The Aviation Safety Management System (SMS) and It's Relevance to System Safety Engineering

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Abstract

The global aviation community has recognized that the reactive nature of aviation safety needs to change so accidents can be identified prior to a catastrophic incident through detecting problems and identifying trends, and then implementing proactive mitigation actions. The methodology they selected is termed the Safety Management System (SMS). Implementation of the SMS into the aviation industry is occurring globally and will be a mandated requirement phased in over the next few years. An understanding of what constitutes an SMS and whether it will conflict or integrate with the system safety engineering process is necessary for system safety engineers and the future safety of the aviation industry.

The SMS elements are compared and contrasted with system engineering and system safety engineering. Additionally, the structure of the International Civil Aviation Organizationõs (ICAOõs), the Joint Planning Development Officeõs (JPDOõs) SMS Standard and the Federal Aviation Administrations (FAAõs) guidance are discussed.

Introduction

Air travel has increased due to population growth, customer confidence due to improved safety, greater affordability, and the globalization of business. It was realized that increasing the numbers of and/or the size of airports was becoming impractical from an economic and/or land availability perspective. Additionally, advances made in avionics and communications due to the maturation of computers and technology, offered aviation operations the potential for better management by leveraging technology to improve the efficiency of airports and aircraft. Benefits of leveraging technology included further increases in safety and reductions in adverse environmental effects.

The Safety Management System (SMS) is envisioned to holistically integrate safety within airborne and ground-based operations and systems. The envisioned benefit is increased efficiency, public confidence, and financial profit. Reducing losses due to personnel injuries and damaged equipment can yield tremendous savings, increase both system reliability and the publicõs confidence.

SMS has a great deal in common with System Safety Engineering Management. A brief history of system safety engineering management and its application compared to what a SMS comprises will illustrate their similarities. The requirements for having and SMS and how to implement one is outlined so the logical process used in safely managing a complex system of systems is better understood. As with the implementation of any new process there are potential issues and challenges and some of these are discussed.

System Safety Engineering Management

System Safety Engineering had it origin in the 1950s and early 1960 in the U.S. Air Force Ballistic Missile Division, where safety was deemed to be especially critical. The previous approaches to safety being primarily based upon ñfly-fix-flyò type methodologies were not sufficient for the development of increasingly sophisticated and expensive systems. A new pro-active systematic concept of System Safety Engineering was created to identify the safety problems ahead of experiencing catastrophic events and thus able to minimize and manage those risks during the design process rather than after fielding.

A key feature of system safety engineering doctrine was that everything operates as a ñsystemò and that all failures or deficiencies (parts, humans, management, and the environment) can have an adverse effect on the final ñsystem. The system safety engineering approach is a pro-active, logical, and systematic process developed to identify likely, potential hazards and failure conditions and then identify their probability at causing the catastrophic failures of the ñsystemò. Recognizing the value of the system safety engineering process the DoD published MIL-S-38130 in 1963. Bell helicopter first used system safety engineering using MIL-S-38130A during their development of a helicopter under contract for the United States Air Force (USAF) in 1966.

System Safety Engineering standard, MIL-STD-882 was published in July of 1969 and has remained in use with the military with continuing revisions up to present Revision E (May 2012). The system safety engineering philosophy has proven itself to the DoD to such an extent that the U.S. military services require system safety engineering be applied to the developmental efforts on military aircraft, missiles, and engines.

A quick look at the definitions for terminology such as; a system, system safety, system safety engineering and, system safety engineering management will be beneficial when comparing system safety engineering management approach to the SMS approach.

Defined
From, ñDoD - Standard Practice for System Safetyò MIL-STD 882E

- System. An integrated composite of people, products, and processes that provide a capability to satisfy a stated need or objective.
- System safety. The application of engineering and management principles, criteria, and techniques to achieve acceptable mishap risk, within the constraints of operational effectiveness and suitability, time, and cost, throughout all phases of the system life-cycle.
- System safety engineering. An engineering discipline that employs specialized professional knowledge and skills in applying scientific and engineering principles, criteria, and techniques to identify and eliminate hazards, in order to reduce the associated mishap risk.
- System safety management. All plans and actions taken to identify, assess, mitigate, and continuously track, control, and document environmental, safety, and health (ESH) mishap risks encountered in the development, test, acquisition, use, and disposal of DoD weapon systems, subsystems, equipment, and facilities.

Defined
From, ñFAA Oder 8000.369, System Safety Management Guidanceò (09/30/2008)

- System. An integrated set of constituent pieces combined in an operational or support environment to accomplish a defined objective. These pieces include people, equipment, information, procedures, facilities, services, and other support services, which interact.
- System engineering. A discipline that concentrates on the design and application of the whole (system) as distinct from the parts. It involves looking at a problem in its entirety, taking into account all the facets and all the variables, and relating the social to the technical aspect. The translation of operational requirements into design, development, and implementation concepts and requirements in the lifecycle of a system.
- System safety. The application of engineering and management principles, criteria, and techniques to optimize all aspects of safety within the constraints of operational effectiveness, time, and cost throughout all phases of the system lifecycle.
- System safety engineering. An engineering discipline requiring specialized professional knowledge and skills in applying scientific and engineering principles, criteria and techniques to identify and eliminate hazards, in order to reduce the associated risk.
- System safety management. A management discipline that defines system safety program requirements and ensures the planning, implementation, and accomplishment of system safety tasks and activities are consistent with the overall program requirement.

While the definitions used by the DoD and the FAA vary, they are essentially possess the same basic elements regarding system safety engineering management. The ñsystemò includes people, machines, technology, processes, costs, time, training, and the environment. All phases of the lifecycle need to be considered. Hazards must be identified and eliminated or controlled/mitigated to the lowest reasonable level.

Requirement for SMS Implementation

The International Civil Aviation Organization (ICAO) is a United Nations affiliated organization that is dedicated to increasing the safety and security of international civil aviation. The organization addresses fundamental issues ranging from air navigation and capacity to emerging environmental concerns such as engine noise and emissions. As a member of ICAO, the U.S. has committed to comply with ICAO safety standards. In 2006, ICAO issued an SMS standard. Part 1 of ICAOôs SMS standard deals with scheduled commercial transport and charter (non-scheduled commercial) operations, while Part 2 deals with private non-revenue aircraft. This standard applies to all operations of aircraft by operators authorized to conduct international commercial air transport (Annex 6, Part 1) and to private aircraft with a certified Maximum Takeoff Weight (MTOW) of 12,500 pounds (5,700 kg) and/or private aircraft with one or more turbo jet engines (Annex 6, Part 2, Chapter 3). ICAO mandates that member states require, as part of a state safety program, operators to establish an SMS for commercial operations. For general aviation (GA), an operator conducting international operations over 12,500 pounds (5,700 kg MTOW) is required to establish an SMS (Annex 6, Part 2).

The Federal Aviation Administration (FAA) is the United Statesô organization responsible for the certification, production approval, and continued airworthiness of aircraft; and certification of pilots, mechanics, and others in safety-related positions. Some of the functions the FAA is responsible for include; certification of all operational and maintenance enterprises in domestic civil aviation, certification and safety oversight of approximately 7,300 U.S. commercial airlines and air operators, civil flight operations, and developing regulations.

The SMS doctrine is derived in part from the statutory authority in Title 49 of the United States Code (49 U.S.C.) and Title 14 of the Code of Federal Regulations (14 CFR). Title 49 U.S.C. Chapter 401 of subpart L part A, Section 40101(d), establishes safety considerations in the public interest and states that the Administrator shall consider the following matters, among others, as being in the public interest:

(1) Assigning, maintaining, and enhancing safety and security as the highest priorities in air commerce.
(2) Regulating air commerce in a way that best promotes safety and fulfills national defense requirements.
(3) Encouraging and developing civil aeronautics, including new aviation technology.
(4) Controlling the use of the navigable airspace and regulating civil and military operations in that airspace in the interest of the safety and efficiency of both of those operations.
(5) Consolidating research and development for air navigation facilities and the installation and operation of those facilities.
(6) Developing and operating a common system of air traffic control and navigation for military and civil aircraft.

The Joint Planning and Development Office (JPDO) was created by the Vision 100 Century of Aviation Reauthorization Act (Public Law 108-176) for the purpose of managing the work related to the development of the Next Generation Air Transportation System (NextGen), a vision of air transportation in 2025. Basic tenets described in the NextGen Integrated Plan include the following:

(1) Ensuring the future air transportation system will remain the world's safest form of transportation requires a new safety approach.
(2) Regulatory authorities must change their role from focusing on testing, inspecting, and certifying individual elements to focusing on approvals and audits of the safety management of aviation product/service providers.
(3) Safety needs to be embedded in all products, policies, or technologies. A comprehensive safety management doctrine will create high-level standards and procedures for the safety programs of aviation product/service providers and those that provide the associated safety oversight.
(4) Standards cannot be put in place without a data analysis capability to identify and resolve accident precursors

The Department of Defense (DoD), National Aeronautics and Space Administration (NASA), Department of Homeland Security (DHS), Department of Commerce (DOC), Department of Transportation (DOT) signed a memorandum of understanding (MOU) June 8th, 2008 for the Next Generation Air Transportation Joint Planning and Development. A primary component of the Next Generation of Air Transportation is the SMS. Government and commercial aviation industries are or will soon be required to implement a SMS in accordance with the requirements of the Joint Planning Development Office (JPDO) SMS Standard v1.4. A phased approach to implementation will be used so government and commercial aviation will be implementing at different stages.

- Memorandum of Understanding (MOU) signed 9 June 2008 by five (5) government agencies:
    - Department of Transportation (DOT)
    - Department of Defense (DoD)

- Department of Homeland Security (DHS)
- Department of Commerce (DOC)
- National Aeronautics and Space Administration (NASA)

The JPDO SMS Standard v1.4 was created by the JPDO's Safety Working Group (SWG) and published 2008. The JPDO SMS Standard v. 1.4 was developed for use exclusively by the government member agencies.

Safety Management System (SMS) Defined

ICAO defines an SMS as a, ``systematic approach to managing safety, including the necessary organizational structures, accountabilities, policies, and procedures." [International Civil Aviation Organization (ICAO), Safety Management Manual, at 1.4.2, ICAO Doc. 9859-AN/460 (1st ed. 2006)]. The FAA defines an SMS as, "An SMS is an integrated collection of processes, procedures, and programs that ensures a formalized and proactive approach to system safety through risk management. Risk analysis is required for all activities or process changes to identify safety impacts. The SMS is a closed-loop system ensuring corrective actions or process changes are documented and all problems or issues are tracked to resolution". [FAA Order 8000.369, System Safety Management Guidance" (09/30/2008)]. The SMS is really just a methodology to logically manage safety of a system from a holistic stand-point akin to the system safety engineering management methodology developed since the 1960's.

SMS and System Safety Attributes

The SMS and System Safety both recognize the need for management responsibility and authority for accomplishment of required activities. They require documented procedures to provide clear instructions for organization employees and members to follow. Along with the documented procedures, employees require training so they understand what is required and the proper technique(s) to follow.

The SMS utilizes a proactive approach to hazard identification, risk assessment and risk management. Controls are implemented to provide organizational and supervisory controls on the activities involved in processes to ensure they produce the desired results. Measurements are taken of both the processes and their outputs. An example would be to measure the time required to accomplish a task properly.

Interfaces are a critical aspect of system management; recognizing the important interrelationships between processes and activities within the company as well as with contractors, vendors, customers, and other organizations with which the company does business. Information control and auditing of processes and procedures are components of the requirements of a SMS.

(The Human Aspect of Organizations). "An organization's Safety Culture consists of its values, beliefs, legends, rituals, mission goals, performance measures, and sense of responsibility to its employees, customers, and the community. A positive safety culture is generated from the top management down through the organization. In the SMS, upper management is required to foster a climate within the organization that is accepting of criticism, comments and feedback from all levels of the organization regarding safety matters.

SMS Elements

The four pillars of what constitutes a SMS are; Policy, Safety Risk Management (SRM), Safety Assurance (SA), and Safety Promotion. The Policy pillar is based upon the need for all management systems to define the policies, procedures, and organizational structures they will use to accomplish their goals. The SRM pillar is the requirements for a formal system of hazard identification and is essential in controlling risk to acceptable levels. The SRM function of the SMS is based upon the system safety process model that is used in FAA Order VS 8000.367, Appendix B.

After SRM controls (mitigations) are identified and implemented, the organization must ensure controls continue to be effective due to the operational environment continually being in a state of change. The SA function accomplishes this, using system safety and quality management concepts and processes. Safety promotion is the fourth pillar and essential for the organization to implement to achieve a complete SMS. The promotion of safety is a core value which encourages and supports a strong and sound safety culture.

<u>SMS Comparisons</u>

The FAA, JPDO and ICAO use slightly different terminology to describe their SMS requirements. As depicted in the following tables they are similar but with enough difference to make it potentially confusing as to whether your organization has a SMS as required by all regulatory bodies. It should also be noted that the JPDO has an additional requirement (Pillar) referred to as, ñInteroperabilityò. The desire to have interoperability between government agencies would ease sharing of safety information between agencies.

Table: SMS Comparisons

POLICY

FAA (AC-120-92A)	JPDO (SMS v. 1.4)	ICAO
1.0 Safety Policy and objectives	4.0 Policy	1.0 Safety Policy and objectives
1.1 Safety Policy	4.1 General Requirements	1.1 Management commitment and responsibility
1.2 Management Commitment and Safety Accountabilities	4.2 Safety Policy	1.2 Safety Accountabilities
1.3 Key Safety Personnel	4.3 Quality System	1.3 Appointment of Key Safety Personnel
1.4 Emergency Preparedness and Response	4.4 Safety Planning	1.4 Coordination of Emergency Response Planning
1.5 SMS Documentation and Records	4.5 Organizational Structure and Responsibilities	1.5 SMS Documentation
	4.6 Compliance with Legal and Other Requirements	
	4.7 Operational Procedures and Controls	
	4.8 Emergency Preparedness and Response	
	4.9 Safety Documentation and Records	

Safety Risk Management (SRM)

JPDO (SMS v. 1.4)	FAA (AC-120-92A)	ICAO
5.0 Safety Risk Management	2.0 Safety Risk Management	2.0 Safety Risk Management
5.1 General Requirements	2.1 Hazard Identification and Analysis	2.1 Hazard Identification
5.2 Describe System	2.1.1 System Description and Task Analysis	2.2 Safety Risk Assessment and Mitigation
5.3 Identify Hazards	2.1.2 Identify Hazards	
5.4 Analyze Safety Risk	2.2 Risk Assessment and Control	
5.5 Assess Safety Risk	2.2.1 Analyze Safety Risk	
5.6 Control/Mitigate Safety Risk	2.2.2 Assess Safety Risk	
	2.2.3 Control/Mitigate Safety Risk	

Safety Assurance (SA)

JPDO (SMS v. 1.4)	FAA (AC-120-92A)	ICAO
6.0 Safety Assurance	3.0 Safety Assurance	3.0 Safety Assurance
6.1 General Requirements	3.1 Safety Performance Monitoring and Measurement	3.1 Safety Performance Monitoring and Measurement
6.2 Information Acquisition	3.1.1 Continuous Monitoring	3.2 The Management of Change
6.3 Analysis of Data/Information	3.1.2Internal Audits by Operational Departments	3.3 Continuous Improvement of the SMS
6.4 System Assessment	3.1.3 Internal Evaluation	
6.5 Corrective Action	3.1.4 External Auditing of the SMS	
6.6 Management reviews	3.1.5 Investigation	
	3.1.6 Employee Reporting and Feedback System	
	3.1.7 Analysis of Data	
	3.1.8 System Assessment	
	3.2 Management of Change	
	3.3 Continuous Improvement	
	3.3.1 Preventive/Corrective Action	
	3.3.2 Management Review	

Safety Promotion

JPDO (SMS v. 1.4)	FAA (AC-120-92A)	ICAO
7.0 Safety Promotion	4.0 Safety Promotion	4.0 Safety Promotion
7.1 Safety Culture	4.1 Competencies and Training	4.1 Training and Education
7.2 Communication and Awareness	4.1.1 Personnel Expectations (Competence)	4.2 Safety Communication
7.3 Personnel Competency	4.1.2 Training	
7.4 Safety Knowledge Management	4.2 Communication and Awareness	

Note: The JPDO SMS Standard v. 1.4 has an additional óPillarô entitled, ñInteroperabilityò

SMS Implementation Steps

Five steps or phases have been recommended by the ICAO and the FAA to use in implementing SMS into your organization.

First step:
The first step involves activities such as gathering information, evaluating your organizationôs goals and objectives, and determining the viability of committing resources to an SMS implementation effort.

Second step:
The second step requires top management to commit to providing the resources necessary for full implementation of SMS throughout the organization:
Conduct a Gap Analysis - An initial step in developing an SMS is to analyze and assess existing programs, systems, processes, and activities with respect to the SMS functional expectations found in the SMS Framework. ñGapsò are those elements required by the SMS Framework that are not already being performed by the service provider.
Create an implementation plan. The implementation plan is simply a ñroad mapò describing how the service provider intends to close the existing gaps by meeting the objectives and expectations in the SMS Framework.

Third step:
Develop and implement a basic safety risk management (SRM) process and plan, organize and prepare the organization for further SMS development.
Information acquisition, processing, and analysis functions are implemented and a tracking system for risk control and corrective actions are established.
Known deficiencies in safety management practices and operational processes are corrected
An awareness of hazards develops and the appropriate systematic application of preventative or corrective action(s) occurs. This allows for reaction to unwanted events and problems as they occur and to develop appropriate remedial action(s)

Fourth step:
Safety risk management (SRM) is applied to initial design of systems, processes, organizations, and products, development of operational procedures, and planned changes to operational processes.
The activities involved in the SRM process involve careful analysis of systems and tasks involved; identification of potential hazards in these functions, and development of risk controls.
The risk management process developed now is used to analyze, document, and track these activities.
The processes are used to look ahead however, these proactive processes have been implemented but their performance has not yet been proven

Fifth step:
This is the final step in SMS implementation.
Processes are in place and the performance and effectiveness have been verified.

The complete safety assurance (SA) process, including continuous monitoring and the remaining features of the other SRM and SA processes are functioning.
A major objective of a successful SMS is to attain and maintain this continuous improvement status for the life of the organization. This has been exactly the objective of system safety engineering management process

SMS Implementation

ñBy 2025 safety design assurance will have been built into all operations under the Next Generation of Air Transportation System (NextGen)ò.
For approximately a decade, many of the System Safety concepts have been or are being integrated into the civil aviation world, under the phrase, ñSafety Management System (SMS)ò.
Transport Canada Agency and the FAA have been extensively involved in risk management systems, as have the North American civil aircraft manufacturers.
New aircraft certifications are now requiring Function Hazard Assessments (FHAs) and System Safety Assessments (SSAs), which are part of SMS for initial certification.
SMS also has a place in Continuing Airworthiness of existing aircraft to stay within the certificated configuration.
The closed loop process used by most Type Certificate (TC) Holders includes hazard or quality deficiency identification, problem analysis, and notification processes, problem correction, and implementing the corrective action(s).
This is a continuous process that TC Holders have been using to improve their fleets and meet several Federal Aviation Regulations (FARs).

Potential Issues/Challenges

Common taxonomy (e.g., SRM is used with FAA SMS. US Army uses CRM, US Air Force uses ORM). Transitioning from accepted terminology can be a challenge. If organizations have effective change management plans and use them, the challenges changing to new verbiage should be minimized. Cost of changes documentation is another challenge when transitioning to a common taxonomy. Even in our ñpaperlessò systems editing and obtaining approvals of modified documents bears a financial and time expense.

Analysis of systems and tasks involved. Some systems and tasks are not equal between entities, such as when specifically does flight time start and end. Some agencies say the flight hour clock starts when the aircraft pushes away from the gate and stops upon touchdown. Others consider the flight time starting when the aircrew enters the flight deck and starts their pre-flight checks. With large fleets and high volume of use this could result in significant differences when conducting trend analysis or trying to benchmark systems.

Identification of potential hazards. How the hazards are identified and what format they are recorded and to what level are not clearly specified. For example, stating ófireô as a hazard does not clearly identify the hazard. óFireô could be a risk however the risk could be either; having a ófireô or not having ófireô. A better way to identify a hazard is through stating the source, mechanism and outcome. A spark from improperly bonded fuel handling equipment occurs during the fueling process resulting in a fire. This provides a clearer picture of the hazard and provides a better opportunity to identify the appropriate mitigation and/or ameliorator(s) to control the hazard and reduce the risk. If the hazard was, ñFollowing a crash landing, aircrew canöt start a signal fire to summon rescueò, the mitigation for this ófireô hazard is much different than the fueling ófireô hazard. Specifying that all hazard statements will be written in the format of stating the source, mechanism and outcome would help standardize the identification of potential hazards and better enable identifying mitigations and/or ameliorators.

Is hazard identification terminology specific enough? For example, the term óFODô (foreign object debris) is often used in the aviation industry however, it is has multiple meanings. óFODô can mean the ground rocks that are on a runway or taxiway, or maintenance debris inadvertently left behind following maintenance operations, or lost tools remaining in aircraft following maintenance activities, or all of the above. Additionally, óFODô (foreign object damage) can refer to the damage caused by rocks on the runway being thrown up and striking the aircraft or being ingested in engine intakes. Damage can also result from the tool that was inadvertently left behind in an aircraft compartment and then during flight striking rotating drive shaft components for example. Perhaps óFODeô and

FODaô acronyms for óDebrisô and óDamageô should be considered to better identify which type of óFODô we are concerned. This would reduce the likelihood for miscommunication or misunderstanding a potential hazard.

FAA has no formal mechanism/department for certification of SMS. Relying on self certification which may not be accepted globally could result in the need for multiple certification audits by multiple ñacceptedò agencies depending upon where aviation operations were planned. Some organizations offer certification (IS-BAO, EASA) but their inspection criteria is not always directly tied to ICAO, JPDO, or FAA requirements and have additional inspection criteria which are often ógood business practiceô concepts but may delay certification efforts and/or increase cost of attaining certification.

Multiple SMS regulations could lead to potential conflicting requirements. A variety of SMS formats/requirements documents (FAA, ICAO, JPDO, DOT, etc.) are materializing which could lead to conflicts between standards and confusion or the need for developing multiple SMSs to be permitted to operate in multiple areas. Also, there is a need to review and align DoD regulations, federal safety standards such as Occupational Safety and Health Administration (OSHA) and Environmental Protection Act (EPA), etc. with SMS requirements/taxonomy. Regulations are updated sporadically and there will be a need to ensure the SMS requirements remain current and in concert with global health & safety and environmental regulations.

Risk assessment matrixes are not standardized. There is the potential for Risk to be calculated at the same rate by two different airlines using the same equipment/engines for example, yet depending upon the matrix each decides to use, one could identify a hazard as, ólowô risk using the matrix they have selected for use and the other identify the hazard as óhighô risk due to using a different matrix. This can make benchmarking and interoperability a challenge. A standardized risk matrix should be agreed upon globally for use in risk assessment.

Conclusions and recommendations

Safety Management System (SMS) is essentially System Safety Engineering Management.
Implementation of SMS for most large aviation corporations and contractors working on U.S. military programs should not be too difficult as they already have most if not all the elements. They may just have to organize and/or name them differently.

The implementation of a SMS is inevitable and government and commercial aviation would be wise to initiate implementation not only because it will become a regulatory compliance issue, but for its real potential to, reduce downtime, increase customer confidence and satisfaction, and increase profits.

The SMS concept is organized in a specific framework order and offers specific guidance regarding a ñphased inò approach. This has the benefit of allowing for a tailored approach to an organizationôs unique requirements. Additionally, a SMS offers a global framework for system safety (consistency).

One requirement of the JPDO SMS standard is interoperability. The international Federal government agencies and civil aviation organizations need to adopt a consistent global taxonomy to reduce opportunities for confusion and non-compliance that may result in, or contribute to, catastrophic incidents. Additionally, they need to work cooperatively with associated safety standards such as OSHA, EPA, etc. in an effort to agree on terminology as well as ensuring requirements are not contradictory.

Regular review of the SMS by a multi-agency and multi-standards development group needs to be mandated and performed annually or bi-annually to ensure the standard remains current and sections have not been made confusing or contradicted by other associated standards.

If changes are made, a grandfathering clause needs to be considered as to its viability as well as consideration given to a phase in grace period. The financial viability of aviation associated operations/companies must be a consideration in safety decisions.

Hazard identification/tracking is vague and leaves it open to the interpretation of the organization. In the future, for true interoperability and to maximize the value of using trend analysis results a consistent methodology for hazard identification and tracking may be required.
Interoperability between organization's data/hazard tracking could be a challenge and should be addressed through agreements on common definitions/parameters and risk assessment calculation.

Certification could be a challenge and become inconsistent due to the number of organizations conducting certification audits, some of which are not universally accepted. This may lead to the need for multiple certifications if an organizationôs aviation activities are being conducted in multiple countries.

References

1. FAA Safety Management Implementation (SMS) Guide Rev. 3.

2. Annex 6 to the Convention on International Civil Aviation, Operation of Aircraft

3. International Civil Aviation Organization (ICAO) Document 9859, ICAO Safety Management Manual (SMM)

4. ICAO Document 9734, Safety Oversight Manual

5. FAA Advisory Circular (AC) 120-92, Introduction to Safety

6. FAA AC 120-92A, Safety Management Systems for Aviation Service Providers

7. FAA Order VS 8000.367, Aviation Safety (AVS) Safety Management System Requirements FAA Order 8000.368, Flight Standards Service Oversight

8. FAA Order 8000.369, Safety Management System Guidance

9. SMS Framework, FAA, AFS SMS Program Office Safety Management System Framework

10. SMS Assurance Guide, FAA, AFS SMS Program Office Safety Management System Assurance Guide

11. SMS Guidebook for Developing a Safety Management System for Air Operators (Currently in development)

12. Safety management System Toolkit, U.S. Joint Helicopter Safety Implementation Team, Sept 2009. www.ihst.org

13. Management Systems for Air Operators, issued June 22, 2006,

14. ICAO's guidance on establishing an SMS framework, may be found at http://www.icao.int/anb/safetymanagement/

15. Joint Planning Development Office (JPDO) SMS Standard v1.4

Biography

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