



## **1. INTRODUCTION**

Quality and Safety is an objective that is readily accessible to corporate aviation operators. The Safety Management System (SMS) is the cornerstone of the *IS-BAO - an International Standard for Business Aircraft Operations*<sup>1</sup>, and provides corporate operators with a straightforward approach to integrate quality and safety management. The SMS model contained in the IS-BAO incorporates elements of a traditional flight safety program with quality management practices in a manner that makes concerted flight safety efforts practical for even a small flight department. In fact, it is so flexible that it can be used effectively by a single person operating a small, simple aircraft or by a flight department with a cadre of professional pilots flying state-of-the-art large complex aircraft.

The IS-BAO was developed by the corporate aviation industry for the benefits of the industry as a “code of practice” designed to help flight departments worldwide achieve a high level of safety and professionalism. The development was managed by the International Business Aviation Council (IBAC) and carried out with the support of its member national and regional associations, including the NBAA, EBAA and BAUA. Approximately 100 flight departments provided input to the process directly and through working groups and focus groups. The IS-BAO contains a set of performance based standards and guidance material for business operators to develop their safety management system including management structure, training programs, operating procedures, operating manuals, etc. It has been structured to enable operators to blend their State civil aviation rules with the best practices of business aviation operators and related sources worldwide including initiatives such as the NBAA Prototypical Business Aviation Safety Program and the Flight Safety Foundation Fatigue Countermeasures guidelines. If operators choose, they are able to register compliance with this internationally recognized standard.

This paper describes the basic elements of an SMS and discusses the process that an operator can use to develop their SMS and apply it to their operation.

## **2. SMS CONCEPT**

The goal of a SMS is to manage safety-risks as effectively as practicable. This means that safety management must be proactive and purposeful, and it must also be appropriate to the operation. The nature and degree of safety management activities (i.e. the safety requirement) is determined by identifying and assessing the hazards and the associated safety-risks that are inherent in the individual operation. The safety-risks are profiled to determine the appropriate level and focus of safety management. That information is then used to develop mitigation that is incorporated into the operator’s management structure, training and checking programs, operations manual and operating procedures with the objective to proactively reduce the identified safety-risk to an acceptable level. Ongoing monitoring, measurement and analysis provide the feedback to continuously be ahead of the safety-risks that threaten the operation. To be effective, all of these activities need to be conducted in a systematic manner within a framework that includes all aspects of the operation, and which involves all people involved. Consequently, an appropriate definition for a SMS can be:

*“The systematic and comprehensive process for the proactive management of safety-risks that integrates the management of operations and technical systems with financial and human resource management”.*

## **3. STARTING THE SMS DEVELOPMENT PROCESS**

### **3.1 Hazard and Risk Identification and Assessment**

The first step in the process to develop an operator’s SMS is to identify the hazards and the associated safety-risks inherent in the operation. This process need not be complex. It can be adjusted to suit the time and resources available and the complexity of the operation that is being examined. The guidance material contained in the IS-BAO provides a one page checklist with explanatory material that operators

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<sup>1</sup> International Business Aviation Council, *IS-BAO\_an International Standards for Business Aircraft Operations*, Montreal, Canada, May 2002 revised 2004.

may use to do a risk analysis. This model provides a straightforward process to identify and assess the likelihood and severity of the operational, technical and human safety-risk factors inherent in the operation. The IBAC publication *Guidelines for the Conduct of Risk Analyses by Business Aircraft Operators*<sup>2</sup> provides additional guidance material on conducting a risk analysis. That document discusses the following steps in the process:

- Identify accident scenarios,
- Identify the associated hazards,
- Determine the severity and likelihood of the associated safety-risks,
- Decide how to manage the hazard and associated risks, and
- Document the information so that action will be taken and tracked, and the results assessed later.

When discussing risk analysis it is important to keep in mind the following terms:

<i>Hazard:</i>	The condition or circumstance that can lead to physical injury or damage.
<i>Risk:</i>	The consequence of a hazard, measured in terms of severity and likelihood.
<i>Mitigation:</i>	The measures taken to eliminate a hazard, or to reduce the severity and likelihood of one or more risks.

One effective way of identifying the possible causes of accidents and the related hazards is through a “*brain storming*” session involving a team of as many people in the flight department as possible. This process can be an effective way to create “*buy in*” and to tap into the knowledge base of the organization. In either event, it is important to identify the highest risks and to categorize similar events and hazards. That information is useful for identifying root causes and for developing appropriate mitigation.

When examining similar hazards, it is necessary to categorize them in terms of whether they are operational, technical, environmental, or related to human factors. The underlying circumstances that might be causing the hazards need to be identified. One underlying circumstance may be a system safety deficiency (a circumstance that permits hazards of like nature to exist in an operation), and usually is based in decisions that have been made about the way the operation is conducted. Examples of potential system safety deficiencies might include:

- regularly operating an aircraft type into a location with a single runway that barely meets the aircraft’s certification requirements;
- employing and crewing pilots with limited experience in the operating conditions; or
- providing knowledge-based training when skill-based training is essential.

This information is then used to reassess the general categorization arrived at in the initial hazard and safety-risk identification process. The hazards and associated safety-risks with the highest severity and likelihood should receive the most attention. The classification system described in Table 1 can be helpful in that process.

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<sup>2</sup> International Business Aviation Council, *Guidelines for the conduct of Risk Analyses by Business Aircraft Operators*, Montreal, Canada, May 2003

**Table 1 – Classification of Safety-Risks**

<b><u>Severity</u></b>	
Category A	Potential for loss of life or destruction of the aircraft
Category B	Potential for serious injury or major damage to the aircraft
Category C	Potential for minor injury or damage to the aircraft
Category D	Trivial (e.g. inconvenience)
<b><u>Likelihood</u></b>	
High	Often
Medium	Occasionally
Low	Seldom
Rare	Unlikely
Very rare	Highly Unlikely

### **3.2 The Safety-Risk Profile**

When the hazards and safety-risks have been identified and classified, they are used to develop the operator’s safety risk profile. A safety-risk profile is a documented overview of the safety-risks that are generally experienced by the operation. It is like a map that charts the “contours” of highest risk and is the basis on which the remainder of the safety management system can be developed. The Safety-Risk Profile helps to ensure that the resources expended on safety are appropriately targeted and will result in optimum safety performance.

After the risk profile is developed, all medium to high risks are identified and risk mitigation or compensation procedures, developed in appropriate sections of the company programs, procedures and manuals, and recorded on the risk profile form. Since risks change with each flight activity, crews need always be cognizant of the necessity to consider mitigation for any operation that involves added risk.

A safety-risk profile is a “living document” that must be periodically updated, particularly during times of operational change. It serves as the underlying rationale for the operator’s safety management system.

### **3.3 Mitigation of Hazards and Risks**

This is an important part of the risk analysis. The first step is to focus on the event scenarios that have been identified as having the highest risk. As an extreme example, if many hazards relating to a particular type of operation or aircraft type at a specific site have been identified, ceasing that type of operation with that type of aircraft into the aerodrome may be warranted. However, if the severity and likelihood of the safety-risks associated with the majority of the hazards are low and one or two are medium or higher, then devising special conditions for conducting the type of operation might be appropriate. Next, the key hazards embedded in the event scenarios should be addressed to determine if they could be eliminated or avoided. For example if pilot fatigue was found to be a hazard in several scenarios, special consideration to these cases could be integrated into the operator’s fatigue countermeasures program.

Subsequently, each event scenario is revisited and the individual hazards that have been identified are addressed. The goal of this activity is to reduce the likelihood of events occurring. However, it is important also to consider measures that reduce the consequences in the event an accident does occur. An example would be a procedure that consistently leads to a go-around rather than (even a low probability) of a collision with an obstacle. Let the information flow freely during this phase of developing mitigation. The ideas will subsequently be refined so that they are realistic and appropriate.

**Table 2 – Steps in Developing Mitigation**

- 1. Mitigate to reduce similar, serious events, if appropriate.**
- 2. Mitigate to reduce similar, serious hazards, if appropriate.**
- 3. Mitigate to reduce the serious single hazards.**
- 4. Mitigate the severity and likelihood of the risks.**

Before turning from one event scenario to the next, ensure that the likelihood and severity of a serious accident has been reduced to a level that is as low as reasonably achievable. This normally means that there are a number of measures that collectively prevent a critical hazard from occurring, or if it does, from it leading to an accident and if it does, from it leading to loss of life.

**Table 3 - Tips in Developing Mitigation**

- Beware of mitigation that might introduce new hazards or risk to the operation. Examples could include new activities that introduce distractions during critical phases of the flight, or procedures that interfere with completing concurrent procedures.
- Not all mitigation is appropriate. For instance, it is not wise to expect consistent, error-free human performance as the sole way to prevent an accident. Challenge the team to determine whether the mitigation they are proposing is realistic given what they know about people, equipment and operations. If there is doubt, have them consider what can be done instead or in addition to, what they propose.
- Not all mitigation is effective. For instance, proposed mitigation may assume a degree of proficiency that is unrealistic to expect under all circumstances. In this case, supplementary mitigation may be necessary. Again, the team should be challenged to test whether the planned mitigation will always perform as well as they intend, or as the criticality of the hazard(s) may require.
- Remember to mitigate for severity when necessary. For instance, changes to flight watch procedures at hazardous, remote locations could improve SAR-alerting services, thus reducing the likelihood of loss of life. Enhanced survival and first aid equipment coupled with a requirement for crews to be trained and proficient in the related skills could reduce the likelihood of a loss of life to survivors of an accident.

### **3.4 Documenting the Results**

Once the likelihood and severity have been considered, review the mitigation that was previously suggested to ensure that it is appropriate. It is important that a disproportionately high amount of resources not be expended to address hazards with a low likelihood of leading to an accident, at the expense of those more likely to occur. At this point it is very important that the risk analysis and the mitigation be documented so that the results of the safety management activities can be tracked and evaluated, and the safety-risk profile can be kept current. The *Guidelines for the Conduct of Risk Analysis by Business Aircraft* provides guidance on the documentation task.

The results of the risk analysis should be in a form so that all persons whose decisions can have an impact on the safety of flight operations (e.g. the company executive, flight crew, maintenance and service crews) are fully aware of the safety-risks inherent in their operation so that the activities being taken to mitigate the risks are understood and supported.

## **4. COMPLETING THE SMS**

The next step in the SMS development process is to establish the linkage to the other elements of the operation in order to structure a systematic process for the management of safety. The most powerful safety tool is the “culture” of the organization. The culture is the basic values of the organization – how we do things here and how people do things when nobody is watching. Accidents are sometimes attributed to the final sequence of events, but the cause is usually much more deeply rooted. For example, the investigation into the *Columbia* space shuttle accident found that the physical cause was the damage to the left wing by a piece of insulating foam. However, it also found that the organizational causes of the accident were rooted in Space Shuttle Program culture including:

- reliance on past successes as a substitute for sound practices,
- organizational barriers that prevented effective communications and stifled difference of opinion,
- lack of integrated management across program elements, and
- organizational dysfunctions.

### **4.1 Safety Policy**

A well constructed safety policy is an effective tool for establishing a cultural framework for the operator’s SMS. The safety policy is a high level statement of desired corporate safety performance. The aim is twofold:

- a. to provide guidance to everyone in the company who has a direct or indirect impact on the company’s safety performance; and
- b. to provide specific direction to ensure that safety management activity is purposeful and directed.

A safety policy generally describes high level accountabilities and responsibilities of the owner, CEO or equivalent of a company, the flight department management and flight department personnel, describes measurable standards, and is constructed so that the short and long-term safety goals and objectives of the flight department can be linked to the safety policy. The safety policy also establishes a framework that ensures that everyone becomes involved in the operator’s safety management activities and that everyone understands that their participation and input is not only valued, but that it is essential.

A sample Safety Policy is contained in the guidance material in the IS-BAO and the generic company operations manuals that are a component of it.

### **4.2 Safety Management Strategy**

A safety management strategy is the flight department’s approach to the management of safety. It is the linkage between the risks identified on the safety-risk profile and the remainder of the safety management system. As such, it provides a summary explanation of, and rationale for, the safety management activities conducted by the operator. This document is the performance standard by which the safety performance can be evaluated. The safety management strategy normally contains the following:

- a. a description of the nature of flight operations;
- b. the safety risk profile of the operator;
- c. a list of the hazards or risks identified and the strategies adopted to mitigate them;
- d. safety performance goals that document the direction and activities being taken to enhance safety performance;
- e. the mechanisms employed to monitor the flight department performance in relation to stated goals and to evaluate the effectiveness of the operator’s safety management; and
- f. identification of other tools employed to manage the safety-risks.

### **4.3 Technical Management System**

The technical management system is the mechanism for translating the mitigation identified in the risk analysis process and included in the safety management strategy, into the programs procedures and manuals used by the operator. For example, if the identified mitigation included training, that training is included in the operator's training programs. Similarly, mitigation that included operating procedures are reflected in the SOP, company operations manual, etc. Items that are to be addressed in the technical management system include:

- a. systems for identifying all applicable laws, regulations and standards, including all approvals, authorizations, exemptions and permitted deviations;
- b. documentation identifying flight department personnel responsibilities and accountabilities for safety and for the management of exemptions and permitted deviations;
- c. systems for ensuring that all flight department personnel have the qualifications, skills, competencies, training, equipment and tools necessary to enable them to discharge their responsibilities in a safe manner;
- d. manuals or other documents addressing:
  - i flight operations and aircraft maintenance, including SOPs;
  - ii personnel training programs and competency certification; and
  - iii aeronautical information.

The requirement for a system to identify all applicable laws, regulations and standards can be satisfied by subscribing to the relevant documents, reviewing all revisions and related material and taking action when appropriate. This is normally identified as the responsibility of the flight department manager.

The documentation of the flight department personnel duties and responsibilities is normally contained in the company operations manual. Also, the company operations manual can contain the system for ensuring that all flight department personnel have the necessary qualifications, skills, competencies, training, equipment and tools. The IS-BAO and the generic company operations manuals that accompany it contain guidance material and examples. At this point operators who are planning to seek registration as being in conformance with the IS-BAO must ensure that their programs, procedures and manuals are in conformance with the standards contained in the IS-BAO.

### **4.4 Hazard Identification and Tracking System**

A hazard identification and tracking system has two components that work together as one system. The system contains programs for the proactive identification of emerging hazards and for tracking and assessing the appropriateness and effectiveness of safety management activities. Accordingly, it links back to the hazards and safety-risk identified in the risk analysis process and the associated mitigation that was developed and it also looks ahead to identify potential hazards, safety-risks and deficiencies in safety management.

The hazard identification program can include voluntary or confidential reporting programs, safety committee meetings, operator data collection systems, brainstorming sessions, safety management system audits and safety reviews. An essential part of the program is the analysis of the identified hazards and the associated safety-risks. As well as considering the severity and likelihood it is very important that the hazard be correctly identified. There is always the possibility that a symptom of the problem, or hazard, is being addressed rather than the root cause. The IBAC publication *Guidelines for the Conduct of Risk Analyses by Business Aircraft Operators* provides guidance material on conducting this type of analysis. Also, the Flight Safety Foundation's *Flight Operations Risk Assessment System (FORAS)* contains risk assessment tools. In addition, tools such as the Flight Safety Foundation CFIT Checklist and other hazard checklists can be effective tools for analyzing the hazards and risks associated with individual operations of types of operations.

The hazard tracking system is the mechanism to document, track and evaluate the effectiveness of remedial measures that are being undertaken. For example, if long duty days were identified as a hazard



with the associated safety-risk of pilot fatigue, the mitigation that was included in the technical management system would include appropriate fatigue countermeasures. The hazard tracking program may require pilots to file reports when working more than a specified number of hours in order that the appropriateness and effectiveness of the operator's fatigue countermeasures can be tracked and assessed. These reports will also build a database that may be used in the future to make modifications to the fatigue countermeasures.

As building an extensive database may be a challenge for a corporate flight department participation in programs such as *The Global Aviation Information Network (GAIN)* and the Flight Operations Quality Assurance (FOQA) program may be effective options. Information on both programs is available from the Flight Safety Foundation.

The design of the hazard identification and tracking system will depend on the size of the flight department and the nature of the operation. It must be complementary to other management systems. It may be automated or manual, and with time can be employed to identify operational safety deficiencies and anomalies in operator safety management.

#### **4.5 Change Management Process**

A change management process flows from the safety management strategy and is used to proactively identify and manage the safety risks that can accompany significant change. Examples of changes that might warrant active change management include:

- a. the introduction of a new aircraft type;
- b. significant change in the nature of the operation (e.g. dynamic business growth, a new operating environment, etc.);
- c. changes in hiring or scheduling practices;
- d. changes to organizational structures; or
- e. significant change in the maintenance contract; etc.

A change management process involves some form of safety planning to demonstrate that hazards associated with the change will be systematically identified and managed, and that safety performance will be evaluated at an appropriate time and in an appropriate manner after the change has been implemented.

Single aircraft operators that operate in stable low-risk environments may choose not to maintain a change management process. It is more appropriate for larger or complex operations, or those that frequently experience significant change. The process describes the types of changes warranting examination, and document how the hazards and risk mitigation strategies will be developed, documented and evaluated. Findings are tracked in the hazard tracking system, and when appropriate, used to update the company safety-risk profile.

#### **4.6 Safety Management Audit**

A safety management system audit is an independent evaluation of an operator's safety management system. It may focus only on the operator's safety management system, or it may be a comprehensive audit to meet registration or regulatory requirements. In all cases, the prime purpose of the audit is to identify areas in which safety performance may be enhanced. The results are used to validate the corporate safety-risk profile, which in turn can be employed to evaluate corporate safety performance.

Operators in a high-risk environment and those without a record of effective risk management (e.g.; new operators), may benefit from more frequent audits. Audits should also be considered after significant changes in a company's operational or management structure. Findings from the safety management audit should be acted upon with a priority that is appropriate to the degree of associated risk documented in the company safety-risk profile, and tracked in the hazard tracking system.



#### **4.7 Operational Safety Reviews**

An operational safety review is an independent (external or internal to the flight department) examination of one or more parts of a company's flight operation. The purpose of an operational safety review is to ensure that the critical aspects of an operation are being effectively managed. Examples of issues that can be examined by a safety review include company dispatch procedures, maintenance practices, operations from a particular site, and various operational practices and procedures. Findings from an operational safety review are tracked in the hazard tracking system, and may be used to update the corporate safety-risk profile and the safety management strategy.

In cases where there appears to be inappropriately high risk or ineffective risk management, an operator should consider an operational safety review. The findings should be addressed with a priority appropriate to the degree of associated risk documented in the company safety-risk profile.

### **5. MANAGING SAFETY AND QUALITY**

An SMS enables a company's safety management to be sound, and its management of risks to be appropriate and effective. An SMS embodies a number of quality management processes so that a company can reduce the risk it faces to a level as low as reasonably achievable. A large part of its safety performance is based on company personnel, equipment and organizational structures performing consistently and reliably – a consistency that normally derives from an effective quality management program. For example, a well-constructed company operations manual is an integral part of the operator's safety management system. It plays a very important role in ensuring that the operational procedure and processes that were developed to mitigate hazards and safety-risks inherent in the operation are carried out in a consistent manner so that safe operations are consistently produced.

### **6. ADDITIONAL CONSIDERATIONS**

An operator's SMS is one of the key components of the *IS-BAO - an International Standard for Business Aircraft Operations*. Operators who have developed an appropriate and effective SMS are well along the road to being in conformance with the IS-BAO and eligible for IS-BAO registration. Operators interested in the IS-BAO, which is quickly becoming the "gold standard" for flight department operations, can obtain more information at the Flight Department Operations page of the NBAA web site.

Feedback from operators who have developed safety management systems as part of their IS-BAO implementation, indicate that a SMS not only provides an appropriate framework for the management of safety and quality, but it is also an appropriate framework for the management of security and other issues. The SMS is a key element of a code of practice developed by the industry to enhance the efficiency and effectiveness of the business aviation flight department.

**SAFETY MANAGEMENT SYSTEM**



**SAFETY MANAGEMENT SYSTEMS FOR CORPORATE AVIATION  
(AN EVOLUTIONARY APPROACH TO INTEGRATION OF QUALITY AND SAFETY)**



**ADDITIONAL REFERENCE MATERIAL**

The following books and documents are a sample of the wealth of reference material related Risk Analyses and Safety Management Systems.

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