automation for all airspace users.	
Final Approach	AOPA	Insufficient capacity at airports without surveillance.		x			Procedural control overly conservative.	Change procedures to allow more direct coordination between pilots.	
Final Approach	AOPA	Insufficient capacity in IMC.		x			TERPS criteria are outdated.	Incorporate RNP concept.	

**Table B-6  
HAI Needs Matrix**

Operational Phase	Org.	Operational Deficiency Description	S	C	E	Other Perf. Obj.	Technical/Operational Causes (Across the System)	Potential Solution	Prioritization (1=most important)
Planning and Dispatch	HAI	IFR requirements for filing flight plans do not accommodate helicopters.	x	x	x	Access	Current procedures designed years ago for fixed wing aircraft that can fly to alternate airport.	Modify regulations to include helicopter specific instrument flight criteria.	1
Planning and Dispatch	HAI	Need for better, more reliable cost-effective weather information.	x	x		Afford	Lack of availability in some locations, i.e., Gulf of Mexico.	Develop new, low-cost accurate weather reporting systems	2
Planning and Dispatch	HAI	Inability to predict icing causes delays in system.	x	x			Lack of research on pre-flight forecasting of icing, in-flight detection of icing, and materials/technologies for prevention of icing.	NASA should do research on developing ice forecasting, detection, and removal technologies.	3
En Route	HAI	Insufficient capacity and efficiency.		x	x	Access	Lack of FAA-approved GPS derived IFR route charts for helicopters.	NAS redesign that incorporates inputs of users of the system.	1
En Route	HAI	Insufficient capacity and efficiency.	x	x			Need for full communication and surveillance coverage in low altitude throughout the US.	Continue development of satellite based technologies for communication and surveillance	2
En Route	HAI	Insufficient capacity and efficiency.		x	x		Unrealistic separation standards (from other aircraft and structures) that accommodate rotorcraft.	Need for research on developing new separation standards for helicopters.	3
En Route	HAI	Insufficient capacity and efficiency.		x	x		Lack of coordination between FAA and users. Lack of decision support tools that allow controllers to make more efficient use of airspace that is not being used.	Need for better coordination between FAA and users. Allow controllers to make more efficient use of airspace that is not being used.	4
Final Approach	HAI	Insufficient capacity and efficiency.		x	x	Access	Lack of procedures that accommodate unique handling characteristics of helicopters, i.e. point-in-space approaches, missed approaches.	New procedure development. Integrate helicopter movement into overall airport development plans (i.e, ability to approach from 360 degrees).	1
Final Approach	HAI	Lack of GPS procedures that accommodate helicopters.		x	x		FAA approval process for GPS procedures too slow.	Use contractors to develop procedures in a cost effective and efficient manner.	2
Strategic Planning	HAI	Need to maintain or improve level of safety.	x				Lack of analysis into safety statistics and why accidents happen.	FAA/NTSB/TRB/Industry studies on the causes of accidents and ways to prevent them.	1
Strategic Planning	HAI	Insufficient capacity and efficiency.		x	x		Lack of heliports in populated areas.	Public education on benefits and uses of helicopters. Need for research on noise reduction technology for helicopters that will enable helicopters to operate near populated areas.	2

**Table B-6  
HAI Needs Matrix**

<b>Operational Phase</b>	<b>Org.</b>	<b>Operational Deficiency Description</b>	<b>S</b>	<b>C</b>	<b>E</b>	<b>Other Perf. Obj.</b>	<b>Technical/Operational Causes (Across the System)</b>	<b>Potential Solution</b>	<b>Prioritization (1=most important)</b>
Strategic Planning	HAI	Human factors research on how to reduce pilot workload, yet increase availability of information in the cockpit	x	x			New technologies and equipment in the cockpit have caused a significant redistribution of the pilot's attention.	Continue development of single-screen, user-friendly, multi-functional, displays.	3

**Table B-7  
DOD Needs Matrix**

<b>Operational Phase</b>	<b>Org.</b>	<b>Operational Deficiency Description</b>	<b>S</b>	<b>C</b>	<b>E</b>	<b>Other Perf. Obj.</b>	<b>Technical/Operational Causes (Across the System)</b>	<b>Potential Solution</b>	<b>Prioritization (1=most important)</b>
Strategic Planning	DOD	Not enough research on human factors when technology is introduced (i.e., crew workload issues for single pilot aircraft).	x	x	x		Institutional barriers, lack of long-term planning and financial incentives	NASA should lead the research, with facilities and expertise	3
Strategic Planning	DOD	Users are unable to plan avionics investment.				Afford	FAA direction not clear and concise. Long term DOD budget process.	Need to know: what to equip with, when, penalty for non compliance due to long budget process.	1
Strategic Planning	DOD	Preservation of SUA				Readiness	Increased demands on use of civilian airspace.		1
Strategic Planning	DOD	Insufficient capacity and efficiency.		x	x		Lack of tools that increase functionality (i.e., more efficient use of SUA by FAA).		4
Strategic Planning	DOD	Lack of FAA long term planning/direction.	x	x	x		Lack of leadership at FAA.		2
Strategic Planning	DOD	Lack of global international architecture.				Access	Lack of consensus among international ATC service providers.	Coordinated Regional Planning	1
Strategic Planning	DOD	"Unimpeded global access to current, transition, and future ATC system"				Access	Future directions of international ATC service providers unclear.		1
En Route	DOD	Insufficient route efficiency.			x		Underutilized FAA use of SUA due to lack of controller automation tools.	Lack of data exchange DOD, FAA and users.	5

**Table B-8  
ACI-NA Needs Matrix**

Operational Phase	Org.	Operational Deficiency Description	S	C	E	Other Perf. Obj.	Technical/Operational Causes (Across the System)	Potential Solution	Prioritization (1=most important)
Strategic Planning	ACI-NA	FAA lacks a credible transition plan to system modernization (i.e., transition plan does not account for users to equip gradually).	x	x	x	Afford	Lack of understanding of user costs, inefficient certification process, inconsistent safety criteria, lack of system performance data.	Include creative solutions using avionics already on board aircraft.	
Strategic Planning	ACI-NA	FAA procurement process lacks overall program coordination and credible economic drivers.	x	x	x		Institutional.	Management reform.	
Strategic Planning	ACI-NA	Terminal area procedure development too slow.	x	x	x		Application of safety criteria and reliable safety data are lacking or inconsistent and prevent prompt revisions of TERPS criteria.	Apply RNP concept to TERPS criteria, procedure development and separation criteria.	
Strategic Planning	ACI-NA	FAA implements improvements in system components without analyzing end-to-end system impact (CRDA is an example).	x	x	x		Lack of data collection, modeling, and analysis capability and long-term planning.		
Strategic Planning	ACI-NA	Limited number of runways in system.		x		Afford	Public resistance to air traffic noise and environmental issues. Economics.		
Strategic Planning	ACI-NA	FAA procurement process is poorly coordinated.	x	x	x		Programs compete for funds, without incentives for sound investment principles.	Management reform. Focus on delivering operational improvements rather than things.	
Strategic Planning	ACI-NA	Insufficient knowledge of system performance.	x	x	x		Performance data lacks detail on causes of delay and inefficiency.	Collect and publish using good metrics.	
Strategic Planning	ACI-NA	Airline scheduling creates peaks.		x	x		Hub strategy.	Spread schedules in time; institute utility pricing.	
Planning and Dispatch	ACI-NA	Inefficient decision making in central flow management process.		x			Lack of infrastructure for sharing operational data between FAA and users.	CDM implementation.	
Planning and Dispatch	ACI-NA	Lack of real-time NAS status data for flight planning.		x	x		Lack of infrastructure for sharing operational data between FAA and users.	Information network and status data collection and dissemination.	
Gate	ACI-NA	Insufficient capacity for new large airplanes.		x			Overly conservative airport design and clearance criteria.	Use probabilistic approach to setting criteria.	
Apron	ACI-NA	Insufficient capacity for new large airplanes.		x			Overly conservative airport design and clearance criteria.	Use probabilistic approach to setting criteria.	
Taxi-out	ACI-NA	Insufficient capacity for new large airplanes.		x			Overly conservative airport design and clearance criteria.	Use probabilistic approach to setting criteria.	

**Table B-8  
ACI-NA Needs Matrix**

<b>Operational Phase</b>	<b>Org.</b>	<b>Operational Deficiency Description</b>	<b>S</b>	<b>C</b>	<b>E</b>	<b>Other Perf. Obj.</b>	<b>Technical/Operational Causes (Across the System)</b>	<b>Potential Solution</b>	<b>Prioritization (1=most important)</b>
Taxi-out	ACI-NA	Insufficient capacity and efficiency.		x			Lack of careful management of taxi clearances creates taxiway congestion.	Automation tool to help controller manage taxiway traffic. Can also be used to manage aircraft for deicing.	
Initial Departure	ACI-NA	Insufficient capacity and efficiency.		x	x		Public resistance to air traffic noise and environmental issues. Wake vortex separation rules.		
TMA Departure (vectors, SID)	ACI-NA	Insufficient capacity and efficiency.		x	x		Public resistance to air traffic noise and environmental issues.		
Approach Transition	ACI-NA	User Preferred Routing en route will cause difficulty in sequencing traffic in TMA.	x	x	x		Lack of ATC automation for sequencing.	Coordinated controller tools.	
Approach Transition	ACI-NA	Insufficient capacity and efficiency, VMC and IMC.		x	x		Public resistance to air traffic noise and environmental issues. Wake vortex separation rules.		
Final Approach	ACI-NA	Insufficient capacity and efficiency.		x	x		Public resistance to air traffic noise and environmental issues.		
Final Approach	ACI-NA	Insufficient capacity and efficiency.		x			Creative approaches to the wake vortex problem.	LAAS with revised procedures that enable smaller aircraft on steeper glideslope to land long, avoiding heavier aircraft.	
Final Approach	ACI-NA	Insufficient capacity and efficiency.		x	x		Poor sequencing efficiency for mixed traffic in terminal areas.		
Taxi-in	ACI-NA	Insufficient capacity for new large airplanes.		x			Overly conservative airport design and clearance criteria.	Use probabilistic approach to setting criteria.	
Taxi-in	ACI-NA	Insufficient capacity for new large airplanes.		x			Lack of accurate surface movement guidance.		
Apron	ACI-NA	Insufficient capacity for new large airplanes.		x			Overly conservative airport design and clearance criteria.	Use probabilistic approach to setting criteria.	
Gate	ACI-NA	Insufficient capacity for new large airplanes.		x			Overly conservative airport design and clearance criteria.	Use probabilistic approach to setting criteria.	

**Table B-9  
ALPA Needs Matrix**

Operational Phase	Org.	Operational Deficiency Description	S	C	E	Other Perf. Obj.	Technical/Operational Causes (Across the System)	Potential Solution	Prioritization (1=most important)
Strategic Planning	ALPA	Implementation of technology (FAA) too slow	x	x	x		Management problems, certification process.		7
Strategic Planning	ALPA	FAA implements improvements in system components without analyzing end-to-end system impact (NRP is an example) or without collecting data beforehand (TCAS is an example).		x	x		Lack of data collection, modeling, and analysis capability and long-term planning.		6
Strategic Planning	ALPA	Insufficient capacity and efficiency.	x	x	x		Lack of cooperation between FAA Flight Standards and Air Traffic in implementing new procedures.		5
Strategic Planning	ALPA	Insufficient capacity and efficiency.		x	x		Lack of real-time data exchange between Central Flow and users.	CDM between Central Flow and airlines.	9
Strategic Planning	ALPA	Insufficient number of runways in system.		x	x	Afford	Public resistance to air traffic noise and environmental issues. Economics.		1
Strategic Planning	ALPA	Not enough research on human factors when new technology is introduced.	x				Institutional barriers, lack of long-term planning and financial incentives.	NASA should lead the research, with facilities and expertise	8
Strategic Planning	ALPA	Airline scheduling creates peaks.		x	x		Hub strategy to reduce airline operating cost.	Spread schedules in time.	2
Strategic Planning	ALPA	Too many ATC facilities.			x			Merge operations and close facilities.	
Planning and Dispatch	ALPA	Insufficient capacity and efficiency.	x	x	x		Lack of good weather data in cockpit.		10
Initial Departure	ALPA	Insufficient capacity and efficiency.		x	x		Public resistance to air traffic noise and environmental issues. Wake vortex separation rules.		12
"TMA Departure (vectors, SID)"	ALPA	Insufficient capacity and efficiency.		x	x		Public resistance to air traffic noise and environmental issues.		13
En Route	ALPA	Insufficient capacity and efficiency.	x	x	x		Lack of traffic awareness in the cockpit.	Display of other traffic in cockpit for planning and safety.	14
En Route	ALPA	Insufficient capacity and efficiency.		x	x		Inefficient use of SUA by FAA.	Communication and coordination with DOD.	15

**Table B-9  
ALPA Needs Matrix**

<b>Operational Phase</b>	<b>Org.</b>	<b>Operational Deficiency Description</b>	<b>S</b>	<b>C</b>	<b>E</b>	<b>Other Perf. Obj.</b>	<b>Technical/Operational Causes (Across the System)</b>	<b>Potential Solution</b>	<b>Prioritization (1=most important)</b>
Approach Transition	ALPA	Insufficient capacity and efficiency, VMC and IMC.		x	x		Public resistance to air traffic noise and environmental issues. Wake vortex separation rules.		11
Final Approach	ALPA	Insufficient capacity and efficiency.		x			Wake vortex separation rules.	Revise procedures, i.e., smaller aircraft on steeper glideslope and land short. Traffic information in cockpit.	3
Final Approach	ALPA	Severe weather safety.	x				Lack of real-time predictive data for windshear avoidance.	Predictive wind shear data to cockpit.	
Final Approach	ALPA	Insufficient capacity and efficiency.		x	x		Poor sequencing efficiency for mixed traffic in terminal areas.		4
Taxi-in	ALPA	Insufficient utilization of runway capacity.		x			Lack of high-speed turnoffs and taxiways.	Improve taxiway design.	
Taxi-in	ALPA	Insufficient capacity, low IMC.	x	x	x		Taxi guidance and situation awareness in very low visibility,	In-ground lighting, CDTI.	16
Gate	ALPA	Insufficient capacity.		x		Afford	Insufficient number of gates at some airports.	Add gates.	

**Table B-10  
NATCA Needs Matrix**

Operational Phase	Org.	Operational Deficiency Description	S	C	E	Other Perf. Obj.	Technical/Operational Causes (Across the System)	Potential Solution	Prioritization (1=most important)
Strategic Planning	NATCA	FAA implements improvements in system components without asking controllers what they want (DSR is an example).	x	x	x		Lack of communication between FAA HQ and field.		2
Strategic Planning	NATCA	FAA implements improvements in system components without analyzing end-to-end system impact (NRP is an example).	x	x	x		Lack of data collection, modeling, and analysis capability and long-term planning.		3
Strategic Planning	NATCA	Not enough research on human factors when technology is introduced.	x	x	x		Institutional barriers, lack of long-term planning and financial incentives.	NASA should lead the research, with facilities and expertise	4
Strategic Planning	NATCA	FAA procurement process is poorly coordinated.	x	x	x		Programs compete for funds, without incentives for sound investment principles.	Management reform.	5
Strategic Planning	NATCA	Insufficient number of runways in system.		x	x	Afford	Public resistance to air traffic noise and environmental issues. Economics.		16
Strategic Planning	NATCA	Insufficient number of controllers in system.	x	x	x	Afford	Budgetary process.		1
Strategic Planning	NATCA	Insufficient capacity and efficiency.		x	x		Lack of tools that increase functionality (i.e., more efficient use of SUA by FAA)		6
Strategic Planning	NATCA	Lack of long term planning/direction.	x	x	x		Lack of leadership at FAA.		7
Strategic Planning	NATCA	Insufficient capacity and efficiency.		x	x		Lack of communication/cooperative planning between TMCs/controllers.		11
Strategic Planning	NATCA	Insufficient capacity and efficiency.		x	x		Snitch-patch creates lack of incentive for controllers to do a better job		11
Strategic Planning	NATCA	Outdated equipment.	x			Afford	FAA management and budgetary process.		7
Strategic Planning	NATCA	Insufficient capacity and efficiency.		x	x		Inability of display system to move/change color of data tags; controllers increase separation to distinguish aircraft		9
Strategic Planning	NATCA	Lack of spare frequencies.	x				Budgetary process.		7
Planning and Dispatch	NATCA	Insufficient capacity and efficiency.		x	x		Lack of communication/cooperative planning between controllers/airlines, controllers/GA pilots.		15
Taxi-out	NATCA	Insufficient capacity and efficiency in IMC.	x	x	x	Afford	Insufficient runway/taxiway marking and lighting		14

**Table B-10  
NATCA Needs Matrix**

Operational Phase	Org.	Operational Deficiency Description	S	C	E	Other Perf. Obj.	Technical/Operational Causes (Across the System)	Potential Solution	Prioritization (1=most important)
Taxi-out	NATCA	Insufficient capacity and efficiency.	x	x	x		Lack of integration among controller tools in tower.		8
En Route	NATCA	Insufficient route efficiency.		x	x		Lack of additional functionality, controller automation, and tool integration (i.e., conflict probe)	Implement conflict probe by combining advantages of URET and UPR.	12
En Route	NATCA	Insufficient route efficiency.		x	x		Lack of communication/cooperative planning between en route centers/approach control, FSS/en route.		13
En Route	NATCA	Insufficient route efficiency.		x	x		Need to redefine airspace from fixed to dynamic structure and develop more procedures to take advantage of new technology.		15
TMA Approach (STAR)	NATCA	Insufficient capacity and efficiency.		x	x		Lack of communication/cooperative planning between en route centers/approach control.		16
TMA Approach (STAR)	NATCA	Insufficient capacity and efficiency.		x	x		Lack of automation tools to more efficiently sequence mixed traffic in terminal areas.		10
Approach Transition	NATCA	Insufficient capacity and efficiency.		x	x		Lack of automation tools to more efficiently sequence mixed traffic in terminal areas.		10
Final Approach	NATCA	Insufficient capacity and efficiency.		x	x		Lack of automation tools to more efficiently sequence mixed traffic in terminal areas.	Increased automation and proper integration using human factors.	7
Final Approach	NATCA	Insufficient capacity and efficiency.		x	x		Wake vortex separation requirements.		13
Taxi-in	NATCA	Insufficient capacity, low IMC	x	x	x	Afford	Taxi guidance, runway marking and lighting for situation awareness in very low visibility		14
Taxi-in	NATCA	Insufficient capacity and efficiency.	x	x	x		Lack of integration among systems in tower.		15

**Table B-11  
ADF Needs Matrix**

Operational Phase	Org.	Operational Deficiency Description	S	C	E	Other Perf. Obj.	Technical/Operational Causes (Across the System)	Potential Solution	Comments
Planning and Dispatch	ADF	Lack of TFM understanding of current operational efficiency and system performance.		x	x		Lack of performance data and user feedback.	Automate data collection.	
Planning and Dispatch	ADF	Insufficient data at Central Flow to predict airport and airspace demand.	x	x	x		ETMS database uses OAG data and daily updates are not practical.	Automate schedule updates from AOCs, and include non-AOG flight plans in the database.	Already in place at 8 major carriers and 36 more carriers will come on line in next 180 days
Planning and Dispatch	ADF	Insufficient data on NAS system resources for user flight planning.		x	x		ETMS database does not include system resource data.	Include system resource data in the database.	2 CDM subgroups already have plans in place and prototypes are being developed
Planning and Dispatch	ADF	NOTAMs and pilot reports only available locally.	x				NOTAMs broadcast locally by ATC facility or FSS.	Include NOTAMs and pilot reports in the database.	
Planning and Dispatch	ADF	Poor communications links between TFM units and users.			x		Only link is by telephone.	Establish email connection, segregated from the Internet.	AOCnet will provide whiteboarding and other messaging services.
Planning and Dispatch	ADF	NAS users are not all accommodated equally in the TFM system.	x		x	Afford	NAS users have different automation capabilities..	Accommodate different levels of automation capability.	There are minimum levels of information access required of all carriers.
Planning and Dispatch	ADF	Lack of flexibility for users to respond to capacity shortfalls.			x		TFM units make decisions on individual flights without knowledge of user's operating conditions.	Implement Collaborative Decision Making to allow users to optimize their operation. Options should include flight substitution, rerouting, creating new flights, adding/removing stops, etc.	Collaboarative routing etc. is working on this.
Planning and Dispatch	ADF	International and oceanic traffic not included in traffic flow management.			x		ETMS database does not include international flights.	Include international flights in database.	ETMS does include Part 129 and Flag flights in US airspace, also many European areas included.
Planning and Dispatch	ADF	Information exchange with TFM fragmented.			x		Information is exchanged through ETMS, NOTAMS, ATIS, and various telephone connections.	Include all information in a single database with a transparent and functional interface.	Some discussions occurring about datafeed to AOC databases vs. one large database; large database concept more popular as we speak.
Planning and Dispatch	ADF	Lack of demand data for NAS resource managment	x	x	x		Flight plan information limited.	Expand flight plan data.	Several efforts in progress on this one.

		decisions.							
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**Table B-11  
ADF Needs Matrix**

<b>Operational Phase</b>	<b>Org.</b>	<b>Operational Deficiency Description</b>	<b>S</b>	<b>C</b>	<b>E</b>	<b>Other Perf. Obj.</b>	<b>Technical/Operational Causes (Across the System)</b>	<b>Potential Solution</b>	<b>Comments</b>
Planning and Dispatch	ADF	GA and DOD lack information on TFM program in effect.	x		x	Afford	GA and DOD lack access to ETMS database, system resource status and TFM programs	Make data available to GA and DOD users.	GA is a real problem.
Planning and Dispatch	ADF	Users are concerned about confidentiality of operational information.			x	Privacy	Data sharing could cause loss of confidentiality.	Ensure protection of confidential data.	CDM data integration group and AOCnet oversight group working on this one.
Planning and Dispatch	ADF	Central Flow lacks real time weather information; users have better weather information.	x		x	Afford	Weather data is not universally available.	Include weather data in the database.	