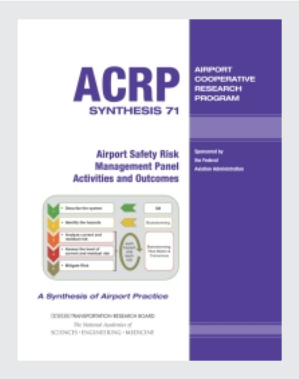

Airport Safety Risk Management Panel Activities and Outcomes

DETAILS

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AIRPORT COOPERATIVE RESEARCH PROGRAM

ACRP SYNTHESIS 71

Airport Safety Risk Management Panel Activities and Outcomes

A Synthesis of Airport Practice

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AIRPORT COOPERATIVE RESEARCH PROGRAM

Airports are vital national resources. They serve a key role in transportation of people and goods and in regional, national, and international commerce. They are where the nation's aviation system connects with other modes of transportation and where federal responsibility for managing and regulating air traffic operations intersects with the role of state and local governments that own and operate most airports. Research is necessary to solve common operating problems, to adapt appropriate new technologies from other industries, and to introduce innovations into the airport industry. The Airport Cooperative Research Program (ACRP) serves as one of the principal means by which the airport industry can develop innovative near-term solutions to meet demands placed on it.

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Cover figure: The SRM Process. *Source*: ASM Consultants.

FOREWORD

Airport administrators, engineers, and researchers often face problems for which information already exists, either in documented form or as undocumented experience and practice. This information may be fragmented, scattered, and unevaluated. As a consequence, full knowledge of what has been learned about a problem may not be brought to bear on its solution. Costly research findings may go unused, valuable experience may be overlooked, and due consideration may not be given to recommended practices for solving or alleviating the problem.

There is information on nearly every subject of concern to the airport industry. Much of it derives from research or from the work of practitioners faced with problems in their day-to-day work. To provide a systematic means for assembling and evaluating such useful information and to make it available to the entire airport community, the Airport Cooperative Research Program authorized the Transportation Research Board to undertake a continuing project. This project, ACRP Project 11-03, "Synthesis of Information Related to Airport Practices," searches out and synthesizes useful knowledge from all available sources and prepares concise, documented reports on specific topics. Reports from this endeavor constitute an ACRP report series, *Synthesis of Airport Practice*.

This synthesis series reports on current knowledge and practice, in a compact format, without the detailed directions usually found in handbooks or design manuals. Each report in the series provides a compendium of the best knowledge available on those measures found to be the most successful in resolving specific problems.

PREFACE

By Gail R. Staba
Senior Program Officer
Transportation Research Board

This synthesis of airport practice compiles information and tools that help Part 139 airports conduct Safety Risk Assessments (SRAs) effectively. To identify the existing tools and state of the practice, a survey and interviews were conducted with Part 139 airports, foreign airports, military organizations, and Safety Management System (SMS) consultants who have been supporting airports with SMS implementation and leading Safety Risk Management panels. This report enhances *ACRP Report 131: A Guidebook for Safety Risk Management for Airports* with additional tools and templates, and presents the conclusions from the survey and interviews as well as the main findings from the literature review. Several tools and templates, including a Quick Reference Guide and a template for the SRA briefing, are provided in the appendices of this report.

Manuel Ayres, Jr., and Allen Parra, Airport Safety Management Consultants, LLC, Ann Arbor, Michigan, collected and synthesized the information and wrote the report. The members of the topic panel are acknowledged on the preceding page. This synthesis is an immediately useful document that records the practices that were acceptable within the limitations of the knowledge available at the time of its preparation. As progress in research and practice continues, new knowledge will be added to that now at hand.

CONTENTS

Note: Photographs, figures, and tables in this report may have been converted from color to grayscale for printing. The electronic version of the report (posted on the web at www.trb.org) retains the color versions.

AIRPORT SAFETY RISK MANAGEMENT PANEL ACTIVITIES AND OUTCOMES

SUMMARY

During the past years a number of Part 139 airports have conducted Safety Risk Assessments (SRAs) assisted by Safety Risk Management (SRM) panels guided by a facilitator. Some of these internal assessments resulted from the FAA Safety Management System (SMS) Implementation Study, some were undertaken by the airport's own initiative, and others resulted from FAA-led initiatives. The facilitation of these assessments has been led by consultants, airport staff, and FAA staff. However, there is still little accumulated experience, and there are many questions regarding the most effective Safety Risk Management practices.

In light of the FAA's proposed rulemaking to require SMS and SRM at Part 139 airports, this Synthesis study compiles information and tools that help Part 139 airports conduct SRAs effectively. To identify the existing tools and state of the practice, a survey and interviews were conducted with Part 139 airports, foreign airports, military organizations, and SMS consultants who have been supporting airports with SMS implementation and leading SRM panels.

A form with 22 questions was submitted to 41 organizations and consultants, and 36 responses were obtained, representing a response rate of 87.8%. Interviews were carried out with 15 of the airports to understand their practices and identify tools that could be shared with other airports. Supplementary information was obtained from a literature review conducted to find best practices in different segments of the aviation industry, as well as in other industries.

This report enhances *ACRP Report 131: A Guidebook for Safety Risk Management for Airports* with additional tools and templates, and presents the conclusions from the survey and interviews as well as the main findings from the literature review. The results from those preliminary tasks showed how different techniques can be used in SRAs and helped answer many of the questions that airport staff have about SRAs.

Based on key gaps identified during the survey and interviews, a summary is provided of the methodologies used by airports for risk assessments. Additional guidance is presented on basic activities of SRAs supported by SRM panels, including planning, facilitation, hazard identification and risk assessment, and implementation of risk mitigation actions.

Finally, in support of SRA activities and tasks, several tools and templates, including a Quick Reference Guide and a template for the SRA briefing, are provided in the appendices of this report.

CHAPTER ONE

INTRODUCTION

Beginning in the mid-1990s, safety began to be viewed from a systemic perspective involving organizational, human, and technical factors. Since then, the aviation industry has taken steps to implement a systematic approach to manage safety, and both the FAA and International Civil Aviation Organization (ICAO) have established requirements and plans to implement Safety Management Systems (SMSs) for air traffic services, airlines, airports, and aviation service providers.

The FAA, including its Office of Airports (ARP), is already implementing its SMS and has established a process to screen project plans or changes proposed by airports listed in the National Plan of Integrated Airport Systems. This screening process evaluates the need to convene a panel and conduct a safety assessment (SA). According to the FAA *Office of Airports Safety Management* (*SMS*)*—Desk Reference* (2012), if a panel is deemed necessary, the airport will be notified by the FAA to coordinate, acquire a facilitator, and arrange a Safety Risk Management (SRM) panel for the SA.

Although airport operators are becoming more familiar with key aspects of the SRM processes and some Part 139 airports are conducting internal airport-led Safety Risk Assessments (SRAs), important questions remain. These questions are related particularly to the facilitation and outcomes of SRAs; the differences between safety assessments led by the FAA (SAs) and those led by the airport (SRAs); decision making for risk mitigation actions; and the processes to implement and ensure that risk mitigation actions are in place.

This report complements *ACRP Report 131: A Guidebook for Safety Risk Management for Airports* (Neubauer et al. 2015) and consolidates information gathered from Part 139 airports to identify existing challenges and lessons learned from past experience conducting SRAs. This information could be shared to help Part 139 airports that are performing SRAs. Processes used by other industries and foreign airports were reviewed to provide additional insight on the SRA process, which may become routine if the FAA finalizes an SMS rule for Part 139 airports.

SRAs can demand a significant workload and involve some challenges; however, it is important to note that the majority of safety issues faced on a routine basis by Part 139 airports do not require convening panels and can be performed by the SMS coordinator and other personnel. It is important that SRAs use SRM panels only for the most complex issues, possibly those that affect multiple airport stakeholders. Routine airport safety issues can be handled on a regular basis by airport staff familiar with SMS procedures.

Although SRAs at Part 139 airports are associated predominantly with safety issues on the airside, the methodology represents a powerful tool for risk management that can be applied to any safety issue on the airside or landside. Also, because SRM practices at Part 139 are still in their early stages, the majority of the information available and collected for this report was originated at the larger airports and represents experience involving safety issues of higher complexity. Nevertheless, smaller airports can benefit from the information presented in this report, which can be adapted to fit less complex safety issues or those that involve fewer stakeholders.

This report presents the tasks employed and the material obtained on SRAs, the results of a survey with Part 139 airports, foreign and military airports, and consultants, a summary of current

practices worldwide, tools used, and a final chapter with conclusions and suggestions for future research.

SAFETY ASSESSMENTS VERSUS SAFETY RISK ASSESSMENTS

It is important to distinguish between the terms Safety Assessment (SA) and Safety Risk Assessment (SRA). Because there is no current regulatory requirement for SRM or standardized industry terminology, both terms have been used in the United States to describe the safety risk management processes using SRM panels. Both have the same objective: to identify hazards, assess risks, and define actions to mitigate risks associated with a proposed change. However, there are some important differences that need to be clarified and understood, particularly because the focus of this report is the current experience with SRAs led by the airports.

The term Safety Assessment was defined by the FAA ARP in Order 5200.11, which introduced ARP's Safety Management System and refers to its SRM internal review and related documentation. If an action or proposed change (e.g., airfield construction, new advisory circular) requires ARP approval, the assessment of the change is led by the FAA and may require convening an SRM panel. If a panel is required by the FAA, an FAA employee or third party consultant will serve as facilitator and the process is managed by the FAA. Therefore, for the purpose of this report, the term Safety Assessment and the acronym SA is used only for risk assessments led by FAA.

During the FAA pilot studies, particularly during the SMS Implementation Study, airport staff and consultants used the term Safety Risk Assessment because this was the term used by the FAA when announcing the request for airports to participate in the study. The SRA acronym has been widely used by Part 139 airports to refer to airport's internal risk assessments and those assessments that are not led by the FAA. For the purposes of this report, the term SRA is used for safety assessments that are not led by the FAA.

This report is intended to address SRAs only; that is, those assessments initiated internally by an airport and led by airport staff or a consultant hired by the airport. Therefore, the term SRA instead of SA is used throughout this document. Table 1 shows the key differences between SRAs and SAs.

The FAA's Notice of Proposed Rulemaking (NPRM) proposed a broad five-step SRM process but did not prescribe requirements detailing how to conduct or document those steps. However, some airports have opted to define the process in their SMS manual. It is in an airport's best interest to have the capability to conduct internal SRAs, particularly those airports that will routinely use SRAs if FAA finalizes an SMS rule.

TABLE 1
SAFETY RISK ASSESSMENT (SRA) AND SAFETY ASSESSMENT (SA)

Item	Airport-Led	FAA-Led
	SRA	**SA**
Airport role	Plan, facilitate, report, SME	SME, obtain facilitator (when requested by the FAA)
FAA role	SME (when necessary)	Plan, facilitate, report, SME
Requirement	• Airport SMS manual	• FAA Order 8000.369A • FAA Order 8040.4A • FAA Order 5200.11
SRM triggers	• Airport SMS manual • Airport management	• FAA ARP SMS Desk Reference •
Guidance	• FAA AC 150/5200-37A (draft) • *ACRP Report 131* • ICAO SMM	• FAA ARP SMS Desk Reference • FAA ARP SOP 4.00 • FAA ATO SMS Manual

Source: ASM Consultants.

BACKGROUND

The 2011 FAA SMS Implementation Study evaluated how airports could implement the SRM and safety assurance elements of SMS. Fourteen airports participated in the program, and many of those airports conducted at least three SRAs to meet the goals set by the FAA. Some of the airports that participated in the SMS Implementation Study continue to convene SRM panels voluntarily and conduct airport-led SRAs for internal purposes.

Separately, airports participated in FAA-led SRM panels convened to meet the requirements of FAA Orders 5200.11, JO 1000.37A, Air Traffic Organization Safety Management System, and the ATO Safety Management System Manual. Order 5200.11 describes conditions in which FAA ARP conducts SAs and convenes an SRM panel. Order JO 1000.37A instructs ATO on when to conduct SRM processes, and the ATO SMS Manual provides detailed guidance on how to conduct an SRM and when to convene an SRM panel. Although ARP-led panels have been primarily limited to project approvals at large and medium hub airports, ATO-led panels have been used for many other safety issues at a variety of airports.

Foreign airports and military organizations have routinely used SRAs in the past and have clearly defined their specific process, the players and their roles, as well as myriad specific tools and templates for use when conducting risk assessments. This report summarizes some of the guidance available to support future efforts by Part 139 airports when conducting SRAs.

In the past few years, several airports have convened panels to conduct risk assessments, in most cases related to capital improvement plans (CIP) on the airside. With the new requirements for SAs, airports have hired consultants and sometimes counted on FAA support to facilitate those risk assessments. A few airports have trained staff to facilitate and report SRAs using SRM panels; however, there are many questions about the process used by Part 139 airports to conduct SRAs. Some of those questions relate to the accuracy and effectiveness of the methodology, and there are concerns about how SRA results and actions will be implemented and questions on how airport staff can gain the necessary expertise to make the process sustainable for use by Part 139 airports.

OBJECTIVE

The objective of this Synthesis study is to present existing practices and tools used by airports and other industries to conduct risk assessments. The intent of this report is to complement existing guidance references, particularly *ACRP Report 131: A Guidebook for Safety Risk Management for Airports*, published in 2015. The intended audience is Part 139 airport operators who plan to convene SRM panels to conduct SRAs.

Although the primary data source of this Synthesis is a small number of airports that have conducted risk assessments with airport-led and FAA-led SRM panels, airport operators will benefit from better understanding the airport's roles and responsibilities in non-airport-led SRM panels. In addition, airport operators can benefit from understanding the experience of other industries that conduct SRM processes.

Through the literature review, survey, and interviews with airport-led SRM panel coordinators, existing guidance, most effective practices, and tools are consolidated to support airport operators administering airport-led SRAs supported by SRM panels. This Synthesis study also combines the overall experience and lessons gained during recent years to answer questions about SRAs that have been raised during and after the FAA SMS Implementation Study.

This report can be used by airport operators who plan to undertake SRAs in the future.

DEFINITIONS

Accident—An unplanned event or series of events that results in death, injury, damage to, or loss of equipment or property.

Assessment—Process of measuring or judging the value or level of something.

Consequence—*See* Outcome.

Control—*See* Risk control.

Credible—Refers to a specific system state and sequence of events supported by data and expert opinion that clearly describes the outcome. It implies that it is reasonable to expect the assumed combination of extreme conditions will occur within the operational lifetime of the system.

Hazard—A condition that could foreseeably cause or contribute to an accident.

Incident—An occurrence, other than an accident, associated with the operation of an aircraft, that affects or could affect the safety of operations.

Likelihood—The estimated probability or frequency, in quantitative or qualitative terms, of a hazard's effect or outcome.

Operational Risk Management (ORM)—A decision-making tool used by personnel at all levels to increase effectiveness by identifying, assessing, and managing risks. By reducing the potential for loss, the probability of a successful mission increases. Recently, the term has been changed to Risk Management (RM).

Outcome—A specific system state and sequence of events supported by data and expert opinion that clearly describes the outcome. The term implies that it is reasonable to expect that the assumed combination of conditions may occur within the operational lifetime of the system.

Preliminary Hazard Analysis (PHA)—An overview of the hazards associated with an operation or project proposal consisting of an initial risk assessment and development of safety-related requirements.

Preliminary Hazard List (PHL)—A list of anything that can go wrong, based on the concept, its operation, and implementation.

Risk—*See* Safety risk.

Risk analysis—Process during which a hazard is characterized for its likelihood and the severity of its effect or harm. Risk analysis can be either quantitative or qualitative; however, the inability to quantify or the lack of historical data on a particular hazard does not preclude the need for analysis.

Risk assessment—Process by which the results of risk analysis are used to make decisions. The process combines the effects of risk elements discovered in risk analysis and compares them against acceptability criteria. A risk assessment can include consolidating risks into risk sets that can be jointly mitigated, combined, and then used in making decisions.

Risk control—Reduction of risk severity and/or likelihood, through the application of engineering and/or administrative hazard controls. Risk control can also be anything that mitigates or ameliorates the risk.

Risk matrix—Table depicting the various levels of severity and likelihood as they relate to the levels of risk (e.g., low, medium, or high).

Risk mitigation—Any action taken to reduce the risk of a hazard's effect.

Risk register—A basic, ongoing working document that captures and describes risks and opportunities as they are identified together with risk accountabilities, actions where required, and review and completion dates.

Root cause analysis—Analysis of deficiencies to determine their underlying root cause.

Safety—The state in which the risk of harm to persons or property damage is acceptable.

Safety Assessment (SA)—Completion of the applicable SAS, the SRM five-step process of identifying and analyzing hazards, and documentation of the SRM panel's findings, as applicable.

Safety Assessment Screening (SAS)—An FAA form (5200-8, 5200-9, or 5200-10) used to document the ARP Safety Assessment process. Specifically, the SAS form is used to document the appropriate level of assessment, the five steps of SRM, and the final signatures and approvals.

Safety assurance—The process and procedures of management functions that evaluate the continued effectiveness of implemented risk mitigation strategies, support the identification of new hazards, and function to systematically provide confidence that an organization meets or exceeds its safety objectives through continuous improvement.

Safety Management System (SMS)—Formal, top-down, organization-wide approach to managing safety risk and ensuring the effectiveness of safety risk controls. An SMS includes systematic procedures, practices, and policies for managing safety risk.

Safety risk—Composite of predicted severity and likelihood of the potential effect of a hazard.
- *Initial*—Predicted severity and likelihood of a hazard's effects or outcomes when it is first identified and assessed; includes the effects of preexisting risk controls in the current environment.
- *Residual*—Remaining predicted severity and likelihood that exists after all selected risk control techniques have been implemented.

Safety Risk Assessment (SRA)—Assessment of a system or component, often by a panel of system subject matter experts (SMEs) and stakeholders, to compare an achieved risk level with the tolerable risk level. The term SRA is used for safety assessments with non FAA-led panels.

Safety Risk Management (SRM)—A formal process within an SMS composed of describing the system, identifying the hazards, and analyzing, assessing, and mitigating the risk.

Safety Risk Management (SRM) Panel—A group created to formalize a proactive approach to system safety and a methodology that ensures hazards are identified and unacceptable risk is mitigated before the change is made. An SRM panel provides a framework to ensure that, once a change is made, the change will be tracked throughout its lifecycle.

Severity—The measure of how severe the results of a hazardous condition's outcome are predicted to be.

System—An integrated set of constituent pieces combined in an operational or support environment to meet a defined objective. Elements include people, hardware, software, firmware, information, procedures, facilities, services, and other support facets.

Triggers—The requirements, precursors, or organizational plans that lead to initiation of the SRA or SA process.

ACRONYMS

5M	Mission, Man, Machine, Management, and Media
AOA	Aircraft operations area
ARFF	Airport rescue and firefighting
ARP	FAA Office of Airports
ATO	FAA Air Traffic Organization
AVS	FAA Aviation Safety Organization
CSA	Comparative Safety Assessment
CSPP	Construction Safety and Phasing Plan
FHA	Functional Hazard Analysis

ICAO	International Civil Aviation Organization
LOB	Line of business
OPS	SWR operations
ORA	Operational Risk Assessment
ORM	Operational Risk Management
OSA	Operational Safety Assessment
PHA	Preliminary Hazard Analysis
RCA	Root Cause Analysis
SA	Safety Assessment (FAA-led)
SAS	Safety Assessment Screening
SME	Subject Matter Expert
SMS	Safety Management System
SOP	Standard operating procedure
SPI	Safety Performance Indicator
SRA	Safety Risk Assessment (airport-led)
SRM	Safety Risk Management
SWR	Somewhere Airport
TWR	Air traffic tower

REPORT CONTENT

This report contains seven additional chapters.

- Chapter two summarizes the results of the literature review; the survey with Part 139, foreign, and military airports and consultants; and interviews with airport staff involved with SRAs.
- Chapter three presents the most common hazard identification and risk assessment techniques that are commonly used by the airport industry in the U.S. and elsewhere. This chapter also provides answers to some common questions raised during the survey and interviews.
- Chapter four summarizes the SRA planning process in four phases and identifies the key deliverables for each phase.
- Chapter five presents practical guidance for hazard identification and risk assessment, and emphasizes the improvements that can be achieved when structuring the hazard identification process.
- Chapter six complements the guidance available in *ACRP Report 131* on facilitation of SRM panels. It highlights key roles, principles, and techniques that can be used by airport staff to achieve successful and effective SRAs.
- Chapter seven describes tools and templates to support SRAs. Some of these materials are available in the appendices.
- Chapter eight presents key conclusions and suggestions for future research.

CHAPTER TWO

STUDY TASKS

An important step in this study was the review of methods currently used by Part 139 airports, foreign airports, and military organizations. The purpose of this review was to identify most effective practices and tools that these organizations currently use. The effort relied on two key tasks: a literature review, and a survey with Part 139 airports, foreign airports, military bases, and consultants. In addition to the survey, interviews were carried out with Part 139 staff involved with SRAs at the surveyed airports.

LITERATURE REVIEW

The objective of the literature review was to seek most effective practices and tools used by the industries to conduct and support safety assessments. References from various industries and different countries were reviewed for helpful information. Guidance information presented in this report was gathered from various sources and adapted or summarized.

Tables 2, 3, and 4 present a summary of the literature review conducted to identify common SRM techniques used by different industries and particularly by the aviation industry. Table 2 contains specific FAA references used internally to support FAA-led SAs. An important point is that the NPRM defines the need to establish an SRM process that incorporates five steps; however, the rule does not provide any detail on how safety risk assessments should be conducted by the airport. Table 3 presents the references applicable to airport-led SRAs, and Table 4 presents other references used in this study. Table 5 presents some of the available tools used in risk assessments.

SURVEY AND INTERVIEWS

This section describes the survey process used in this Synthesis study. The survey questionnaire is available in Appendix A, and the list of airports, consultants, and other stakeholders participating in the survey or interviews is presented in Appendix B.

The survey was carried out with airport staff and consultants who have been involved with airport SRM, to collect information on their experience with the SRA process, procedures, and tools. The objective was to identify most effective practices, gaps, and solutions that have been used by the industry. Particular attention was focused on the application of SRM techniques involving multidisciplinary teams to evaluate safety issues associated with airports.

The majority of surveys were carried out with airport staff from Part 139 airports. A limited number of responses were obtained from foreign airports, consultants, and military bases. The questions submitted to the airports addressed both SAs and SRAs with no distinction on the type of assessment associated with the response; therefore the conclusions from the survey are not related to the type of facilitation, whether led by the FAA or done internally by the airport. Table 6 summarizes the profile of survey respondents.

Responses were obtained from 36 of 41 organizations and consultants to which the questionnaire was submitted, representing a response rate of 87.8%. To complement the survey information, 15 telephone interviews were conducted with Part 139 and foreign airports that responded to the survey. The purpose of the interviews was to clarify some responses and attempt to obtain materials and tools developed by the airports. The materials obtained are included in the appendices.

TABLE 2
FAA-LED SAFETY ASSESSMENTS (SAs)

Source	Related Content
FAA, Order 8000.369A, Safety Management System, May 2013	To meet ICAO State Safety Program (SSP) framework, this Order explains the SMS principles and requirements; establishes the FAA SMS Executive Council and FAA SMS Committee; standardizes terminology for SMS; requires FAA organizations to implement SMS; and provides guidance to FAA organizations and their industry segments to implement SMS.
FAA, Order 8040.4A, Safety Risk Management Policy, Apr. 2012	This order supports FAA Order 8000.369, Safety Management System Guidance, and establishes requirements for how to conduct Safety Risk Management (SRM) in the FAA. This order establishes the Safety Risk Management (SRM) policy for the FAA and also establishes common terms and processes used to analyze, assess, and accept safety risk.
FAA Order 5200.11, FAA Airports (ARP) Safety Management System, Aug. 2010	Order 5200.11 is the basis for implementing SMS within the FAA Office of Airports (ARP). It defines Safety Management System (SMS) requirements and describes the roles and responsibilities of ARP management and staff as well as other FAA lines of business that contribute to the ARP SMS.
FAA Office of Airports—Safety Management System (SMS)—Desk Reference, V 1.0, June 2012	Describes FAA ARP internal SRM and Safety Assessment process, including Safety Assessment Screening (SAS), using SRM panels, SRM triggering actions and safety assessment tools [Preliminary Hazard Analysis (PHA)], Comparative Safety Assessment (CSA), and Operational Safety Assessment (OSA).
FAA, ARP SOP 4.00—Safety Risk Management (SRM) Under the FAA Office of Airports Safety Management System (SMS), Standard Operating Procedure (SOP), Sep. 2014	This SOP establishes uniform procedures for conducting the Safety Risk Management (SRM) component of the ARP Safety Management System (SMS) for certain ARP approval actions. ARP approval for these actions can only be given after completing the Safety Assessment (SA) in accordance with the SRM component.
FAA JO 1000.37A, Air Traffic Organization Safety Management System, May 2014	Order JO 1000.37A establishes the SMS policies for ATO, defining the scope, requirements, and applications, and establishes the responsibility for owning and executing the SMS to all employees at all levels of the ATO.
FAA, Air Traffic Organization, Safety Management System (SMS) Manual version 4.0, May 2014	This SMS Manual describes the objective of the ATO SMS and the interrelationship among the four components of the SMS, and instructs readers on the process of identifying safety hazards and mitigating risk in the National Airspace System (NAS). The Manual is complemented by the Safety Risk Management Guidance for System Acquisitions (SRMGSA), ATO Safety Guidance (ATO-SG) documents, and other FAA safety documents, to carry out the safety mission of the FAA and requirements of the SMS.

Source: ASM Consultants.

TABLE 3
AIRPORT-LED SAFETY RISK ASSESSMENTS (SRAs)

Source	Related Content
FAA, Notice of Proposed Rulemaking (NPRM), Federal Register Volume 75, Issue 194 (Oct. 7, 2010)	Proposed amendment to Part 139 to require certificate holders to establish an SMS for the airfield environment. The FAA proposal specifies implementation of a systematic process to analyze hazards and associated risks using a 5-step process, with no further specifics on the SRM process.
FAA, AC 150/5200-37A (Draft), Safety Management Systems for Airports, 2012	This AC, released in draft to supplement the NPRM, presents the concepts of a Safety Management System (SMS) and provides detailed guidance about developing and implementing SMS on an airport. It applies to all civil airports when adapted to the size, activity level, staff level, and resources of each facility. Also, it establishes guidelines for SMS implementation for and by airport operators at Part 139 airports.
ACRP Report 1: Safety Management Systems for Airports, Volume 2: Guidebook, 2009	Reference to help users understand what constitutes an airport SMS; describes its components and their interactions; and offers guidance in the planning, implementation, and operation of an airport SMS.
ACRP Report 131: A Guidebook for Safety Risk Management for Airports, 2015	Guidebook organized to help airport staff understand where the SRM process falls within an overall SMS. The guidebook provides information on conducting a safety risk assessment (SRA), explaining how small airports with fewer resources can scale it down. Tools and templates are provided as appendices.
ACRP Synthesis 37: Lessons Learned from Airport Safety Management Systems Pilot Studies—A Synthesis of Airport Practice, 2012	Describes data and information from the FAA SMS Pilot studies initiated in 2007 and completed in 2011.

Source: ASM Consultants.

TABLE 4
ADDITIONAL SRA REFERENCES

Source	Related Content
Aviation Risk Management Solutions (ARMS) Working Group, The ARMS Methodology for Operational Risk Assessment in Aviation Organizations, 2010	Presents a methodology for Operational Risk Assessment (ORA). The primary target for the methodology is the airlines, but it is also applicable to other aviation organizations, such as airports. The working group consisted mainly of safety practitioners from airlines.
FAA/EUROCONTROL ATM Safety Techniques and Toolbox, V2.0, Oct. 2007	Document contains some of the best safety assessment techniques available in 2007 for Air Traffic Management applications, based on the joint experience of the FAA and EUROCONTROL, and based on a review of more than 500 safety techniques used in nine industries. The result is a set of 27 techniques that can be used by safety practitioners and managers to evaluate and improve safety in Air Traffic Management.
Bircham, B., *A Simple Guide to Hazard Identification,* Presentation, Amey Seco, 1999	PowerPoint Presentation of practical guidance for identifying hazards by individuals or a panel approach.
Naval Safety Center, Time Critical Risk Management (TCRM) Multimedia Training Module, Facilitator Guide, Version 2, Aug. 2009	Training module introduces a tool to help improve performance in applying the four principles of risk management: • Accept risk when benefits outweigh the cost. • Accept no unnecessary risks. • Anticipate and manage risk by planning. • Make risk decisions at the right level.

(continued on next page)

TABLE 4
(*continued*)

Source	Related Content
Pullan, P., Murray-Webster, R., *A Short Guide to Facilitating Risk Management,* 2011	Describes how skilled facilitators can help groups who need to manage risk. The focus is the brainstorming workshop.
European Commercial Aviation Safety Team (ECAST)—SMS WG, Guidance on Hazards Identification, Mar. 2009	This document develops the concept of "the hazard" within a safety risk management framework, which also defines risk, safety events, undesirable events, outcomes, consequences, and risk controls (barriers or mitigations). It describes the basic concepts behind hazard identification methodologies (data-driven and qualitative).
European Commercial Aviation Safety Team (ECAST)—SMS WG, Planning and Conducting FHA Sessions, Jan. 2003	The purpose of this Guidance Material is to provide recommendations to conduct sessions to identify a hazard and its worst credible effect. It describes the role of the panel and the psychology of the brainstorming session, in addition to practical guidance for planning the workshop.
National Aerospace Laboratory (NLR), Safety Methods Database, V1.0, Mar. 2013	Living document that presents an overview of Techniques, Methods, Databases, and Models that can be used during a Safety Assessment. Divided into three parts: Part 1—Overview of Safety Methods; Part 2—Statistics; and Part 3—References. Includes description of 807 methods. This version includes the methods identified in a project on safety methods conducted by NLR for the FAA in 2011–2012.
Air Force Pamphlet 90-803, Feb. 2013	This pamphlet provides the definitions, guidelines, procedures, and tools for integration and execution of risk management as a risk reduction process to assist personnel in identifying and controlling safety and health hazards in making informed decisions. The term "Operational Risk Management" (ORM) has been replaced with the term "Risk Management" (RM) to emphasize the importance of hazard and risk mitigation and management in all aspects of the Air Force, not just Operations.
UK Civil Aviation Authority, CAP 760—Guidance on the Conduct of Hazard Identification, Risk Assessment and the Production of Safety Cases for Aerodrome Operators and Air Traffic Service Providers, Dec. 2010	This document is a consolidated reference addressing the development of Safety Cases for the purposes of assuring the safety of ATS and airport operations. The guidance is based on a seven-step safety assessment process to airport operators and ANSPs on the development of a Safety Case and, in particular, on hazard identification, risk assessment and the mitigation techniques that may be used. A Safety Case presents adequate evidence and argument to demonstrate that the new system or change is tolerably safe.
EUROCONTROL, Guidelines for the identification of hazards—How to make unimaginable hazards imaginable?, NLR-CR-2004-094, Mar. 2004	Presents guidelines on how to perform hazard identification brainstorms. These guidelines are based on experience at NLR and supplemented with other knowledge judged valuable. Combinations of functional and brainstorming approaches to hazard identification are expected to be valuable because of the different subsets of hazards these methods yield. It is recommended and motivated to perform brainstorms first.

Source: ASM Consultants.

TABLE 5
SAFETY ASSESSMENT TOOLS

Source	Related Content
FAA Air Traffic Organization—SRM Panel Orientation Briefing, July 2015	Model briefing for SRM panels.
EUROCONTROL, Air Navigation System Safety Assessment Methodology (SAM), Ed. 2.1, Oct. 2006	Guidance material for conducting safety assessment of air navigation systems. This toolkit/manual was developed by the EATMP Safety Assessment Methodology Task Force (SAMTF). The manual contains best practices for safety assessment of Air Navigation Systems and provides guidance for their application.
ICAO Toolkit, 2013	The toolkit is downloadable and includes the latest editable appendices of the ICAO Safety Management Manual (SMM) 3rd Ed., 2013.
Civil Aviation of New Zealand, Aviation Risk Management, an Introduction, Booklet 4, June 2013	Quick reference guide for practicing risk management.

Source: ASM Consultants.

TABLE 6
SUMMARY OF SURVEY PARTICIPANTS

Organization	Category	SMS Implementation Study Participant		
		Yes	No	Total
Part 139 Airport	Large Hub	3	9	12
	Medium Hub	4	4	8
	Small Hub	—	1	1
	Non-Hub	2	—	2
	Reliever	1	—	1
	GA	1	—	1
Foreign	International	—	5	5
Military Bases	Air Force	—	3	3
SMS Consultants	N/A	3	—	3
	Total	14	22	36

Note: N/A = not applicable.
Source: ASM Consultants.

It is important to note that only a small percentage of Part 139 airports have conducted SRAs or had SAs led by FAA, and that most airports currently using SRAs and SAs in a routine basis are medium and large hub airports. Therefore it was difficult to obtain survey responses from smaller airports, as shown in Table 6.

SURVEY RESPONSES

Each airport participating in the survey received a questionnaire with 22 questions about their experience conducting safety assessments. A summary of the responses to each question in the survey follows.

Question 1: Who were the SRA or SA facilitator(s), and how many SRAs or SAs were completed at your airport?

At least 12 Part 139 airports that responded to the survey indicated they had SAs led by the FAA, in most cases by FAA ATO facilitators. Of the 25 Part 139 airports responding, 14 had SRAs led by airport staff.

The foreign airports surveyed use SRAs on a regular basis. Most risk assessments were led by airport staff, with an average of 40 SRAs per year reported by those five foreign airports. Most of those SRAs were developed by a small group of airport staff, and the large majority of discussions with stakeholders were not facilitated in a brainstorming session to identify hazards and assess risks. One of the foreign airports reported the availability of staff specifically for the development of SRAs. The military organizations surveyed indicated they have specific trained staff who develop preliminary assessments to discuss with the group affected by the issue; however, this procedure is normally used in situations in which time is not a critical factor.

Question 2: What criteria do you use for selecting a facilitator?

A summary of responses is presented in Figure 1. A few Part 139 airports identified FAA facilitators as leading SA brainstorming sessions. One airport pointed out that engineers from construction/design firms have acquired skills to facilitate airport-led SRAs, particularly for safety issues related to airfield improvement formulation, design, and construction. Another Part 139 airport indicated that cost was the basis for selecting and hiring consultants to facilitate the SRAs.

Foreign airports use their own staff for most risk assessments; however, the process is slightly different, and most hazards are identified and risks assessed by a small team. In the

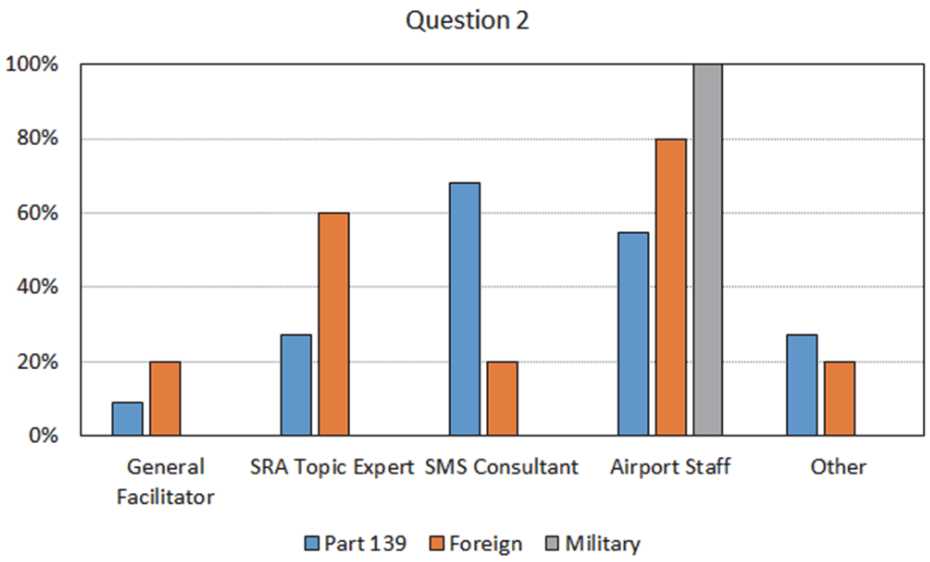


FIGURE 1 Selection of SRA facilitators (*Source*: ASM Consultants).

military organizations surveyed, risk assessments were conducted by their own staff, military or civilian.

Appendix F of the FAA ARP SMS Desk Reference (2012) provides a list of qualifications that can be used for hiring SRM consultant services, including SRA facilitators.

Question 3: During SRM panel meetings the facilitator uses_____:

Responses to question 3 are summarized in Figure 2. The majority of the respondents use a risk matrix, visual aids, and risk assessment worksheets. Foreign airports rely less on a briefing to stakeholders; preliminary risk assessments are prepared by a small team, and information is circulated among stakeholders, rather than having a brainstorming session managed by a facilitator. Military staff using the Operational Risk Management (ORM) approach use checklists of common hazards (however, the small sample of military organizations does not allow general inferences). Few airports have defined meeting rules for SRA brainstorming sessions.

Some Part 139 airports have developed quick reference guides containing basic information required during the brainstorming sessions, including the risk matrix, likelihood and severity definitions, and guidance on the SRM process. Sometimes a "one-page" guide worksheet is used as an aid to the SRA exercise.

For most SAs and SRAs related to formulation, design, and construction of airfield improvements, the use of concept drawings, plans, maps, illustrations, and other information to help understand the context and the changes are common. Military organizations use "electronic staff packages" containing references, forms, templates, and other tools to support Risk Management.

The FAA and many Part 139 airports use a PowerPoint briefing template. The briefing is modified to address the safety issue to be assessed, and the content includes the scope of the project, panel introductions, administrative issues, and an explanation of the SRA process. The briefing is considered helpful, particularly for participants with little experience with safety assessments.

Question 4: How do you identify panel members, including subject matter expertise?

Responses for question 4 are summarized in Figure 3. Airports rely on stakeholders affected by the safety issue to compose the SRM panel. A number of observers and airport staff have participated

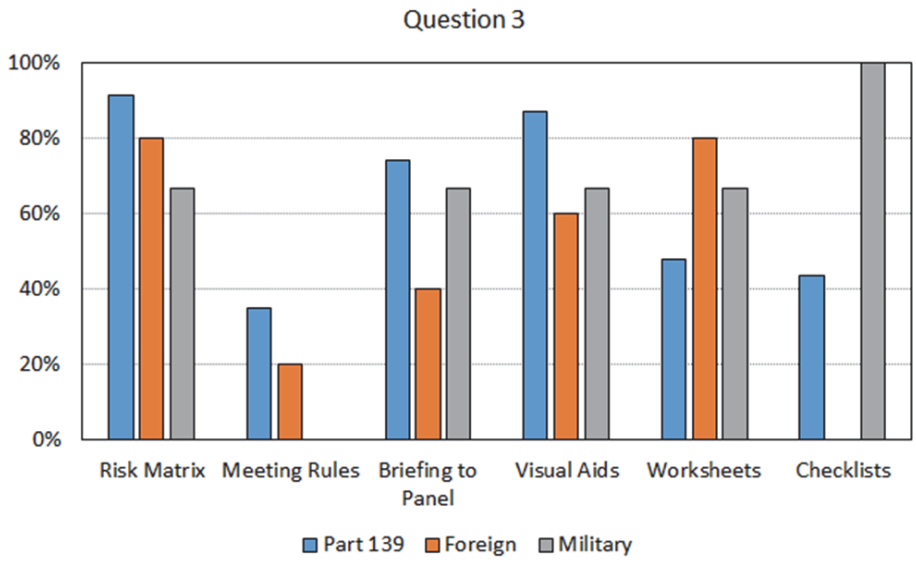


FIGURE 2 Tools used in SAs and SRAs (*Source*: ASM Consultants).

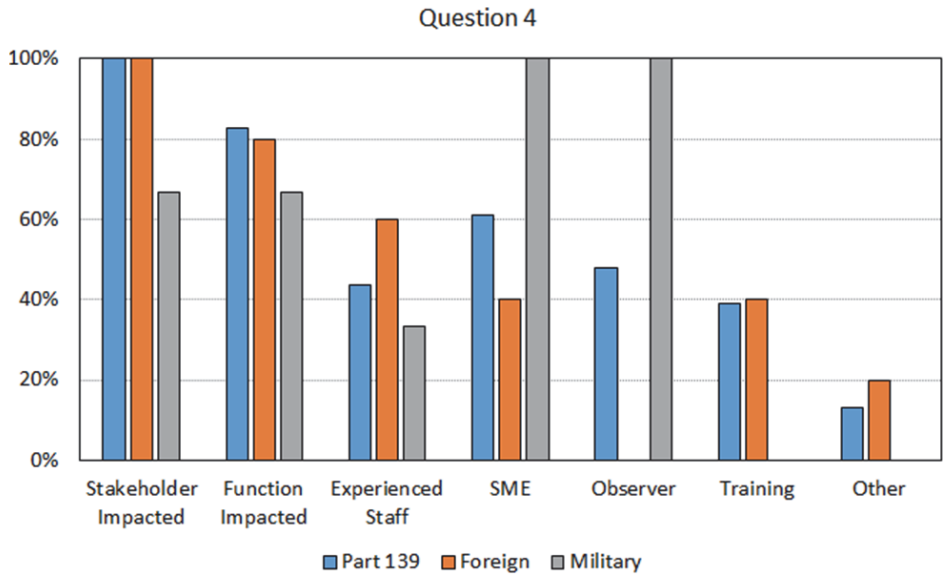


FIGURE 3 Panel participants (*Source*: ASM Consultants).

in SRAs to gain practical experience. A few airports have brought observers from other airports to acquire and share their experiences.

Most foreign airports indicated the importance of including airline pilots and the regulator to review safety assessments, and in the majority of the cases air traffic control staff is part of the panel reviewing the analysis. Few airports indicated that specific subject matter experts (SMEs) were brought in to participate in the SRM panel. Many Part 139 airports have hired consultants to facilitate the sessions.

Question 5: Which are your major obstacles to convening a panel to conduct an SRA?

This was a key question in the survey, particularly to identify gaps that Part 139 airports have experienced when conducting SRAs. Response results are summarized in Figure 4.

The major difficulty reported by all categories of organizations surveyed was the scheduling of SRA sessions to ensure participation of key stakeholders. Foreign airports also reported that the lack

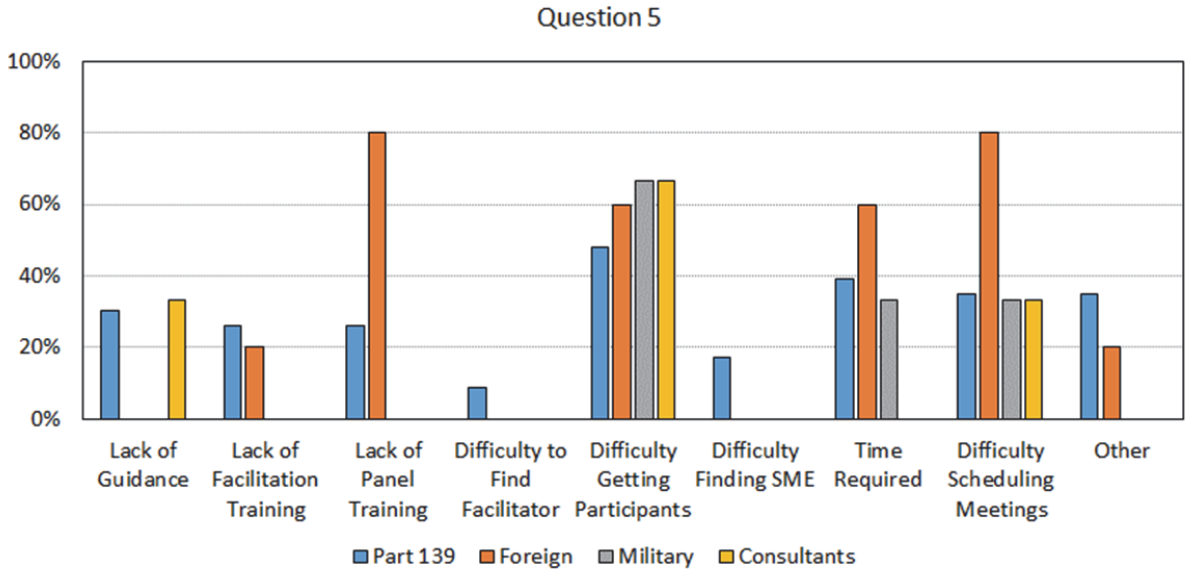


FIGURE 4 Major difficulties in conducting SRAs (*Source*: ASM Consultants).

of specific training for stakeholders participating in risk assessments has been a major issue. One probable reason is that the brainstorming session is not facilitated and there is no briefing to help participants understand and get familiar with the process. The time required to complete an SRA involving several airport staff is another major issue identified in the survey.

Most Part 139 airports responding to the survey have experienced a limited number of airport-led SRAs and indicated some difficulty responding to this question. Some airports reported that they had limited experience with safety assessments and therefore had to rely completely on the facilitation team of FAA staff or consultants.

Question 6: What are your most common triggers for convening an SRM panel?

The majority of safety issues that led Part 139 and foreign airports to trigger SAs and SRAs were related to formulation, design, and construction associated with CIPs, as shown in Figure 5. Most SAs, particularly at airports that had not participated in the Pilot Study, were initiated after receiving notification from the FAA that they would convene a panel.

SRAs generated from accidents and incidents at the airports were another frequent trigger for SRAs. Few Part 139 airports have used SRAs to evaluate new or revised standard operating procedures (SOPs). In the past few years it has become more common to have SRAs prior to special events (e.g., Super Bowl, air shows).

Question 7: Which airport area was impacted by the project/change that triggered the SRA?

As expected, most Part 139 and foreign airports use SRAs for safety issues associated with the airside, in both the movement and nonmovement areas. There have been few experiences using SRAs for landside issues, particularly by Part 139 airports. However, some airports with more mature SMS, including Part 139 airports, have found it beneficial to use the SRA process to evaluate landside safety issues.

Question 8: How does the airport document panel results?

Full SA reports have been developed to document those SAs led by the FAA. Some Part 139 airports have developed simple templates to document SRAs triggered by internal processes and involving few stakeholders.

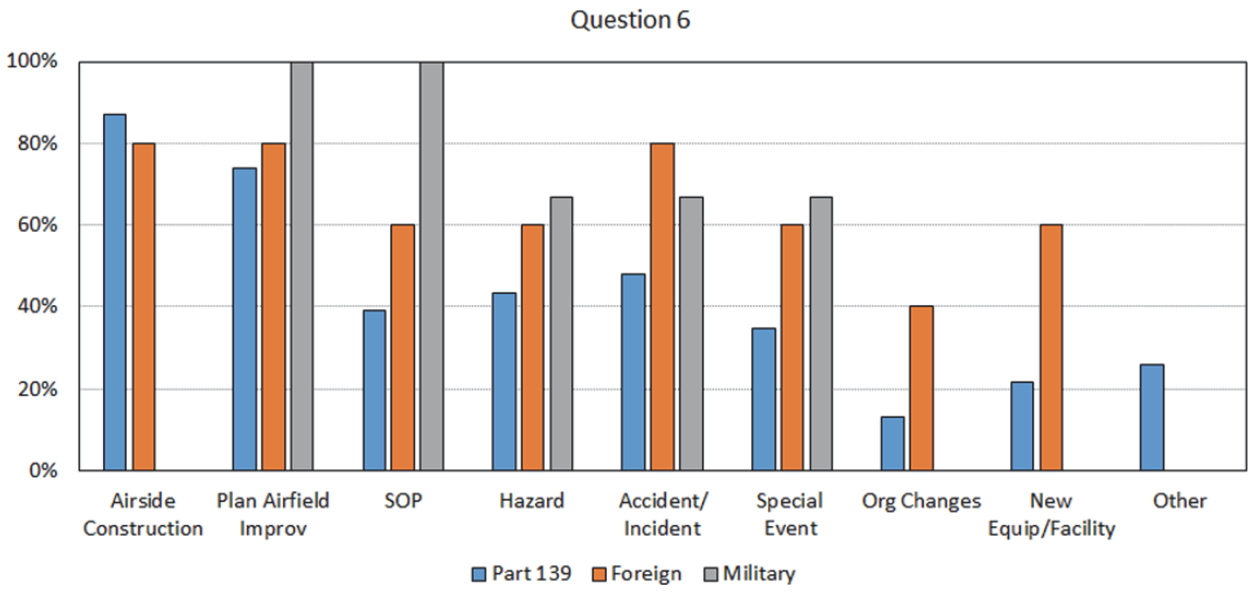


FIGURE 5 SRA triggers (*Source*: ASM Consultants).

Some foreign airports prepare comprehensive reports, depending on the complexity of the safety issue. A couple of foreign airports surveyed use only a risk assessment template with summary of risk mitigation actions and approvals. Some foreign airports use a preliminary hazard analysis to determine the need for further in-depth analysis of a safety issue. These studies are called Safety Study, Aeronautical Study, or Safety Case, depending on the convention used by the specific country. For Part 139 airports, a preliminary hazard analysis may be performed and lead to convening a panel for the safety assessment, similar to the safety assessment screening used by FAA ARP.

Question 9: What is the method for mitigation follow-up?

Based on the responses obtained, there is still a major deficiency in ensuring that risk mitigation actions defined in an SRA are actually implemented and monitored. A few Part 139 airports keep track of risk controls defined in the SRA; however, the procedures are still not systematic. Chapter seven presents techniques to improve implementation and monitoring of risk mitigation actions, gathered from the literature review and foreign airports.

Most Part 139 airports rely on the assigned responsibilities described in the SRA Report, or a summary of control actions is passed to contractors for inclusion in the Construction Safety and Phasing Plan (CSPP). It is important to note that a CSPP contains actions under the responsibility of the airport contractor and that some of the actions may fall under the responsibility of another airport stakeholder. A couple of Part 139 airports have reported difficulties obtaining the support of stakeholders when the risk control action can affect their operations and cause delays.

The NPRM issued by the FAA in 2010 requires that Part 139 airports "establish and maintain records that document the certificate holder's Safety Risk Management processes" and that these records "shall provide a means for airport management's acceptance of assessed risks and mitigations."

FAA Order 8040.4A, which is only applicable to FAA-led SRM panels, points out the need to include a methodology for monitoring and tracking the predicted residual risk. FAA typically identifies parties responsible for mitigations within the SA documentation. ATO's SMS Manual provides guidance to ATO personnel on developing monitoring plans and tracking of mitigations.

Every foreign airport surveyed indicated that it tracks completion of those actions. A few Part 139 airports have risk registers to monitor completion of risk control actions; however, it was not possible to assess how effective these systems are.

Some foreign airports from Europe and Asia record the actions in a risk register, however these airports think there is still room for improvement. One foreign airport reported that an airport staff is appointed to manage risk mitigation actions, and a summarized plan is developed to ensure the actions are implemented.

Question 10: Do you have predefined procedures to handle conflicts during meetings and, if so, what are they?

Other than attempting to obtain consensus and possibly voting when conflicting assessments are presented during brainstorming sessions, there are few predefined procedures to handle conflicts. Possibly this has to do with the lack of specific guidance and training on facilitation of brainstorming sessions for safety assessments. Some guidance on resolving these conflicts is presented in chapter six. A summary of responses to question 10 appears in Figure 6. One of the consultants indicated use of FAA Order 8040.4A—Safety Risk Management Policy as general guidance.

Most Part 139 airports prefer to document the issue or opinion when a conflict arises during the sessions. Many airports reported the importance of a skilled facilitator to handle undesirable situations and control the duration of the session. When a consensus cannot be achieved about the severity or likelihood of a risk, many airports responded that they tend to use the highest level of

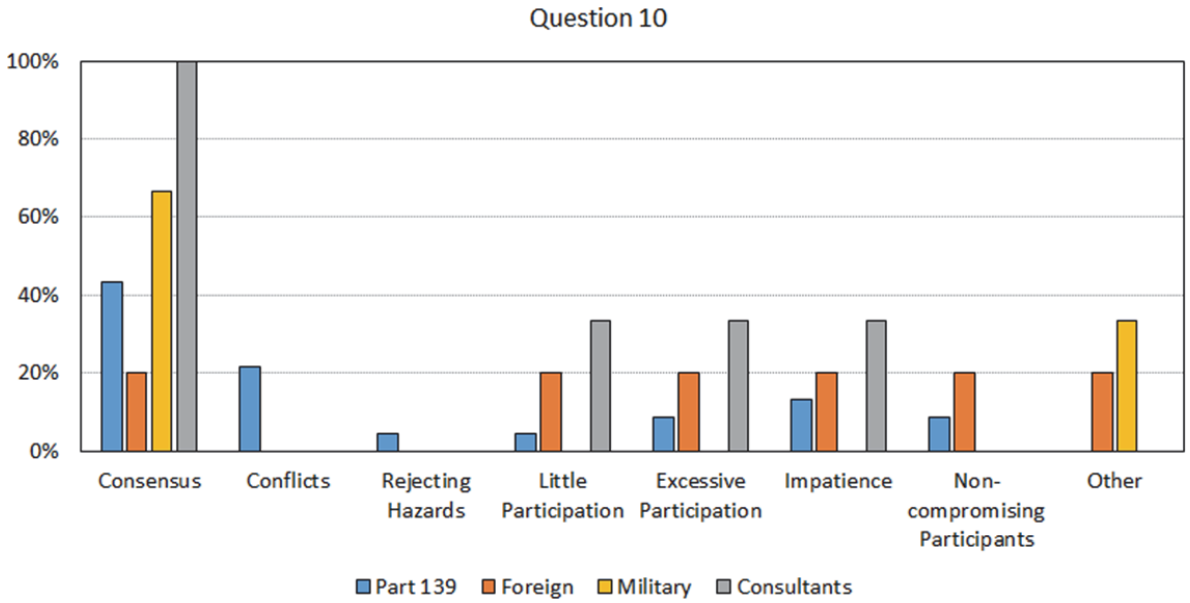


FIGURE 6 Techniques for resolving conflicts during SRAs (*Source*: ASM Consultants).

risk in the assessment. One of the techniques that has been used during conflicts is to have a session break.

Question 11: How are media and public inquiries and participation handled?

Few airports provided any response to this question. Most Part 139 airports have not faced this type of inquiry, and none of the SAs or SRAs conducted had participation of media or general public. However, many Part 139 airports pointed out that safety assessment related information requested would be provided if supported by local sunshine laws.

Question 12: What are lessons learned and advice to share with other airports conducting SRM panels?

A summary of responses to this question appears in Figure 7. Many airports find that preliminary information passed to the panel before the meeting and during the brainstorming is beneficial to a

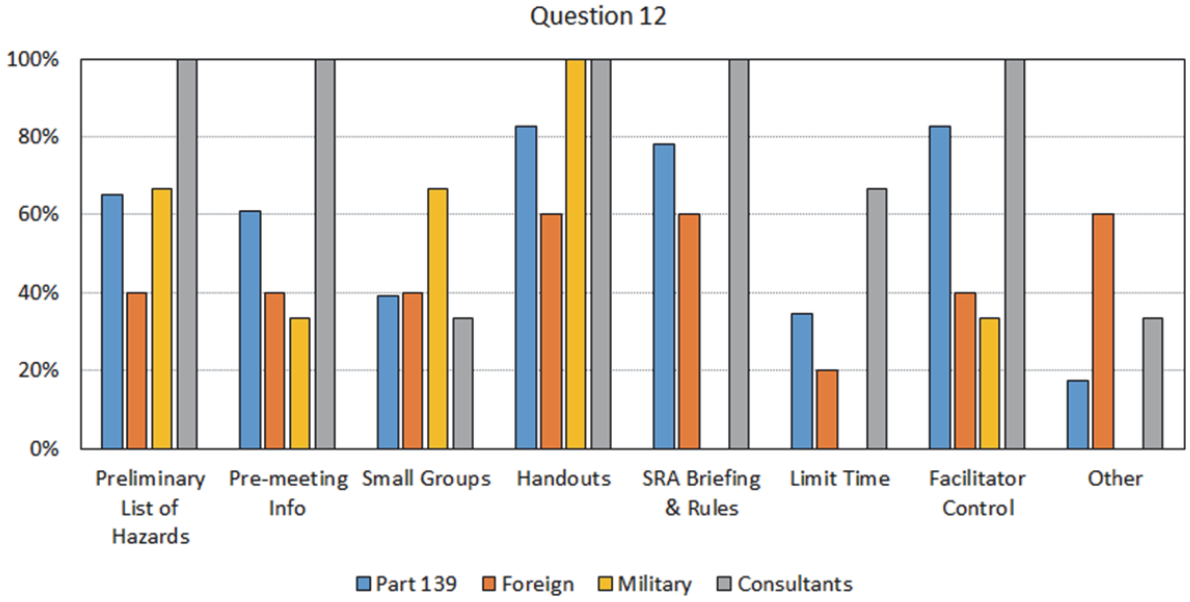


FIGURE 7 Summary of SRA techniques used (*Source*: ASM Consultants).

successful SRA. In most cases, SMS consultants make extensive use of material prepared for the specific SRA. Some airports prefer not to develop a preliminary list of hazards because it may cause bias and limit creative thinking during the brainstorming process.

Some airports have developed Quick Reference Guides to assist the SRA process. A couple of foreign airports surveyed have been promoting the importance of SRAs by organizing safety workshops with the participation of stakeholders and other airports. A few airports have used smaller groups associated with specific airport functions for preliminary risk assessments, particularly when more than 20 stakeholders are involved in the SRA.

A few Part 139 airports reported using the information from past projects, particularly when involving construction activities on the airside. During the SRA briefing, some airports have reminded the panel to use a compassionate attitude toward safety and a collaborative approach during the brainstorming session. To demonstrate the importance of the assessment, some airports have the director or other high level management representative attend the beginning of the session.

The survey indicated that airport operators believed it was beneficial to have observers from other airports involved in the process. This allows the visiting airport representatives the opportunity to gain practical experience and knowledge to use at their airports, which may be in the early stages of SMS implementation.

One consultant reported having preliminary meetings with the FAA, airport operations, and engineering to identify key hazards and pre-populate the SA and SRA worksheet before bringing the airlines and other stakeholders to discussions. During the initial briefing in the second meeting, the facilitator makes it clear that the list is only preliminary, to help initiate the brainstorming process. When using the preliminary hazard assessment, the total duration of the second session involving the complete panel can be better managed because the information is better organized and many hazards and risks have been identified.

The preliminary material is normally circulated at least 1 week before the meeting. Some consultants reported limiting panels to a maximum of 20 participants to make the session more manageable. One of the consultants noted that the FAA ATO has a template for the SRA briefing that may be used by the airports.

Having an experienced facilitator with expertise in the area being discussed is key to an effective SRA, according to responses to question 12. A lunch break sponsored by the airport helps bringing the group together and serves to recharge energy for the second half.

Question 13: What kind of tools does your airport use to complete a risk assessment?

As illustrated in Figure 8, templates, checklists, worksheets, and preliminary lists of hazards have been used by many organizations surveyed. A few airports indicated the use of one-page templates, and most Part 139 airports have used the available FAA guidance. PowerPoint presentations, projectors, flip charts, and white boards have been used extensively to identify and highlight hazardous conditions and to keep track of the assessments and SRA worksheets.

Question 14: What additional tools would be beneficial to the maturing of SRA process?

Many airports pointed out the need to have specific SRA training and guidance to airport staff. Some tools, including lists of typical hazards and industry baseline risk levels, are available in the recently published *ACRP Report 131* and were not considered in the survey. Figure 9 summarizes the responses to question 14. Some of the tools and templates identified by the respondents appear in the appendices of this report.

One airport indicated the need to develop an electronic risk register to help the airport keep track of hazards and risk control actions. Many of the airports were interested in developing electronic

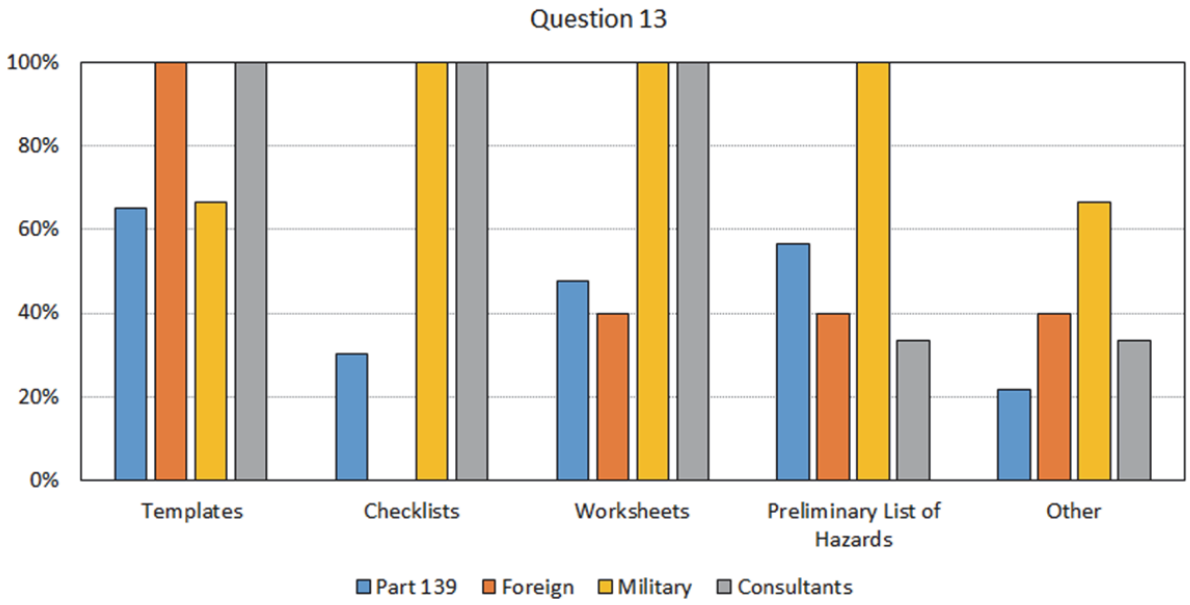


FIGURE 8 Basic SRA tools (*Source*: ASM Consultants).

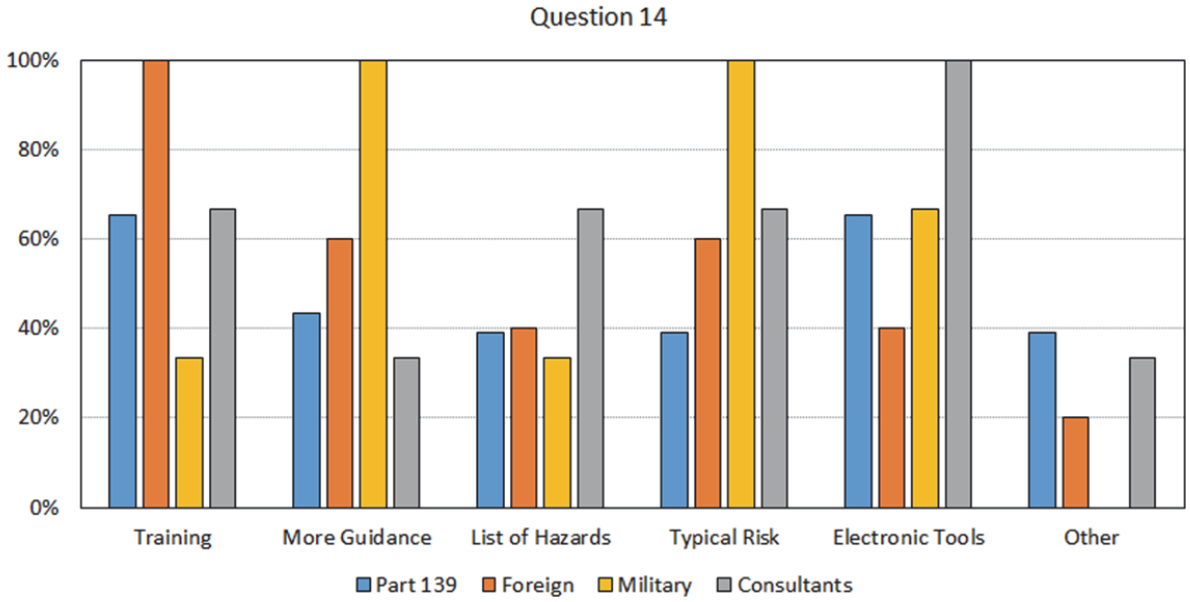


FIGURE 9 Additional SRA tools (*Source*: ASM Consultants).

tools (e.g., electronic worksheet) that could be helpful in running the SRA exercise. One of the consultants reported using the FAA internal SMS documentation (ARP SMS Desk Reference 2012) to develop similar tools that can be applied by Part 139 airports.

Question 15: How do you verify that existing and new risk controls are implemented?

Figure 10 summarizes the responses to question 15. It is clear that this is a major deficiency that Part 139 airports need to overcome. Many respondents cited the CSPP as the main tool to ensure that risk controls will be in place; however, it is important to note that the CSPP describes only the contractor responsibilities, and other stakeholders may be in charge of other measures. Also, even if the CSPP documents those risk controls, the airport can oversee those measures to make sure they are implemented and that the outcome is effective to reduce risks.

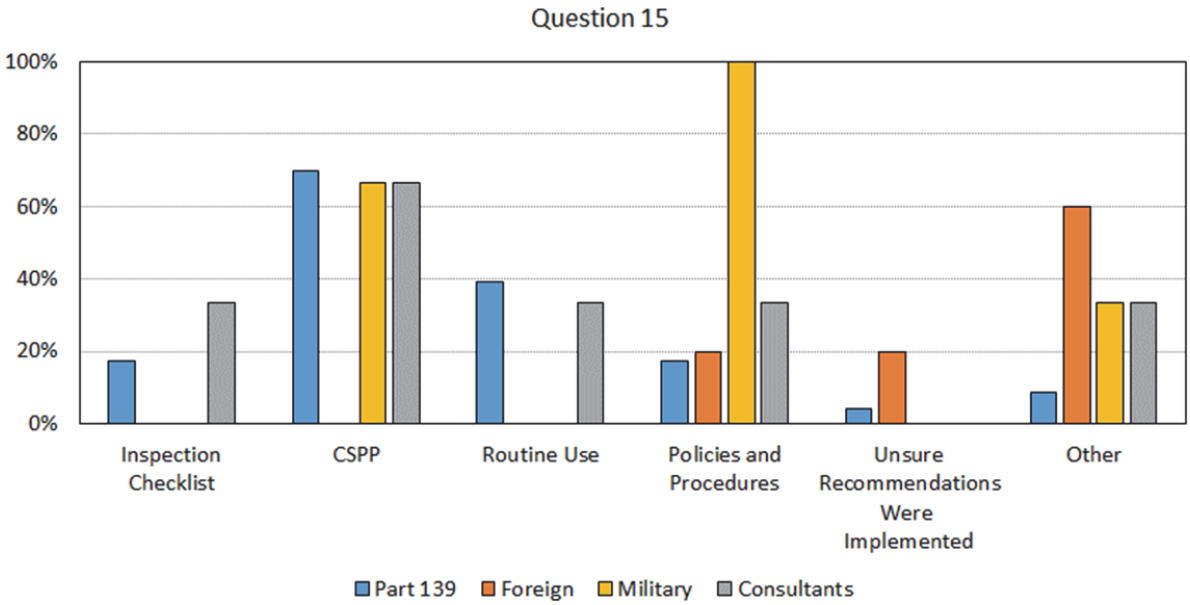


FIGURE 10 Safety assurance of risk mitigation actions (*Source*: ASM Consultants).

The most common response for verifying implementation was Part 139 airport inspections by operations staff. One of the airports developed a special form to track risk mitigation actions; it appears in Appendix C.

Question 16: What was the total duration of the SRM panel meeting(s)?

The time required to complete an SA and SRA and the additional workload by the stakeholders involved has been a major concern by Part 139 airports. Comparison between Part 139 and foreign airports indicate similar time spent with SRAs. As expected, as the complexity of the safety issue increases, the time it takes to perform the risk assessment increases proportionally.

Foreign airports tend to involve fewer people to prepare a preliminary risk assessment that is discussed during a regular safety meeting for the given project or change. Some foreign airports commonly establish safety working groups for projects and have regular periodic meetings. These meetings provide the opportunity to discuss new hazards and track the status of risk mitigation actions in a continuous process that appears to be quite effective.

Based on the small sample of military organizations, risk assessments take from 2 to 4 hours to complete; however, the sample of military organizations is too small for a strong inference. The military organizations use ORM standard procedures and have gained strong experience with this approach. Figure 11 summarizes responses to question 16.

Question 17: Based on the SRAs and SAs completed at your airport, please indicate the approximate number of participants in the panel meetings.

As expected, there is a wide range of panel sizes conducting SAs and SRAs, and results were similar for both Part 139 and foreign airports. Panels ranged from five to 25 people for most assessments. However, for the foreign airports surveyed, only one or two people are responsible for developing a preliminary risk assessment before it is discussed with the panel. The maximum number of people convened was 50, at a foreign airport. For military organizations, an average of nine people compose the SRM panels—once again, this inference is based on a small sample size.

Limiting the number of panel participants was also a challenge, as most airport stakeholders can be impacted by changes in the airfield and there has been significant interest in participating in SRM

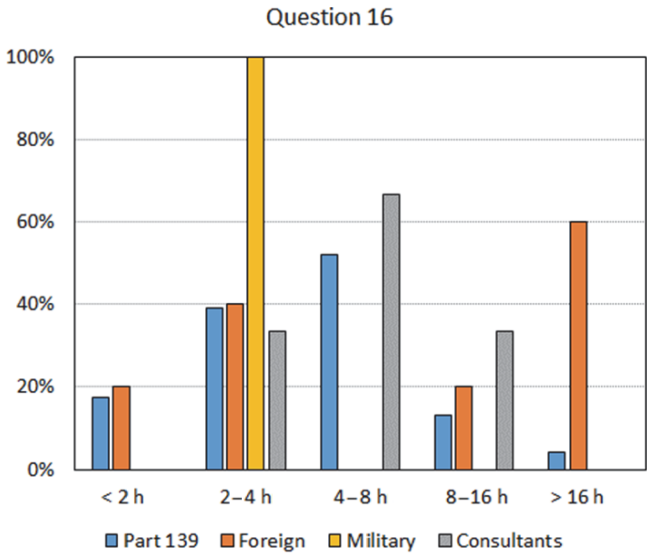


FIGURE 11 Duration of SRAs (*Source*: ASM Consultants).

panels to gain experience. Some airports highlighted the importance of balancing the need to identify as many hazards as possible with the need to keep the exercise as practical and fast as possible. Some consultants indicated the need to split a large group into smaller groups to keep facilitation under control and make the brainstorming more effective.

Question 18: How did you avoid long SRM panel meetings?

A summary of responses to this question appears in Figure 12. Airports with mature SMS and the military organizations make extensive use of preliminary risk assessments and premeeting information circulated among stakeholders and panel members.

Preliminary information has proved to be effective, particularly when enough preparation time allows panel members to have internal discussions within the subgroups and may prevent longer discussions during the brainstorming meeting. The military organizations use standard procedures

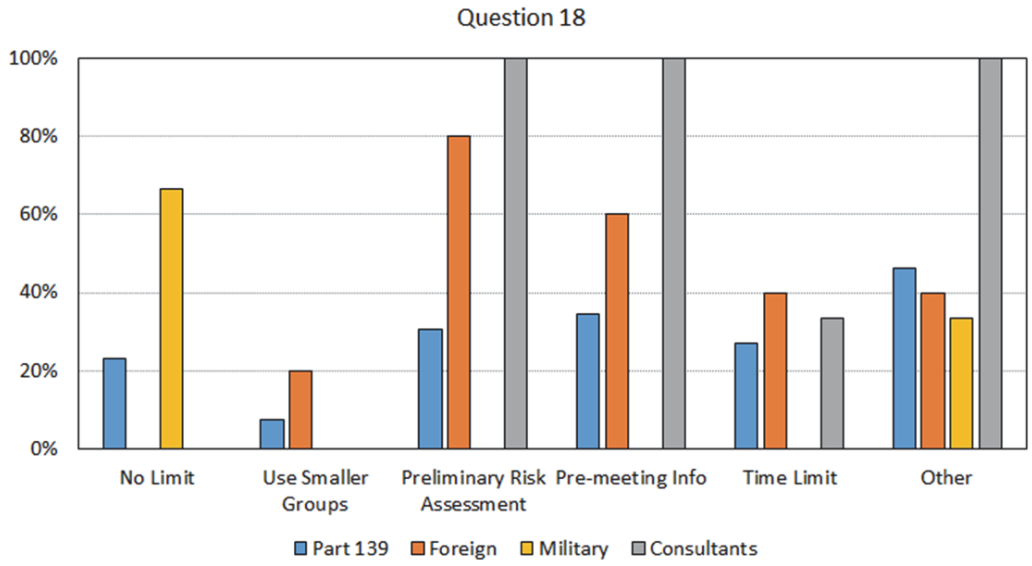


FIGURE 12 Techniques to control SRA duration (*Source*: ASM Consultants).

and are able to complete risk assessments within 2 to 4 hours, based on the small sample of air force bases evaluated.

It is important to remember the response by a consultant to question 12, who reported having a preliminary brainstorming with a smaller group in preparation for the SRA with all stakeholders involved. The preliminary assessment of hazards saves time and allows structuring the brainstorming session for more effective results. However, another airport reported avoiding using preliminary lists of hazards or even preliminary assessments because the outcome of the SRA may be biased and some important contributions to the brainstorming process may be lost.

Another important help to limit the duration of an SRA is to have a skilled and experienced facilitator. Splitting the attendees into meetings of smaller groups before a final meeting is convened with representatives of all stakeholders also was believed to be an effective way of managing an SRA's duration.

Question 19: Some risk mitigation actions have not been implemented because_____:

Responses to this question are summarized in Figure 13. Most organizations, particularly the military, will implement every risk control established in the SRA. Some foreign airports have not implemented actions because of the high cost involved. Also, some Part 139 airports have found it challenging to coordinate and assign responsibilities when external organizations are involved, particularly when the actions may impact that organization's operations. One airport indicated that a CIP had to be postponed because risk control actions would affect the airport capacity.

In addition, with limited experience in the United States, many stakeholders assume that the SRA exercise is complete upon approval of the report. In reality, it is necessary to monitor hazards and risks continuously, during the entire duration of the project or change.

Some Part 139 and foreign airports have developed special checklists for tracking and oversight of risk mitigation actions. When there are significant changes in conditions of the system evaluated in the SRA, the impact of those changes can be evaluated and a corrective action plan can be developed, if necessary.

Foreign airports reported that it is harder to ensure implementation of risk mitigation actions assigned to external airport stakeholders, simply because these actions are not under the control of the airport or may impact the stakeholder's operations.

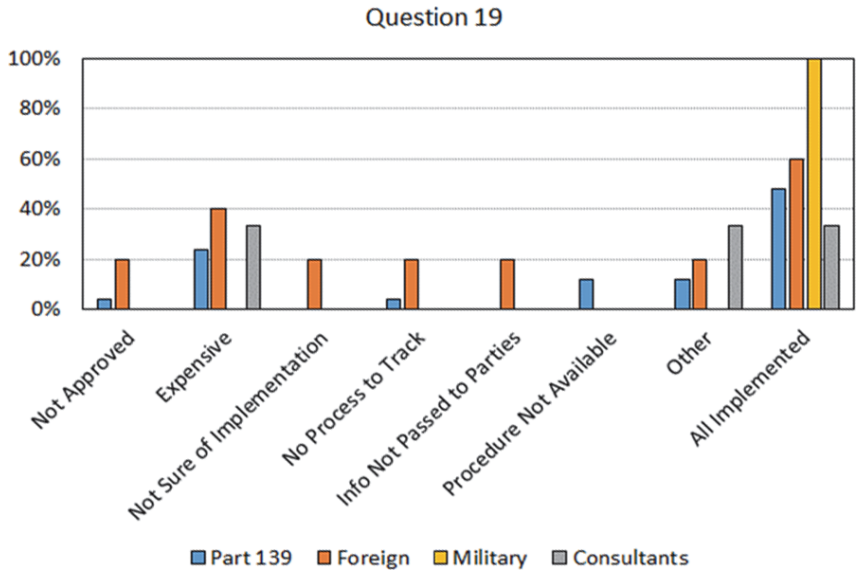


FIGURE 13 Reasons for not implementing risk control actions (*Source*: ASM Consultants).

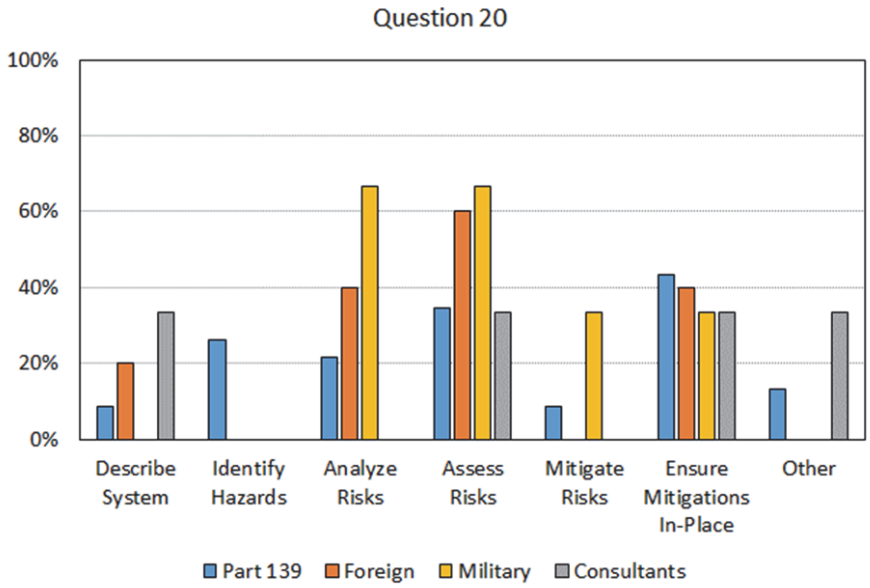


FIGURE 14 Main challenges in the SRM process (*Source*: ASM Consultants).

Question 20: The Safety Risk Management (SRM) process is composed of steps that are followed according to the methodology applied (e.g., FAA-led SAs use five steps). Which of the steps used in your SRA was the most challenging?

As shown in Figure 14, the greatest challenges are associated with the analysis and assessment of risks. Many airport staff find the process subjective and apt to lead to a broad range of opinions. However, the main challenge is making sure that risk mitigations will be implemented and monitored. Some effective techniques to track risk control actions are discussed in chapter seven. A few Part 139 airports have faced difficulties with risk identification; however, improvement is expected as the SRM process becomes part of the routine work and airport staff becomes familiar with risk assessments.

There is still some misunderstanding on the differences between hazard, cause, risk, and effect. *ACRP Report 131* clarifies these differences, and it is suggested to include these definitions with examples in a Quick Reference Guide for SRAs, as presented in Appendix D.

Another challenge that was reported is the delay or difficulty of getting approval by upper management for implementation of certain risk control actions involving higher costs or workload.

Question 21: The SRA outcome was_____:

A large majority (88%) of organizations and consultants surveyed found beneficial results from SRAs. Risk assessments have helped those organizations safely implement projects and changes. Some foreign airports with mature SMS have reported monetary savings from avoiding accidents and reducing insurance costs. Foreign airports that have implemented SMS in the last decade use safety assessments on a routine basis because they find value in systematically controlling safety risks.

Question 22: Please describe any lessons learned when convening SRM panels that may be helpful to other airports.

A wide range of answers were obtained from this question and are summarized in the following lists:

Challenges

- The logistics of the meetings was difficult and time consuming to handle.
- Effective reporting and approval of report

- Workload required to complete SA and SRAs
- Difficulty to facilitate brainstorming with large number of participants
- Unable to train staff in facilitation techniques
- There is little information available about typical industry risk levels.
- How should airports deal with construction changes? Is a new SRA required?

Lessons Learned—Planning SRAs

- Circulate relevant information prior to SRA meetings.
- Provide background information and briefing to panel participants on the SRA process.
- Get decision makers to participate in meetings.
- Having facilitators with expertise and skills is key for successful SRAs.
- Establish working groups for CIPs.
- Gain experience sending observers for SRAs at other airports.
- Ensure participation of construction management in the SRM panel and working group to discuss potential changes to the project.
- Bring pilots and controllers because they can bring valuable contribution to the SRA.
- Avoid gaps in key experience; operational or risk analysis and facilitation experience alone provides ineffective assessments; combination of experiences is essential.
- Involve competent people who are familiar with the activities involved.

Lessons Learned—Brainstorming

- Encourage participation of stakeholders impacted by safety issue.
- Offer lunch as an SRA break.
- Restate key definitions like hazards, risks, and consequences.
- Use as many illustrations as possible during the briefing to characterize the safety issue.
- Prepare illustrations to explain complex hazards.
- Have the airport manager welcome panel participants during the briefing to enforce the level of importance of the SRA.
- Do not completely assign responsibility for risk control actions to manager level; tasks should be assigned to supervisor or team leader levels.
- Find the correct level of detail; keep it as simple as possible but do not over simplify.

Lessons Learned—SRA Reporting

- Keep reports concise and meaningful to management and decision makers.
- Make risk mitigation guidelines available to the industry.
- Write SRA reports to “non-specialists.”
- Complete the SRA report as soon as possible and circulate while the panelists have recent memory of discussions.
- Develop an objective plan for implementation and monitoring of risk mitigation actions.

CONCLUSIONS OF SURVEY

Based on the analysis and descriptive statistics of responses, it is possible to infer these key conclusions from the survey.

- It is evident that those Part 139 airports that have taken the initiative to lead their own SRAs are having some difficulties finding airport-specific training programs on SRA planning, facilitation, and reporting. For the time being, consultants and FAA personnel primarily provide planning, facilitation, and reporting services for SAs and SRAs.
- A large majority of airports found that SRAs are beneficial; those Part 139 airports with more mature SMS and foreign airports that have implemented SMS for more than 10 years use SRAs on a routine and voluntary basis, and as a requirement under their internal SMS program.

- Many of the airports surveyed indicated the benefits of having an experienced facilitator guiding the risk assessment process, supported by SRM panels; hazard identification and risk assessments can be more effective.
- Two of the main concerns reported by airports were SRA scheduling and the duration of the brainstorming session. Sometimes it is difficult to schedule participation of key people, and the SRA process demands a significant amount of time.
- Some airports have confidence issues using subjective risk assessments with the help of a risk matrix; these airports are seeking additional tools, guidance, and training to conduct effective SRAs.
- A major deficiency of the SRA process, reported by Part 139 and foreign airports, is the safety assurance of risk control actions; airports are still seeking more effective means to ensure that risk controls are implemented and monitored upon completion and approval of the SRA report.

CHAPTER THREE

UNDERSTANDING THE SAFETY ASSESSMENT METHODOLOGY

During FAA's Part 139 SMS Implementation Study in 2011, 14 airports participated in the program with the intent to implement the Safety Risk Management and Safety Assurance components of SMS. Since then, those airports and other Part 139 airports have conducted airport-led SRAs; however, there are still some questions about the process:

- Is the risk assessment methodology being used accurate enough?
- Is there a better process that is more accurate and faster to perform?
- Is there another methodology that does not require involving so many stakeholders? Scheduling these meetings has been a real pain!

The best way to answer to these questions is to present risk assessment techniques that have been used by the industry and particularly by foreign airports that already have mature SMS and SRM processes. These techniques are presented in the next section of this report.

The majority of SRAs conducted by Part 139 airports were related to airside issues and particularly to CIPs. In many situations, the airports hired a consultant to manage and facilitate the SRA. For complex issues, a panel of airport staff and external stakeholders was convened for discussions with the support of a facilitator (Landry et al. 2012). Airport staff, FAA, or consultants led the facilitation during the SRA sessions.

The basic safety assessment process for complex safety issues typically involves convening a panel of subject matter experts. This approach was used by Part 139 airports in the Implementation Study and by airports participating in FAA-led panels. FAA ARP also uses a safety assessment screening tool to evaluate the need to convene a FAA-led panel to conduct their SAs.

The process of creating the SRM panel involves selecting representatives of airport stakeholders who could be affected by the safety issue or change. A facilitator leads the brainstorming session to identify hazards, assess risks, and define actions to control risks. The process has been used extensively in the aviation industry, particularly by air traffic organizations. FAA ATO has gained experience by applying the technique to safety issues in their area of responsibility.

The SRA process that has been used by Part 139 airports is comprised of a cluster of risk assessment techniques that have improved its effectiveness. FAA's proposed SMS rule would require Part 139 airports to use a general five-step SRM process but does not go into further detail. Specific techniques are used in each step of the process, as presented in Table 7.

Some techniques listed in Table 7 are discussed further in chapter five. Because the process is new and airport staff has had little experience with this type of approach, it creates a significant workload that previously did not exist at Part 139 airports. It is not unusual that airports will have questions about SRM and SRAs at this early stage of SMS implementation; however, the number of questions should decline as airport staff becomes more familiar with the process.

RISK ASSESSMENT METHODOLOGIES USED BY AIRPORTS

Most foreign airports rely on ICAO guidance to conduct risk assessments. Although the five foreign airports surveyed in this study use panels, only in special cases do they use facilitators for discussions and brainstorming. The basic process used by those foreign airports relies on a preliminary risk

TABLE 7
TECHNIQUES USED BY SRM PANELS

SRM Step	Technique Used in SRA or SA Session	Reference	
		SRA	SA
1 - Describe the System	5M (Mission, Man, Machine, Media, Management)	• *ACRP Report 131* (2015)	• FAA Order 8040.4 (2012) • FAA Order 5200.11 (2010) • ARP SMS Desk Reference V1.0 (2012) • FAA Order JO 1000.37A (2014) • ATO SMS Manual V4.0 (2014)
2 - Identify the Hazards	Brainstorming, Root Cause Analysis	• *ACRP Report 131* (2015) • *ACRP Report 1, Vol 2* (2009)	
3 - Analyze Risks	Brainstorming and Risk Definitions (severity and likelihood)	• Airport's SMS Manual • FAA AC 150/5200-37A	
4 - Assess Risks	Risk Matrix	• Airport's SMS Manual • FAA AC 150/5200-37A	
5 - Mitigate Risks	Brainstorming, Consensus, and Documentation	• Airport's SMS Manual • *ACRP Report 131* (2015)	

Source: ASM Consultants.

assessment conducted by a small group or even an individual. The documented results of the risk assessment are circulated among stakeholders for comments and suggestions, and the assessment is presented in regular meetings in which further discussions lead to an agreed list of risk control actions with associated responsibilities. The preliminary risk assessment report is then consolidated with the final changes and circulated again for approval.

Some foreign airports have successfully reduced the time required for a panel session by using the same approach, that is, circulating a preliminary risk assessment among the stakeholders. However, a significant disadvantage of this approach is that there is no facilitated brainstorming that can build synergy and obtain buy-in on key decisions.

More recently, airports in the United Kingdom and Asia have made an attempt to introduce the bow-tie model (see Table 8) to assess airport safety issues. For example, the bow-tie method has been adopted by Manchester Airport as its standard for SRAs and was included it in its 2015 Aerodrome Manual, which incorporates the SMS Manual.

A study (NLR, NLR-CR-2012-582, 2013) developed by the NLR Air Transport Safety Institute for the FAA, identified several risk assessment methods for safety risk management used in the aviation industry. One of the objectives of that study was to identify risk assessment methods that best serve specific programs and can help harmonize risk assessment and risk management across the FAA lines of business. A summary of those methods that could be applied to airport safety issues appears in Table 8. The list is not comprehensive, and other methodologies are available to the industry; however, those techniques may not be practical when applied to airport safety issues and airport staff; some techniques may require the assistance of operational specialists and statisticians. Many methodologies listed in NLR-CR-2012-582 are seldom used by Part 139 airports.

FAA ARP primarily uses the Preliminary Hazard Analysis (PHA) to analyze the development and modification of ARP standards, and airport planning projects. The FAA ARP SMS Desk Reference (2012) suggests alternative methods for specific situations:

- Operational Safety Assessment (OSA), in case the planning study does not have extensive operational data to support quantitative analysis for risk assessment; and
- Comparative Safety Assessment (CSA) for situations in which multiple alternatives need to be compared.

TABLE 8
MOST RELEVANT METHODS FOR RISK ASSESSMENT AND RISK MANAGEMENT FOR USE BY AIRPORTS

Method	Remark	Importance
5M Model	5M = Man, Machine, Medium, Mission, Management model A variation of the 5M Model is the SHELL Model (Software, Hardware, Environment, and twice an L for Liveware (human element), the central element.	• Used to describe the system that represents the first step in the SRM process. • This is one of the techniques used during the SRA process, and details are presented in *ACRP Report 1, Vol 2.*
Preliminary Hazard Analysis (PHA)	This is the basic method being used by Part 139 airports in conducting SRAs. It is a cluster of methods, including the 5M Model, that include a hazard analysis worksheet, risk matrix, and sometimes a preliminary hazard list (PHL).	• Effective in the early stages of formulation and implementation (e.g., airport improvements). • Used by all FAA LOBs. • PHA primarily aims to support SRM Steps 2 (Identify hazards), and 3 (Analyze safety risk). • PHA is easy to use and takes little time compared to other methods for risk assessment.
Comparative Safety Assessment (CSA)	CSA uses brainstorming to list hazards and assess risks for each alternative considered. The process uses the risk assessment to rank the options for decision-making purposes.	• Excellent for identifying issues that may require further analysis. • Used to evaluate multiple airport development alternatives in FAA SAs. • Applied in airport master planning.
Operational Safety Assessment (OSA)	OSA provides an assessment of hazards and safety requirements for various functional components of a system. It establishes how safety requirements are to be allocated between air and ground components and how performance and interoperability requirements might be influenced.	• Applied to long range formulation when operational data are not available. • The OSA is a two-step process. The first step identifies system physical and functional characteristics as well as air traffic and airport operational procedures. The second step is performing an operational hazard assessment for each component identified in step 1.
Collision Risk Models	Cluster that includes a variety of Collision Risk Models applied by subject matter experts	• Includes methods for quantitatively assessing risk of aircraft collisions. • Models applicable to airports include those to assess risk of collisions during approaches, overruns, undershoots, and veer-offs.
FMEA (Failure Modes Effects Analysis)	FMEA comprises a family of techniques to identify potential failure modes of a system, the effects of these failures, and the criticality of these failure effects.	• FMEAs serve for identification and analysis of technical systems. • FMEA is a well-established method; however it is relatively complex, requires subject matter experts, and is seldom used by airports.
Fault Tree Analysis (FTA)	Cluster of techniques that include Fault Trees, Dependence Diagrams, Reliability Block Diagrams, Functional Flow Diagrams.	• FTA is a well-established method; however, it requires specific expertise and is seldom used by airports. • FTA is considered to be well-accepted for the safety assessment of aviation equipment only.

(*continued*)

TABLE 8
(*continued*)

Method	Remark	Importance
Bow-Tie Model	The knot of the bow tie represents a releasing event or a hazard. The left wing shows threats and proactive measures, which improve the chances to avoid the hazard; the right wing shows consequences and reactive measures to mitigate risk consequences from escalating.	• Developed by Boeing Co. in 1965. • The approach has been popularized at the EU Safety Case Conference, 1999, as a structured approach for risk analysis within safety cases in which quantification is not possible or desirable. • Airports in the United Kingdom and Asia are using it for common airport risks. • Preventive and mitigating measures are linked to tasks, procedures, responsible individuals, and competencies.
Risk Register	Used for tracking of hazards, including status of control actions, reassessment of risks upon changes, and monitoring performance of control actions.	• The cluster includes established as well as updated methods. • Airports can have their own risk register and it can be quite simple, particularly for smaller airports.
Root Cause Analysis	This is a structured facilitated team process to identify root causes of an event that resulted in an undesired outcome and develop corrective actions. The process helps identify breakdowns in processes and systems that contributed to the event and how to prevent future events. The purpose of an RCA is to find out what happened and why it happened, and determine what changes need to be made.	• Reactive approach for risk assessment, the methodology is normally used to investigate accidents and incidents occurring at airports. • A common technique used in Root Cause Analysis is the 5-Whys (see *ACRP Report 1, Vol 2*).
Structured What-if Hazard Technique (SWIFT)	Structured brainstorming method of determining what things can go wrong based on the panel's past experiences and judging the likelihood and consequences of those situations occurring.	• Applicable for the review of SOPs and commonly used during SRA sessions, particularly to review hazards under different conditions (e.g., low visibility). • One of the most commonly used method by various industries (e.g., Chemical, Oil).
Checklist Method	Review of a detailed list of prepared questions about potential impacts to safety.	• Method used for hazard identification. • Example list of questions for airfield construction is presented in Appendix E.

Source: Developed by ASM Consultants based on NLR-CR-2012-582 (2013).

PHA is the primary methodology used by most Part 139 airports for SRAs. OSA and CSA techniques are rarely used in airport-led SRAs. PHA is an effective technique to identify the potential for major hazards at an early stage. It provides the basis for formulation, design, and construction decisions to mitigate the risks identified; however, one important limitation is that PHA may later require further in-depth analysis of risk.

PHA is an effective method that can help Part 139 airports perform their internal risk assessments associated with the most common changes and safety issues, for example, CIP. PHA combines techniques that allow building synergy within the multidisciplinary team that composes the panel, to better identify hazards and assess risks associated with a certain change. In addition, the technique also serves to get buy-in and sharing of responsibilities on risk control actions derived from the assessment.

BENEFITS OF SAFETY RISK MANAGEMENT PANELS

Based on the work by Bircham (2015), some of the key benefits of a well-facilitated safety assessment supported by a SRM panel are:

- An understanding of the most critical risks to prioritize
- A defined risk control plan for each risk
- Discussion of risks with airport stakeholders
- Consensus about relative importance of risks among all stakeholders
- Awareness of different viewpoints
- Understanding of where current risk control procedures cannot take the risk down to acceptable levels
- Shared responsibilities on risk management.

According to the survey conducted in this study, a typical risk assessment session lasts about 2 to 4 hours and involves 15 to 25 people, including managers, supervisors, staff, consultants, and a facilitator. Discussions about each risk normally take about 15 minutes to reach consensus about the risk level and control actions. Beyond the personnel costs, there are also travel requirements and considerable scheduling challenges. The importance of an effective and well-run SRM cannot be overemphasized.

CHAPTER FOUR

SAFETY RISK ASSESSMENT PROCESS FOR AIRPORTS

Based on the survey and interview responses, the guidance presented in *ACRP Report 131* (2015), and on the Eurocontrol Safety Assessment Methodology (2006), a summary of common practices and issues related to the various steps of conducting an SRA is presented in this chapter. The guidance presented is applicable to SRAs only; that is, safety assessments that use airport-led SRM panels.

The SRA process, from the moment the assessment is triggered to the implementation of risk mitigation actions, is illustrated in Figure 15 and includes four phases. These phases should not be confused with the five steps of the SRM process used by the SRM Panel in the SRA brainstorming session.

It is important to understand the process flow, as well as the objective, most effective practices, and the deliverables of each phase of this process. A summarized template for SRA planning appears in Appendix F. Many foreign airports define the SRA process in their SMS manuals.

PHASE 1—PLANNING

In Phase 1, a risk assessment is triggered by an internal decision made by airport management, by a trigger defined in the airport's SMS Manual, or in another reference or procedure used by the airport. Table 9 summarizes the objective and the methodologies used in Phase 1.

In this phase the airport makes the decision to conduct the SRA and develops a plan for execution. The plan includes the identification and invitation of stakeholders to compose the SRM panel, and preparation of material to explain the safety issue to be discussed.

In addition to inviting stakeholders to serve on the SRM panel, the SMS coordinator is responsible for evaluating the need to bring SMEs and facilitators to support the SRA.

When scheduling an SRA, if at all possible, it is beneficial to split the sessions between 2 days. In addition to the panel getting some rest, the facilitator will have time to organize notes and prepare documentation for the second session.

PHASE 2—PREPARATION AND SCHEDULING

In Phase 2, the participants receive pre-meeting information about the safety issue to be discussed and assessed. FAA ARP and ATO use summary documents called Project Proposal Summaries or Change Proposals to summarize the safety issue using plain language, charts, and graphics. The SRA facilitator may also prepare an SRA briefing to help panel participants understand the SRA process and the safety issue that will be discussed. In this phase the SRA brainstorming meeting is scheduled, and scheduling is one of the most critical tasks in the process. The importance of ensuring participation of key people in the SRA cannot be overestimated. Experienced stakeholders can bring light to hazards that were missed during the brainstorming process and point out risk control actions that are not feasible from a practical perspective.

Based on the survey conducted for this study, scheduling is one of the most difficult tasks, and the more participants are involved, the greater the difficulty to get confirmation from key people. Upon confirmation, the SRM panel participant receives the summary information about the safety issue

FIGURE 15 Safety assessment process (*Source*: *ACRP Report 131* 2015).

TABLE 9
SRA PHASE 1

Phase 1	Triggering and Planning of SRA
Objective	• Initiation of the SRA, preparation of preliminary material, and selection and invitation of stakeholders to participate as panel members. • Help participants understand safety issues involved in advance of brainstorming meeting.
Methodology	Trigger SRA • SMS triggers defined in the airport's SMS manual. • Airport management decision. • Triggers described in *ACRP Report 131*. Identify Stakeholders • Identify stakeholders impacted by safety issue/change/project. Prepare Preliminary Material • Collect information and documentation about safety issue to be assessed, including maps and plans, schedule, implementation phases. • Summarize information to circulate among stakeholders participating in the SRM panel. • Develop SRA schedule. Invite SRM Panel Participants • Submit invitation and proposed schedule. • Submit preliminary material.
Checklist	• Do we have a well-defined scope for the SRA? • Do we have a list of stakeholders that will populate the SRM panel, with their contact information for inviting participation? • Has the panel list been reviewed, and does everyone agree with the list? • Have we invited the panel participants with proposed date for the SRA session? • Have the key requirements and specifications been captured and summarized in the preliminary material to be circulated among panelists? • Have we submitted a summary of the safety issue and SRA schedule to the panel participants? • Do we have the facilities to run the SRA session(s) with a white board, flip chart, and electronic means?

Source: ASM Consultants, based on *ACRP Report 131* (2015).

being assessed. The intent is that the participant understands the safety issue before the brainstorming meeting takes place to identify hazards and assess risks.

Some airports hired experienced consultants to facilitate the SRA, and the task of hiring this person and a note-taker is also part of this phase. When a consultant is hired, the consultant will help preparing the preliminary material and the SRA briefing. Table 10 summarizes the actions for Phase 2.

For an SRA, the airport is responsible for setting the agenda, selecting and inviting panel participants, and confirming how decisions will be made (consensus, vote, or unilaterally after reviewing

TABLE 10
SRA PHASE 2

Phase 2	Preparation of SRA
Objective	Submit preliminary information and prepare SRA briefing.
Methodology	• Phone calls and electronic messages to invite participants. • Attach preliminary information. • Develop a structure for the SRA identifying phases and associated activities. • Develop preliminary list of hazards. • Use briefing template (Appendix G) or adapt FAA briefing.
Checklist	• Have all panel members confirmed participation? • Has the preliminary material been submitted to panel participants? • Do we have an agreed schedule? • Have we developed a structure for hazard identification? • Do we have a preliminary list of hazards? • Have we prepared a 30-min briefing for the SRA? • Do we have handouts, sticky notes, and pencils for the session?

Source: ASM Consultants, based on *ACRP Report 131* (2015).

TABLE 11
SRA PHASE 3

Phase 3	Conduct the SRA
Objective	Conduct the SRA brainstorming meeting to identify hazards, assess risks, and determine actions to control risks.
Methodology	• SRA briefing. • 5-step risk assessment process recommended by the FAA. • 5M to describe the system. • Brainstorming and preliminary list of hazards to identify hazards. • Brainstorming and consensus to assess risks. • Consensus to assign responsibilities for implementation of risk control actions. • Risk register and checklists to monitor implementation of risk control actions.
Checklist	• Have we delivered the briefing and explained the SRA process? • Have we presented a structure for the brainstorming process of hazard identification? • Do we have an SRA worksheet with hazards, risks, and control actions? • Do we have the notes taken during the brainstorming session? • Have we pointed out to panelists the next steps of the SRA process?

Note: Examples of SRM worksheets used during SRA sessions are presented in Appendix I.
Source: ASM Consultants, based on *ACRP Report 131* (2015).

opinions). A checklist of tools and equipment required for the brainstorming meeting prepared by Hartsfield–Jackson Atlanta International Airport is presented in Appendix H.

PHASE 3—CONDUCTING THE SAFETY RISK ASSESSMENT

In Phase 3 the SRA is conducted according to the plan developed in Phase 1. The details of this step are presented in chapters 5 and 6 of this report and summarized in Table 11. The purpose of the SRA meeting is to understand the impacts to operations and identify the hazards associated with the safety issue discussed, infer potential outcomes and levels of risks related to the hazards, and deliberate on the mitigation actions to balance the safety outcome and resource constraints.

PHASE 4—SAFETY RISK ASSESSMENT REPORTING

In Phase 4 the SRA Report is prepared. In most situations the report is prepared by the facilitator, possibly with the help of a note taker (a note taker can improve the dynamics of the brainstorming session and make it more effective, particularly when there are many panelists). Initially, a preliminary report is prepared and circulated among panel members for review. The reviews are consolidated in a Final SRA Report, and it is circulated among panel participants for approval. If the SRA is internal to the airport, some airports will require a responsible manager to sign the approval of the report. Table 12 presents a summary of actions for Phase 4, and Table 13 provides an example structure for SRA report.

TABLE 12
SRA PHASE 4

Phase 4	SRA Report
Objective	Consolidate results of the SRA meeting.
Methodology	• SRA Report template (see report templates and examples in Appendices J, K, and L). • Review of report by SRM panel. • Consolidation of SRM panel reviews. • SRA approval. • Create risk register.
Checklist	• Have we prepared a preliminary SRA Report? • Has the report been circulated and approved by panelists? • Do we have a summary of risk control actions and the most critical risks? • Have we included the SRA information in the airport's risk register? • Do we have a plan to implement and monitor risk mitigation actions? • Do we have a Final SRA Report approved by the panelists?

Source: ASM Consultants, based on *ACRP Report 131* (2015).

TABLE 13
CONTENTS OF AN SRA REPORT

- Cover page
- Version tracking
- Approval signature pages, including list of SRM panel members
- Table of contents
- Executive summary
- Introduction
- Description of safety issue/change
- Implementation phases and activities
- Description of the system
- Risk assessment templates with hazards, risks, and control actions
- Summary of risks and mitigation actions with responsibilities
- Plan to ensure implementation of risk mitigation actions
- Appendices
  - Project phasing
  - Pictures, drawings, plans, and illustrations
  - Map of most critical hazards
  - SRA worksheets
  - SRM panel attendees
  - Other

Source: PDX SRM Report.

FAA ARP documents the SA by combining the following contents (FAA ARP SMS Desk Reference, V1.0 2012):

- Completed Safety Assessment Screening form signed by the panelists, the appropriate FAA representative, and the airport sponsor
- Project proposal summary
- Hazard identification and analysis tool worksheet
- Hazard mitigation plan completed as defined by the panel
- Narrative of issues discussed and further explanation of findings and dissenting opinions, when applicable
- Pictures and other illustrations.

Although the structure presented is not required for SRA reports, it provides a good organization that can be used by airports to document their SRAs conducted by an SRM panel. A sample SRA Report is shown in Appendix J, and two additional templates are shown in appendices K and L. A few of the airports that participated in the FAA Implementation Study have developed their own templates to simplify documenting the SRA, as shown in Appendix K. A worksheet with description of hazards, potential outcomes, and current and residual risk levels with associated risk mitigation actions, is the key information to document in the SRA report.

One important component of an SRA Report is the plan to ensure that risk mitigation actions will be in place. Based on the survey conducted in this study, many airports have found it challenging to ensure that risk control actions derived from the SRA are actually monitored and implemented. Chapter seven describes most effective practices used by Part 139 and foreign airports for planning of safety assurance measures.

CHAPTER FIVE

HAZARD IDENTIFICATION AND RISK ASSESSMENT TECHNIQUES

As described in earlier sections, several techniques and approaches have been used by airports to conduct SRAs successfully. Current practice by Part 139 airports is to have a multidisciplinary panel of stakeholders when evaluating complex safety issues affecting airside stakeholders.

The panel is led by a facilitator during a brainstorming session when a cluster of techniques is used, including the preparation of material to support the assessment, the use of the 5M Model to describe the system, a structured or unstructured brainstorming to identify hazards, a risk matrix to assess risks, and additional brainstorming with the panel to evaluate feasible actions to mitigate risks further.

Part 139 airport staffs are gradually becoming familiar with these techniques, but a few gaps were identified during the survey and interviews for this project. This chapter addresses some of the gaps related to techniques frequently used by airports to identify hazards and assess risks.

The goal of the hazard identification step in the SRA process is to identify as many hazards as possible that are applicable to the operation, within the scope of the risk assessment. Most of the SRAs with panels have used facilitated brainstorming techniques to identify hazards. This is the second step of the SRM process recommended by the FAA; however, the airport industry has used other techniques described in this section.

HAZARD IDENTIFICATION CONCEPTS

According to H. de Jong (NLR-CR-2004-094—EUROCONTROL/NLR 2004), "experience shows that hazard identification brainstorming sessions are a rich source of hazards, not only in quantity but also in quality: brainstorming sessions often yield hazards that would not easily be obtained by other means, such as the functional approach to hazard identification in functional hazard analysis (FHA). Such functionally unimaginable hazards could not have been obtained by logical thinking in terms of functions and failures, but their identification depends in an essential way on the creativity of operational experts."

It is not possible to state that any of the hazard identification techniques described in this report will lead to the identification of each and every hazard involved with an airport project, a proposed change, or even accidents and incidents. Therefore it is necessary that hazard identification be periodically reviewed, particularly during the implementation of a project or change. In addition, the aviation system involves many complex interactions between the technical and human components operated by the airlines, the airport, air traffic control, and ground support organizations. Each of these stakeholders must manage the risks that are under its control; however cooperation between those parties will help the coordination and management of interactions and interfaces.

When performing a brainstorming session, the participation of representatives of functions affected by the safety issue is important. Adapted from the work by de Jong (2004), Figure 16a illustrates a brainstorming session with representatives of only one airport function (e.g., operations). The white circle represents the entire system defined in the SRA; the small hashed circles represent hazards identified; and the dashed circle represents the function assessed for hazards. It is likely that the hazards identified are only those related to the specific airport function conducting the SRA and that many hazards will be missed.

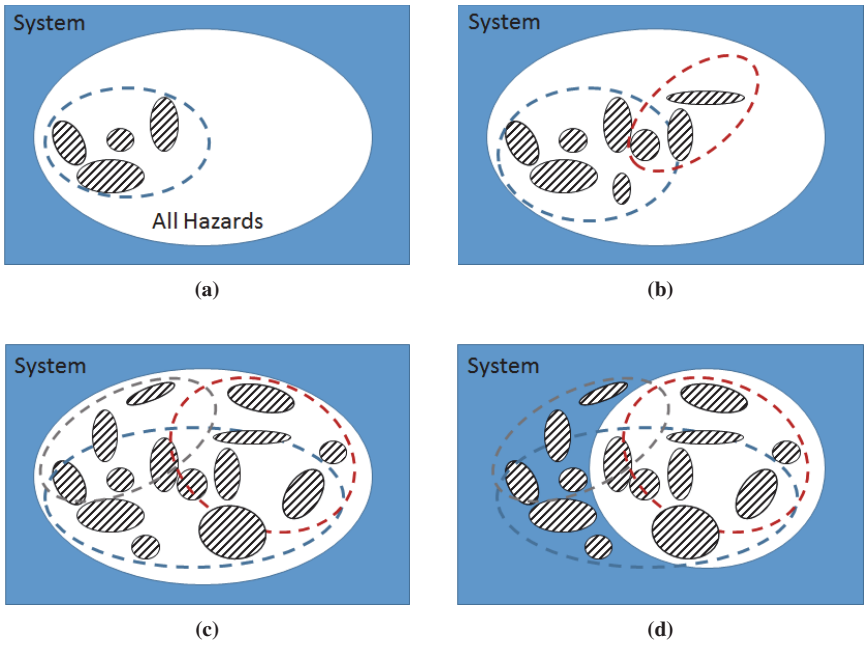


FIGURE 16 (a) Hazard identification with one function present (e.g., engineering); (b) hazard identification with additional function (e.g., operations and engineering); (c) structured hazard identification; (d) hazard identification with poor definition of the system (adapted from NLR-CR-2004-094 2004).

In Figure 16b, another airport function is included in the brainstorming. In this situation, new hazards are identified, not only those associated with the second function but additional hazards derived from the interactions between the two functions in the brainstorming process. When more functions are included in the hazard identification, the scenario is changed and it will cover a much larger spectrum of hazards.

Moreover, when the brainstorming process is structured to cover project/change implementation phases and activities, a broader region of potential hazards is covered and the process becomes more systematic and comprehensive, as illustrated in Figure 16c. One effective way to improve current SRA techniques used by Part 139 airports is to structure the hazard identification by outlining the different parts or sub-tasks of the change being examined. Breakdown may be by function, chronological order, operational phases, or other factors. This breakdown will help with the systematic identification of risks.

An example of structuring a risk assessment is presented here. The airport was having problems with the aircraft towing service provided by airport staff. A number of incidents resulting in minor damage to aircraft had occurred, and the airport wanted to take measures to reduce risk. To help with the identification of hazards, the aircraft towing process was divided into different tasks:

- Prepare work order,
- Assign tow crew,
- Select tow equipment,
- Position tug and hook up,
- Tow aircraft,
- Maneuver aircraft in/out of hangar, and
- Park and secure aircraft.

By dividing the process into tasks, it became easier to identify hazards in each task and the possibility of missing important hazards was reduced.

Another important conclusion is that the system must be well defined, otherwise the panel will not be able to see and discuss hazards outside the limits of the defined system, as shown in Figure 16d.

COMMON HAZARD IDENTIFICATION TECHNIQUES

Based on *ACRP Report 131* (2015), the most common hazard identification techniques used by airports are:

- Brainstorming,
- Checklists,
- Safety performance indicators (SPI),
- Hazard, incident and inspection reports,
- Structured What-if (SWIFT), and
- Safety audits.

It is important to note that these techniques are applied in all SRM processes used by airports; however, some of those techniques are not used commonly by SRM panels. Reports, SPIs, and audits are considered data-driven methodologies, and information normally is recorded through systematic processes that allow tracking and further analysis. The other methodologies, classified as qualitative, can be generated in a formal process such as an SRA, or an informal process based on discussions and interviews; these methodologies are considered heuristic processes based on judgment by experienced people or experts. Hazard identification should be as comprehensive as possible and take into consideration design, organizational, work environment factors, procedures, and operating practices (ICAO SMM, 3rd ed. 2013).

The FAA-EUROCONTROL Toolbox (2007) recommends that identification of hazards be done by an individual or group-based assessors. The main challenge of both approaches is to identify hazards that exist but are difficult to recognize. Other hazard identification techniques have been developed to help overcoming this type of deficiency; however, the use of those methods may require specific expertise not commonly available at airports.

In the individual approach, one or two assessors trained in SRM take the responsibility of identifying routine hazards that normally represent the majority of hazards at an airport. In most cases, the SMS coordinator and assistants are responsible for this role. In addition, this method is helpful for a preliminary and high-level identification of hazards. The main question to be asked in the individual approach is, "What can go wrong?"

The group-based approach involves stakeholders and experts for the hazard identification exercise. This is the basic PHA methodology used during SRAs supported by panels and managed by a facilitator. At smaller airports, the groups will be small but each department should be represented. A participant may represent two or more airport functions.

Some hazards are difficult to identify (EUROCONTROL 2003) regardless of which approach is used, particularly those hazards associated with situational awareness issues. In certain situations a relevant function for the safety of the operations is implicit, or the description of the system is not complete and some "unimaginable hazards" may be present.

According to Bircham (2015), one of the most productive means of encouraging cooperation between management and the rest of the airport workforce is to share the information resulting from the assessment with all who might be exposed to the risk. This provides management an opportunity to explain the precautionary risk control measures being considered, and to involve airport staff in their development. Wherever possible, a team exercise involving different levels of personnel and stakeholders will help strengthen the feeling of ownership and help develop a positive safety culture in the airport organization. Unless the airport manager responsible for dealing with eventual outcomes has a good understanding of the processes involved, the manager will have to implement recommendations under blind conditions.

When an individual is responsible for the risk assessment, the work is done faster. However, that individual needs to have substantial experience. The most common problem with this approach is that it may perpetuate "safety is the SMS Department problem." In most cases a risk assessment conducted by an individual is not as comprehensive as when a team is involved. Personal perception may be biased. However, when quick reaction to address a hazard in a dynamic environment—such as an airport—is necessary, it is not always possible to convene a panel to assess risks.

Brainstorming

"Brainstorming is an unbounded but facilitated discussion within a group of experts and stakeholders where the facilitator encourages imaginative thinking" (ECAST 2009). There are two basic rules for hazard identification in brainstorming sessions:

- Identify as many hazards as possible; and
- Criticism and analysis are forbidden during the session.

Advantages:

- Good for identifying new hazards in unique systems
- Involves airport stakeholders impacted by the safety issue or change
- Relatively simple and easy to run
- Airport staff with little experience can participate
- Can be applied to many airport safety issues
- Shared responsibility of outcome.

Disadvantages:

- In most cases it is relatively unstructured and may not be comprehensive
- Depends on the expertise, experience, and profile of participants
- Strong influence of group dynamics and experience of facilitator
- Can be time consuming
- Ties up airport and stakeholder resources
- Scheduling can be a challenge when large groups are involved.

Brainstorming is the typical SRA technique used to identify hazards by Part 139 airports. EUROCONTROL (2004) suggests that a group of four to six people is ideal for brainstorming. However, surveyed Part 139 airports indicate that panels average 15 participants, with a maximum of 40. Again, it is important to recognize that survey responses did not differentiate between the number of participants in FAA and airport-led SRM panels. Moreover, the use of SRM panels represents a new experience to Part 139 staff, and it has raised interest in experiencing the process. During the early stages of SRM implementation, groups tend to be larger; this is also beneficial for gaining experience and on-the-job training.

Some Part 139 airports have divided larger groups into smaller group sessions with representatives of each group in a final, consolidating session. Cognitive science research (Nijstad 2000) indicates that the brainstorming groups' productivity generally does not grow proportionally with the number of participants.

Many foreign airports have a few staff members with expertise in risk assessment who can develop a preliminary SRA that is circulated among panel participants for comments and suggestions. The consolidated results are then presented in a regular meeting for additional and final feedback. Lastly, the final document is circulated for approval.

Checklists

Lists of common hazards have been developed from past projects and people experienced with the type of project or change. The Pennsylvania Department of Labor and Industry (2013) says there are advantages and disadvantages of checklists.

Advantages:

- Can be used by nonexpert airport staff
- Based on evidence from previous projects or similar changes
- Assurance that the most obvious hazards will not be missed.

Disadvantages:

- Less effective when applying to novel systems
- Can inhibit creative thinking
- Would miss hazards that were not included in the list
- There may be critical gaps when checklists are used by unexperienced people.

Formulation of airfield improvements and construction projects are the most common airport activities requiring an SRA when it has any impact on the airside. A typical checklist for airfield construction projects is presented in Appendix E.

Safety Performance Indicators

According to *ACRP Report 1, Vol. 2* (2007), a Safety Performance Indicator (SPI) is any measurable parameter used to point out how well any activity related to safety is performing over time, and to assess the overall SMS health indirectly. SPIs are used to track and identify undesirable trends in safety performance. The analysis of SPI trends is the basic safety assurance tool used by airports that have implemented SMS.

The airport selects appropriate parameters, in most cases derived from safety objectives defined by the airport management or related to known safety issues. Data on SPIs are monitored and trends are evaluated to identify the need for risk control actions.

Advantages:

- Raises safety awareness
- In line with the airport's safety objectives
- Addresses specific safety issues.

Disadvantages:

- Requires regular data collection
- Requires consistent data quality
- Prone to seasonality bias when monitored over a short period
- May require application of statistical techniques.

Accident and Incident Investigation Reports

Accident and incident investigation reports contain information on hazards, incidents, and accidents and are effective sources for identification of hazards. For undesirable events, sometimes it is necessary to conduct a root cause analysis (RCA), which is the analysis of deficiencies to determine their underlying cause (FAA AC 120-79A 2010).

Advantages:

- Proactive and effective for identifying hazards
- Root cause analysis can be relatively simple and easy to use (e.g., 5-Whys technique)
- Effective multiplier of the "eyes" of the airport to identify hazards
- Airports always have tools/systems for reporting safety issues
- Multiple hazards can be identified from safety reports.

Disadvantages:

- Will only address hazards associated with reported events
- Root cause analysis is only effective if applied by a person familiar with the causes
- Subject to reporting policies applied by the airport.

Structured What-if (SWIFT)

This hazard identification technique was adapted from the Hazard and Operability (HAZOP) methodology originated in the chemical industry. The technique also involves a multidisciplinary panel of experts chaired by a facilitator; however, different from brainstorming, it is typically conducted at a higher level of the system, with fewer components. The facilitator prepares a list of questions to ask to the panel such as:

- What if . . . ?
- Could someone . . . ?
- Has anyone ever . . . ?

Advantages:

- Provides a detailed and auditable record of the process
- Takes less time than other more sophisticated techniques
- Effectiveness will depend on experience of the facilitator.

Disadvantages:

- Less thorough when looking for details
- Relies heavily on expert opinion
- Careful thought is required in preparation for the application of this technique.

Sometimes a facilitator will use SWIFT techniques during a brainstorming, even when it is not the predominant method used during the session.

Safety Audits

Safety audits are routinely used under an SMS for safety assurance, to assess compliance with regulatory and internal requirements, and to evaluate the effectiveness of a system, process, or procedure.

Advantages:

- In addition to identify deficiencies and deviations, audits can detect potential hazards.
- Highlight areas of concern for further investigation
- Recommend solutions and risk control measures for improvements
- Fresh and impartial pair of eyes can identify issues that have been overlooked.

Disadvantages:

- Intense workload required
- Direct objective is not to identify hazards
- Airport staff may feel intimidated.

BOW-TIE MODEL FOR RISK ASSESSMENT

The basic SRA process that has been used by Part 139 airports to conduct safety assessments includes the use of a worksheet or table, and moving to the identification of hazards and applying the five-step SRM process recommended by the FAA. Each hazard and associated risk is individually evaluated using this process. Several hazards and risks can be evaluated, and the worksheet is used to summarize the process for all hazards. The method is useful for proactively assessing risks related to formulation, design, and construction of CIPs.

More recently, airports in Europe and Asia have been using a well-known risk assessment model called “bow-tie.” The name is related to the shape of the diagram used in the risk assessment. Atypical bow-tie diagram is illustrated in Figure 17.

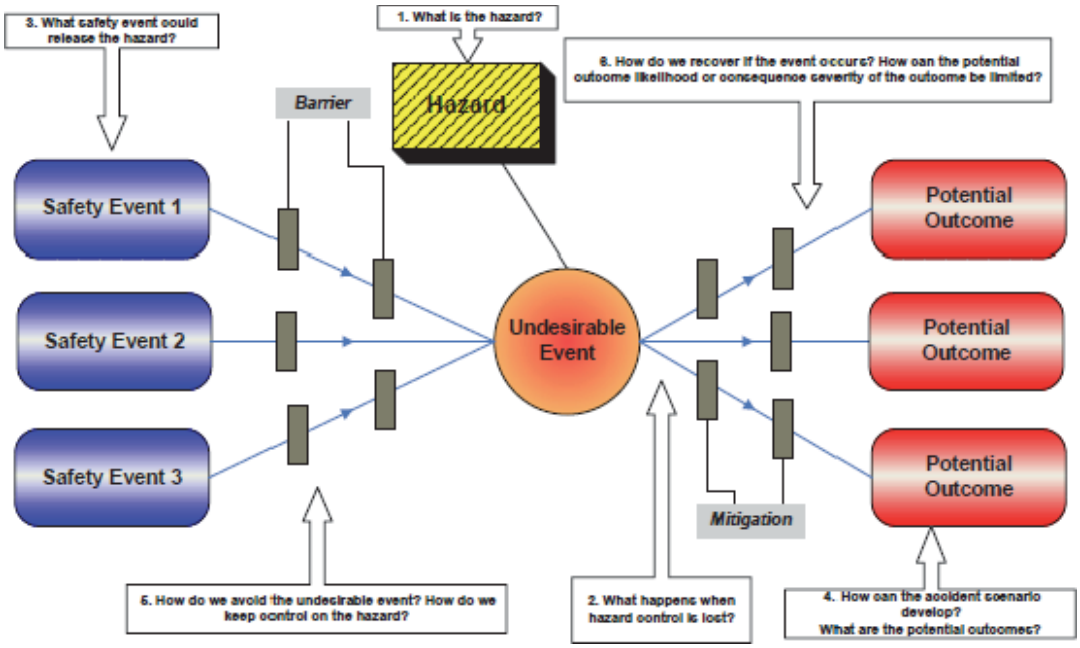


FIGURE 17 Bow-tie diagram (*Source*: ECAST, Guidance on Hazards Identification 2009).

The bow-tie diagram in Figure 17 presents the hazard (e.g., airfield construction), the undesirable event (e.g., runway incursion), the safety events or threats (e.g., construction workers near movement areas) and potential outcomes (e.g., aircraft running over construction worker). In addition, two categories of risk controls are illustrated. On the left side of the undesirable event are the proactive or preventive controls called barriers (e.g., safety awareness training to construction workers), in most cases intended to reduce the probability of the undesirable event occurring. On the right side are the mitigation controls (e.g., emergency response plan) intended to reduce the severity of the outcome upon occurrence of the undesirable event.

The bow-tie method has many advantages over the more simple method of applying the risk matrix used by Part 139 airports; however it is certainly more complex and may take more time to complete. A typical bow-tie diagram appears in Figure 18. Among the main advantages of the bow-tie method are:

- Provides an effective illustration to represent the risk structure and its elements
- Increased awareness and understanding of safety risks
- The identification of critical risk controls and assessment of how effective these controls are
- Possibility to identify control ownership, control function, control type, control criticality and threat exposure
- Represents a tool to continually monitor risks and make adjustments to controls when changes impacting the risk of an undesirable event are introduced to the system.

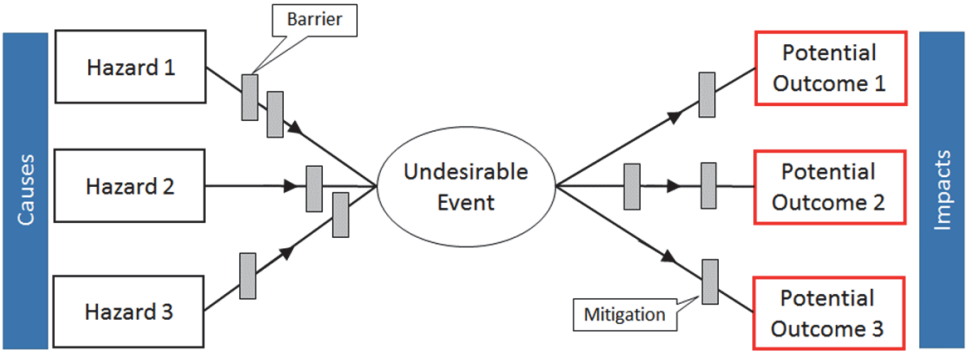


FIGURE 18 Basic typical bow-tie diagram (*Source*: ASM Consultants).

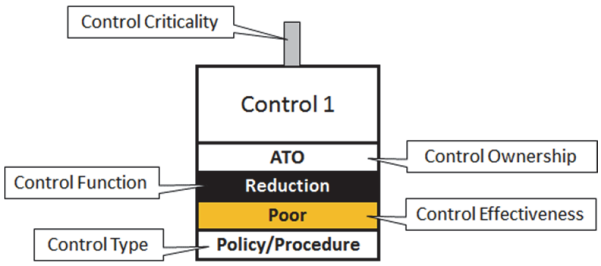


FIGURE 19 Representation of risk controls in bow-tie diagram (*Source*: UK CAA website 2015).

TABLE 14
RISK CONTROL CATEGORIES

Hazard exposure	How frequently is the threat present
Control ownership	Stakeholder responsible for implementing the control
Control function	Type of action provided by the control
Control effectiveness	How effective is the control to reduce risk
Control type	Category based on purpose of control
Control criticality	Importance of control to prevent/mitigate undesirable event

Source: UK CAA website (2015).

The most important advantage of the bow-tie model is that preventive and risk mitigation measures are linked to actions, procedures, and assigned individuals or organizations, thus linking these risk controls with the safety assurance component of SMS. Risk controls, hazards and consequences can be classified according to a variety of categories that can be represented in the bow-tie diagram. Some classifications used for risk controls are illustrated in Figure 19 and summarized in Table 14.

Figure 20 is an example of a bow-tie diagram using those capabilities.

As mentioned earlier, the bow-tie diagram may require more time for development, and it is not a replacement for the approach currently in use by Part 139 airports for CIPs. However, when dealing with specific safety issues such as runway incursions or bird strikes, the bow-tie model can be an excellent alternative. It is becoming more common with foreign airports that have matured SMS programs. The method for building a bow-tie diagram for safety issues of the aviation industry is well documented at the UK CAA website under "Operations and Safety."

Figure 21 presents a portion of the bow-tie diagram developed by the UK CAA for runway excursions. The original, comprehensive diagram is available on the UK website. The original diagram addresses many types of hazards and risk controls, including those under the responsibility of flight safety and air traffic. The intent in presenting this diagram is to show how comprehensive and how much information is available in this type of model.

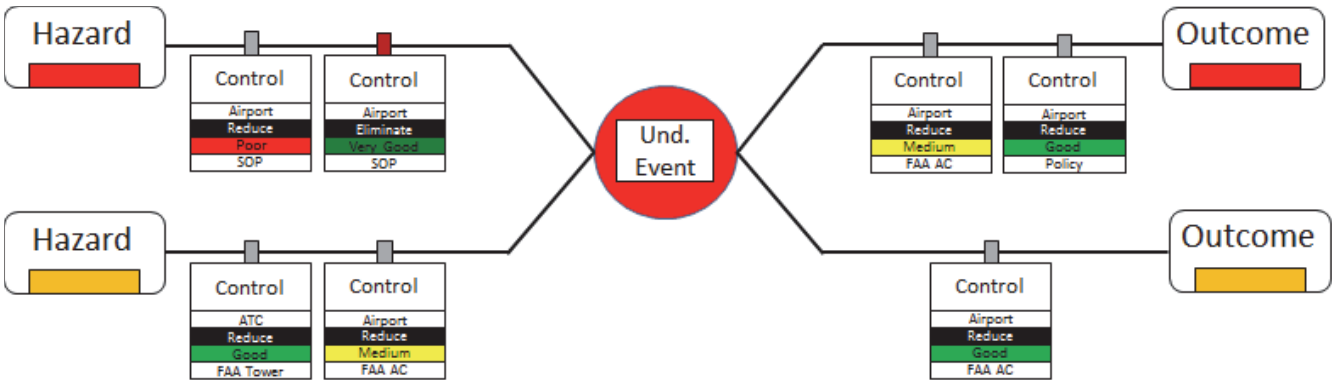


FIGURE 20 Typical bow-tie diagram (*Source*: ASM Consultants).

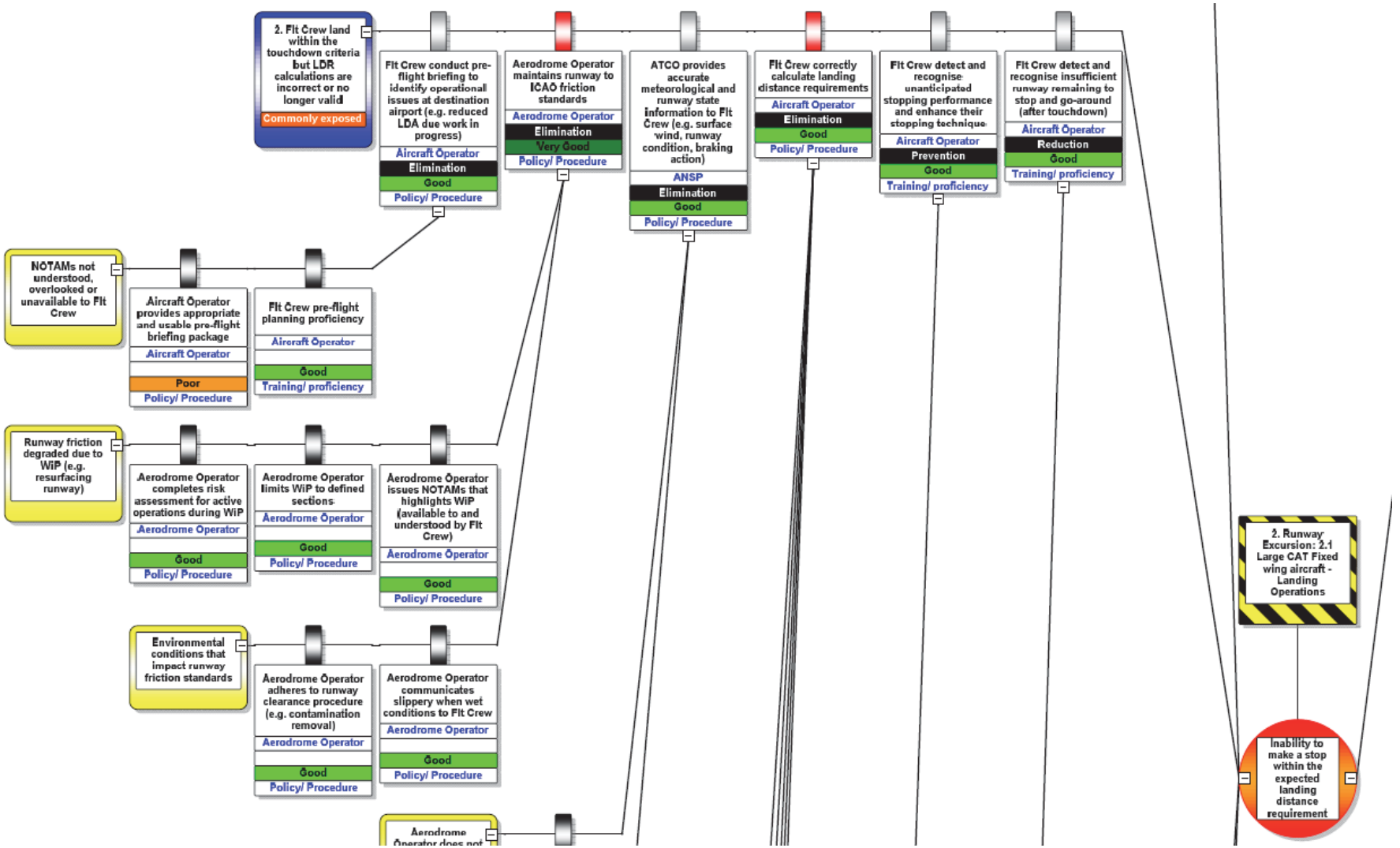


FIGURE 21 Part of a bow-tie diagram (*Source*: UK CAA website, Significant Seven Bowtie Templates 2015).

CHAPTER SIX

FACILITATION OF AIRPORT-LED SAFETY RISK ASSESSMENTS

A key element of an SRA involving an SRM panel is the facilitation of the brainstorming session. The main objective of the facilitation process is to manage the SRA session to help the panel effectively perform the SRM process on a safety issue. In most cases the SRA session is a one-time opportunity because of the scarcity of key operational experts. Experience and background in brainstorming and risk assessment, as well as extensive preparation, are important for a successful SRA session.

SAFETY RISK ASSESSMENT ROLES

There are three main roles in conducting safety assessments using SRM panels.

The Panel

An SRM panel would include representatives from the various organizations and airport functions affected by the safety issue to be discussed. The interactions between panelists with a range of experience and knowledge associated with the safety issue can lead to a much broader and comprehensive analysis and, most importantly, to a balanced consideration of safety issues and alternatives to mitigate risks. Despite these benefits, it is important to note that it is harder to perform in-depth analysis of individual issues and ideas discussed by the group. It is common that some time may be wasted with irrelevant technical discussions. *ACRP Report 131* identifies typical panelists in a SRA as shown in Table 15.

The Facilitator

Facilitation is a process to help a group achieve its objectives and free the group from potential obstacles. In SRM panels, a facilitator is required to keep an unbiased management of the meeting and avoid conflicts of interest. The facilitator helps obtain the best from a panel by keeping a high level of participation and open discussion, controlling the duration of the session, and determining the breaks. Ideally, the facilitator would be experienced with risk assessments and preferably with the type of safety issue being assessed. The facilitator has the critical role of leading the SRM panel to make the brainstorming session as effective and productive as possible. The tasks in this role involve strictly observing the basic rules of brainstorming, making short notes of the hazards on a flip chart or computer, and subtly steering the hazard identification process along the many dimensions of the operation and spectrum of hazards. A good facilitator performs this role independently from external and internal pressures and leads the effort in a completely rational, unbiased fashion.

A good facilitator makes sure the preliminary material and briefing are compatible with the safety issue to be discussed, and that meeting resources such as a conference or meeting room with at least a projector and white board are available. A preliminary brainstorming structure and possibly a list of key hazards would also be prepared for the meeting.

Although FAA uses trained personnel or third party consultants to facilitate its SAs, many airports opt to have the SMS coordinator or hired consultants facilitate most SRA exercises. Larger airports may prefer to train staff from various departments to conduct internal SRAs, particularly because they are more familiar with the technical issues involved with the SRA topic. For example, an engineer from the department of engineering can be trained to facilitate SRA exercises involving formulation and design of airfield facilities.

TABLE 15
TYPICAL SRM PANELISTS

- Airport operations
- SMS coordinator
- Risk management
- FAA
- ATC
- Airlines
- Subject matter experts
- Airfield maintenance
- Airport planning
- Development and engineering
- Public safety (police and fire)
- Environmental management
- Ground handlers
- FBOs
- Fueling services
- Transportation

Source: *ACRP Report 131* (2015).

The Note Taker

A note taker is also an important element in the SRA session, as pointed out by many survey respondents. The person filling this role will take all notes required to document the SRA. The most effective way to perform this role is to use a computer with a safety assessment worksheet and a projector showing the notes being taken in the template. It is virtually impossible for a facilitator of a large panel to moderate and take notes simultaneously, without jeopardizing the dynamics of the session. Projecting all the notes being written by the note taker can also be distracting to participants and the facilitator should evaluate the best alternative for showing information to panelists during the session. For small airports, where the SRM panel is generally very small, the facilitator may be able to fill this role if necessary.

GENERAL FACILITATION PRINCIPLES

There is good information readily available on how to facilitate meetings. A summary of best practices is provided in this section based on several sources (EUROCONTROL 2003; KnowledgeLeader 2007; U.S. Navy 2009; Bircham 2015). However, it is important to recognize that facilitation is more than using certain techniques and applying procedures; facilitation is art and it takes talent, in addition to training and practice. Some basic facilitation principles include:

During the Safety Risk Assessment Briefing

- Invite people to sit at the front of the room.
- Control time and avoid taking too much time discussing one issue.
- Manage expectations and, if necessary, point out what cannot be met.
- Make sure you explain the basic concepts of risk assessment during the briefing, particularly if there are panelists who are new to the concepts.
- Overview the whole process so panelists know what to expect.
- Set the duration of the SRA session and the intervals between breaks.

During the Facilitation

- Lead discussion but do not dominate the SRA session.
- Be knowledgeable of SRM to be able to provide guiding questions.
- The facilitator role is not to respond to panelist questions, but rather be a guide to help panelists perform the SRM process.

- It is important to study the safety issue and be prepared with preliminary material (e.g., brainstorming structure, checklists, probing questions).
- Allow attendees to draw their thoughts together.
- Draw in the quiet team members and motivate participation.
- Allow silence.
- Paraphrase—help participants understand by paraphrasing the input; always check with the originator that the paraphrase is correct.
- Write it down verbatim to acknowledge the person's contribution and value of the idea.
- Encourage clarity (e.g., "Say more about that").
- Use ground rules.
- Avoid judging panelist comments and being overly critical.
- Avoid talking too much; however, talk enough.
- Order the input from panelists (e.g., you, then you).
- Do not step out of the facilitator's role; if you do, tell people that you are not in that role.
- Listen to every comment made during the SRA session.
- Keep to the scheduled agenda.
- The facilitator must be neutral—an honest broker.

Identification of Risks

- Ensure that there is a verb included in the definition of the risk (e.g., instead of stating "the risk of FOD," use "the risk of FOD causing damage to aircraft engine").
- Ask panelists how they would formulate the definition of the risk.
- To regain focus after a long discussion, summarize the discussion or ask a panelist to do it.
- Always ask if the definition is clear to everyone.
- Keep focus on what is being discussed (e.g., avoid discussing risk level if the risk has not been defined).

Risk Assessment

- Always attempt to get consensus.
- Vote only if that has been defined as a ground rule.
- Only re-vote after additional discussions and if panelists want to re-vote.
- Hazards should be assessed for resolution and never disregarded or repeated.
- Decisions are taken with participation, support, and explanation to optimize buy-in.
- Arguments or rationale for a debate or a decision on risk classification will be visibly and constructively captured because everyone would be heard.
- The rules to resolve dissenting opinions are known and agreed.

Defining Risk Controls

- Ensure risk controls are assigned to a responsible party to implement and that the party agrees with it.
- Make sure there is an adjective/verb when you formulate the justification for the risk control (e.g., instead of using safety awareness, use "increase in safety awareness").
- Make sure to add a due date for implementation of the risk control.

SRA Reporting

- Check the most effective format and structure to report the SRA.
- Prepare a preliminary report to circulate among panelists as soon as possible while the discussions are fresh.
- Review the follow-up requirements.
- Describe next steps report to the panel when they should expect the preliminary report.

The Naval Safety Center identifies some skills for effective facilitation (Table 16).

TABLE 16
EFFECTIVE FACILITATION

Best Qualities of a Facilitator (PREPARE)

- **P**erception of important issues
- **R**espectful to all group members
- **E**xpertise with facilitation skills/techniques
  - Mastery of facilitation techniques
  - Knowledge and ability to use each appropriately
- **P**atience
  - Allow some tension
  - Allow discussion of differing views
  - Ask open-ended questions
- **A**ttitude is positive, upbeat, and realistic
- **R**esponsible by meeting course objectives
- **E**xpert who knows the subject and available resources

Source: U.S. Navy (2009).

COMMON FACILITATION ISSUES

Difficult People and Situations

- Group Think—when members of a group fail to speak up when they do not agree with a decision made by the group or the group leader. In most situations group think leads to incomplete analysis and possibly erroneous decisions.
- Cape Cod Syndrome—when a group of people have difficulty making a decision, to the extent that by the time the decision is made there is no more time to discuss other options.
- Abilene Paradox—when a group of people decide and act in a way that is contrary to their real desires.

The facilitator encourages lateral and free thinking and may appoint a couple of panelists to play "devil's advocates." The facilitator can drive the discussion and control the time for discussions; however, the facilitator should not influence the panel decisions.

Confusion Between Key Terms

- Difference between the hazard, its effect(s) and its cause(s)
- Difference between the severity of a hazard (does not exist), the severity of hazard effect, and the likelihood that it can occur
- Explain during SRA briefing and have definitions in a Quick Reference Guide or handout for panelists.

No Consensus on Risk Likelihood, Risk Severity, or Both

- Attempt to extend the discussions for consensus.
- If voting is used, it is important that the different opinion be documented in the SRA report.
- An alternative is to include both risk levels in the assessment; most likely the risk control actions will serve for both situations and a final assessment can be made when comparing risks according to priority.
- Take a break.

SUCCESSFUL SAFETY RISK ASSESSMENT SESSIONS

A brainstorming meeting can be beneficial to share perspectives and experiences; to build synergy for hazard identification and risk assessment; to get buy-in to decisions; and to develop practical plans to mitigate risks and obtain commitment to follow-up actions. However, there are many possible negative outcomes of an SRA session with SRM panels. Some of the most common concerns that can lead to unsuccessful SRAs can be summarized.

Facilitator Techniques

Open-ended Questions

Avoid questions that can be answered with a simple "yes" or "no."

Redirection

Invite panelists to answer a question.

Examples

The facilitator should share personal experiences and invite panelists to do the same.

Intervention

Long discussions or distracting situations should be interrupted and the panel be brought to discussion on SRA topics.

Projection

The facilitator makes projections into the future (e.g., many of the panelists here will be involved with this issue during the implementation).

Role-plays

Ask panelists to play specific roles in a potential scenario.

Bridging

Connect several topics within a discussion to help panelists identify the links.

Transitioning

Change topics with minimal impact to discussions.

Eliminating Weak Ideas

A good idea, but . . .

- . . . people won't like it.
- . . . it needs more study.
- . . . let's make a survey first.
- . . . against the company policy.
- . . . the directors won't go for it.
- . . . ahead of its time, people are not ready for it.
- . . . let's sit on it a while.
- . . . we've never done it that way before. Has anyone else tried it successfully?

Helping Good Ideas

Yes, . . .

- . . . that's a good idea/point/comment.
- . . . great, let's try it.
- . . . what resources would we need to do it?
- . . . tell me more.
- . . . how can we make it work?
- . . . can you draw up a plan of action? What can I do to help this happen?
- . . . that sounds interesting, tell me more.

Source: U.S. Navy (2009).

Common Concerns

- Panelists are unclear about the meeting's goals or have their own goals.
- Panelists are unclear about the process that will be followed and the expectations of the group.
- Panelists have individually defined responsibilities and tightly defined jobs.
- The group plays political games.
- Part of the available information is not given to panelists.
- Some participants do not trust each other.
- The session is poorly prepared and led.
- There are no ground rules.
- Some panelists avoid supporting decisions because they were not involved or consulted.

- Panelists adopt win-or-lose attitudes or avoid conflict management.
- The panel relies on one leader.

Many of the concerns that negatively impact the outcome of an SRA are associated with the performance of panelists in the brainstorming session. Some suggestions for panelists on how they can help the session run more effectively are listed here.

Running Effective SRA Sessions

- Have a basic understanding of the SRM and SRA processes.
- Read and understand the preliminary information.
- Follow the brainstorming rules.
- Postpone judgment during the hazard identification.
- Think about potential hazards that might negatively impact safety.
- Write your risks/concerns on sticky notes.
- Avoid over and under participation.
- Be unbiased.
- Be realistic.
- Use common sense.
- Help the group (provide examples, etc.).
- Meet the schedule.
- Avoid criticism but play devil's advocate when necessary.
- Keep electronic communications off.
- Be patient when discussions are not related to your area.

Finally, an important element of SRA sessions is the set of Brainstorming Rules that the facilitator presents during the initial briefing.

Key SRA Rules

- One person talk at a time
- Breaks every hour
- Any idea is welcomed for discussions, no matter how exaggerated it is
- Quantity counts at this stage, not quality
- Build on the ideas put forward by others
- Every person and every idea has equal worth
- No sidebar conversations.

Key information to help the facilitation exercise during SRA brainstorming sessions can be summarized in a handout for panelists. An example of Quick Reference Guide (QRG) for SRAs is presented in Appendix D.

SAFETY RISK ASSESSMENT FACILITATION TRAINING

The FAA maintains a number of in-house training courses for FAA-staff conducting facilitation. These courses typically are not available to non-FAA facilitators. However, third-party consultants providing facilitation services for ARP-led panels may take online courses, including:

- ARP SMS Overview: online training on basic SMS components; and
- ARP SRM Facilitation: online training describing the requirements of ARP SRM facilitation (ARP SMS Desk Reference 2012).

There are several general facilitation courses available to the industries and training programs to become a certified facilitator; however, these courses do not focus on risk assessments of aviation safety issues. It is important to note that there are two basic skills desirable to become an effective SRA facilitator: proficiency with facilitation techniques and SRM expertise.

CHAPTER SEVEN

SUPPORT MATERIALS AND TOOLS FOR AIRPORT-LED SAFETY RISK ASSESSMENTS

This chapter consolidates information on support materials and tools currently used by airports and consultants to plan, facilitate, and report SRAs. Some important tools are described, and examples or actual templates that can be immediately used by airports are available in the appendices.

SAFETY RISK ASSESSMENT AND SAFETY ASSESSMENT TRIGGERS

SRA triggers are changes or events that can have safety impacts on airport operations and may require airports to convene a SRM panel to conduct an assessment. It is important to note that convening panels to run SRAs is not appropriate for time-critical safety issues requiring immediate actions. The SRA process can take many hours and days and should only be used for deliberate safety issues involving multiple stakeholders, when time is not a critical factor to safety. According to FAA Order 5200.11 (2010), "SRM panels are an effective tool for providing a thorough examination of hazards and risk associated with any proposal. However, they are labor-intensive and should be used judiciously, on the most safety-critical decisions."

As mentioned earlier, most hazards and safety issues that airports face routinely will not require convening SRM panels with a facilitator. Table 17 presents typical triggers used for SRAs.

RISK MITIGATION ISSUES AND SOLUTIONS

One important part of the SRA process is defining which risk mitigation actions will be established, who will be responsible for implementing them, and when they will be implemented.

As described earlier, many risk controls are already in place, but in certain situations it will be necessary to reduce risks further with additional actions. During the SRA process, representatives of airport functions and other airport stakeholders will agree on which actions and how the actions will be implemented, but some general principles can be followed.

When analyzing options for risk controls, it is important to bear in mind that each alternative may have a different potential for reducing risks. The panel assesses how effective the option is before a decision is made to use it. In addition, the panel evaluates the feasibility, costs, and practicality of implementing a specific control. Different perspectives for the decision-making process are shown in Table 18.

Evaluation of these perspectives is not a formal part of the SRA process; however SRM panel participants may use these options when suggesting or approving risk mitigation actions. Table 19 presents the categories of risk mitigation alternatives available, and Table 20 shows options to control risks.

Two types of risk mitigation actions are identified during the brainstorming process:

- *Existing controls*—The first type is the existing mitigation actions; these are used to assess the risk for the existing conditions. These controls are not to be implemented because they are assumed to be already in place. In this risk control category, airport procedures, FAA advisory circulars, and Part 139 Regulations are frequently identified by the panel. For example, airfield inspections are mandatory under the Part 139 Regulations, and it represents an action to control

TABLE 17
TYPICAL TRIGGERS FOR SAFETY RISK ASSESSMENTS

Source Organization	SRA and SA Triggers
Part 139 Airports	• Airside construction • Formulation of airfield improvements • Special events • Accidents and incidents • New standard operating procedure • Introduction of new aircraft class • Other defined in the airport's SMS manual
Foreign Airports	• Major safety issue identified (e.g., frequent bird strikes) • Airfield developments or changes • Changes to operating procedures • Implementation of new airfield system • Changes to airport manual • Changes to air traffic procedures or systems • Deviations from airfield standards • Activities that may impact aircraft operations • Other defined in the airport's SMS manual
ACRP Report 131	See Appendix M.

Source: Survey and interviews.

TABLE 18
EVALUATING RISK MITIGATION ALTERNATIVES

Consideration	Description
Effectiveness to reduce risk	How much risk reduction in qualitative or quantitative terms can be achieved with the option?
Cost	Does risk reduction outweigh the level of costs involved with the implementation?
Practicality	Are there resources available in terms of technology, and manpower? Is it feasible to implement, and is it in compliance with regulations?
Acceptability	Will stakeholders buy-in the alternative selected?
Enforceability	Can the risk control action be enforced, if necessary?
Durability	Are the safety benefits temporary or permanent?
New risks	Are we creating new risks when implementing the alternative?

Source: ICAO Doc 9859 (2013).

TABLE 19
RISK MITIGATION CATEGORIES

Alternative	Description	Example
Avoid the risk	Eliminate exposure to risk by avoiding the task or operation because it is too dangerous.	Close parallel taxiway to larger aircraft if separation is not compliant with standards.
Reduce the risk	Reduce risk likelihood, consequence or both.	Improve runway friction to reduce the risk of runway excursions; perform job at night, when volume of operations is low.
Transfer or share the risk	Advise stakeholders of risks so they can take actions from their side.	NOTAM for safety awareness of construction activities near movement areas.
Refer the risk	Pass information about the risk to higher management levels.	Actions that require costs beyond the panel decision-making level.
Retain the risk	Accept the risk level achieved with or without new risk mitigation actions.	The rate of bird strikes is relatively low compared to other airports, and the airport will keep monitoring trends.

Source: NZ CAA (2013).

TABLE 20
OPTIONS TO REDUCE RISKS

Type	Example
Engineer	Limit speed, use rumble strips, and wash construction truck tires to avoid generation of FOD.
Guard	Use fences to prevent access to movement areas.
Improve design	Reduce number of taxiways in intersection.
Limit exposure	Avoid construction works during low visibility (Surface Movement Guidance & Control System) conditions.
Selection of personnel	Use experienced staff to access movement areas.
Training	Provide airside driver training to construction drivers.
Warn-signs and briefings	Offer daily briefings to construction workers for safety awareness.
Motivate	Oversee risks with performance measures and introduce award program.
Reduce effects	Ensure availability of personal protective equipment, emergency response plans.
Rehabilitate controls	Repaint faded markings.

Source: Adapted from U.S. Air Force (2007).

FOD during routine operations. Daily inspections are also used to monitor FOD generated by construction activities. Possibly the airport has an internal procedure to increase the frequency of inspections in construction areas. Some of these actions are cited in the SRA as existing but may not be present when and where required, and therefore it is necessary to ensure the existing mitigation actions are in place.

- *Additional controls*—The second type of risk mitigation action is additional measures to further reduce risks. These are the actions that, during the SRA brainstorming process, the panel will assign responsibilities for implementation. The most common type of safety issue that requires an SRA is airfield construction, and an alternative is to incorporate the implementation of actions under the responsibility of the CSPP. However, as mentioned earlier, it is common to have responsibilities assigned to airport functions and even to the airport tower or other stakeholders which are not part of the CSPP.

Many airports face questions on how to ensure that risk mitigation actions derived from an SRA will be put in place in a timely manner; this was a key challenge identified during the survey for this report. After the SRA is completed, risk controls are defined and responsibilities assigned; however, most Part 139 airports believe that the process of tracking control actions and making sure these actions will be in place when needed is not effective and could be improved.

There are many alternatives available to make this safety assurance process more effective. A series of options based on the literature review are listed in Table 21. Individual techniques or a combination can be used, and selection will depend on the airport characteristics and level of SMS implementation.

Many foreign airports with mature SMS use risk registers to track the implementation of risk controls. A typical risk register table is presented in Appendix N. A software solution (spreadsheet, database, or SMS application) may be required, particularly for larger airports, to facilitate sorting and monitoring control of numerous risks identified in the SRM processes. For smaller airports and a limited number of monitored risks, an electronic spreadsheet may suffice.

The risk register should include a reference code that identifies the project, project phase or safety issue, and the specific hazard and risk. It is important that screening all risk controls for a given project be part of the risk register capabilities. One or more control actions are assigned to a responsible party, and information on the status of implementation and due date for completion can be monitored in the risk register.

TABLE 21
TOOLS AND PROCEDURES FOR SAFETY ASSURANCE OF RISK MITIGATION ACTIONS

Technique	Description
Plan to implement and track risk mitigation actions	Develop a summary or plan of risk mitigation actions with responsibilities and due dates for implementation, and submit it to responsible parties. The plan is based on mitigations defined during the SRM panel session and can be incorporated to the SRA Report.
List of risk control actions for incorporating to the CSPP	Based on the actions defined in the SRA, prepare and submit a list of risk control actions under the responsibility of the construction contractor for inclusion in the CSPP.
Risk register	Develop an airport risk register containing basic information about the risks and risk controls defined. The risk register is used to track resolution of actions and make appropriate changes to risk level based on the revised residual risk.
Inspection checklists	Create inspection checklists describing the procedures and actions that should be in place for each project phase, area, and activity. The checklists are used by airport staff performing daily inspections of the sites.
Safety working group	Create a safety working group for the project with the intent of convening periodic meetings to discuss project progress, project changes and impacts to risk assessment, status and resolution of risk control actions, identification of new hazards, and occurrence of incidents.
Safety performance indicators	Create safety performance indicators to monitor effectiveness of risk control measures.
Assign coordinator to manage risk control plan	Assign a responsible coordinator to track timely completion and implementation of risk mitigation actions.

Source: ASM Consultants.

Another practical alternative is to use checklists that airfield inspectors use to oversee risk control actions associated with a project or change phase and location. Although it is usually assumed that control actions included in CSPPs and FAA advisory circulars are active, a customized inspection checklist ensures that recommendations and further actions decided during the SRA process will be in place. An example inspection checklist associated with a SRA is presented in Appendix C.

The most effective way to ensure that both existing and additional mitigation actions will be in place is to develop a plan for implementation and to monitor the actions in a risk register developed by the airport and managed by the SMS coordinator or airport staff responsible for coordinating airside safety issues. Appendix O presents a template provided by Hartsfield–Jackson Atlanta International Airport to develop an action plan for risk control actions.

CHAPTER EIGHT

CONCLUSIONS

This study has reviewed current practices used by Part 139 airports to conduct safety assessments with the support of safety risk management (SRM) panels. The objective was to identify gaps and information that can be used to fill those gaps, and to share experiences with safety assessments (SAs) and safety risk assessments (SRAs). To support the information provided in this report, a literature review and survey of foreign airports, military practices and other industries was performed to identify most effective practices and tools that could be used or adapted for use by Part 139 airports.

SURVEY FINDINGS

Responses from a survey submitted to Part 139 airports, foreign airports, military bases, and safety management system (SMS) consultants that participated in the FAA SMS Implementation Study led to some important conclusions and key gaps that can lead to further research studies. The survey's most important conclusions include:

- The majority of airports surveyed find airport-led SRAs beneficial to undertaking airfield projects and change procedures. Airports with the most mature SMS use SRAs in a routine basis. Airports that use or have used the SRA techniques find them helpful to systematically identify and treat hazards, thus fulfilling a capability that was not available to airports.
- Some foreign airports surveyed that have implemented SMS for more than 10 years have reported significant savings through avoiding accidents and reducing insurance costs.
- The most common triggers for SRAs are airfield changes and CIPs that include formulation, design, and construction or renovation of airfield infrastructure.
- Typical participants of SRM panels include airport staff (operations, engineering, maintenance, ARFF, SMS, public safety), FAA [ARP (Office of Airports) and ATO (Air Traffic Organization)], airlines and consultants, ranging from a few panel members for smaller airports to more than 30 participants for larger airports and more complex safety issues.
- Typical duration of SRAs range from 2 to 4 hours of brainstorming; however some airports reported SRAs taking less than 2 hours or several days, particularly when larger panels are divided into smaller groups. Airports with mature SMS programs and military organizations indicated that they make extensive use of preliminary risk assessments, and pre-meeting information is circulated among panel members to avoid long brainstorming meetings.
- Airports typically hire consultants to facilitate airport-led SRAs until they gain enough experience to have their own staff do this work. For FAA-led SAs, the FAA either assigned a local facilitator or requested a third-party consultant.
- Airports believe that monitoring and control of risk control actions defined in SRAs can be improved. SRAs do not end with documentation and approval; it is necessary to ensure implementation and monitor risk controls for effectiveness.
- Typical tools used in SRAs include worksheet templates, risk matrix, panel briefings, projectors, whiteboards, and quick reference guides. Examples of these tools are presented in the appendices of this report.
- Some airports reported difficulties in ensuring implementation of risk control actions by non-airport stakeholders, particularly when the action could impact a stakeholder's operations. In a few cases at foreign airports, risk control actions were not approved because of the action's high cost.

- Airports with more mature SMS have been using SRAs to evaluate safety issues on the airside as well as on the landside, and have found SRAs to be a routine and beneficial decision-making tool.
- Many of the Part 139 airports surveyed reported that they would benefit from additional SRA tools, including panel training programs and materials, as well as additional regulatory and expert guidance from those with experience in the SRA process.

MAIN GAPS IDENTIFIED

Survey responses identified a few gaps that raise questions by airport staff. Filling these gaps can assist Part 139 airports in conducting SRAs that are more effective and are completed faster and at a lower cost. One major surprise was to find out that some airports perceive SRAs as the basic methodology to operate the SRM component of their SMS, and this confusion is making airport staff more resistant to adopting SMS principles. There is still little experience with SRAs outside the small group of airports that participated in the FAA SMS Implementation Study. The resistance to application of safety assessments by Part 139 airports often involves:

- The challenges of scheduling an SRA,
- The time and workload that it takes to complete the SRA process, and
- The feeling that the techniques that have been used are complex and may not be the most effective approach.

Most airport staff working with SMS would like to obtain additional directions, particularly practical guidance, tools and templates that would allow them to conduct the SRAs with less workload, and assurance that risk control actions defined during the process will be implemented. Another main concern is the lack of guidance or training programs available to prepare airport staff to use the SRM process and to facilitate SRAs. Some of the key concerns are:

- Lack of training, particularly facilitation, and experience,
- Little guidance focused on safety issues experienced by airports,
- Lack of experience with the entire SRM process, and
- Challenges to ensure that risk mitigation actions will be in place.

TOOLS AND TEMPLATES

A number of tools and templates listed in Table 22 are presented in the appendices to this report and can be used by Part 139 airports. Some of the information available was reproduced from references listed in this report, and adapted or created based on information obtained in the surveys and interviews.

FUTURE RESEARCH

Taking into consideration the findings and gaps identified in this report, suggestions for further research to fill those gaps are presented.

Development of Guidance to Use the Bow-Tie Models with Airport Examples

As pointed out earlier, the bow-tie model for risk assessment is becoming more common in the airport industry, particularly at foreign airports with a mature SMS. This risk assessment approach allows effective integration with the safety assurance component of SMS, and the bow-tie diagram provides a helpful visual depiction of risk illustrating the links, assigned risk control responsibilities of stakeholders, and the identification of critical proactive and reactive risk controls with an assessment of their effectiveness. Practical guidance applied to airport safety issues on the use of bow-tie models for airport SRM and SRAs can be helpful for Part 139 airports, particularly when airport staff becomes more familiar with SMS and its processes.

TABLE 22
SRA TOOLS AND TEMPLATES

Tool/Template	Description
Sample Checklist for Inspection of Risk Control Actions (Appendix C)	Sample checklist that airports can use to ensure that risk control actions are in place when and where required.
Quick Reference Guide for Safety Assessments (Appendix D)	Handout template that can be distributed to SRM panelists for participation in the brainstorming session.
Checklist for Airfield Construction (Appendix E)	This checklist can be used during SRA sessions to assess risks related to airfield formulation, design, and construction, which represent the majority of airport safety issues requiring an SRA.
Template for SRA Planning (Appendix F)	This template can be used as a guide to plan the entire SRA process, and includes the phases explained in chapter four.
Briefing Template for Safety Assessments (Appendix G)	Template of PowerPoint presentation to present to SRM panels when initiating an SRA.
Sample Checklist for SRA (Appendix H)	Template with list of equipment, tools, and participants for SRA sessions.
Sample Worksheets for Safety Assessments (Appendix I)	Typical template used by the FAA and ICAO for SRAs, including template to use the bow-tie model.
SRA Report Example—Comprehensive (Appendix J)	Example of SRA Report for an airfield construction project.
SRA Report Template (Appendix K)	SRA Report template used by Hartsfield–Jackson Atlanta International Airport.
Simple SRA Report (Appendix L)	Simplified one-page worksheet template for reporting SRAs.
Common SRA Triggers (Appendix M)	Table reproduced from *ACRP Report 131: A Guidebook for Safety Risk Management for Airports* (2015).
Risk Register (Appendix N)	Explains what a risk register is and describes the basic information that should be included.
Safety Risk Management Worksheet—Action Plan (Appendix O)	Template used by ATL to develop action plans to mitigate risks.

Development of Bow-Tie Templates Applied to Airport Safety Issues

In addition to guidance using the bow-tie model, development of airport-specific bow-tie templates and electronic tools for common airport hazards (e.g., FOD, bird strikes, runway excursions and undershoots, runway incursions) can help many Part 139 airports achieve increased awareness and understanding of the safety risk leading to these most common airport risks.

Guidance for Other Risk Assessment Methodologies

As shown in Table 8, a number of techniques for hazard identification and risk analysis have been applied to safety issues associated with airports. Many of the methodologies are seldom used because there is little guidance and few examples of real airport safety issues. Future research addressing the use of those methodologies specifically applied to airport safety issues would be helpful to the industry.

Training Programs on SRAs

The survey found that one major gap in the industry is the lack of training programs specifically addressing SRAs and including all phases of the risk assessment process using SRM panels, including planning, facilitation, reporting, and developing risk mitigation action plans.

A few airports reported participation of staff in SRA sessions conducted by other airports. Hosting airports offer an opportunity for other airports to gain practical experience in the SRA process.

Another training opportunity is participation in the SMS Online Group meetings held on a regular basis and managed by Scott Ayers (ATL) and Joanne Landry (Landry Consultants). Some of the industry associations might show interest in developing SMS and SRM training programs if SMS becomes a Part 139 requirement. ACI-NA, AAAE, and ACC may desire an active role in developing and presenting training modules for airport SMS.

Guidance and Tools to Create a Risk Register for Airports

The survey identified the need to improve how risk mitigation actions are tracked for implementation and monitored for performance. Alternatives have been suggested in this report; however, it is necessary to provide comprehensive information on how Part 139 airports can implement some of these alternatives and, in particular, create a risk register to manage risks identified from the airport's risk assessments. In addition, risk register tools based on electronic spreadsheets could be helpful in tracking risk control actions defined in SRAs, particularly for smaller airports where a more complex and faster database solution is not necessary.

Guidance for Development of Risk Mitigation Plans

An implementation plan that describes the actions, responsibilities, and timing of those actions can also help airports track completion of risk controls derived from SRAs. Additional and more comprehensive guidance specific to airports can help Part 139 airports fill one of the important gaps identified during the survey.

Guidance for Facilitation of SRAs and Participation in SRM Panels

This report summarizes the brainstorming facilitation techniques used in the industry and identifies some desirable characteristics for members of SRM panels. A guidebook addressing participation and facilitation of SRM panels could be helpful to the airport industry in the United States as it moves on with upcoming SMS rulemaking for Part 139 airports.

REFERENCES

Airport Authority of India (AAI), *HAZLOG Template*, Aviation Safety Advisory Circular No. 03/2014, AAI, New Delhi, India, 2014.

Airport Authority of India (AAI), *Guidelines for Safety Assessment of New Projects and Changes*, Aviation Safety Advisory Circular No. 01/2014, AAI, New Delhi, India, 2014.

Aviation Risk Management Solutions (ARMS) Working Group, *The ARMS Methodology for Operational Risk Assessment in Aviation Organizations, 2007–2010.*

Bircham, B., A Simple Guide to Hazard Identification, presentation, 2015.

Center for Social Science Theory and Methodology, Sept. 29, 2000.

Civil Aviation Authority of New Zealand, "Aviation Risk Management—An Introduction," Booklet 4, Auckland, 2013.

European Aviation Safety Agency (EASA), European Aviation Safety Plan (EASp), *Methodology to Assess Future Risks*, EASp EME1 1 Final Deliverable—Draft, EASA, Cologne, Germany, 2012.

European Organization for the Safety of Air Navigation (EUROCONTROL), *Air Navigation System Safety Assessment Methodology V2.2*, SAF.ET1.ST03.1000-MAN-01, Brussels, Belgium, 2006.

European Organization for the Safety of Air Navigation (EUROCONTROL), Facilitation Helpful Hints, presentation, Brussels, Belgium.

European Organization for the Safety of Air Navigation (EUROCONTROL), *Identification of Failure Modes, External Events and Hazards*, SAF.ET1.ST03.1000-MAN-01-01-03-B1, Brussels, Belgium, 2003.

European Organization for the Safety of Air Navigation (EUROCONTROL), *Guidelines for the Identification of Hazards*, NLR-CR-2004-94, Brussels, Belgium, 2004.

European Organization for the Safety of Air Navigation (EUROCONTROL), *Planning and Conducting FHA Sessions*, SAF.ET1.ST03.1000-MAN-01-01-03-A, Ed.2.0, Brussels, Belgium, 2003.

European Organization for the Safety of Air Navigation (EUROCONTROL), *Review of Techniques to Support the EATMP Safety Assessment Methodology*, Brussels, Belgium, 2003.

European Strategic Safety Initiative (ECAST), *Guidance on Hazards Identification*, SMS and Safety Culture Working Group, 2009.

European Strategic Safety Initiative (ECAST), Safety Management System and Safety Culture Working Group (SMS WG), *Guidance on Hazards Identification*, 2009.

Everdij, M. and J. Scholte, *Unified Framework for FAA Risk Assessment and Risk Management Toolset of Methods for Safety Risk Management NLR Air Transport Safety Institute*, NLR-CR-2012-582, 2013.

Federal Aviation Administration (FAA)/European Organization for the Safety of Air Navigation (EUROCONTROL), ATM Safety Techniques and Toolbox V2.0, Issue 2, FAA, Washington, D.C., 2007.

Federal Aviation Administration (FAA), Order 5200.11 and Changes, FAA Airports (ARP) Safety Management System, FAA, Washington, D.C., 2010.

Federal Aviation Administration (FAA), Office of Airports Safety Management System (SMS), *Implementation Guidance V1.0*, FAA, Washington, D.C., 2011.

Federal Aviation Administration (FAA), *Implementation Guidance*, V1.0, Office of Airports Safety Management System (SMS), FAA, Washington, D.C., 2011.

Federal Aviation Administration (FAA), *Safety Management Systems for Airports*, AC 150/5200-37A (Draft), FAA, Washington, D.C., 2012.

Federal Aviation Administration (FAA), *Office of Airports Safety Management System (SMS)—Desk Reference*, V1.0, FAA, FAA, Washington, D.C., 2012.

Federal Aviation Administration (FAA), FAA Order 8040.4A, Safety Risk Management Policy, FAA, Washington, D.C., 2012.

Federal Aviation Administration (FAA), Office of Airports, Safety Risk Management (SRM) Panel Facilitation Briefing, FAA, Washington, D.C., 2012.

Federal Aviation Administration (FAA), Training Module F: Participating in the ERC Meeting, Aviation Safety Action Programs, presentation, FAA, Washington, D.C., 2012.

Federal Aviation Administration (FAA), *Safety Management System* (*SMS*) *Manual V4.0*, Air Traffic Organization, FAA, Washington, D.C., 2014.

Federal Aviation Administration (FAA), ARP SOP 4.00, Safety Risk Management (SRM) Under the FAA Office of Airports Safety Management System (SMS), Standard Operating Procedure (SOP), FAA, Washington, D.C., 2014.
Federal Aviation Administration (FAA), *Safety Management System* (*SMS*) *Manual Version 4.0*, Air Traffic Organization, FAA, Washington, D.C., 2014.
Federal Aviation Administration (FAA), *Safety Management System* (*SMS*) *Quick Reference Guide*, AFS SMS Program, FAA, Washington, D.C., 2015.
Federal Aviation Administration (FAA), Safety Risk Management (SRM) Panel Orientation Briefing, Air Traffic Organization, FAA, Washington, D.C., 2015.
German, L., Hazard Identification Studies (HAZID), GL Plants and Pipelines, 2008.
Global Aviation Safety Network (GAIN), *Guide to Methods & Tools for Airline Flight Safety Analysis*, 2nd Ed., GAIN, Alexandria, Va., 2003.
Health & Safety Laboratory, *Good Practice and Pitfalls in Risk Assessment*, Research Report 151, High Peak, Derbyshire, U.K., 2003.
Hong Kong International Airport, Aerodrome Safety Management System, 2014.
International Civil Aviation Organization (ICAO), *Runway Safety Team Handbook*, 1st ed., Bangkok, Thailand, 2014.
KnowledgeLeader, Risk Assessment Process—Facilitation Tips, 2007.
Landry, J., Dave Fleet Consulting, LLC, and Hybrid-3, Inc., *ACRP Synthesis 37: Lessons Learned from Airport Safety Management Systems Pilot Studies*, Transportation Research Board of the National Academies, Washington, D.C., 2012.
Lewis, S. and K. Smith, "Lessons Learned from Real World Application of the Bow-tie Method," 2010 Spring Meeting of the American Institute of Chemical Engineers, San Antonio, Tex., Mar. 21–25, 2010.
Manchester Airport, *Aerodrome Manual*, Manchester Airports Group, 2015.
Marine Corps Institute, *Operational Risk Management*, ORM 1-0, 2002.
Neil, M., *Using "Risk Maps" to Visually Model & Communicate Risk*, Risk Assessment and Decision Analysis Research Group, Department of Computer Science, Queen Mary, University of London, 2013.
Nijstad, B.A., *How the Group Affects the Mind*, PhD thesis, University of Utrecht, Interuniversity, the Netherlands.
NLR, Safety Methods Database Version 1.0, 2013.
Pennsylvania Department of Labor & Industry, Hazard Identification, Bureau of Worker's Comp PA Training for Health & Safety (PATHS), presentation, 2013.
Public Safety Canada, All Hazards Risk Assessment—Methodology Guidelines, Ottawa, ON, Canada, 2013.
Scharl, A., et al., Functional Hazard Analysis (FHA) Methodology Tutorial, presentation, Naval Sea Systems Command, Washington, D.C., 2014.
Toups, H., *Hazards*, *Accidents, Process Safety Management & Process Hazard Analysis*, SACHE 2003 Workshop, LSU Department of Chemical Engineering, Baton Rouge, 2003.
UK Civil Aviation Authority (UK CAA), *CAP 760: Guidance on the Conduct of Hazard Identification, Risk Assessment and the Production of Safety Cases*, UK CAA, Gatwick, 2010.
UK Civil Aviation Authority (UK CAA), *CAP 215: Airports Commission Shortlisted Options, Module 14: Operational Efficiency Preliminary Safety Review*, UK CAA, Gatwick, 2014.
University of Leeds, Risk assessment Guidance, Health and Safety Services, 2007.
U.S. Air Force, ORM Briefing, Spangdahlen Air Base, 2007.
U.S. Air Force, "Risk Identification and Acceptance for Airworthiness Determinations," Bulletin AWB-013A, Washington, D.C., 2011.
U.S. Air Force, *Risk Management*, Air Force Instruction 90-802, Washington, D.C., 2013.
U.S. Air Force, *Risk Management* (*RM*) *Guidelines and Tools*, Air Force Pamphlet 90-803, Washington, D.C., 2013.
U.S. Department of the Navy, Operational Risk Management, OPNAV Instruction 3500.39C, 1998.
U.S. Navy, Naval Safety Center, Time Critical Risk Management (TCRM), Multimedia Training Module, Facilitator Guide, V2, Norfolk, Va., 2009.
U.S. Navy, OPNAV Instruction 3500.39C—Operational Risk Management, 2010.

APPENDIX A

Survey Questionnaire

ACRP S04-14—Airport Safety Risk Management Panel Activities and Outcomes

Survey of Safety Risk Assessment (SRA) Panels

This survey is part of the Airport Cooperative Research Program (ACRP) Synthesis Project S04-14—Airport Safety Risk Management Panel Activities and Outcomes. The objective of this survey is to identify industry gaps and share experiences on convening panels to conduct Safety Risk Assessments (SRA). Your involvement and input are important to the success of this project. The results of this research will be made available to the industry in an ACRP Synthesis Report.

This survey is comprised of 22 questions and will take approximately 20 minutes to complete. Please note that you may select one or more responses to each question.

Please contribute by filling out this survey. This study is required to have a high participation rate, please respond ASAP if you are not able to participate. We wish to assure you that the survey data will be kept confidential.

Airport Category: Choose an item.

Function of Staff Completing Questionnaire: Choose an item.

1	**Who were the SRA facilitator(s) and how many SRAs were completed at your airport?**
☐	a. In-house Please indicate position/job title: Click here to enter text. Please indicate the number of SRAs completed in this category: Click here to enter text.
☐	b. Consultant Please indicate the number of SRAs completed in this category: Click here to enter text.
☐	c. FAA – ARP Please indicate the number of SRAs completed in this category: Click here to enter text.
☐	d. FAA – ATO Please indicate the number of SRAs completed in this category: Click here to enter text.
☐	e. Military Please indicate the number of SRAs completed in this category: Click here to enter text.
☐	f. Other (please specify) Click here to enter text. Please indicate the number of SRAs completed in this category: Click here to enter text.
2	**What criteria do you use for selecting a facilitator?**
☐	a. General certified facilitator
☐	b. Facilitator with experience in SRA topic
☐	c. SMS consultant with SRA experience
☐	d. Own airport staff
☐	e. Other (please specify) Click here to enter text.
☐	f. No predefined process
3	**During SRA panel meetings the facilitator uses:**
☐	a. Handout with the risk matrix and risk classification tables
☐	b. Handout with rules of the meeting
☐	c. Pre-panel briefings
☐	d. Visual aids
☐	e. Worksheets
☐	f. Checklists
☐	g. Other (please specify) Click here to enter text.
4	**How do you identify panel members-including subject matter expertise?**
☐	a. Stakeholder impacted by safety issue
☐	b. Airport function affected by change
☐	c. Staff with SRA experience
☐	d. Specialized expert
☐	e. Interest to participate
☐	f. Bring staff that need to gain experience with SRA
☐	g. Other (please specify) Click here to enter text.

5	**Which are your major obstacles to convene a panel to conduct a SRA?**
☐	a. Lack of practical guidance material
☐	b. Lack of practical training or inexperience to facilitate SRAs
☐	c. Lack of practical training for SRA panel participant(s)
☐	d. Difficulty finding a facilitator
☐	e. Difficulty scheduling stakeholder representatives
☐	f. Difficulty finding Subject Matter Experts
☐	g. Time required to complete the SRA
☐	h. Difficulty scheduling SRA meetings
☐	i. Other (please specify) Click here to enter text.
6	**What are your most common triggers for convening a SRA panel?**
☐	a. Airside construction
☐	b. Planning airfield improvements
☐	c. New/change Standard Operating Procedure
☐	d. Reports of hazardous conditions
☐	e. Accidents/incidents
☐	f. Special event
☐	g. Organizational changes
☐	h. New equipment/facility
☐	i. New suggested triggers Click here to enter text.
☐	j. Other (please specify) Click here to enter text.
7	**Which airport area was impacted by the project/change that triggered the SRA?**
☐	a. Movement area
☐	b. Non-movement area
☐	c. Both movement and non-movement areas
☐	d. Other (please specify) Click here to enter text.
8	**How does the airport document panel results?**
☐	a. Full SRA Report
☐	b. Simple (less than 5 pages) SRA Report
☐	c. Only risk assessment template
☐	d. Other (please specify) Click here to enter text.
9	**What is the method for mitigation follow up?**
☐	a. Get approval from Upper Management
☐	b. Assign responsible parties and submit information to each party
☐	c. Tracking completion of actions by responsible parties
☐	d. Require inclusion of risk mitigation actions in the Construction Safety and Phasing Plan (CSPP)
☐	e. Develop checklist with risk mitigation actions for responsible parties
☐	f. Develop checklist for inspection and safety assurance
☐	g. Other (please specify) Click here to enter text.
10	**Do you have pre-defined procedures to handle conflicts during meetings and if so, what are they?**
☐	a. Consensus on risk classification (severity or probability) Please explain: Click here to enter text.
☐	b. Conflicts about risk mitigations Please explain: Click here to enter text.
☐	c. Addressing or not specific hazards Please explain: Click here to enter text.
☐	d. Little participation Please explain: Click here to enter text.
☐	e. Excessive participation Please explain: Click here to enter text.
☐	f. Impatience when topics from other areas were being discussed Please explain: Click here to enter text.
☐	g. Noncompromising stakeholders Please explain: Click here to enter text.
☐	h. Other Click here to enter text.
☐	i. We have no pre-defined procedures
☐	j. Please briefly describe the strategy to handle conflicts Click here to enter text.

11	**How are media and public inquiries and participation handled?**
☐	a. Information is released upon request
☐	b. Documentation is not available to media
☐	c. Non stakeholders and media do not engage in SRAs
☐	d. Other (please specify) Click here to enter text.
12	**What are lessons learned and sage advice to share with other airports conducting SRA panels?**
☐	a. Develop preliminary list of hazards
☐	b. Pass around pre-meeting information
☐	c. Work with small groups
☐	d. Provide handouts with basic information and risk matrix
☐	e. Explain the SRA process and rules before running the SRA
☐	f. Limit time of brainstorming meeting
☐	g. Use an experienced facilitator
☐	h. Other (please specify) Click here to enter text.
13	**What kind of tools does your airport use to complete a risk assessment?**
☐	a. SRA templates
☐	b. Checklists
☐	c. Worksheets
☐	d. List of common hazards
☐	e. Other tools for easy reference by airports undertaking SRA panel processes (please specify) Click here to enter text.
☐	f. Which "tool(s)" were found to be of most benefit and value? Click here to enter text.
☐	g. Other (please specify) Click here to enter text.
14	**What additional tools would be beneficial to the maturing of SRA process?**
☐	a. Training
☐	b. Further guidance materials
☐	c. Lists of typical hazards
☐	d. List with typical/baseline risk levels
☐	e. Electronic tools (e.g., intelligent spreadsheets)
☐	f. Other (please specify) Click here to enter text.
15	**How do you verify that existing and new risk controls are implemented?**
☐	a. We developed a checklist for safety inspectors
☐	b. We reviewed the AC and passed the information to the Contractor to include in the Construction Safety and Phasing Plan (CSPP) and implement
☐	c. We routinely use the FAA recommendations in our daily work
☐	d. We have policies and procedures in place for follow up on recommendations
☐	e. We are unsure if every recommendation was in place
☐	f. Other (please specify) Click here to enter text.
16	**What was the total duration of the SRA panel meeting(s)**
☐	a. Less than 2 hrs
☐	b. 2 - 4 hrs
☐	c. 4 – 8 hrs
☐	d. 8 – 16 hrs
☐	e. More than 16 hrs (please specify) Click here to enter text.
17	**Based on the SRAs completed at your airport please indicate the approximate number of participants in the SRA panel meetings**
☐	a. Maximum: Click here to enter text.
☐	b. Average: Click here to enter text.
☐	c. Minimum: Click here to enter text.
18	**How did you avoid long SRA panel meetings?**
☐	a. We did not avoid
☐	b. We split the meeting into smaller groups
☐	c. We used a preliminary risk assessment template
☐	d. We passed information to participants prior to the meeting
☐	e. We established a maximum time goal
☐	f. Other (please specify) Click here to enter text.

19	**Some risk mitigation actions have not been implemented because:**
☐	a. There was no approval by Upper Management
☐	b. It was too expensive to implement
☐	c. There was no tracking of implementation
☐	d. We didn't have a process to ensure implementation
☐	e. The information was not passed to the parties responsible for implementation
☐	f. It required the development of a procedure that has not been completed
☐	g. Other (please specify) Click here to enter text.
☐	h. Not applicable
20	**The Safety Risk Management (SRM) process is comprised of steps that are followed according to the methodology applied (e.g., the FAA uses 5 steps). Which of the steps used in your SRA was the most challenging?**
☐	a. Describe the system
☐	b. Identify the hazards
☐	c. Analyze the risks
☐	d. Assess the risks
☐	e. Mitigate the risks
☐	f. Ensure that mitigation actions were implemented
☐	g. Other (please describe) Click here to enter text.
☐	h. Please describe why it was challenging: Click here to enter text.
21	**The SRA outcome was**
☐	a. Beneficial
☐	b. Fair
☐	c. No benefit
☐	d. Not sure
☐	e. Other (please specify) Click here to enter text.
22	**Please describe any lessons learned when convening SRA panels that may be helpful to other airports** Click here to enter text.

APPENDIX B

List of Organizations and Consultants Participating in the Survey

Type of Organization	Name	Interviewed
Part 139 Airport	Atlanta International Airport (ATL)	✓
	Baltimore International Airport (BWI)	✓
	Cheyenne Regional Airport (CYS)	
	Chicago O'Hare International Airport (ORD)	
	Dubuque Regional Airport (DBQ)	
	Dallas/Ft Worth International Airport (DFW)	
	Denver International Airport (DEN)	
	Dulles International Airport (IAD)	
	Eau Claire County Airport (EAU)	
	Houston Airport System (HAS)	✓
	Indianapolis International Airport (IND)	✓
	Jacksonville International Airport (JAX)	✓
	Lambert–St Louis International Airport (STL)	✓
	Milwaukee International Airport (MKE)	✓
	Norfolk International Airport (ORF)	
	Portland International Airport (PDX)	✓
	Pittsburgh International Airport (PIT)	✓
	Ronald Reagan Washington National Airport (DCA)	
	Salt Lake City International Airport (SLC)	✓
	San Antonio International Airport (SAT)	✓
	San Juan International Airport (SJU)	
	Seattle International Airport (SEA)	
	Southern Illinois Airport (MDH)	✓
	Southwest Florida International Airport (RSW)	
	Tallahassee Regional Airport (TLH)	
Foreign Airport	Narita International Airport (NRT)	
	São Paulo Guarulhos International Airport (GRU)	✓
	Singapore Changi International Airport (SIN)	✓
	Paris Charles de Gaulle International Airport (CDG)	
	Toronto Pearson International Airport (YYZ)	✓
Military Organization	Charleston Air Force Base	
	McGuire Air Force Base	
	Hickam Air Force Base	
Airport SMS Consultant	Dave Fleet	
	Heidi Benaman	
	Joanne Landry	

APPENDIX C

Sample Checklist for Inspection of Risk Control Actions

Source: ASM Consultants.

Sample Checklist for Inspection of Risk Controls					
Project: *Airfield excavation to replace runway lighting system*	**Location**: *Area adjacent to RWY 04/22 safety area*				**Date**: *9/7/2015*
Risk Control	**Yes**	**No**	**N/A**	**Freq.**	**Comments**
1 – Is the unserviceable area clearly marked, lighted and signed?	☒	☐	☐		
2 – Are existing utilities clearly marked to avoid damage during excavations?	☐	☒	☐	1/day	*Reported to Contractor (name), correction before end of day*
3 – Is construction equipment below maximum height authorized?	☒	☐	☐		
4 – Is FOD being generated to active (movement and non-movement) airfield areas	☒	☐	☐		
5 – Is there a valid NOTAM reporting the closure of the airfield area	☒	☐	☐		
6 – Are workers eating while in the construction zone?	☒	☐	☐		
7 – Has ARFF been informed about changes to emergency routes?	☒	☐	☐		
8 – Are speed limits being followed by construction vehicles?	☒	☐	☐		
…					
Notes:					
Contractor: (*name, position, organization*)					
Airport: (*name, position*)					

APPENDIX D

Quick Reference Guide for Safety Assessments

Source: ASM Consultants.

1

Quick Reference Guide for SA

QRG Content

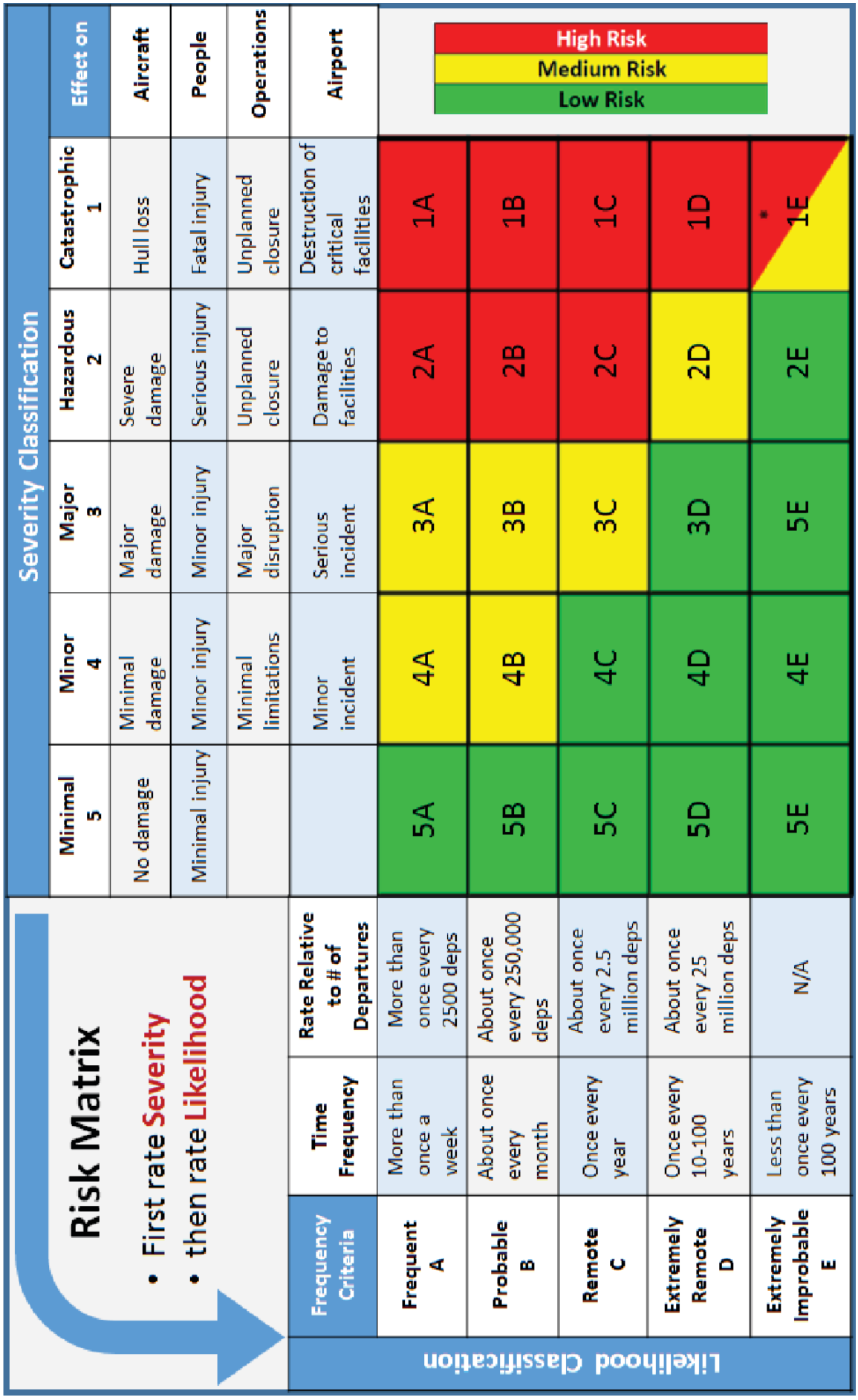
SRM Cycle

Step	Method
1 – Describe the System	5M Model
2 – Identify Hazards	Brainstorming, Checklists
3 – Analyze Risks	Brainstorming, What-if
4 – Assess Risks	Risk Matrix
5 – Mitigate Risks	Brainstorming, Consensus, Risk Register, Checklists

Brainstorming Rules

- One person talk at a time
- Any idea is welcomed for discussions
- Quantity counts at this stage, not quality
- Build on the ideas put forward by others
- Every person and every idea has equal worth
- No sidebar conversations
- Consensus
- Breaks every hour

2



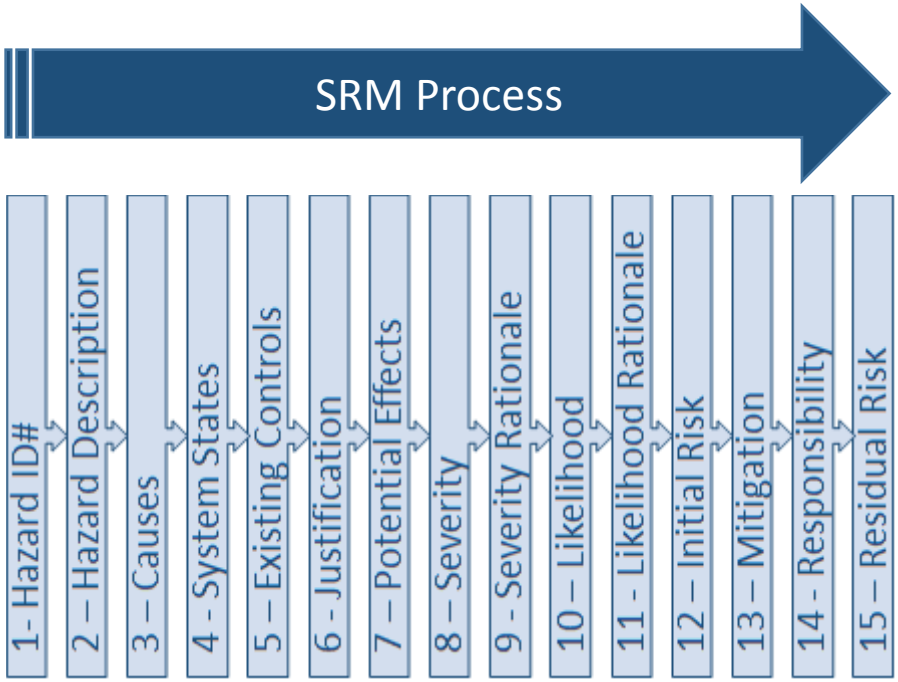
3

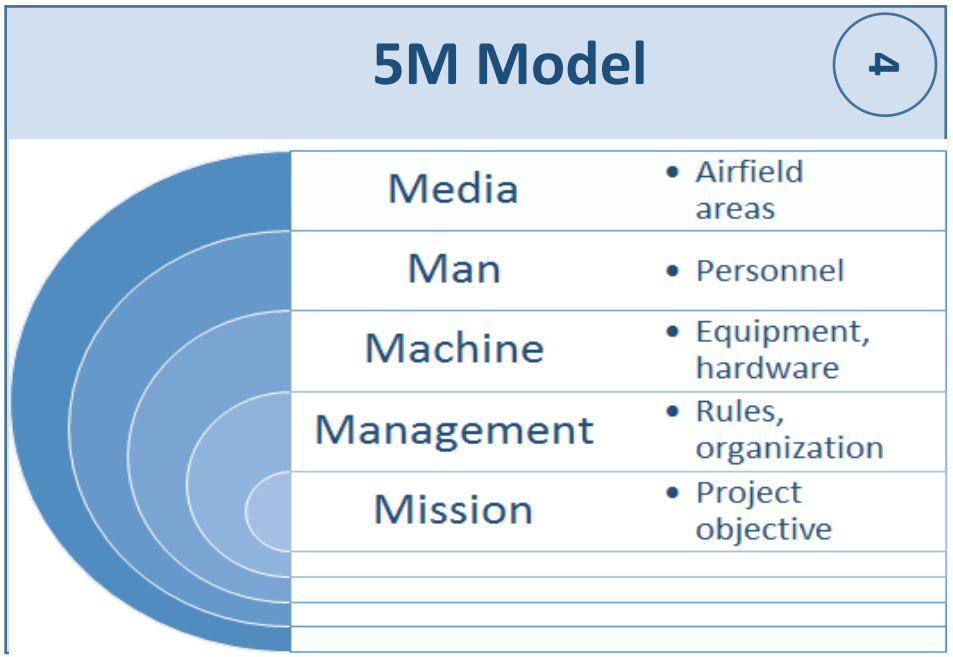
Key Definitions

Term	Definition	Example
Accident	An unplanned event or series of events that results in death, injury, or damage to, or loss of, equipment or property	• Runway incursion accident (e.g. Tennerif airport accident) • Runway excursion accident (e.g. Connair Flight 5191)
Current Risk	The predicted severity and likelihood at the current time	• Medium (3C) – see risk matrix
Effect	The real or credible harmful outcome that has occurred or can be expected if the hazard occurs in the defined system state	• Aircraft collision with fatalities • Hull loss
Hazard	A condition that could foreseabbly cause or contribute to an accident	• Faded marking • Rubber contaminated pavement
Residual Risk	The remaining predicted severity and likelihood that exist after all selected risk control techniques have been implemented	• Low (3D) – see risk matrix
Risk	The composite of predicted severity and likelihood of the potential effect of a hazard	• Runway incursion accident • Runway excursion incident • High, Medium or Low
Risk Control	A means to reduce or eliminate the effects of hazards	• Repaint markings • Runway rubber removal

Guide to SA Participants

- **Have a basic understanding of the SRM and SA processes**
- **Read and understand the preliminary information**
- **Follow the brainstorming rules**
- **Think about potential hazards that might negatively impact safety**
- **Write your risk/concern on sticky notes**
- **Postpone judgement during the hazard identification**
- **Avoid over and under participation**
- **Be unbiased, be realistic, and use common sense**
- **Help the group (provide examples, etc)**
- **Meet schedule**
- **Avoid criticism but play devil's advocate when necessary**
- **Keep electronic communications off**
- **Be patient when discussions are not related to your area**





1 Hazard ID	2 Hazard Description	3 Causes	4 System States	5 Existing Controls	6 Justification/ Supporting Data	7 Effects	8 Severity	9 Severity Rationale	10 Likelihood	11 Likelihood Rationale	12 Initial Risk	13 Mitigation	14 Mitigation Responsibility	15 Predicted Residual Risk
1														
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30														

Source: ASM Consultants.

What to Avoid During SRAs

- **Not adequately understanding the scope of the risk assessment**
- **Failing to use existing organizational skills, knowledge and experience in a team environment**
- **Failing to use the correct risk assessment tools**
- **Automatically assuming reliability/effectiveness of existing risk controls**
- **Implementing risk controls that don't address the identified priority risks**
- **Failing to ensure implementation and to test effectiveness and consequences of risk controls**

Source: Jim Knowles Group, Queensland, Australia, 2010 (adapted)

Key Definitions

Defintion	Description	Example
Hazard	A condition that could foreseeably cause or contribute to an accident	Faded holdline marking
Consequence or Outcome	A specific system state and sequence of events supported by data and expert opinion that clearly describes the outcome	Runway incursion
Risk or Safety Risk	The composite of predicted severity and likelihood of the potential effect of a hazard	Aircraft collision accident
Likelihood	The estimated probability or frequency, in quantitative or qualitative terms, of a hazard's effect or outcome	Extremely remote probability of runway incursion with resulting collision with another aircraft
Severity	the consequence or impact of a hazard's effect or outcome in terms of degree of loss or harm	Aircraft collision with multiple fatalities

APPENDIX E

Checklist for Airfield Construction

Source: ASM Consultants.

The following are some of the most common impacts to operations associated with construction activities in the airside. The list can be used in the Checklist Method for identification of hazards, or as a list of common hazards associated with airfield construction to be used with alternative techniques for hazard identification during brainstorming sessions.

- Is there possibility of runway incursions by workers and construction equipment/vehicles?
- Can the presence of equipment and temporary installations in the airside or landside penetrate Part 77 surfaces?
- Are there activities with the potential to generation foreign object debris (FOD) and dust that can endanger operations?
- Are workers, equipment, temporary facilities, excavations, or piles possibly interfering with NAVAIDs' signals, particularly Glide Path and Localizer signals?
- Can construction activities create wildlife attractants such as food and presence of worms in excavations and paving operations?
- Are construction areas clearly marked and lighted to warn pilots of obstacles?
- Are work areas in the proximity of an active runway and subject to the risk of runway excursions and undershoots?
- Can jet blast by aircraft engines blow debris or generate high wind velocities to construction areas?
- Is there a plan for effective communication and coordination between construction crews, airside operations, and air traffic control activities?
- Is it possible to occur damage to airfield services and NAVAIDs as a result of excavations or crossing of heavy equipment?
- Are there changes to airfield operations requiring timely NOTAMs?
- Is construction traffic crossing movement and non-movement areas?
- Can construction areas and activities impact emergency response routes?
- Are there new situations requiring new/revised emergency response plans (e.g., need for emergency opening of runway closed for construction activities)?
- Are there procedures in place to prevent security breaches and access of unauthorized persons/vehicles in the airside?
- Is there a potential for the presence of vehicles/workers unfamiliar with the airport layout, regulations and procedures pertaining to vehicle operations in the airfield?
- Are there effective procedures and training for safe escorting of construction vehicles, equipment, and workers?
- How can changes to the operations environment impact safety of operations (e.g., low visibility, opening/closure of runways)?
- How can the issue of timely and accurate NOTAMs be assured?
- Is stockpiling of spoils/soil in/near movement and non-movement areas impacting safety areas and Part 77 surfaces?
- Is staging of equipment movement and non-movement areas impacting safety areas and Part 77 surfaces?
- Is there a chance that lighting of closed areas is not turned off?
- Is it possible that non-native English speaking workers fail to understand briefings and orders?
- How can the incorrect use/installation of temporary marking and lighting be avoided?
- Are there any deficiencies in procedures to close and open airside areas to operations?
- Are paving operations in opposite direction of predominant aircraft operations?
- Are construction lights causing glare to pilots?

APPENDIX F

Template for SRA Planning

Source: ASM Consultants.

Phase	Activity
Phase 1 – SRA Planning	Trigger SRA
	Identify Stakeholders
	Collect and Summarize Preliminary Information
	Invite Participants
Phase 2 – SRA Preparation and Scheduling	Submit Preliminary Information
	Schedule SRA Session
	Develop Structure for SRA
	Preliminary List of Hazards
	Prepare Briefing and Handouts
Phase 3 – Conducting the SRA	Brief Participants
	Brainstorming for 5-Step SRM Process
	Plan for Implementation and Monitoring of Risk Controls
	Register Risks
Phase 4 – SRA Reporting	Prepare Preliminary Report
	Circulate Report for Review
	Prepare and Approve Final Report
	Create Risk Register

APPENDIX G

Briefing Template for Safety Assessments

Source: Developed by ASM Consultants based on FAA ATO Panel Facilitation Briefing (2015).

Safety Risk Assessment (SRA) Panel Orientation Briefing

Project: Reconstruction of TWY B

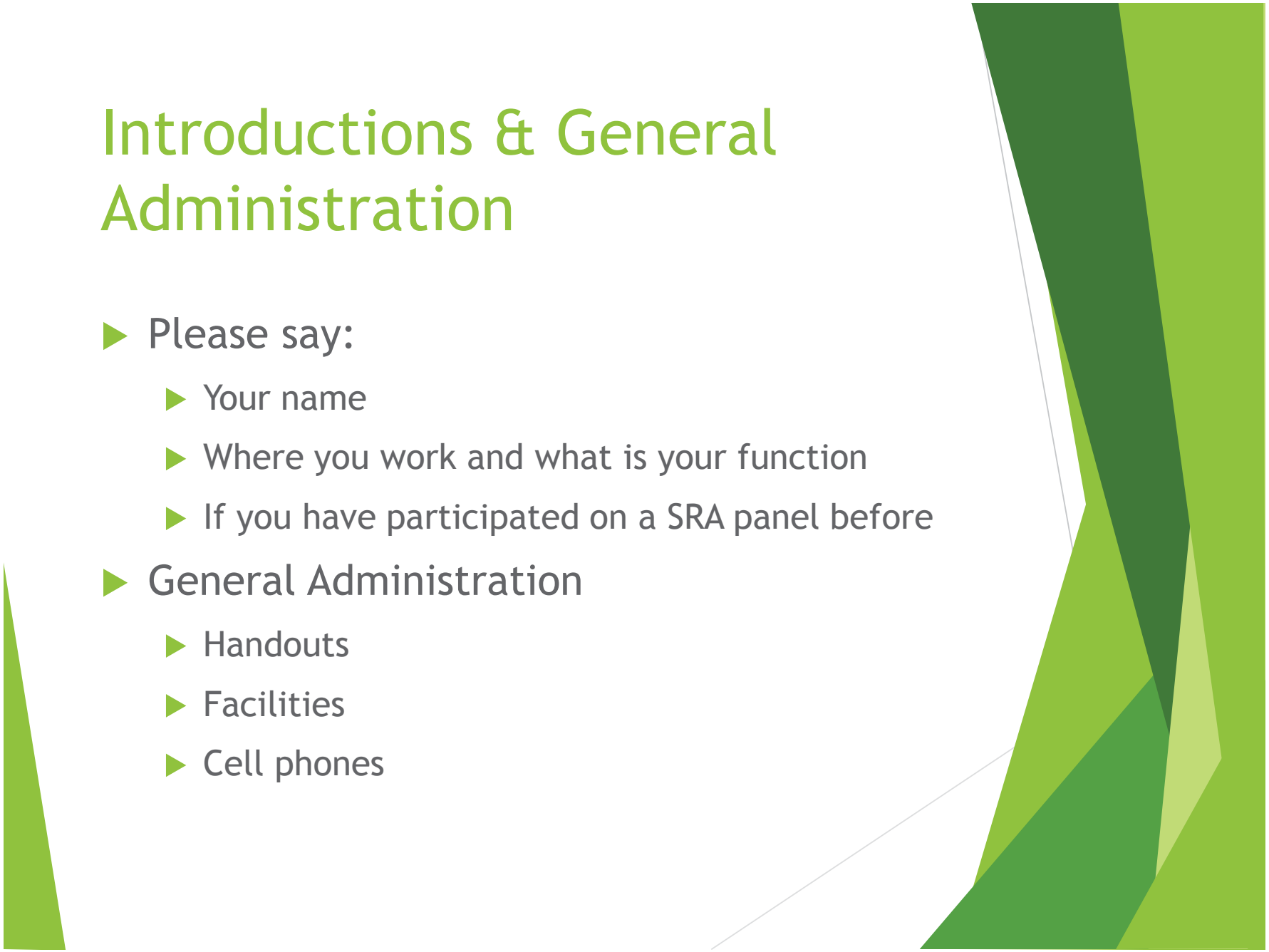
Date: 09/07/2015

Outline (less than 30 min)

- Objective
- Introductions & General Administration
- Schedule and Handouts
- Rules of the Meeting
- SRA Process (if unexperienced participants are present)
  - Key definitions (hazard, risk) and SRM Concepts
  - The brainstorming goal and process
  - How can you help?
- Summary of Safety Issue
  - Maps
  - Plans
  - Pictures

Introductions & General Administration

- Please say:
  - Your name
  - Where you work and what is your function
  - If you have participated on a SRA panel before
- General Administration
  - Handouts
  - Facilities
  - Cell phones

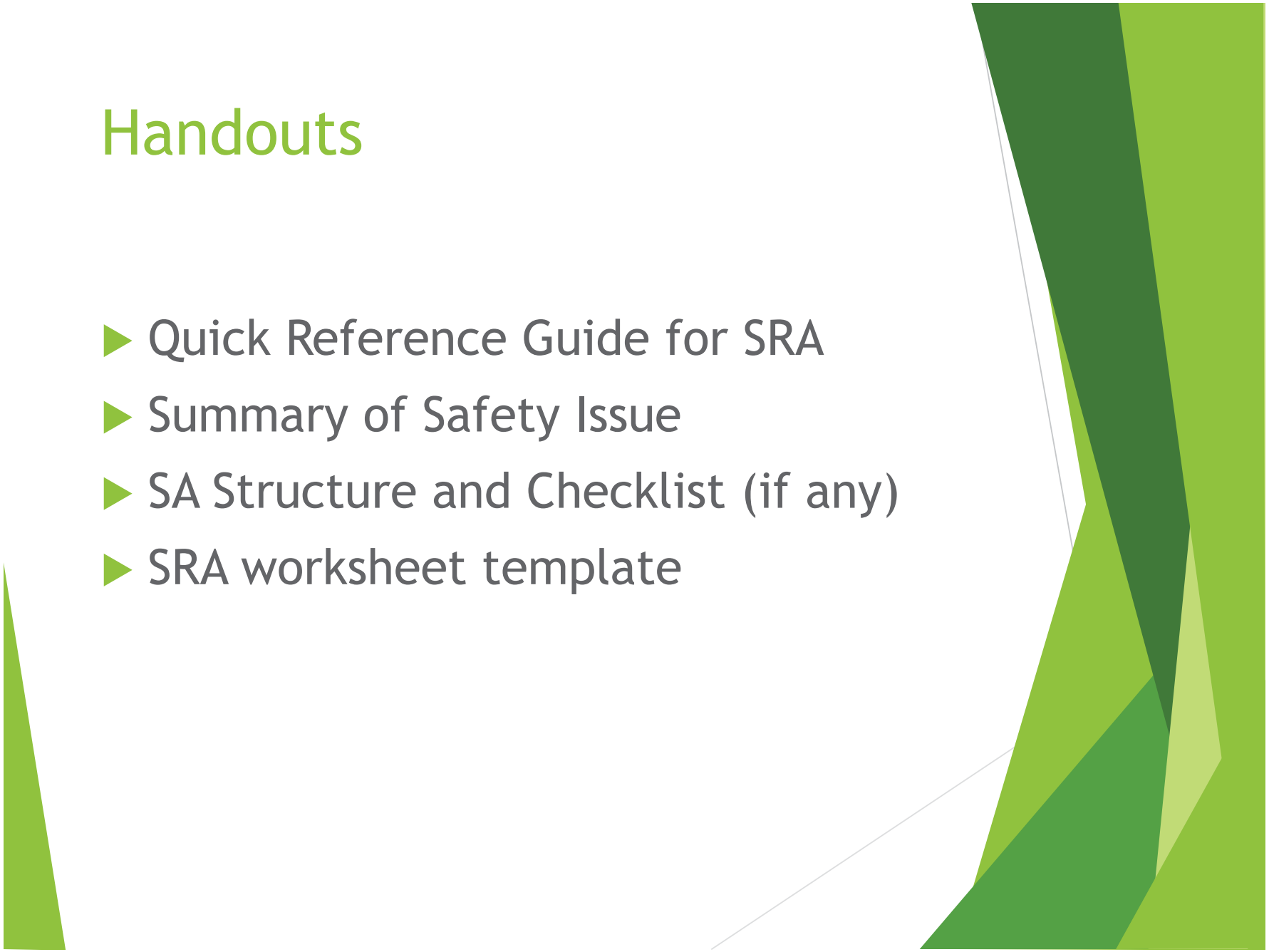


Schedule

- 9A to 12P: SRA with breaks every 50min
- 12P to 1P: lunch (here)
- 1P to 2:50P: SRA with breaks every 50min
- 2:50P to 3P: closing and next steps

Handouts

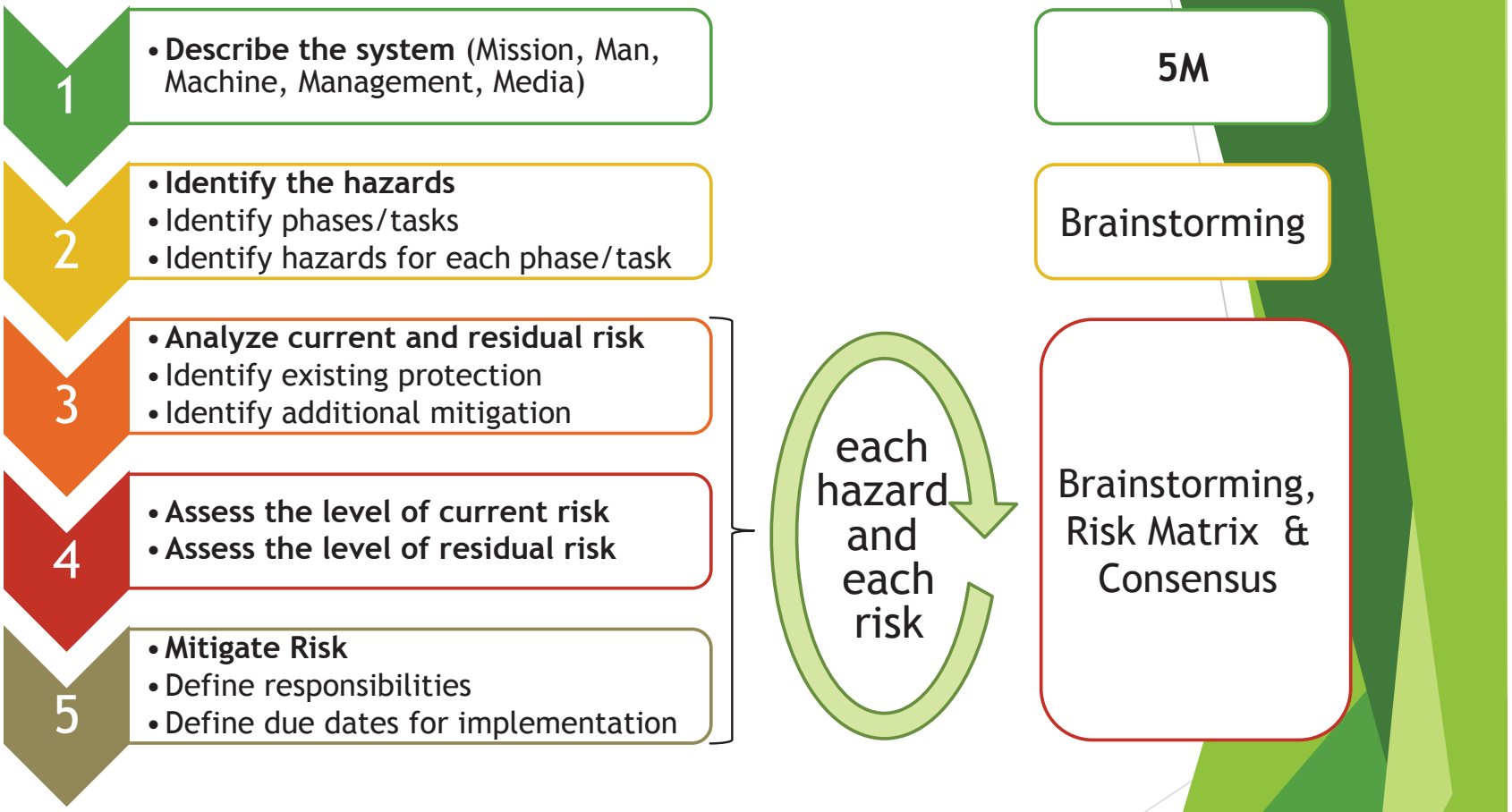
- Quick Reference Guide for SRA
- Summary of Safety Issue
- SA Structure and Checklist (if any)
- SRA worksheet template



Rules of the Meeting

- One person talk at a time
- Breaks every hour
- Any idea is welcomed for discussions, no matter how exaggerated it is
- Quantity counts at this stage, not quality
- Build on the ideas put forward by others
- Every person and every idea has equal worth
- Postpone judgement when identifying hazards
- No sidebar conversations

SRM Process



SRM Example

Identify Hazards

(1) Hazard ID	(2) Hazard Description	(3) Causes	(4) System State
REG2015-01	Delay to measure rwy friction	CFME breakdown	Rain

Analyze Risk

(5) Existing Control(s)	(6) Existing Control Justification	(7) Effects	(8) Severity	(9) Severity Rationale	(10) Likelihood	(11) Likelihood Rationale
Periodic Runway friction measurement	Part 139 Regulation	Rubber contamination and low friction leading to rwy excursion	Catastrophic (1)	loss of aircraft directional control	Extremely Remote (D)	Likelihood increases if rwy is contaminated when wet
	Frequency survey frequency (AC 150/5320-12C)					

SRM Example

Assess Risk

(7) Effects	(8) Severity	(10) Likelihood	(12) Initial Risk
Rubber contamination and low friction leading to rwy excursion	Catastrophic (1)	Extremely Remote (D)	1D - High

SRM Example – Initial Risk

Risk Matrix

- First rate **Severity**
- then rate **Likelihood**

Likelihood Classification	Frequency Criteria	Time Frequency	Rate Relative to # of Departures	Minimal 5	Minor 4	Major 3	Hazardous 2	Catastrophic 1
				Severity Classification				
				No damage	Minimal damage	Major damage	Severe damage	Hull loss
				Minimal injury	Minor injury	Minor injury	Serious injury	Fatal injury
					Minimal limitations	Major disruption	Unplanned closure	Unplanned closure
					Minor incident	Serious incident	Damage to facilities	Destruction of critical facilities
	Frequent A	More than once a week	More than once every 2500 deps	5A	4A	3A	2A	1A
	Probable B	About once every month	About once every 250,000 deps	5B	4B	3B	2B	1B
	Remote C	Once every year	About once every 2.5 million deps	5C	4C	3C	2C	1C
	Extremely Remote D	Once every 10-100 years	About once every 25 million deps	5D	4D	3D	2D	1D
	Extremely Improbable E	Less than once every 100 years	N/A	5E	4E	5E	2E	* 1E

Effect on
Aircraft
People
Operations
Airport

Low Risk / Medium Risk / High Risk

SRM Example – Treat Risk

Treat Risk

(13) Risk Controls	(14) Organization Responsible for Implementing Risk Control	(15) Predicted Residual Risk	(16) Safety performance Targets
Rent CFME for immediate measurement	Airport Maintenance (Joe Smith)	1E - Medium	No runway excursions associated with low rwy friction
Limit operations during rainy conditions if friction is below minimum level	ATC Tower/Airport Ops (Jeanne Smith)		

SRM Example – Residual Risk

Risk Matrix

- First rate **Severity**
- then rate **Likelihood**

Likelihood Classification	Frequency Criteria	Time Frequency	Rate Relative to # of Departures	Minimal 5	Minor 4	Major 3	Hazardous 2	Catastrophic 1
				Severity Classification				
				No damage	Minimal damage	Major damage	Severe damage	Hull loss
				Minimal injury	Minor injury	Minor injury	Serious injury	Fatal injury
					Minimal limitations	Major disruption	Unplanned closure	Unplanned closure
					Minor incident	Serious incident	Damage to facilities	Destruction of critical facilities
	Frequent A	More than once a week	More than once every 2500 deps	5A	4A	3A	2A	1A
	Probable B	About once every month	About once every 250,000 deps	5B	4B	3B	2B	1B
	Remote C	Once every year	About once every 2.5 million deps	5C	4C	3C	2C	1C
	Extremely Remote D	Once every 10-100 years	About once every 25 million deps	5D	4D	3D	2D	1D
	Extremely Improbable E	Less than once every 100 years	N/A	5E	4E	5E	2E	REG 2015 -01

Effect on
Aircraft
People
Operations
Airport

Low Risk / Medium Risk / High Risk

Summary of Safety Issue

- Present images to help the Panel understand the safety issue and what is involved
- Describe basic activities involved
- Describe potential impacts to operations
- Describe planned schedule and main players
- Point out critical issues that must be discussed

Additional slides can be added to this presentation to characterize the system and the change involved, or to highlight specific hazards and safety concerns

How Can You Help?

- Have a basic understanding of the SRM and SRA processes
- Read and understand the preliminary information
- Follow the brainstorming rules
- Postpone judgement during the hazard identification process
- Think about potential hazards that might negatively impact safety and write your risk/concern on sticky notes
- Avoid over and under participation
- Be unbiased, realistic and use common sense
- Help the group (provide examples, etc)
- Meet schedule
- Avoid criticism but play devil's advocate when necessary
- Keep electronic communications off
- Be patient when discussions are not related to your area

APPENDIX H

Sample Checklist for SRA

Courtesy: Hartsfield–Jackson Atlanta International Airport (2015).

HJAIA Safety Risk Assessment (SRA) Process Checklist

1. Department/Division conducting SRA: Airport Operations	2. Station: ATL	3. SRA Owner:	4. Schedule SRA Date/Time Duration:

5. General Office:				
Criteria	**Yes**	**No**	**Owner of Task**	**Date Completed**
A. Schedule Conference Room	☐	☐		
1. Projector	☐	☐		
2. Laptop Computer	☐	☐		
3. Conference phone setup	☐	☐		
4. Flip Charts	☐	☐		
5. Recorder	☐	☐		
6. Participants/Stakeholders	☐	☐		
B. Agenda	☐	☐		
C. Copies of Risk Matrix & Severity and Likelihood Definitions	☐	☐		
D. Copies of the SMS SRA 1 and SMS SRA 2	☐	☐		
E. Relevant Diagram(s) ATL for Airport	☐	☐		
F. ATL Aerial	☐	☐		
G. ATL utilities, airfield lighting, FAA facilities drawings.	☐	☐		
H.	☐	☐		
I.	☐	☐		
J.	☐	☐		

6. Recommended Participants:	
a.	n.
b.	o.
c.	p.
d.	q.
e.	r.
f.	s.
g.	t.
h.	u.
i.	v.
j.	w.
k.	x.
l.	y.
m.	z.

7. SRA Topic:	
Criteria	**Owner of Task**
A. Describe the System that prompted this SRA:	
B. Hazard that prompted this SRA:	

8. Documentation				
Criteria	**Yes**	**No**	**Owner of Task**	**Date Completed**
A. Review all Supporting SMS SRA1 and SRA 2	☐	☐		
B. Publish minutes of meeting and SRA recommendation(s)	☐	☐		
C. SRA Review by SMS committee	☐	☐		
D. SRA Review by Executive Committee	☐	☐		
E. SRMD recommendation(s) (dis)approval & signature	☐	☐		
F. Implement SRA recommendation (s)	☐	☐		
G. Track implementation for six months	☐	☐		
H. Close SRA or Adjust SRA Recommendation(s)	☐	☐		
1. Was SRA closed	☐	☐		
2. Was SRA recommendation (s) adjusted	☐	☐		
I. Complete 8C through 8H again	☐	☐		

9. This section to be completed by Safety Division personnel:			
A. Risk Code	B. Report Status: ☐ Closed	C. Date Closed:	D. Report Closed by (Enter Initials):
E. Comments:			

APPENDIX I

Sample Worksheets for Safety Assessments

TABLE I1
SAFETY ASSESSMENT TEMPLATE

(1) Describe the System	(2) Identify Hazards	(3) Analyze Outcomes	(3a) Identify Existing Control	(4) Assess Level of Risk	(5) Mitigation Actions	(5a) Reassess Level of Risk with Mitigation Actions in Place
5M: Mission, Man, Machine, Media/environMent, Management	*Hazard A*	*Effect A1*	*CA11, CA12,*	*A1-prior*	*MA11, MA12, ...*	*A1-after*
		Effect A2	*CA21, CA22,*	*A2-prior*	*MA21, ...*	*A2- after*
		Effect A3	*CA31, CA32,*	*A3-prior*	*MA31, MA32,*	*A3- after*
	Hazard B	*Effect B1*	*CB11, CB12,*	*B1-prior*	*MB11, MB12,*	*B1- after*
		Effect B2	*CB21, CB22,*	*B2-prior*	*MB21, ...*	*B2- after*
	Hazard C	*Effect C1*	*CC11, CC12,*	*C1-prior*	*MC11, ...*	*C1- after*
		Effect C2	*CC21, CC22,*	*C2-prior*	*MC21, MC22,*	*C2- after*
		Effect C3	*CA31, CC32,*	*C3-prior*	*MC31, MC32,*	*C3- after*

Source: *ACRP Report 131: A Guidebook for Safety Risk Management for Airports.*

TABLE I2
FAA ARP SMS TEMPLATE FOR PRELIMINARY HAZARD ANALYSIS

Preliminary Hazard Analysis

SMS ID: Airport:

Locid: City:

Project Manager:

Description:

1 Hazard ID	2 Hazard Description	3 Causes	4 System States	5 Existing Controls	6 Justification/ Supporting Data	7 Effects	8 Severity	9 Severity Rationale	10 Likelihood	11 Likelihood Rationale	12 Initial Risk	13 Mitigation	14 Mitigation Responsibility	15 Predicted Residual Risk
1														
2														
3														
4														
5														
6														
7														
8														
9														
10														
11														
12														
13														
14														
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17														
18														
19														
20														
21														
22														
23														
24														
25														
26														
27														
28														
29														
30														

Source: *FAA Office of Airports—Safety Management System (SMS)—Desk Reference, V 1.0, Jun 2012.*

TABLE I3
ICAO SRM WORKSHEET 1

Table A - Hazard and Consequence:

OPERATION/ PROCESS:	[Describe the process/operation/equipment/system being subject to this HIRM exercise]
HAZARD [H]:	[If there is more than one Hazard to the Operation/Process, use separate Worksheet to address each Hazard]
UNSAFE EVENT [UE]:	[If there is more than one UE to the Hazard, use separate Worksheet to address each UE-U combination]
CONSEQUENCE [UC]:	[If there is more than one UC to the Hazard, use separate Worksheet to address each UC]

Table B - Evaluate Risk Index and Tolerability of Consequence/ UE (See Annex 1):

Table B-1 / Table B-2

	CURRENT Risk Index & Tolerability (taking into consideration any **existing** PC/RM/EC)				**RESULTANT Risk Index & Tolerability** (taking into consideration any **new** PC/RM/EC)		
	Severity	Likelihood	Tolerability		Severity	Likelihood	Tolerability
Unsafe Event							
Ultimate Consequence							

Table C - Risk Mitigation:

Hazard [H]	**Preventive Control [PC]**	**Escalation Factor [EF]**	**Escalation Control [EC]**		**Recovery Measure [RM]**	**Escalation Factor [EF]**	**Escalation Control [EC]**	
H	PC1 *(Existing)*	EF *(Existing)*	EC1 *(Existing)*	UNSAFE EVENT [UE]	RM1*(Existing)*	EF (to RM1)	EC (to EF)	ULTIMATE CONSEQUENCE [UC]
			EC2 *(New)*					
	PC2 *(Existing)*	EF1 *(New)*	EC *(New)*		RM2 *(New)*	EF (to RM2)	EC (to EF)	
		EF2 *(New)*	EC *(New)*					
	PC3 *(New)*	EF *(New)*	EC *(New)*		RM3	EF (to RM3)	EC (to EF)	

Source: *Editable Appendices of the ICAO Safety Management Manual (SMM) 3rd Ed. (2013).*

TABLE I4
ICAO SRM WORKSHEET 2

Sht 3	Hazard Identification & Risk Mitigation (HIRM) Worksheet [Safety Assessment]	6Mar13 HIRM Wsht R5
Table A		
1. OPERATION/ PROCESS:	[Describe the Operation/ Process/ Equipment being subject to this HIRM (Safety Assessment) exercise]	
2. HAZARD / THREAT [H/T]:	[Describe. If more than one Hazard, may use separate block of cells to address each additional Hazard]	
3. UNSAFE EVENT [UE]:	[Describe. If more than one Unsafe Event, may use separate block of cells to address each additional Unsafe Event]	
4. ULTIMATE CONSEQUENCE [UC]:	[Describe. If more than one Consequence, use separate block of cells to address each additional Consequence]	

Table B

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
	>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>> Unsafe Event Mitigation (as applicable) >>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>																											
	Existing Preventive Controls [E-PC]												Existing RI & T		New Preventive Controls [N-PC]												Resultant RI & T	
Hazard / Threat	1. ERP	2. Backup System	3. Abnormal Procedure	4. SOP	5. Duplicate Inspn	6. GM	7. PEL	8. Personnel Approval	9. TRNG	10. Others	Escalation Factor [EF]	Escalation Control [EC]	Risk Index	Tolerability	1. ERP	2. Backup System	3. Abnormal Procedure	4. SOP	5. Duplicate Inspn	6. GM	7. PEL	8. Personnel Approval	9. TRNG	10. Others	Escalation Factor [EF]	Escalation Control [EC]	Risk Index	Tolerability
[Describe the Hazard/ THreat here]	E-PC1										EF (to E-PC1)	EC1 (to EF) EC2 (to EF)						N-PC5							EF (to N-PC5)	EC1 (to EF) EC2 (to EF)		
		E-PC2									EF1 (to E-PC2)	EC (to EF1)								N-PC6					EF1 (to N-PC6)	EC (to EF1)		
				E-PC3							EF2 (to E-PC3)	EC (to EF2)											N-PC7		EF2 (to N-PC7)	EC (to EF2)		
								E-PC4			EF (to E-PC4)	EC (to EF)																

30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59
	>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>> Ultimate Consequence Mitigation (as applicable) >>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>																												
	Existing Recovery Measures [E-RM]												Existing RI & T		New Recovery Measures [N-RM]												Resultant RI & T		
Unsafe Event	1. ERP	2. Backup System	3. Abnormal Procedure	4. SOP	5. Duplicate Inspn	6. GM	7. PEL	8. Personnel Approval	9. TRNG	10. Others	Escalation Factor [EF]	Escalation Control [EC]	Risk Index	Tolerability	1. ERP	2. Backup System	3. Abnormal Procedure	4. SOP	5. Duplicate Inspn	6. GM	7. PEL	8. Personnel Approval	9. TRNG	10. Others	Escalation Factor [EF]	Escalation Control [EC]	Risk Index	Tolerability	Ultimate Consequence
[Describe projected Unsafe Event here]	E-RM1										EF (to E-RM1)	EC1 (to EF) EC2 (to EF)					N-RM5								EF (to N-RM5)	EC1 (to EF) EC2 (to EF)			[Describe projected Ultimate Consequence / Accident here]
		E-RM2									EF1 (to E-RM2)	EC (to EF1)								N-RM6					EF1 (to N-RM6)	EC (to EF1)			
				E-RM3							EF2 (to E-RM3)	EC (to EF2)																	
					E-RM4						EF (to E-RM4)	EC (to EF)																	

HIRM Procedure				
	1	Fill out Table A. Be very precise in naming each entity, especially the Hazard. (Refer Sheet 2 for definitions of each entity)	5	Based on the Existing Risk Index obtained above, annotate its corresponding Tolerability description (Sheet 6) in column 15/ 44 as applicable.
	2	Annotate Table A item descriptions (2, 3 & 4) into their respective columns (1, 30, 59) in Table B.	6	If the Existing Risk Index's Tolerability is unacceptable, proceed to evaluate possible enhancement of Existing PCS/ RMs or New (additional) PCs/ RMs in order to reduce the Risk Index to a new acceptable level.
	3	Annotate existing PCs (columns 2 to 11) and/ or RMs (columns 31 to 40) within the relevant PC/ RM (10 categories) as available . For supplementary guidance on PC/ RM categories consideration, refer to Sht 8. Where a PC/ RM may be affected (compromised) by an EF (Escalation Factor), then the EF & EC (Escalation Control) columns (12, 13, etc) should be completed accordingly for that PC/ RM.	7	With any modified or New PCs/ RMs in place, together with the Existing PCs/ RMs, proceed to re-assess the Resultant Risk Index (Severity & Likehood) of the projected UE/ UC as applicable. Annotate result in column 28/ 57 as applicable. (Refer Tables in Sheets 3 & 4).
	4	Based on these existing PCs/ RMs being in place, assess the Existing Risk Index (Severity & Likelihood) of the projected UE/ UC. Annotate result in column 14/ 43 as applicable. (Refer Severity & Likelihood Tables in Sheets 3 & 4).	8	Based on the Resultant Risk Index obtained above, annotate its corresponding Resultant Tolerability description (Sheet 6) in column 29 & 58 as applicable. This Resultant Risk Index & its corresponding Resultant Tolerability description is the final outcome of the HIRM exercise.

Source: Editable Appendices of the ICAO Safety Management Manual (SMM) 3rd Ed. (2013).

APPENDIX J

SRA Report Example

The SRA Report presented in this appendix is associated with a fictitious airport and was developed by ASM Consultants as an example for this ACRP Synthesis only.

SWR Airport

Safety Risk Assessment

Report 01/2016

Prepared by Airport Safety Management Consultants
www.asmcons.com

01/09/2016

QUALITY ASSURANCE AND VERSION TRACKING

Authorization

Title	SWR Safety Risk Assessment – Rehabilitation of Apron Pavement Areas
Report number	01/2016
Version	1.0
Prepared by	M. Ayres
QA by	A. Parra
Approved by	SWR SMS Manager

Version tracking

Version	Action	By	Date
0.1	Development	Ayres	1 Jan 2016
0.2	Review	Parra	8 Jan 2016
1.0	Final review	SWR SMS Manager	9 Jan 2016

TABLE OF CONTENTS

EXECUTIVE SUMMARY

The apron of SWR Airport will be partially closed for the rehabilitation of a deteriorated area on the east side while the airport and the remaining of the apron stay open to regular flights and apron activities.

A Contractor is being hired and SWR management decided to conduct an internal Safety Risk Assessment (SRA) to identify hazards and risks, and to define risk mitigation actions to ensure construction activities are safe to aircraft operations.

Two consultants were hired to facilitate the SRA and a Safety Risk Management (SRM) Panel of SWR stakeholders was appointed to support the SRA exercise. The SRM process followed the five steps recommended by the FAA in the Draft AC 150/5200-37–Introduction to Safety Management Systems (SMS) for Airport Operators.

Eleven hazards were identified and associated with risks generated by the construction activities. Seven of the risks were classified in the Low level according to SWR Risk Matrix and three of those risks were classified as Medium level, requiring additional mitigation actions to be implemented. No High level risks were identified by the SRM Panel.

This report summarizes the SRM process used and the findings. A plan to implement the risk mitigation actions and to ensure those actions will be in place and are effective during the construction period is presented in tabular format.

1. INTRODUCTION

This Safety Risk Assessment (SRA) Report describes the process and the results of a safety assessment conducted internally by SWR Airport in January of 2015. The SRA was supported by a Safety Risk Management (SRM) Panel of SWR stakeholders, including SWR operations, engineering, maintenance, ARFF, and one airline and a ground handling organization. The SRA was facilitated by Mr. Bob Smith, a consultant hired by SWR.

a. Background

The apron at SWR Airport has deteriorated in the east section as a result of aircraft loads over the past 25 years. The concrete pavement has structural cracks and rain water has degraded the subbase and the bearing capacity of the pavement. The pavement will be rehabilitated and SWR Airport has made a decision to conduct a Safety Risk Assessment supported by a SRM Panel of SWR stakeholders to evaluate risks and take proactive actions to ensure the construction activities will be safe to aircraft operations.

SWR Airport has only one apron and it is necessary to execute the rehabilitation of the pavement without closing the airport for operations. Construction will take place in the deteriorated area during daylight hours and can affect activities and operations in the apron.

Many of the risks identified during this assessment are attributed to the presence of construction staff unfamiliar with airport operations on the aircraft operations area; the performance of routine aircraft operations in the presence of unfamiliar structures; the changes in the environment (lay out, congestion, etc.); and those introduced as a result of construction activities (e.g., generation of FOD, excavations, presence of construction equipment, haul routes, etc.).

According to the risk matrix used by SWR Airport (*SWR Airport SMS Manual* 2016), the risks identified were classified in 3 categories: High, Medium and Low. Those classified as High are considered unacceptable and action should be taken immediately to reduce the risk value.

During the workshops, risks in all categories were identified. However a combination of programs, policies and procedures already in place at SWR supplemented by mitigating actions implemented to manage the pavement rehabilitation project has reduced all identified risks to acceptable levels.

Some of the key mitigating actions associated with this project are under the responsibility of the Contractor and should be part of the Construction Safety and Phasing Plan (CSPP). Many of these actions are related to the temporary physical protections to be deployed in and around the construction area such as barriers, fencing and markings, the control of FOD and control of access of construction personnel in the apron area.

A few new initiatives were suggested during the workshops that SWR may want to consider. Their implementation may help to further reduce risk.

Lastly, it is recommended that once all these measures are implemented, they be monitored. Monitoring will ensure that the selected measures are effective and will allow for adjustments should any be necessary.

b. SRM Panel and SRA Approval

Name	Organization	Position	Date	Approval
J. Smith	NWR Airfield Ops	Manager	01/09/2016	
K. Maker	NWR Engineering	Project Manager	01/08/2016	
L. Benign	NWR Airfield Ops	Safety Manager	01/09/2016	
M. Jobs	NWR Airfield Ops	Supervisor	01/08/2016	
N. Save	NWR ARFF	Supervisor	01/08/2016	
O. Wings	ABC Airline	Safety Manager	01/09/2016	
P. Grounds	XYZ Handling	Supervisor	01/09/2016	
M. Ayres	Consultant	Facilitator	01/09/2016	
A. Parra	Consultant	Note Taker	01/09/2016	

c. Objective

The objective of this SRA was aimed at identifying the potential hazards introduced by the construction activities to rehabilitate the east area of SWR apron. Moreover this SRA assessed the risks associated with the hazards, classified the risks according to the risk matrix presented in SWR SMS Manual, established risk mitigation actions and responsibilities to implement and monitor these actions.

d. Project Scope and Phases

The project will be executed in one phase and the entire east area of the apron will be closed for aircraft operations because of the construction activities. Project tasks will include demolition of existing slabs, excavations to remove deteriorated subbase material, replacement of subbase, casting of new concrete slabs. The project will be completed two months after the start, and the area will be reopened to operations one month after the work has been completed to allow for curing of the concrete. The total duration of the project is three months.

2. SAFETY RISK MANAGEMENT PROCESS

The risk assessment process conducted for this SRA was that recommended by the FAA AC 150/5200-37 and incorporated to SWR SMS Manual. The process consists of five steps, as follows:

a. Step 1 - Describe the system

The first step in performing SRM is to describe the system under consideration. The system description includes the functions, general physical characteristics and resources, and operations of the system.

b. Step 2 - Identify hazards

Hazard identification is the act of identifying any condition with the potential of causing injury to personnel, damage to equipment or structures, loss of material, or reduction of the ability to perform a prescribed function.

c. Step 3 - Determine risk

This step is to identify the type of risk associated with each hazard listed in the previous phase. One hazard may have one or more risks associated with it.

d. Step 4 - Assess and analyze the risk

Risk assessment is the process which associates "hazards" with "risks." The process involves both estimating and classifying risks. The simplest way to estimate the risk associated with a specific hazard is to ask the following two questions:

– What possible harm could the hazard present (the potential outcome)?
– How likely is it that harm could occur (the likelihood)?

After estimating the potential outcome and the likelihood, this information is used to classify risk according to SWR risk matrix presented in Figure 1. Risk classification is necessary to identify how serious is the risk and to define the priorities to treat these risks.

e. Step 5 - Treat and monitor risk

Risk treatment alternatives should address the risk probability, the risk severity, or both. More detailed information on these steps is presented in ensuing sections of this report.

3. DESCRIPTION OF THE SYSTEM

For this SRA the 5M Model is used to describe the system and set the bounds of the risk assessment exercise.

a. Mission

The scope of the project is to rehabilitate the deteriorated pavement in the east area of the apron and ensure that the rehabilitated pavement area complies with standards and is safe to aircraft operations.

b. Man

The human resources involve the construction workers and airport personnel appointed to manage and coordinate the project execution, ensure that construction work complies with design specifications and that risk mitigation actions are in-place and are effective.

Risk Matrix

- First rate **Severity**
- then rate **Likelihood**

Likelihood Classification			Severity Classification					
Frequency Criteria	Time Frequency	Rate Relative to # of Departures	Minimal 5	Minor 4	Major 3	Hazardous 2	Catastrophic 1	Effect on
			No damage	Minimal damage	Major damage	Severe damage	Hull loss	Aircraft
			Minimal injury	Minor injury	Minor injury	Serious injury	Fatal injury	People
				Minimal limitations	Major disruption	Unplanned closure	Unplanned closure	Operations
				Minor incident	Serious incident	Damage to facilities	Destruction of critical facilities	Airport
Frequent A	More than once a week	More than once every 2500 deps	5A	4A	3A	2A	1A	Low Risk / Medium Risk / High Risk
Probable B	About once every month	About once every 250,000 deps	5B	4B	3B	2B	1B	
Remote C	Once every year	About once every 2.5 million deps	5C	4C	3C	2C	1C	
Extremely Remote D	Once every 10-100 years	About once every 25 million deps	5D	4D	3D	2D	1D	
Extremely Improbable E	Less than once every 100 years	N/A	5E	4E	5E	2E	* 1E	

FIGURE 1 SWR Risk Matrix.

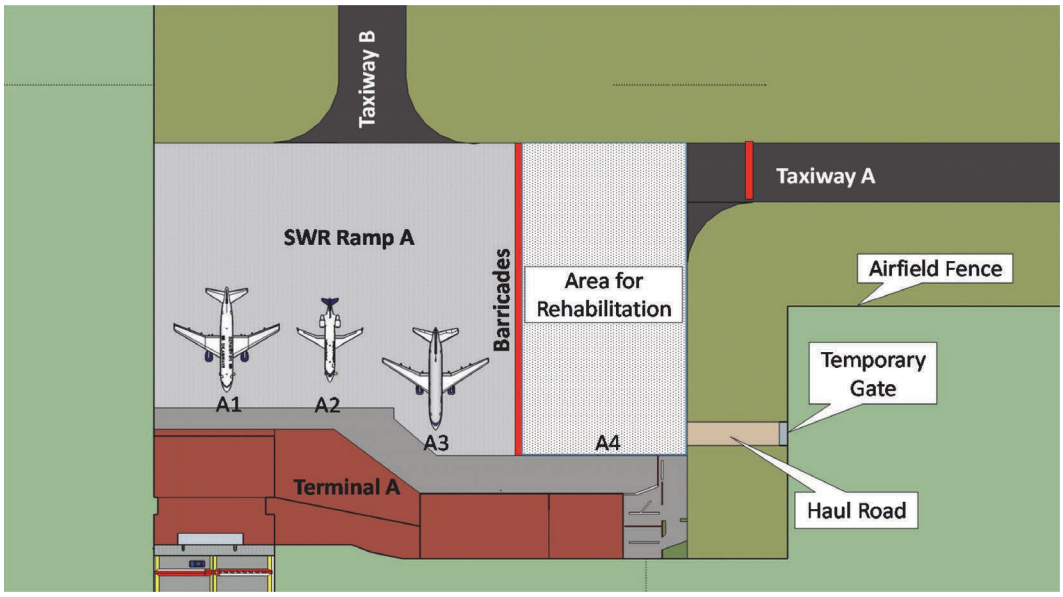

FIGURE 2 SWR Airport–Characterization of Construction Area.

c. Machine

This component involves construction equipment and construction materials needed to perform the works. Most of the cement treated subbase and concrete to cast the slabs will be mixed in the contractor plant located 5 miles from the airport.

d. Media

The construction area is shown in Figure 2. It is defined by the paved area of 56m (width) by 100m (length) in the east most portion of SWR apron. A temporary gate for control of access and a haul route will be used by construction personnel and equipment to access the construction area. Equipment staging area and contractor offices will be outside the airport fence, as shown in Figure 2. During the construction and curing of concrete, Taxiway A will be closed and access to the apron.

e. Management

A Contractor was hired by SWR to rehabilitate the paved east area of the apron. An independent consultant was also hired to perform quality assurance of construction works. The project will be managed by SWR Engineering and SWR Airfield Operations will monitor safety issues and risk mitigation actions impacting operations. Frequent special inspections will be performed by Airfield Operations to ensure the Construction Safety and Phasing Plan (CSPP) is followed and that safety issues are resolved in a timely manner.

4. HAZARDS, RISKS AND RISK CONTROL

Table 1 presents a summary of the Hazards, Risks, Potential Outcomes, Likelihood and Risk Levels identified by the SRM Panel during the brainstorming session. Risk Levels are given as High (H) in red; Medium (M) in yellow; and Low (L) in green. These risk levels are associated with the risk matrix described in SWR SMS Manual. No high level risks were identified by the SRM Panel.

Table 2 is a continuation of Table 1 and presents additional risk mitigation actions with the associated residual risks. Table 2 also presents the responsibilities for implementation of actions defined by the SRM Panel and describes how the actions will be implemented and monitored for safety assurance.

- The SWR Project Manager will ensure that risk mitigation actions under the responsibility of the Contractor and described in this section will be included in the Contractor CSPP.
- Hazards and risks identified in the SRA will be recorded in SWR Risk Register and will be monitored by the SWR SMS Manager.

TABLE 1
HAZARDS, RISKS, AND RISK VALUES

Hazard #	Hazard Description	Causes	System State	Potential Outcome	Existing Controls	Severity	Likelihood	Initial Risk
SWR-1	Ingestion or Displacement of Foreign Object Debris	Demolition of concrete slabs and construction traffic	Construction activities near active operational area	Damage to aircraft by engine ingestion during taxiing or injury to ground personnel by jet blast	• Daily inspection by airfield officers • FOD management plan in CSPP • Monitoring of FOD by construction supervisors	Major	Probable	**M**
SWR-2	Inoperative NAVAIDs	Demolition of concrete slabs and excavations to remove deteriorated subbase causing power and water outage or leaks in underground pipelines	Active runway under instrument or night conditions during construction	Loss of navigational references by pilots during instrument approach leading to runway excursions and severe damage to aircraft	• Locate utilities before excavations	Hazardous	Extremely Remote	**M**
SWR-3	Loss of Situational Awareness by Pilots	Change in apron geometry owing to closed construction areas	Closure of Taxiway A and part of the apron closed to aircraft operations	Aircraft entering closed areas resulting in damage to aircraft	• NOTAMs • Barricades and other signs	Major	Extremely Remote	**L**
SWR-4	Loss of Situational Awareness by Construction Workers	Workers unaware of boundaries to operational areas and unfamiliar with airport activities	Presence of workers and construction equipment near active operational areas	Damage to aircraft and/or construction equipment; serious injuries to construction workers	• Daily briefings to construction personnel • Contractor supervision during work hours • Barricades and temporary signs	Hazardous	Extremely Remote	**M**
SWR-5	Delayed Response by ARFF	Contractor workers unaware of existing emergency routes or ARFF unaware of changes to emergency routes	Emergency conditions require quick access by ARFF	Delay to respond to emergencies in movement areas or in the apron, increased severity of injuries	• Barricades and temporary signs • Construction management coordination with ARFF • Safety meetings	Major	Extremely Remote	**L**

(*continued on next page*)

TABLE 1
(*continued*)

Hazard #	Hazard Description	Causes	System State	Potential Outcome	Existing Controls	Severity	Likelihood	Initial Risk
SWR-6	Failure to coordinate construction activities with TWR, OPS, ARFF	Changes to existing conditions owing to construction closures	Section of existing emergency route or taxiways temporarily closed	Pilots and ARFF unaware of changes entering construction areas leading to accidents	• NOTAM • Construction coordination • Weekly construction safety meetings	Major	Extremely Remote	**L**
SWR-7	Jet blast of aircraft during breakaway thrust after pushback	Jet blast launching debris or displacing equipment in construction areas	Construction area near active apron areas and operation of aircraft	Injuries to construction workers caused by debris or displaced construction equipment	• Weekly construction safety meetings • Use of PPE by construction workers • FOD Management Plan in CSPP	Major	Remote	**M**
SWR-8	Increased wildlife activity	Construction worker food waste attract birds to airport areas	Active runway operations during construction period	Bird strikes causing major damage to aircraft (engines, fuselage, wings)	• Daily briefings to construction workers	Major	Extremely Remote	**L**
SWR-9	Loss of situational awareness by pilots or workers	Improper coordination of construction activities	Closed taxiway and east portion of apron	Major damage to aircraft entering closed construction areas	• Publish NOTAM with status of closed areas • Weekly construction safety meetings	Major	Extremely Remote	**L**
SWR-10	Tall equipment on airfield during construction	Construction equipment penetrating Part 77 surfaces	Construction equipment near active runway and other operational areas	Aircraft collision with construction equipment causing severe damage to aircraft and serious injuries to passengers or workers	• Obtain FAA approval for tall equipment	Hazardous	Extremely Improbable	**L**
SWR-11	Congestion on ramp	Smaller apron increase congestion in apron area	Apron area reduced owing to construction area	Congested area leading to collision of equipment and aircraft	• Weekly construction safety meetings	Minor	Remote	**L**

TABLE 2
RISK MITIGATION ACTIONS AND IMPLEMENTATION PLAN

Hazard #	Initial Risk	Existing Risk Mitigation Actions	Additional Risk Mitigation Actions	Residual Severity	Residual Likelihood	Residual Risk	Responsibility for Implementation	How to Implement	Safety Assurance
SWR-1	**M**	• Daily inspection by airfield officers • FOD management plan in CSPP • Monitoring of FOD by construction supervisors	• Increase daily inspections in construction area	Major	Extremely Remote	**L**	• Daily inspections by Airfield Operations • Contractor to develop and approve a plan to manage FOD	Increase to 6 daily inspections in the construction area when work is in progress	Record safety issues associated with the construction work in a separate form
SWR-2	**M**	• Locate utilities before excavations	• Prepare and use procedure to carefully demolish pavement and excavate subbase in areas were utilities are located	Hazardous	Extremely Improbable	**L**	• Contractor (CSPP) • SWR Engineering to obtain existing plans	• Contractor to locate existing utilities based on surveys and existing plans • Contractor develops procedures and submits for approval by SWR Engineering	Execution of procedures will be checked by SWR Engineering staff
SWR-3	**L**	• NOTAMs • Barricades and other signs	-	Major	Extremely Remote	**L**	• NOTAMs: Airfield Ops • Barricades: Contractor	• Airfield Ops in coordination with SWR Engineering and Contractor will prepare NOTAMs • Contractor will develop plan to place barricades limiting closed construction areas	Airfield Ops will prepare checklist for daily inspection of construction areas and vicinities

(*continued on next page*)

TABLE 2
(*continued*)

Hazard #	Initial Risk	Existing Risk Mitigation Actions	Additional Risk Mitigation Actions	Residual Severity	Residual Likelihood	Residual Risk	Responsibility for Implementation	How to Implement	Safety Assurance
SWR-4	**M**	• Daily briefings to construction personnel • Contractor supervision during work hours • Barricades and temporary signs	Basic safety training to construction workers	Hazardous	Extremely Improbable	**L**	Contractor (CSPP)	Contractor will have daily briefings with workers highlighting the importance of staying within construction area. A basic safety training approved by SWR will be provided to highlight the importance of staying away from operational areas	• Airfield Ops will prepare checklist for daily inspection of construction areas and vicinities • Access to construction areas will be denied to workers without safety training
SWR-5	**L**	• Barricades and temporary signs • Construction management coordination with ARFF • Safety meetings	-	Major	Extremely Remote	**L**	Contractor (CSPP)	Contractor daily briefings to construction workers. Changes to emergency routes to be discussed in weekly safety meetings	Airfield operations will pass information to ARFF when changes to emergency routes are implemented
SWR-6	**L**	• NOTAM • Construction coordination • Weekly construction safety meetings	-	Major	Extremely Remote	**L**	Airfield Ops SWR Engineering Contractor	Airfield Ops in coordination with SWR Engineering and the Contractor will identify need to submit NOTAMs owing to project changes	Airfield Operations will check published NOTAMs for correctness
SWR-7	**M**	• Weekly construction safety meetings • Use of PPE by construction workers • FOD Management Plan in CSPP	• Use temporary blast fence to protect construction area	Major	Extremely Remote	**L**	Contractor	Contractor will submit plan to place temporary blast fence for approval by SWR Engineering	Airfield Operations will check effectiveness of blast fence after pushback of aircraft in position A4 during one week

Hazard #	Initial Risk	Existing Risk Mitigation Actions	Additional Risk Mitigation Actions	Residual Severity	Residual Likelihood	Residual Risk	Responsibility for Implementation	How to Implement	Safety Assurance
SWR-8	**L**	• Daily briefings to construction workers	• Use covered bins to collect food waste • Ban food in construction areas	Major	Extremely Improbable	**L**	Contractor (CSPP)	Contractor will install covered bins and ensure the bins will not be displaced by jet blast	Airfield inspections will check if bins are covered and presence of food waste in construction areas
SWR-9	**L**	• Publish NOTAM with status of closed areas • Weekly construction safety meetings	-	Major	Extremely Remote	**L**	Airfield Ops SWR Engineering Contractor	Airfield Ops in coordination with SWR Engineering and the Contractor will identify need to submit NOTAMs owing to project changes	Airfield Operations will check published NOTAMs for correctness
SWR-10	**L**	• Obtain FAA approval for tall equipment	-	Hazardous	Extremely Improbable	**L**	Contractor	Contractor will submit FAA Form 7460-1 for approval of tall equipment	Airfield Ops will ensure only tall equipment approved by the FAA is used by Contractor
SWR-11	**L**	• Weekly construction safety meetings	-	Minor	Remote	**L**	Airlines and Ground Support organizations using the apron	Organizations to develop own plans to manage activities in reduced apron area	Airfield Operations to monitor apron activities and report hazards and risks in weekly safety meetings

- The SWR Project Manager will ensure that risk mitigation actions under the responsibility of the Contractor and described in this section will be included in the Contractor CSPP.
- Hazards and risks identified in the SRA will be recorded in SWR Risk Register and will be monitored by the SWR SMS Manager.

APPENDIX K

SRA Report Template

Courtesy: Hartsfield–Jackson Atlanta International Airport (2015).

Safety Risk Assessment (SRA) Report
1

From the desk of: **2**
Duty Title: **3**
Office Phone: **4**
Cell Phone:
Office Fax:
Email address: **5**

To: **6**

IN TURN
Date: **7**
Subject: **8** Safety Risk Assessment - #

Change Control and Version Tracking				
Version Number		**Changes Made**	**Changes By**	**Date of Change**

1.1 COMPLIANCE: SMS Manual; Part III, dated 1 June, 2011, paragraph 3.0. Procedures for conducting a Safety Risk Assessment (SRA). SRA stakeholders will review the corrective actions taken in response to Safety or Hazard Reports and make recommendations when necessary to increase the safety of the Hartsfield – Jackson Atlanta International Airport (H-JAIA) and the Department of Aviation.

1.2 PURPOSE: Facilitate the interfaces between various operational divisions within the Department of Aviation (Airport Operations, Safety, Risk Management, Facilities, Airfield Maintenance, ARFF, Airport Police, Planning & Development, Property Management, Environmental, Finance, etc.) and tenants on the Airport. They will conduct an SRA when necessary or as requested by the SMS Committee or Executive Committee on safety concerns related to H-JAIA.

1.3 ATTENDEES

SRA Principal Stakeholder-Office	Names	Attended (date)	Attended (date)	Attended (date)
		☐ **YES**/☐ **NO**	☐ **YES**/☐ **NO**	☐ **YES**/☐ **NO**
		☐ YES/☐ NO	☐ YES/☐ NO	☐ YES/☐ NO
		☐ YES/☐ NO	☐ YES/☐ NO	☐ YES/☐ NO
		☐ YES/☐ NO	☐ YES/☐ NO	☐ YES/☐ NO
		☐ YES/☐ NO	☐ YES/☐ NO	☐ YES/☐ NO
		☐ YES/☐ NO	☐ YES/☐ NO	☐ YES/☐ NO
		☐ YES/☐ NO	☐ YES/☐ NO	☐ YES/☐ NO
		☐ YES/☐ NO	☐ YES/☐ NO	☐ YES/☐ NO
		☐ YES/☐ NO	☐ YES/☐ NO	☐ YES/☐ NO
		☐ YES/☐ NO	☐ YES/☐ NO	☐ YES/☐ NO
		☐ YES/☐ NO	☐ YES/☐ NO	☐ YES/☐ NO
		☐ YES/☐ NO	☐ YES/☐ NO	☐ YES/☐ NO

1.4 Location: *where the SRA was accomplished*

1.5 Overview:

1.5.1 – Executive Summary*(unlimited text field)*

1.5.1 – Current System*(unlimited text field)*

1.5.2 – Proposed Change *(unlimited text field)*

1.5.3 – SRM Planning and Impacted Organizations *(unlimited text field)*

1.5.4 – Assumptions *(unlimited text field)*

1.6 Safety Risk Assessment

1.6.1 Describe the System: *(unlimited text field)*

1.6.2 Identify the Hazard: *(unlimited text field)*

1.6.3 Analyze the Risk: *(unlimited text field)*

1.6.4 Assess the Risk: *(unlimited text field)*

Hazard	Severity	Likelihood	Risk
Hazard 1 /*Name*	*(1) Catastrophic*	*(E) Improbable*	*Medium*
Hazard 2 /*Name*	Prepopulated from Hazard Assessment section		
Hazard 3 /*Name*			

1.6.5 Risk Mitigation

The corrective actions consist of design and procedural requirements to enhance the safety of the proposed change. The following corrective actions are described for each hazard identified:

Hazard 1: *(text field)*

Hazard 2: *(text field)*

Hazard 3: *(text field)*

1.6.5.1 Residual Risk

The panel members reviewed the proposed actions and considered the expected residual risk with the identified hazards as follows:

Hazard	Severity	Likelihood	Risk
Hazard 1	*(2) Catastrophic*	*(E) Improbable*	*Medium*
Hazard 2			
Hazard 3			

1.6.6 Manage the Risk *(text field)*

1.7 Remarks *(text field)*

Attachments: *(text field)*

1.8 SRA Approval

SRA Participant	Role/Position	Signature & Date	Contact

Safety Risk Assessment (SRA) Report

Item Number	Title	Instructions
Item 1 through 16 will be completed by the SRA Owner as appropriate		
1	**Safety Risk Assessment Report**	Enter the Title of the SRA
3	**Duty Title**	Enter the Duty Title of the SRA Owner
4	**Phone numbers**	Enter the phone numbers for each: Office Phone – Cell Phone – Office FAX
5	**Email Address**	Enter the email address of the SRA owner
6	**TO:**	Enter the name of each person that the SRA owner want to review this SRA Report as a minimum SMS Manager and Appropriate Assistant Director (Note: the SMS Manager may take it to one of the Committee
7	**Date:**	Enter Date that this SRA Report is completed
8	**Subject**	Enter the SRA assigned number for the division in the following format: Year / Enter the current year "2010" SRA Number / Enter the numerical number of the SRA that has been completed in SRA owner Division. e.g. if this is the third one accomplished with in the division enter 003 Division Codes / as stated in paragraph 4.4.1.7.1.2 of this chapter
9	**Attendees**	Enter the required information as indicated at the top of each column, also you should have a sign in sheet for them to sign in on that will be attached to the SRA Report.
Para - 1.4	**Location**	Enter the location where this SRA has taken place e.g. SAT or SSF and physical address of the meeting
Para - 1.5	**Overview**	Enter a short overview of the SRA
Para - 1.6	**System Description**	Enter a short explanation of the System that this SRA effects
Para - 1.6.6	**Manage the Risk**	Enter the overall assigned risk level for this SRA
Para - 1.6.6	**Manage the Risk**	Enter the overall action plan that will be taken by the Aviation Department to correct this hazard
Para - 1.7	**Remarks:**	Enter any additional comments in the remarks section
Para - 1.8	**SRA Approval**	Enter the names of the SRA panel participants, who initiated the SRA, who facilitated with respective roles in SRAs, date, signature and contact information for each person

APPENDIX L

Simple SRA Report

Developed by ASM Consultants based on the worksheet presented in ICAO Doc 9974—Flight Safety and Volcanic Ash (2012).

Simple SRA Report Template

Project/Change:	
Date:	
Description of System (5M):	

Safety Risk Assessment Worksheet

				Outcome (Pre-Mitigation)				Outcome (Post-Mitigation)				
(1) Hazard #	(2) Hazard Description	(3) Hazard Consequence	(4) Existing Controls	(5) Severity	(6) Probability	(7) Risk Tolerability	(8) Further Actions to Reduce Risk	(9) Severity	(10) Probability	(11) Risk Tolerability	(12) Risk Owners	(13) Monitoring and Review Actions
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												

SRA Participants						Approval			
#	Name	Position	Role in SRA	Date Reviewed & Agreed	Signature & Date	#	Name	Position	Signature & Date
1									
2									
3									
4									
5									

List of Appendices	
1	
2	
3	

APPENDIX M

Common SRA Triggers (*ACRP Report 131* 2014)

Source: *ACRP Report 131:* A *Guidebook for Safety Risk Management for Airports.*

SRA Trigger	Description	Example
Construction	Airfield improvement	Runway 15 extension
	Airfield rehabilitation	Resurfacing Taxiway C
	Airfield maintenance (beyond day to day work)	Rubber removal; chip seal on Runway 10
	Construction of tower	Construction of new ATC tower
	Terminal expansion	Additional gates and gate areas
	Landside roadway reconfiguration	Additional lanes into the terminal area
	Parking area modifications or rehab	Parking garage rehab or updating facilities
	Changes in access roads onto airport property	Adding or subtracting lanes and access points
Standard Operating Procedures Changes	New SOP	SOP for towing aircraft; SOP for mowing grass in safety areas
	Modification to existing SOP	Changes to SOP on snow removal due to new equipment
Airport Organization	Significant changes to airport organizational structure or key personnel	Rearranging the Department of Operations; creating an SMS Division
Safety Reports (Hazardous Condition Reports)	Safety issues reported by pilots or airport employees (including tenants)	Reports of pavement failure, blind spots, or hazardous conditions on the ramp
	Safety issues resulting from daily inspections	FOD generated by poor pavement conditions at the intersection of taxiways
	Accidents and incidents	Surface or ramp accident; birdstrikes
Special Event	Major sport events	Super Bowl; Olympic Games; Major College Football Game
New Equipment or Software	New aircraft brought in by a carrier	Starting operation of A380 or B787 aircraft
	New passenger boarding bridge	Installation of new bridges that have different capabilities
	New ramp equipment that requires special consideration	Introduction of towbar-less tractor
	Changes to information management systems	Changes to reporting procedures during self-inspections
Proposed New Infrastructure/Facilities and Regulatory Standards	FAA research and development work (e.g., the FAA Tech Center)	Perimeter taxiway; new NextGen equipment
Safety Assurance	Trends identified from safety performance indicators (e.g., birdstrikes, FOD, etc.)	Increase of birdstrikes with damage to aircraft
	Safety audits	Unsatisfactory SMS internal or external audit results

APPENDIX N

Risk Register

The Risk Register is an electronic tool that can be created by airports to track risks and risk control actions. It is a database where most of the information obtained through the SRM process is itemized. Smaller airports can use electronic spreadsheets to create a Risk Register. *ACRP Report 74: Application of Enterprise Risk Management at Airports* (2012) identifies key information that should be available in a Risk Register.

- Risk Number: This is a numerical ID allocated for each risk. Every risk should be given a unique number and not a letter or symbol.
- Risk ID: This is an alphabetical reference that will be used to illustrate risks on the risk map.
- Every risk should be given a unique Risk ID. Once all letters have been used, start a second set of the alphabet; e.g., A2, B2, and C2. Please note: only each risk, not every cause and consequence, should be allocated a Risk Number and Risk ID.
- Risk: Record the risk in this column.
- Causes: Record the risk causes in this column; record all causes in the same cell.
- Consequences: Record the risk consequences in this column; record all consequences in the same cell.
- Risk Owner: Record the name of the risk owner in this column.
- Risk Category: Record the risk category in this column.
- Inherent Impact: Record the inherent risk impact score in this column, using the Impact Assessment Criteria. You will only be able to record a number between 1 and 5.
- Inherent Likelihood: Record the inherent risk likelihood score in this column, using the Likelihood Assessment Criteria. You will only be able to record a number between 1 and 5.
- Inherent Risk Score: This will be automatically calculated. Do not enter any data in this column.
- Current Controls: Record the controls that are in place to mitigate the risk.
- Control Assessment: Use the drop-down menu to assess whether the effectiveness of the current controls is considered poor, average, or good. Use the Control Assessment Criteria to guide this.
- Residual Impact: Record the residual risk impact score in this column, using the Impact Assessment Criteria. You will only be able to record a number between 1 and 5.
- Residual Likelihood: Record the residual risk likelihood score in this column, using the Likelihood Assessment Criteria. You will only be able to record a number between 1 and 5.
- Residual Risk Score: This will be automatically calculated. Do not enter any data in this column.

A Hazard Log Template suggested by the European Strategic Safety Initiative (ECAST), SMS WG, Guidance on Hazards Identification is presented in Table N1.

Smaller airports may opt for a simplified Risk Register that can be created in an electronic spreadsheet. An example of this type of template suggested by the Civil Aviation Authority of New Zealand (NZ CAA, Aviation Risk Management—an Introduction—Booklet 4, June 2013) is shown in Figure N1.

TABLE N1
EXAMPLE HAZARD LOG TEMPLATE

Operation / System			
Hazard No.			
Hazard Description			
Safety Events (Causes or Threats)			
Potential Outcomes (and Associated Consequence Magnitudes)			
Risk Controls (Barriers and Mitigations)			
No.	Description		Responsible
1			
2			
3			
4			
5			
Risk Assessment (Worst Foreseeable Scenario – i.e. Highest Risk)			
Hazard Frequency			
Outcome Likelihood			
Consequence Severity			
Risk			
Management Approval	Name:	Post:	Signature:
Relevant Previously Reported Incident Data			
Safety Performance Monitoring Requirements			
No.	Description		Responsible
1			
2			
3			

Source: ECAST (2009).

SERIAL NO.	IDENTIFY			ANALYSE			EVALUATE
	HAZARD / SOURCE OF RISK	RISK AND IMPACT ON OBJECTIVES	EXISTING CONTROLS	CONSEQUENCE	LIKELIHOOD	RISK LEVEL (ACCEPTABLE?)	TREAT Y/N?
1							
2							
3							
4							

FIGURE N1 Risk register template for smaller airports (*Source*: NZ CAA 2013).

APPENDIX O

Safety Risk Management Worksheet—Action Plan

Courtesy: Hartsfield–Jackson Atlanta International Airport (2011).

SAFETY RISK MANAGEMENT WORKSHEET
(ACTION PLAN)

1. AIRPORT:	2. DEPARTMENT/DIVISION	3. NAME OF DEPARTMENT / DIVISION MANAGER	4. DATE
□ ATL	Aviation		

Initial Risk Assessment
Residual Risk Assessment

Note: A Risk Management worksheet should be filled out for each Hazard of Concern Identified during the process of assessing risk. Also a Risk Management Worksheet – Action Plan should be filled out for each SRA worksheet that is filled out.

5. IDENTIFY THE HAZARD OF CONCERN:

6. SAFETY RISK ASSESSMENT NUMBER: (Year/Number/SRA number assigned) - - 2011-3.0

7. Action Plan Steps:	b. Milestone Date	c. Responsible Person	d. Completion Date	e. Closure Verification (30, 90, 180)		
Action Plan Status:			0 out of 3 completed	0%	0%	0%

8. Performance Assessment

a. Performance Description
b. Progress Measurement: □ Meeting expectations □Not meeting expectations
c. Remarks:

9. Additional or Alternate Action

10. Participants List

Abbreviations and acronyms used without definitions in TRB publications:

A4A	Airlines for America
AAAE	American Association of Airport Executives
AASHO	American Association of State Highway Officials
AASHTO	American Association of State Highway and Transportation Officials
ACI–NA	Airports Council International–North America
ACRP	Airport Cooperative Research Program
ADA	Americans with Disabilities Act
APTA	American Public Transportation Association
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATA	American Trucking Associations
CTAA	Community Transportation Association of America
CTBSSP	Commercial Truck and Bus Safety Synthesis Program
DHS	Department of Homeland Security
DOE	Department of Energy
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FAST	Fixing America's Surface Transportation Act (2015)
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
HMCRP	Hazardous Materials Cooperative Research Program
IEEE	Institute of Electrical and Electronics Engineers
ISTEA	Intermodal Surface Transportation Efficiency Act of 1991
ITE	Institute of Transportation Engineers
MAP-21	Moving Ahead for Progress in the 21st Century Act (2012)
NASA	National Aeronautics and Space Administration
NASAO	National Association of State Aviation Officials
NCFRP	National Cooperative Freight Research Program
NCHRP	National Cooperative Highway Research Program
NHTSA	National Highway Traffic Safety Administration
NTSB	National Transportation Safety Board
PHMSA	Pipeline and Hazardous Materials Safety Administration
RITA	Research and Innovative Technology Administration
SAE	Society of Automotive Engineers
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (2005)
TCRP	Transit Cooperative Research Program
TDC	Transit Development Corporation
TEA-21	Transportation Equity Act for the 21st Century (1998)
TRB	Transportation Research Board
TSA	Transportation Security Administration
U.S.DOT	United States Department of Transportation

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