JOINT PLANNING AND DEVELOPMENT OFFICE

NATIONAL AVIATION SAFETY STRATEGIC PLAN

VERSION 1.0B

10 JUNE 2011

<blank>

EXECUTIVE SUMMARY

The *National Aviation Safety Strategic Plan* (*NASSP*) defines national goals, objectives, and strategies for aviation safety improvements. The plan provides a basis on which the Joint Planning and Development Office (JPDO) government partners can plan their aviation safety resources and to which the Office of Management and Budget (OMB) can align budgets relative to aviation safety. The plan is organized into three goal areas: Safer Practices, Safer Systems, and Safer Worldwide.

Safer Practices emphasizes an integrated, systematic approach to safety risk management through implementation of formalized Safety Management Systems (SMS) that incorporate safety data analysis processes, advancing current capabilities to assure the successful transition to and operation of the Next Generation Air Transportation System (NextGen). The objectives of safer practices are to *provide consistent safety management approaches that are implemented throughout government and industry*; to *provide enhanced monitoring and safety analysis of the Air Transportation System*; and to *provide enhanced methods for ensuring safety is an inherent characteristic of the Next Generation Air Transportation System.*

Safer Systems emphasizes implementation of safety-enhancing technologies, which will improve safety through human-centered interfaces and improvements for airborne and ground-based systems. The objectives of safer systems are to *provide risk reducing systems interfaces*; to *provide safety enhancements for airborne systems*; and to *provide safety enhancements for ground-based systems*.

Safer Worldwide provides strategies for coordinating the adoption of technologies, policies, and procedures worldwide such that safety improvements are commensurate with increases in demand to achieve the maximum level of safety across Air Transportation System boundaries. The objectives of safer worldwide are to *develop and implement safer practices and safer systems worldwide* and to *establish equivalent levels of safety across Air Transportation System boundaries*.

The *NASSP* was developed by the JPDO Safety Working Group and vetted by the JPDO government partners and through close collaboration with subject matter experts and industry stakeholders. This plan is a living document that the JPDO will maintain, review, and periodically update to ensure that an appropriate safety focus is maintained and effective safety management approaches and technologies are identified, assessed, and implemented.

<blank>

TABLE OF CONTENTS

EXECUTIVE SUMMARY **3**

TABLE OF CONTENTS **5**

ACRONYMS **7**

BACKGROUND **9**

INTRODUCTION **13**

GOALS & OBJECTIVES **15**

Goal 1: Safer Practices 15

Objective 1A – Provide consistent safety management approaches that are implemented throughout government and industry 16

Objective 1B – Provide enhanced monitoring and safety analysis of the Air Transportation System 20

Objective 1C – Provide enhanced methods for ensuring safety is an inherent characteristic of the Next Generation Air Transportation System. 22

Goal 2: Safer Systems 24

Objective 2A – Provide risk reducing systems interfaces 25

Objective 2B – Provide safety enhancements for airborne systems 27

Objective 2C – Provide safety enhancements for ground-based systems 29

Goal 3: Safer Worldwide 31

Objective 3A – Encourage development and implementation of safer practices and safer systems worldwide 32

Objective 3B – Establish equivalent levels of safety across Air Transportation System boundaries 33

SUMMARY **37**

DOCUMENT REVISION HISTORY **38**

<blank>

ACRONYMS

ASAP – Aviation Safety Action Programs

ASIAS – Aviation Safety Information Analysis and Sharing

ASRS – Aviation Safety Reporting System

ATM – Air Traffic Management

ATS – Air Transportation System

FOQA – Flight Operational Quality Assurance

GASR – Global Aviation Safety Roadmap

GPS – Global Positioning System

ICAO – International Civil Aviation Organization

IWP – Integrated Work Plan

JPDO – Joint Planning and Development Office

MOQA – Maintenance Operational Quality Assurance

NAS – National Airspace System

NASA – National Aeronautics and Space Administration

NASSP – National Aviation Safety Strategic Plan

NCARC - National Civil Aviation Review Commission

NextGen – Next Generation Air Transportation System

OMB – Office of Management and Budget

SESAR - Single European Sky Air Traffic Management Research

SMS – Safety Management System

SPC – JPDO Senior Policy Committee

SRM – Safety Risk Management

WG – Working Group

<blank>

BACKGROUND

The United States' Air Transportation System (ATS) facilitates the safe and efficient movement of people and goods around the globe and serves as a critical economic engine for the nation. The existing ATS is reaching the limits of its potential for growth and it is not scalable to safely accommodate future demand.[1] Improvements are needed to safely accommodate increasing demand. Failure to accommodate this growing demand in the years ahead will result in costly travel delays throughout the system and will almost certainly compromise the Country's ability to create jobs and economic growth.[2]

In 2003, President George W. Bush and Congress took a significant step toward transforming the ATS with the enactment of the Vision 100 – Century of Aviation Reauthorization Act (Pub.L. 108-176). The Vision 100 Act established a mandate for the Next Generation Air Transportation System (NextGen) initiative to achieve goals that include accommodating a significant increase in demand for air transportation, accommodating a wide range of users and operations, and improving aviation safety.

Federal responsibility for various aspects of the air transportation system is dispersed among several agencies, each with its own program responsibilities, policy priorities, and budgets. To meet U.S. civil aviation, national defense, and homeland security challenges, a national, transformational effort is required that aligns and integrates the air transportation-related missions, strategic visions, and activities of these agencies.[3]

To this end, the Vision 100 Act established a charter to transform the U.S. air transportation system into the Next Generation Air Transportation System by the year 2025. Vision 100 tasked the Department of Transportation to lead this transformational effort, in close coordination with U.S. government stakeholders, and the congressionally mandated Joint Planning and Development Office (JPDO) was implemented pursuant to the Act. The JPDO is tasked to operate in conjunction with relevant programs in the Department of Defense (DoD), the National Aeronautics and Space Administration (NASA), the Department of Commerce (DoC) and the Department of Homeland

[1] FAA Air Traffic Organization, 2006 Annual Performance Report, pg. 32

[2] Letter from Norman Mineta, Secretary, Chairman, Senior Policy Committee, and Marion Blakey, FAA Administrator, dated 12 December 2004, transmitting to Congress the Integrated National Plan for the Next Generation Air Transportation System: *Next Generation Air Transportation System Integrated Plan. 2004,*

[3] Memorandum of Understanding among the Department of Transportation, Department of Commerce, Department of Defense, Department of Homeland Security and National Aeronautics and Space Administration for the next generation air transportation system joint planning and development.

Security (DHS). The JPDO is tasked to consult with the public and ensure the participation of experts from the private sector, including commercial aviation, general aviation, aviation labor groups, aviation research and development entities, aircraft and air traffic control suppliers, and the space industry.[4]

Vision 100 directed the Secretary of Transportation to establish and chair a Senior Policy Committee (SPC) to work with the JPDO. SPC members include, in addition to the Secretary of Transportation, the Administrators of the FAA and NASA, the Secretaries of Defense, Homeland Security, and Commerce, and the Director of the Office of Science and Technology Policy (OSTP), (or their respective designees) and designees from other Federal agencies determined by the Secretary of Transportation to have an important interest in, or responsibility for, other aspects of the system.[5]

The SPC oversees JPDO work, including NextGen plan development. The SPC members are responsible for execution of NextGen strategies and plans by their respective departments, agencies, or offices. Among its key activities, the SPC works to provide policy guidance, resolve major policy issues, and identify and align resource needs. Agreed to by the JPDO agencies, the *Next Generation Air Transportation System Integrated Plan,* the first product of this groundbreaking effort, was delivered by the JPDO to Congress in December 2004.[6] The SPC is responsible for approving the *National Aviation Safety Strategic Plan (NASSP)* as a supplement to the *Next Generation Air Transportation System Integrated Plan*.

In addition to responding to the social, economic, political, and technological changes that are evolving worldwide, this transformation must ensure that NextGen meets the country's air transportation safety, security, mobility, efficiency, and capacity needs. The JPDO is charged with developing the concepts, architectures, roadmaps, and implementation plans for transforming the current national ATS into the Next Generation Air Transportation System. JPDO tasking includes overseeing research and development on NextGen systems, reviewing activities relating to safety conducted by the Federal Agencies comprising the JPDO, and coordinating goals and priorities and research activities within the Federal Government with United States aviation and aeronautical firms.[7] Upon endorsement of the NASSP by the SPC members, the member agencies and the JPDO will consider the NASSP in carrying out their

---

[4] Vision 100 – Century of Aviation Reauthorization Act, Public Law 108-176, Section 709-710

[5] Ibid

[6] Joint Planning and Development Office. *Next Generation Air Transportation System Integrated Plan. 2004,* http://jpdo.gov/library/NGATS_v1_1204r.pdf.

[7] Memorandum of Understanding among the Department of Transportation, Department of Commerce, Department of Defense, Department of Homeland Security and National Aeronautics and Space Administration for the next generation air transportation system joint planning and development.

responsibilities with regard to NextGen safety. The JPDO engages in an annual planning process to analyze, define, coordinate, and synchronize NextGen research, development, and implementation plans with JPDO government and industry partners, resulting in the publication of the JPDO Integrated Work Plan[8] (IWP). The NASSP will be revised periodically to ensure that an appropriate safety focus is maintained and effective safety management approaches and technologies are identified, assessed, and implemented.

[8] The plan is accessible at http://www.jpdo.gov/iwp.asp.

<blank>

INTRODUCTION

The JPDO Safety Working Group (WG) is tasked with developing products and plans for achieving the NextGen safety goals. The JPDO Safety Working Group chartered a Strategic Planning Standing Committee, comprised of public and private stakeholders, to develop the *National Aviation Safety Strategic Plan* (*NASSP*). The *NASSP* provides strategies for achieving NextGen safety goals through practice, procedure, and system improvements implemented domestically and coordinated worldwide. The plan defines the objectives and strategies that will ensure aviation safety increases are commensurate with the growing demands on the ATS. When adopted by the JPDO, the plan will provide a basis on which the JPDO government partners can plan their aviation safety resources and to which the Office of Management and Budget (OMB) can align budgets relative to aviation safety. Such planning and prioritization will take into account the planning, programming, budgeting, and execution cycle for all JPDO government partners in order to optimize the meeting of each partners' mission requirements.

A common vision for safety, safety goals, and safety metrics will drive all aviation system improvement activities and investments. This vision includes safety risk management, operating procedures, and technologies designed for enhanced safety, with regulations and technologies implemented consistently worldwide.

The vision of the NASSP is for a transformed Air Transportation System that is inherently safe, employing comprehensive, proactive safety practices and safer systems that enable the realization of the national goals for air transportation.

The following pages outline the specific goals, objectives, and strategies of the *NASSP*. The safety objectives and strategies are organized into three goal areas: Safer Practices, Safer Systems, and Safer Worldwide. **Safer Practices** emphasizes an integrated, systematic approach to safety risk management through implementation of formalized Safety Management Systems (SMS) that incorporate safety data analysis processes, and the enhancement of methods for ensuring safety is an inherent characteristic of NextGen. **Safer Systems** emphasizes implementation of safety-enhancing technologies, which will improve safety for human-centered interfaces and enhance the safety of airborne and ground-based systems. **Safer Worldwide** encourages coordinating the adoption of the safer practices and safer systems technologies, policies and procedures worldwide, such that the maximum level of safety is achieved across national ATS boundaries.

<blank>

GOALS & OBJECTIVES

The goals of NextGen include accommodating a significant increase in demand for air transportation, accommodating a wide range of users and operations, and improving aviation safety. These goals will be achieved through a combination of new policies, procedures, and technologies.

There are three specific goals of the NASSP: Safer Practices, Safer Systems, and Safer Worldwide. Each goal has numbered objectives, with multiple associated strategies (in boldface type). The numbering and ordering of goals, objectives, and strategies are for reference only and do not suggest any prioritization or temporal relationship among them.

Goal 1: Safer Practices

Safety is assured by applying consistent safety management approaches; comprehensive safety information sharing, monitoring and analysis; and developing NextGen to have inherent safety

An overarching aspect of the Safer Practices goal is the integration of safety within all NextGen concepts and during the transition from today's National Airspace System (NAS) to NextGen, assuring safety in all aspects of design, implementation, and operation. Manufacturers, those responsible for systems acquisition, and operators alike share a common responsibility to each other and to the public to ensure that their decisions and actions maintain or enhance systemic safety.

To support the priority of safety within each of the participating organizations, safety management systems will be established. These systems require written policies and procedures, along with formal data collection, analysis, and communication protocols. The SMS processes will be continually evaluated for their effectiveness in enhancing safety. SMSs, together with a positive safety culture, encourage and empower management and front line operators to communicate and act to reduce risk.

To support the priority of safety at a national level, cooperative partnerships between government and industry will be critical in the area of information sharing. Innovative methods of data access and analysis for safety risk management will aid in risk identification across operators and sectors, leading to a higher national standard for safety. An essential component for a meaningful and effective transition to system-wide, routine, safety information sharing is acceptance and promotion of the perspective that safety reporting must be a protected aspect of safety assurance.

To ensure the safety of NextGen operations, the overall structure of NextGen operating concepts and their corresponding, detailed operating procedures must be purposely designed to improve safety. This requires predictive methods of analyzing their potential safety impact before and throughout their implementation.

Objective 1A – Provide consistent safety management approaches that are implemented throughout government and industry

The International Civil Aviation Organization (ICAO) adopted a mandate to implement a systematic approach to safety management, referred to as a SMS by its member states. An SMS provides a systematic and deliberate approach to safety management in four key areas identified as safety policy, SRM, safety assurance, and safety promotion. SMSs establish safety involvement and accountability at all organizational levels by using management principles, practices, and procedures geared towards the identification and control of risk and the promotion of a positive safety culture.

Inherent in any successful SMS is the understanding that SMS protocols by themselves are unlikely to promote substantive change and that achieving positive safety changes requires a positive safety culture. Organizations foster a positive safety culture through strong safety leadership. Hallmarks of successful leadership include actively seeking employee participation in the safety improvement process, seeking systems solutions for individual errors, and implementing a dynamic safety program that continually refines standards of excellence. Management's commitment to safety is made evident through leadership by example and systematic attention to safety matters, not just by establishing policies. The characteristics of a positive safety culture are defined in the JPDO *Safety Culture Improvement Resource Guide*,[9] which includes tools to measure safety climate and culture, and recommendations for how to promote a positive safety culture.

The following strategies will be adopted to support the implementation of SMS throughout government and industry, and to improve the processes, tools, and procedures associated with safety management.

Implement the National Safety Management System Standard.[10] Formal safety management approaches, many of which systematize safety management, are in

[9] See the *Safety Culture Improvement Resource Guide*, written by the Safety Culture Study Team of the JPDO Safety Working Group, for specific tools and guidance in helping JPDO government partners create a positive safety culture.
http://www.jpdo.gov/library/InformationPapers/Safety_JPDO_SC1G_v1.0.pdf

[10] See Safety Management System Standard.
http://www.jpdo.gov/library/InformationPapers/JPDO_SMS_SPC_v1_4.pdf

use today within many aviation organizations. The value of formal SMSs is in the comprehensive and systematic approach they provide to address safety. Multiple approaches are taken in the identification of potential safety issues and in the management of known risks, including the development of written policies and procedures, establishment of accountability structures, implementation of data collection and analysis routines, and support for safety promotion. These processes enable a multi-directional flow of information in which management communicates safety information and directives clearly and routinely to employees, who, in turn, provide feedback regarding the effectiveness of safety procedures, policies, and potential risk factors. Standardization and interoperability of these aviation safety management approaches would permit integration of safety management goals and results at a national, system-wide level.

The remaining strategies associated with SMS focus on improvements within each of the four key areas in the SMS Standard.

Improve safety policy. The general policy requirements of the SMS Standard oblige organizations to document safety policies and to promote the growth of a positive safety culture. It also addresses safety planning, organizational structures and responsibilities, compliance, operational procedures and controls, emergency preparedness and response, and documentation and recordkeeping requirements. It requires organizations to commit resources to implement and maintain SMS policy recommendations and standards. These measures will promote safety throughout the entire lifecycle of an organization and the growth of a strong safety culture.

The SMS Standard establishes what organizations must do, but offers no prescription for how to meet its requirements, nor advice on what methodologies are most effective. As the SMS Standard is implemented by aviation organizations, and as NextGen evolves, efforts to determine and document the effectiveness of various methods used to comply with the SMS Standard's policy requirements must be used to improve its policy requirements and to develop guidance. Consideration of the effectiveness of the SMS Standard's policy requirements in meeting national safety objectives must be part of this effort.

Improve safety risk management. The SMS Standard identifies a five-step, cyclic process associated with SRM. Although it may be entered at any of the five steps, it typically begins with describing the system, and then progresses through identification of hazards, analysis of the risk the hazards pose, assessment of that risk to determine its acceptability, and if unacceptable, through implementation of controls to mitigate the risk. The mitigations' effects on the system result in feedback to the other process elements, and when the risk is determined to be acceptable, the system is permitted to operate and the safety assurance function of SMS is used to monitor ongoing operations.

Improving risk management capabilities will provide decision-makers with more accurate information, will help prevent the assumption that a lack of negative outcomes signifies negligible risk, and ultimately, will increase the likelihood that intended safety outcomes are achieved. Reducing the SRM process to customary procedures and increasing stakeholders' confidence in the results will reduce the overall risk management cycle time, which will reduce the potential for recurrence of incidents and accidents from known risks.

Coincident with the development of advanced methods for risk management is the opportunity to develop and refine advanced methods to monitor operational risk in complex systems.

Improve safety assurance processes. Safety assurance is defined within the SMS Standard as a set of management functions that systematically provide confidence that organizational outputs meet or exceed safety requirements. Safety assurance functions include information acquisition, analysis, assessment, and corrective action. Key aspects of information acquisition include encouraging reporting, and timely, fair investigation of reports and incidents. Communicating information on new hazards, implementing corrective actions, and reviewing the effectiveness of the SMS itself restarts the safety assurance cycle.

The functions of safety assurance focus on monitoring for known risk and identifying new risk in operational systems. Risk can result from failure of risk mitigations to perform reliably, or as outcomes unanticipated by the application of the SRM process when making deliberate changes to a system. Risk can also arise from unintended changes that are introduced to the system without appropriate scrutiny.

Current safety assurance practices are generally limited to monitoring for known risks. The search for unrecognized risk focuses on identifying vulnerabilities in the system and assessing the risk they pose. This search requires consideration of all aspects of the aviation system. In the future, all users must be able to report vulnerabilities, and their investigation must be fully supported. Vulnerabilities do not necessarily represent hazards, but rather areas of interest that warrant additional analysis to determine their importance. In particular, support is needed for research that focuses on aspects of operations that do not exceed prescribed limits, but fall outside the expected performance of the system, and for anticipating risk from evolving technology.

Elements of known system-level safety risks can be identified and rated for their contribution to a specific risk. However, it is much more difficult to determine the contribution of a singular action to a system-level risk outcome. This bottom-up method of analysis is possible when modeling the interactions and influences of each system

component on the remainder of the system. Methods are needed to reliably predict risk prior to its appearance as incidents or accidents. Advanced analytic tools with the capacity to synthesize data from numerous diverse databases, coupled with improved modeling and simulation capabilities, will make it possible to identify and accurately assess risks in operational systems.

Improving safety assurance processes will help identify developing hazards in the system, increase conformance with safety requirements, and improve responses to known risks.

Increase safety promotion. Senior management is a key promoter of safety at all levels,[11] and sets the stage for middle management and front-line operators in realizing the priorities of the organization. Within an SMS framework, organizations promoting safety will do so by communicating valuable safety information gained from risk assessments and risk data collection, by promoting awareness of the organization's documented safety guidelines and priorities, and by securing safety feedback as an integral part of the safety improvement process. Communication, awareness, and interaction are as valuable with employees as they are with affected outside parties, such as stakeholders and oversight organizations. Proactive safety knowledge management manifests itself through organizational responsibility and responsiveness to information received from all sources. Organizations that promote safety ensure that aviation safety leaders, middle management, and front-line supervisors are knowledgeable in the areas of risk pertinent to their area of operation, are competent in managing this risk, and share information across organizational and sector boundaries. All personnel, however, should be trained to identify, report and, if possible, to mitigate risk. Organizations that value this competency will allow managers the flexibility in time-critical safety decisions to rely on front-line operators.

The goal of safety promotion is to go beyond simply meeting regulations and documenting and assessing safety risk. It also includes guidelines for creating a positive safety culture - an environment in which leaders show the value of safety by routinely attending to safety-critical factors, [12] and where employees feel empowered to communicate risks and involve themselves in the safety improvement process.

[11] See the *Safety Culture Improvement Resource Guide*, written by the Safety Culture Study Team of the JPDO Safety Working Group, for specific tools and guidance in helping JPDO government partners a positive safety culture. http://www.jpdo.gov/library/InformationPapers/Safety_JPDO_SC1G_v1.0.pdf

[12] Hopkins, A. (2005). *Safety, Culture, and Risk: The Organizational Causes of Disasters.* CCH Australia Limited; Sydney, Australia

Objective 1B – Provide enhanced monitoring and safety analysis of the Air Transportation System

Current risk assessment practices involve collecting data as a means of identifying and monitoring for indicators of risk, in addition to monitoring for accidents and a limited, prescribed set of incidents. Operators collect and analyze data through Flight Operational Quality Assurance programs, Maintenance Operational Quality Assurance programs, and Aviation Safety Action Programs (ASAP). In accordance with FAR Part 193, commercial operators may voluntarily share safety information with the FAA, which uses it to carry out its safety responsibilities while protecting it from disclosure. The Aviation Safety Reporting System (ASRS), operated by NASA, also provides the means and motivation for individuals to report safety related incidents on a voluntary basis, bringing safety issues to light for all aviation stakeholders. The FAA's Aviation Safety Information Analysis and Sharing (ASIAS) program seeks to create coalescent access to these and other data to better understand aviation safety issues. Maintaining safety in an increasingly complex ATS will require building from these programs to develop a more proactive approach.

Broader access to and increased analysis of aviation system data would permit a more proactive safety approach that uses leading, as well as lagging, safety risk indicators. Routine access across the organizational boundaries of air traffic system regulators, air traffic service providers, aircraft operators, and supporting elements would enable the monitoring of a more comprehensive set of risk indicators. However, several factors challenge this access, including data protection concerns and data analysis challenges. These include privacy, liability, and data ownership concerns, and the inherent complexity of synthesizing data with a variety of sources, types, and formats.

This objective focuses on actively managing risk in the aviation system through a continuous process that monitors and analyzes data for safety risk. It begins by increasing access to operational data and extends to the application of advanced analytic methods. Increased data, in and of itself, may not guarantee an abundance of useful information. A critical component of progress in predicting and mitigating safety risks through analysis is identifying the most appropriate data for such use. For this reason, stakeholders must engage in planning to ensure that key information is made accessible, and that it meets minimum standards for data integrity, reliability, and validity. The following strategies will be adopted towards enhanced monitoring and safety analysis of the ATS.

Increase data access for safety risk management by implementing policies that permit timely data access throughout government and industry for the sole purpose of safety analysis. This will require providing and enhancing protections for data shared by government agencies and industry, implementing information technologies that

permit secure remote access, and enacting penalties for inappropriate access, use, and/ or release. Increased data access would permit both government and industry experts to examine more comprehensive data for risk factors than could be accessed within each individual organization.

Increase data analysis for safety risk management. In addition to compromising data sharing, concerns regarding data access have also limited the development and availability of data analysis and risk modeling and simulation tools. The development of advanced safety data analysis tools, and the application of current and future tools to the ATS change process, is necessary to ensure system safety is maintained or improved as NextGen evolves.

Under NextGen, analysis needs to go beyond traditional causal factor monitoring to seek new and proactive methods to identify incident and accident precursors. An increasing and more diverse set of data sources will enable advanced methods of analysis and more meaningful and widely applicable results. Simply increasing the quantity of data analyzed without ensuring the data is relevant and sufficient to support the analyses is inadequate. Automation at all levels of analysis will free experts to explore data to identify hazards, allowing a broader analytic scope. Increased analysis will provide earlier detection of safety risks associated with a wider range of operations than is possible today.

Develop prognostic methods to assess risks. Analysis of historical data is limited in its ability to assess potential risks associated with future ATS changes. Prognostic risk assessment focuses on predicting risk. The research community has applied a variety of modeling and simulation methods to this problem. The ATS is an emergent system; that is, system-level behaviors result from the collective behaviors of the system's individual elements. Agent-based simulation relies on the emergent system property to predict system-level behaviors using elemental agents that act and interact within an environmental construct. Air traffic simulations have demonstrated the ability to replicate existing air traffic system behaviors when incorporating cognitive human performance models into controller and pilot agents. Modeling techniques using event trees and inference rules to map interactions between nodes have shown potential for adaptation from forensic to prognostic use. Additional research on these and other prognostic methods of risk assessment will yield the ability to predict certain risks based on validated analytic methods. This activity will support safety risk management decisions associated with making changes to the ATS at the rate and of the scope envisioned under the NextGen plan.

Increase confidence in analytical results by demonstrating the validity of the analytic techniques and the reliability of the results. Inherent to achieving this is ensuring that the data meets minimum standards for integrity, and that the most appropriate and useful data are analyzed. Unambiguously characterizing data sources,

models, and simulations to identify the limitations associated with them is critical to placing confidence in their results. The NextGen information sharing environment will provide the opportunity to collaboratively define, document, share, and manage the methodologies, tools, and algorithms used for processing accurate and standardized data. Effectively communicating the basis for increased confidence to decision makers will serve to reduce uncertainty among industry stakeholders in devoting valuable resources for the correction of safety concerns.

Objective 1C – Provide enhanced methods for ensuring safety is an inherent characteristic of the Next Generation Air Transportation System.

The transition from today's ATS to NextGen will be a lengthy and critical process. This objective focuses on advancing current capabilities in four key areas needed to assure the successful transition to and operation of NextGen. They are system safety assessment capabilities, complex system validation and verification processes, operational procedure development, and training.

Advance capabilities for integrated safety assessment. New assessment techniques are needed to consider safety from a macro perspective to ensure that, as systems become more complex, our understanding of and ability to manage system safety risk is maintained or enhanced. Rapid prototyping of complex systems is a critical component of this macro-level understanding, permitting system developers to engage in full mission simulation aimed at the identification of system safety considerations.

Ultimately, adaptation of analytic tools used to consider system-wide interactions is needed to monitor system safety performance in real or near real-time to speed the discovery of unrecognized system safety risks. While these tools may provide early detection of system safety risks, they will be limited in their ability to predict them. Thus, work is needed to develop reliable predictions of system safety risk based on individual behaviors, both in nominal and in off-nominal conditions. Although prediction for human behavior is less reliable than for technology, reasonable estimations of human performance can be simulated to determine whether the system meets an acceptable level of risk.

Advance complex system validation and verification methods in support of operational use. Under NextGen, automated systems will assume responsibility for operational elements that are performed today by humans. As direct human control of system functions is removed from the system, it will be critical to ensure that automated systems perform these functions with sufficient reliability to guarantee acceptable levels of safety. System design must enable human operators to ensure appropriate system functioning. If the automation expands the capacity of the system beyond what is safely possible with human operators, it will not be possible to safely revert to human

performance of these functions in the presence of system failures. Therefore, redundancy to prevent critical failures and automated recovery mechanisms to deal with critical failures must be designed into future automation.

Developing requirements for NextGen systems will be a significant engineering challenge. The requirements validation process will ensure that they reflect the intended capabilities of the system. Verification will ensure that systems, including software, meet the validated requirements and are not associated with unintended or undesirable behaviors. Validation and verification methods are relatively well understood for purely mechanical systems performing simple functions. For complex systems, testing all possible behaviors of interactive software-intensive systems is considered impractical. Therefore, research is needed to develop improved methods for validation and verification of complex systems, including software and operational procedures, in support of their certification for operational use.

Enhance the focus on safe operational procedures. NextGen concepts will be realized through the execution of new and improved operational procedures. The safety of these operational procedures must be assured at multiple levels beginning with an examination of the overall structure of NextGen and its concepts. As NextGen Operational Improvements are refined and their enabling technologies are developed, continued focus on their safety implications must be maintained and safety requirements must be integrated into the development of operational procedures associated with them. Rapidly evolving human roles and responsibilities, as well as human-centered interfaces, will be associated with technological advances. The procedures developed to make use of these advances must focus on effective information management and use of decision aids, enhanced communication, and situation awareness, all geared towards supporting human performance and robust operation in degraded conditions.[13]

At every level of the system, SRM and validation and verification processes must be informed by knowledge of the operational procedures that define the intended use of new ground-based and airborne systems in all NextGen domains.

Advance training concepts for safe system operation. Training programs, if designed effectively, ensure that all operators carry out operational procedures as intended, and in a consistent and standardized manner. Enhancements in training methods and scope will be required to support a successful transition to NextGen, with new and advanced systems and procedures, and new roles and responsibilities across

[13] For an overview of principles for the advancement of human-computer interaction in the aviation domain, see: FAA Human Factors Team Report on: The Interfaces Between Flightcrews and Modern Flight Deck Systems. June 1996.

an array of domains. With advances in technology, operators will be trained as operations monitors, with automated systems performing many of the functions now routinely performed by humans. As humans perform these functions less frequently, if they are expected to do so in response to system degradation or failure, new methods for maintaining proficiency and retention will be needed.

Training methods will be developed and verified to meet the needs of new human-centered interfaces and methods of communication, with a focus on individual and group situation awareness.[14] To this end, crew resource management will be a tool for front-line operator teams across the aviation system: flight and cabin crews, dispatch and air traffic controllers, and ground and maintenance crews. In addition, combined crew resource management training will be provided for groups whose interactions are critical to operational safety, providing greater understanding of the roles, responsibilities, challenges, and resources of other front-line operators.

As with operational procedures, the process of improving training protocols and guidelines should be dynamic, incorporating valuable feedback from multiple sources collected via processes outlined in the SMS. Training is no substitute for solid design and procedures. Inefficiencies in procedures or system design must be identified and addressed.

Goal 2: Safer Systems

Aviation system technologies are aimed at managing hazards, eliminating recurring accidents, and mitigating accident and incident consequences

NextGen operational requirements for both ground-based and airborne systems will lead to the implementation of advanced technologies with improved capabilities in all NextGen domains, including the following: communication, navigation, and surveillance; Air Traffic Management (ATM); vehicle systems; manufacturing methods; vehicle and ground systems health management; maintenance; and human-centered interfaces for air and ground systems. The integration of safety-derived requirements and safety-specific functions and technologies within all NextGen domains, as well as the implementation of safety-focused systems will be required to achieve NextGen safety goals.

[14] For a discussion of the value of developing enhanced procedures and training guidelines on countermeasures for lack of situation awareness (hazardous states of unawareness), see: 1996 FAA HF REPORT.

Objective 2A – Provide risk reducing systems interfaces

For the time epoch of this plan, the overall safety and efficiency of the ATS will depend upon human operators as the ultimate integrators of the numerous space, air, and ground elements. Understanding and accounting for the role of humans, and their positive and potentially negative contributions, will be important to maintaining and improving safety, while also improving efficiency. While data exist on human error, empirical data on humans' positive contributions are lacking. A review of aviation accidents indicates that human error continues to be a primary contributing factor in commercial, public-use, and general aviation accidents.[15] However, numerous events can be cited where humans found and successfully compensated for a wide variety of vulnerabilities and inefficiencies in design, implementation, training, procedures, and operations. Humans are able to react to unknowns and unexpected events by applying experience, learned skills, innovation, and general knowledge.[16]

The best human performance depends on effective and timely communication. In many cases, errors result from failures in the transfer or communication of critical information.[17] Typical failures include operator misinterpretation of information presented by automated systems or in written guidance, unfamiliarity with systems or information, failure to monitor systems states, or miscommunication between key operators. Automation, if not designed and trained properly, can increase the chances for human error.[18] NextGen systems must increase operators' potential to detect, understand, and successfully respond to unanticipated situations.

Human cognitive processing capability, communication, and coordination must be supported. One key element is situation awareness. Situation awareness includes the *state* of awareness, which encompasses an accurate perception of elements in the environment within a volume of time and space (the situation), an accurate

---

[15] AOPA Air Safety Foundation (2006). *Nall Report: Accident Trends and Factors for 2005*, http://www.aopa.org/asf/publications/06nall.pdf. See also Dismukes, R. K., Berman, B. A. & Loukopoulos, L. D. (2007). *The Limits of Expertise: Rethinking Pilot Error and the Causes of Airline Accidents.* Ashgate Publishing Company, Burlington, VT, pages 275 through 288. See also Boeing Statistical Summary (May 2005), Hull Loss Accidents - Worldwide Commercial Jet Fleet 1995 through 2004.

[16] Final Report of RTCA Task Force 4 – Certification, Feb. 1999

[17] Schroeder, D.; Bailey, L., Pounds, J., Manning, C. U.S. Federal Aviation Administration (FAA) Office of Aerospace Medicine. DOT/FAA/AM-06/21. *A Human Factors Review of the Operational Error Literature'*. August 2006. 66 pp. Available via the Internet at http://www.faa.gov/library/reports/medical/oamtechreports/2000s/media/200621.pdf.

[18] Skitka, L. J., Mosier, K. L., Burdick, M., & Rosenblatt, B. (2000). Automation bias and errors: Are crews better than individuals? *International Journal of Aviation Psychology, 10(1)*, pp 85-97. See also Endsley, M. R., & Kiris, E. O. (1995). The out-of-the-loop performance problem and level of control in automation. *Human Factors, 37(2)*, pp 381-394.

comprehension of their meaning, and the ability to make an accurate projection of their status,[19] and the *process* of achieving this state of awareness. Some cognitive processing activities critical to dynamic, event-driven, and multi-task decisions, such as those required of pilots, controllers, and dispatchers, include sensory perception, memory, attention, and categorization. To respond adequately and efficiently, to make productive decisions, and to communicate effectively, it is essential that the operator have an accurate awareness of their situation.

Therefore, a primary consideration in the design of risk reducing systems is to increase operator situation awareness across a host of dimensions, defined by the goals and decision tasks for a particular operator's job. For pilots, this might include temporal and spatial positioning, as well as an acute awareness of the system state, limits, and future sequences. In nominal conditions, greater awareness of systems health will help to prevent accidents through actions taken by operators to ensure that operational demands do not exceed system capabilities. In off-nominal conditions, operators and maintainers will be able to mitigate the consequences of a failure or undesirable system state through timely responses in intervening, managing and restoring full system capabilities. Especially in the presence of partial system failures, both operators and maintainers will need an accurate awareness of systems health, for both aircraft and ATM systems. Systems designed to increase situation awareness will provide operators with relevant information in an accessible, understandable, and usable format.

This objective focuses on effective and safe systems interfaces that improve individual and collaborative situation awareness, information management, and decision making. It includes human-to-human, human-to-automation and automation-to-automation interfaces. It emphasizes the exchange and presentation of information, the means to obtain information for sound decision-making, and the appropriate role of humans, human interaction, and automation in the future's highly automated systems needed to accomplish the NextGen goals. Though the primary focus will be on systems interfaces for the front-line operator (e.g. pilot, controller, maintenance technician, and security personnel), the same concepts extend to the larger population of users of information whose decisions directly or indirectly affect the front-line operator. The following four strategies will be adopted in the development and implementation of risk reducing systems interfaces.

Ensure the availability and accessibility of required information by providing and assuring the continuity of critical information and limiting the manipulation required for operator access. **Increase the usefulness and understandability of information,**

[19] Endsley, M. R., & Garland, D. J. (2000). Situation Awareness, Analysis, and Measurement. Lawrence Erlbaum Associates, Inc: Mahwah, NJ. Pages 5 to 6.

such that priority is given to critical information, that it is presented in a clear and concise manner, and is grouped and ordered in a consistent and logical sequence. Available, accessible, useful, and understandable information will be instrumental in decreasing operator confusion and increasing appropriate, timely, and accurate decision-making.

To meet demands for capacity and safety, the current trend toward automated systems with increased capabilities will continue. However, developing and implementing these systems responsibly will require that NextGen systems **maintain appropriate human engagement.** System designers must consider the benefits and limits of human performance in both nominal and off-nominal conditions to secure and maintain the operator's attention without exceeding their ability to interact and process. When system degradation prompts an automated reversion to lower system performance limits, automation-to-automation design integrity is critical. An appropriate allocation of human versus automation functions will decrease the possibility for authority-responsibility double binds where the human is responsible for the tedious monitoring of highly reliable automation, will allow the operator to successfully attend to and satisfy the most pressing tasks, and will provide the operator with a coherent set of tasks supported by reliable automated functions.

NextGen operational concepts will require more effective and efficient communication and collaboration between pilots, controllers, dispatch, and maintenance personnel, especially during off-nominal events. Therefore, **improve operational decision aids**, by developing decision-aiding automation for airborne and ground-based systems that assists appropriate operator interaction and intervention. A key component of developing decision-aiding interfaces is identifying the best methods to communicate critical information, and standardizing the training of these methods and required interactions. Improving operational decision aids and the communication of critical information in a timely and effective manner will help to reduce communication errors, decrease decision errors, and ultimately improve response to unforeseen events.

Objective 2B – Provide safety enhancements for airborne systems

In the Next Generation Air Transportation System, airborne systems will become an increasingly integral and diverse part of the overall ATM system. The JPDO *Concept of Operations for the Next Generation Air Transportation System*[20] proposes to include aircraft as interactive nodes on an ATM network under the Network Enabled Operations concept. It also identifies several key capabilities, such as Aircraft Trajectory-Based Operations, Equivalent Visual Operations, and Super Density

[20] Joint Planning and Development Office Concept *of Operations for the Next Generation Air Transportation System, Version 2.0*. 2007. http://www.jpdo.gov/library/NextGen_v2.0.pdf

Operations that will require aircraft automation systems to carry out functions that today are performed by air traffic control systems. Likewise, pilots, whether onboard, remote, or automated, will be required to take on responsibilities traditionally performed by air traffic controllers. To increase system throughput, reductions in aircraft spacing (longitudinal, lateral, and/ or vertical) in all operational phases of flight (including the ground phase) will be required. To minimize the risk of aircraft collisions and wake vortex encounters, barriers to reduced separation will be addressed, to include performance limits of communications, navigation, and surveillance systems.

This objective focuses on integrating safety requirements into the development and implementation of capacity-enhancing advancements for aircraft, to maintain or improve safety as capacity is increased. The following five strategies will be adopted in the development and implementation of airborne systems.

Improve the reliability and airworthiness of aircraft through increased reliability of control, avionics, software, and information management systems, as well as the long-term structural airworthiness of new materials and advanced aircraft designs. This strategy is aimed at reducing systems failures and reducing diversions or incomplete missions.

Improve vehicle systems health management through advanced monitoring systems and decision aids. These systems can monitor various aspects of systems health, both during flight and through post-flight analysis, including vehicle structures, propulsion systems, control system elements, and avionics hardware and software. To provide pilots, dispatchers and maintenance personnel with ready access to system health information, advanced aircraft monitoring systems will be developed that integrate sensor information. Integration of advanced monitoring systems will increase operators' timely and accurate understanding of system health, resulting in quicker identification of sub-system faults and failures and increased opportunity to successfully mitigate and prevent these failures. Enhanced decision aids will assist operators in preventing unacceptable safety risks from developing, enhancing operators' recognition and incorporation of complex factors in situation assessment and mitigative decision-making. To ensure an efficient response, certain system failures will precipitate automatic transition to alternate operating parameters, with backup procedures in the event of anomalous conditions. Executing this strategy will help to reduce the number of hazards encountered, enhance the understanding of off-nominal conditions, and reduce the response time in making optimal decisions, ultimately improving operator awareness and mitigative response to airborne events and hazards.

Increase the reliability and accuracy of airborne systems data and information by implementing strict controls on the acquisition and processing of information critical for air crew response in both nominal and off-nominal operating conditions. The data acquisition process must ensure the integrity of data through

quality checking for displayed data and for the execution of automated programming, especially those supporting automated reversion functions and automation-to-automation interfaces. Timeliness of data is critical to maintaining data accuracy and integrity for time-critical decisions. These controls will become increasingly important as aircraft are more highly integrated in the ATM system. This strategy will help to lower instances of system degradation caused by data latency, faults, and/ or failures, and increase air crew confidence in the use of and reliance on the data.

Ensure aircraft conformance to more stringent operations requirements; achieving many NextGen capacity gains will require a higher level of performance in some aspects of navigation, guidance and control, especially for reduced-separation and trajectory-based operations. Historically, uncertainties in navigation conformance have provided a certain measure of safety from collision. As these uncertainties are reduced and future procedures rely on reduced uncertainty, they must also permit trajectories to be adjusted in response to close-in conflicts and accommodate other causes of deviation from assigned trajectories to minimize the potential for collisions, near misses, runway incursions, and other losses of safe separation.

While it is preferable to prevent rather than mitigate the consequences of aircraft accidents, ultimately, it is not possible to prevent all accidents across all sectors of aviation under all operating conditions. Therefore, work must be undertaken to **increase aircraft system contributions to survival in crash scenarios**, with systems and technologies designed to mitigate the consequences and hazards associated with accidents, such as post-crash fires, toxic fumes, and impact loads. This will help to reduce fatalities and severe injuries from the levels sustained in accidents today.

Objective 2C – Provide safety enhancements for ground-based systems

NextGen concepts, such as Network-Enabled Operations, Aircraft Trajectory-Based Operations, and Super-Density Operations, require the integration of ground-based and airborne systems, and the introduction of collaborative air traffic control functions. Associated ground-based system safety enhancements must mitigate the risks associated with new or changing operational concepts. Considering the appropriate level and limits of automation and human performance will be critical to maintaining ATS safety. Ground-based support elements, such as aircraft and ATM maintenance systems, as well as airport infrastructure, must evolve to support the proposed capacity enhancing concepts of NextGen.

This objective focuses on increasing the level of safety with the advancement of ground-based systems to meet complex operational demands from an increasingly complex set of aviation stakeholders. In addition to the existing community of commercial, general aviation, rotorcraft, public use, and military users, and expanded reliance on unmanned aircraft by military and public use users, new operators and

operations of manned and unmanned aircraft and space vehicles must be accommodated by the ATS. The following four strategies will be adopted to assure safety in the development and implementation of ground-based systems.

Improve ground-based systems health management through advanced monitoring systems and decision aids. NextGen concepts will require new levels of automation in air traffic, maintenance, and other ground-based systems. These systems will be designed to meet increased demands during nominal operations and maintain integrity at degraded performance levels in off-nominal conditions. Operators of ground-based systems should have a clear understanding of the internal and external factors that affect their operation. The concomitant, relevant performance limits of the system must be respected to maintain safety. To improve operator awareness, advanced monitoring systems will continuously communicate system state information and detect system faults and failures. Integration of advanced monitoring systems will increase key operators' timely and accurate understanding of system health, resulting in quicker identification of system failures and increased opportunity for their successful mitigation and prevention. Enhanced decision aids will be developed to assist operators in preventing unacceptable safety risks from developing. They will enhance operator recognition and incorporation of complex factors in situation assessment and in decision-making. As with aircraft systems, maintaining the appropriate level of automation and human engagement will be critical. To ensure an efficient response, certain system failures will initiate automatic transition to alternate operating parameters, with backup procedures in the event of anomalous conditions. Executing this strategy will help to improve operator awareness and mitigative response to events and hazards by reducing the number of hazards encountered, enhancing the understanding of off-nominal conditions, and reducing the response time required to make optimal decisions.

Increase the reliability and accuracy of ground-based systems data and information by implementing strict controls on the acquisition and processing of information critical for ground-based system response in both nominal and off-nominal operating conditions. The data acquisition process must ensure the integrity of data through quality checking for displayed data and for the execution of automated programming, especially those supporting automated reversion functions and automation-to-automation interfaces. Timeliness of data is critical to maintaining data accuracy and integrity for time-critical decisions. These controls will become increasingly important as the ATS becomes more highly integrated. This strategy will help to lower instances of system degradation caused by data latency, faults, and/ or failures, and increase users' confidence in the use of and reliance on ground-based systems.

Ensure ground-based system conformance to more stringent operations requirements; implementing NextGen capacity enhancing concepts will require a

higher level of accuracy and complexity in ground-based systems in collaborating with advanced aircraft systems. Future ground systems will be designed to meet the requirements of reduced separation and trajectory-based operations. Strict conformance to these requirements will help to reduce deviations from assigned flight trajectories, fewer near miss and collision incidents and accidents, and fewer runway incursions.

As aircraft and air traffic system reliability has improved, the work associated with aviation safety has turned from mitigation of accidents and their consequences to their prevention. However, it is not possible to prevent all aviation accidents. We must **increase ground-based system contributions to survival in crash scenarios** by implementing advanced emergency detection capabilities, response methods, and airport infrastructure. These advancements will play a key role in the reduction of the severity of accidents, and provide a more timely and effective emergency response, leading to fewer fatalities and less severe injuries than those sustained in accidents today.

Goal 3: Safer Worldwide

System technologies, standards, regulations, and procedures are harmonized domestically and internationally to create an equivalent and improved level of safety across transportation system boundaries

U.S. citizens have come to expect the same level of safety when traveling internationally as they do in the U.S. This is because of aviation's excellent safety record in the U.S. NAS, because of safety improvements abroad, and because, for international itineraries, the transition between domestic and foreign operations is becoming seamless. One goal of the NextGen Integrated Plan is to "ensure safety", which includes an objective to "increase the safety of worldwide air transportation". Towards this end, the NextGen Integrated Plan proposes that JPDO encourage and participate in global safety practices and promote expansion of U.S. capability to meet national and international safety goals and objectives.

The U.S. Government actively advocates worldwide aviation safety and makes significant investments to protect its citizens both domestically and abroad. Part of this investment includes validating that foreign-built aircraft and air carriers operating in the U.S., as well as foreign repair shops performing maintenance for domestic carriers, meet U.S. safety standards. In addition, the U.S. military makes considerable investments and efforts to ensure the safety of aviation operations in foreign countries.

The United States also participates in aviation regulation on a global scale through its membership in ICAO, a specialized agency of the United Nations whose

mandate is to ensure the safe, efficient, and orderly evolution of international civil aviation. In accordance with the ICAO's Convention on International Civil Aviation, each of the 190 Contracting States has complete and exclusive sovereignty over the airspace above its territory. On adhering to the Convention, States agree to conduct all civil aviation operations under internationally accepted minimum operating standards, procedures, and practices. It is ICAO's responsibility to create and modernize guidance material that establishes minimum operating standards, recommended practices, and procedures.

The JPDO's Global Harmonization Working Group is responsible for communicating U.S. positions on standards and policies for international negotiations and to foster government and industry collaboration in the U.S. on global standards and policies. Its mission includes expanding collaborative relationships with multilateral, regional, national, and non-governmental international partners in coordinating long-term transformation plans globally. The objectives and strategies associated with goal area three provide focus areas for the work of the Global Harmonization WG.

Objective 3A – Encourage development and implementation of safer practices and safer systems worldwide

This objective focuses on U.S. Government and industry participation in concept development and implementation planning on an international level. The following strategies will be adopted to facilitate the use of consistent technologies, policies, and procedures worldwide.

The United States' effort to modernize its ATS is just one of many such efforts underway globally. Europe is developing the Single European Sky Air Traffic Management (ATM) Research (SESAR) master plan, similar in many respects to the NextGen plan. Like the U.S., Australia is deploying ADS-B technology to provide expanded air traffic services in national and oceanic airspace that they manage. Africa and China are developing their air traffic systems with the direct assistance of the FAA. Harmonization with multiple countries with independent modernization efforts poses a significant challenge. Important first steps in meeting this challenge will require the U.S. to **promote aviation safety internationally** in aviation forums and to **establish safety-enhancing international aviation partnerships.** In executing both strategies, the U.S. will advocate for the achievement of the objectives in goal areas one and two of this plan, not just in the United Sates, but also worldwide. Participation in aviation forums in safety, capacity, and other domains will provide information to the international community on NextGen concepts and their safety implications and provide the U.S. the opportunity to learn about the international community's efforts. Entering into formal international partnerships will permit collaboration on research and development for aviation systems, technologies, and practices, and on implementation planning.

International collaboration will increase the likelihood that compatible systems and practices will be implemented globally.

In 2006, ICAO endorsed the Global Aviation Safety Roadmap (GASR), which provides a framework for the coordination, integration, and implementation of ICAO safety initiatives and policies. The roadmap identifies 12 focus areas that industry has accepted as required to enhance safety within commercial aviation globally, and includes an implementation plan that identifies the tasks necessary to achieve the associated objectives. The GASR focus areas provide direct analogs to many of the objectives and strategies of this plan, including consistent use of SMS, protected, increased data sharing between government and industry and across aviation system boundaries, use of technology to improve safety, coordinated, consistent implementation of standards, etc. The Commercial Aviation Safety Team (CAST) is a government-industry initiative founded in 1998. It exceeded its goal to reduce the U.S. commercial aviation fatality rate by 80% by 2007, and is now promoting new government and industry safety initiatives throughout the world. Under ICAO auspices, international safety teams have committed to implement CAST safety enhancements worldwide.[21] The CAST supports the GASR as a strategic plan to promote aviation safety initiatives that compliment CAST's tactical safety enhancements.

To achieve the *NASSP* objective of encouraging development and implementation of safer systems and practices worldwide, the U.S. will **support the execution of the ICAO Global Aviation Safety Roadmap[22] and implementation plan[23]**. The GASR implementation plan calls for the development of regional action plans that recognize the regional capacity to undertake sophisticated safety initiatives and their obligation to correct deficiencies already noted. The U.S. will create a North American Region plan in cooperation with Canada, our regional partner. Regional plans will identify specific actions that can be taken to reduce hazards to civil aviation. The U.S. will also provide support for international improvement through direct financial and technical assistance, and sharing lessons learned in the development and execution of other regions' plans. Executing these plans will result in greater coordination between all international entities, and the promotion of U.S. aviation safety standards.

Objective 3B – Establish equivalent levels of safety across Air Transportation System boundaries

The NextGen Integrated Plan envisions seamless use of data, information, equipment, and operational procedures across international boundaries. It also

[21] http://www.cast-safety.org

[22] http://www.icao.int/fsix/_Library/Global_Aviation_Safety_Roadmap_Part_1.pdf

[23] http://www.icao.int/fsix/_Library/Global_Aviation_Safety_Roadmap_Part_2.pdf

commits the JPDO government partners to working with international partners to adopt a global safety management approach consistent with ICAO standards.

The ICAO Convention includes aviation safety requirements in all 16 of its technical Annexes, requiring states to establish a safety program that obligates aircraft operators, maintenance organizations, and service providers to implement SMSs. ICAO Convention Article 37 requires that States collaborate to secure the highest practicable degree of uniformity in regulations, standards, procedures and organization in all matters in which such uniformity will facilitate and improve air navigation. Article 12 requires that each State undertake to keep its own regulations uniform, to the greatest possible extent, with those established under the Convention.

This objective focuses on domestic and international adoption and implementation of consistent regulations to minimize risks at the interface between national aviation systems, and between aviation and other modes of transportation. The following strategies will be adopted to reduce risk in international aviation operations and in the transport of people, cargo, and baggage using multiple transportation modes.

The ICAO verifies, among many other things, whether States have established procedures for the amendment of its enabling regulations and national standards. To this end, the U.S. will **harmonize safety standards, regulations, and procedures** to comply with the requirements of ICAO Articles 37 and 12. The U.S. will ensure that its interests are represented in the standards, regulations, and procedures ICAO promulgates by participating in Air Navigation meetings, Commission Panels, Study Groups, and Council Technical Committees. International harmonization will reduce the number of exceptions to ICAO requirements, standardize operations, and reduce the capital investment, maintenance, and training costs required by operators when operating internationally.

Even with internationally harmonized standards and procedures, the potential exists for non-standard implementation and non-conforming operations to contribute to increased safety risk. To **improve the implementation of harmonized safety standards, regulations, and procedures**, the U.S. must actively seek to identify instances of its own non-standard implementation and correct them through active participation in ICAO audit processes and through self-auditing of NAS operations. In addition, the U.S. will offer assistance to other countries in correcting ICAO identified deficiencies, ensure transparency of U.S. compliance, and share information and lessons learned. For non-ICAO members, other audit methods, such as those used by the military, must be developed; ideally, ICAO membership would be established. As an increasing number of national ATSs achieve compliance with ICAO requirements, the safety of international aviation operations may also improve.

The United States military maintains bases and conducts operations both in the U.S. and in countries throughout the world. In parts of the U.S., and in certain allied countries, it is responsible for operating portions of the airspace system. In the U.S., the military coordinates its air traffic system acquisitions to ensure compatibility with U.S. civil systems. However, these systems may not always be compatible with host country systems, necessitating temporary procedures and protocols to address incompatibilities. As standards, regulations, and procedures, and their implementation are harmonized in a manner that takes into account the different needs of all users, these risks may be reduced.

The United States also responds to foreign countries' requests to provide assistance to those affected by natural disasters and, occasionally, political crises, regularly engaging our military aviation forces in humanitarian operations throughout the world. During these missions, the result can be unsynchronized operations between the U.S. and other nations. Harmonization of operational procedures and adoption of compatible technologies for communication, navigation, and surveillance will provide improved interoperability between U.S. forces and host country systems, speeding delivery of aid to those most in need, and providing a safer operational environment for our military.

Along the northeast corridor of the United States, and in many other parts of the world, multiple transportation modes intersect. Trains follow highways and stop at airports, truck terminals, and seaports to exchange cargo and passengers. Today, travelers can transfer between flight and rail modes of transport without having to monitor the transfer of their baggage. The trend toward just in time delivery has fueled the growth of rapid, reliable delivery systems with the flexibility to reroute goods in transit to meet changing schedule demands in real-time, routinely transitioning cargo through multiple modes of transportation. This results in cargo being transported by air after being accepted and packaged for another mode of transportation.

Annex 18 to the ICAO Convention addresses the safe transport of dangerous goods by air. For the air cargo industry, verifying the information provided by freight originators and forwarders about packaged goods is critical to managing risks. Aircraft accidents and incidents caused by improper materiel handling are not limited to cargo aircraft. As part of their business model, most passenger airlines regularly carry cargo in baggage compartments when capacity is available. The freight business permits companies and individuals to send goods to every corner of the globe, advertising their expertise in providing rapid, safe delivery. They are hampered, however, in managing risk in both domestic and international multi-modal transport by different and sometimes conflicting requirements for packaging and shipping the same materials via different modes or across international borders. To address these issues, the U.S. must continue efforts to **harmonize the standards for handling dangerous goods transported by multiple transportation modes that include air.** Achieving this

strategy will begin with a campaign to educate the public and aviation stakeholders on the importance of this issue, and the fostering of partnerships to address it. Consistent standards will help to reduce the frequency of incidents and accidents associated with materiel transport within this critical sector of the air transportation industry and the world economy.

SUMMARY

The *National Aviation Safety Strategic Plan* (*NASSP*) defines national goals, objectives, and strategies for improving aviation safety commensurate with the growing demands on the ATS. The plan was developed by the JPDO Safety WG and vetted by the JPDO government partners, and through close collaboration with industry stakeholders and academia subject matter experts. The *NASSP* goals, objectives, and strategies provide a basis on which the JPDO member departments and agencies can plan their aviation safety resources and to which the OMB can align budgets relative to aviation safety. The plan's objectives and strategies are organized by its three goal areas: safer practices, safer systems, and safer worldwide.

Safer Practices promotes an integrated, systematic approach to safety risk management through the implementation of formalized SMSs that incorporate safety data analysis processes, and provide enhanced methods for ensuring safety is an inherent characteristic of NextGen. **Safer Systems** promotes implementation of safety-enhancing technologies, which will improve safety for human-centered interfaces and enhance the safety of airborne and ground-based systems. **Safer Worldwide** promotes the coordination and adoption of technologies, policies, and procedures worldwide such that the maximum level of safety is achieved across ATS boundaries.

DOCUMENT REVISION HISTORY

VERSION	Release Date	DESCRIPTION
Draft v0.1	09 April 2007	Draft written by Safety WG ASSP SC
Draft v0.2	01 August 2007	Strategy Narratives added by Safety WG ASSP SC
Draft v0.3	29 August 2007	Draft transmitted to Stakeholder SMEs; draft revised based on comments received
Draft v0.4	16 November 2007	Strategy survey transmitted to Agency SMEs; draft revised based on survey results
Draft v0.5	20 March 2008	Draft transmitted to Stakeholder SMEs, JPDO WG Co-Chairs and Division Leads; draft revised based on comments received
Draft v0.6	24 June 2008	Draft transmitted to Agency SMEs; draft revised based on comments received
Draft v0.7	31 July 2008	Draft transmitted to Agency Leads; draft revised based on comments received
Draft v0.8	08 September 2008	Draft transmitted to Agency Leads; draft revised based on comments received
Draft v0.9	06 October 2008	Draft transmitted to Agency Leads; draft revised based on comments received
Version 1.0	23 June 2009	Recommended by JPDO Board for endorsement by JPDO Senior Policy Committee
Version 1.0B	10 June 2011	Revised to reconcile Background language with Vision 100 Act and JPDO Partner Agency MOU, and minimally in other areas related to DoD's individual mission