AIRPORT SAFETY MANAGEMENT SYSTEM FOR THE FUTURE

Linling SUN*, Tingdi ZHAO*, Zhanggao QIN**, Daojie SHAO**
*Reliability Engineering Institute, Beihang University, Beijing, China
**Airport Department, CAAC (General Administration of Civil Aviation of China)

Abstract

Airports are complex operating service systems and airport safety is important for aviation safety. ICAO Annex 14 has listed safety management system as a mandatory requirement for all certified airdromes. Airport Department of CAAC (General Administration of Civil Aviation of China) has paid much attention to airport safety management system (Airport SMS) in light of ICAO requirements, the booming aviation throughput, and past lessons.

Based on system analysis of airport SMS, this paper highlights life-cycle safety management and different SMS needs for government-level users and airport operators. A two-level airport SMS structure model is presented. Airport SMS elements are described separately for government-user level and in-service airport level. It is found that emphasis on safety management process and methods is not enough, and 'people' and 'information' are recommended to be strengthened for a dynamic, proactive, and effective SMS.

1 Introduction

Safety management now is as much a part of modern business as any of other traditional factors, such as financing, budgeting, personnel, resources, equipment etc. ICAO introduced the concept and requirements of safety management system (SMS) for application to airdrome operations in the November 2003 amendment to Annex 14, Volume 1 Airdromes.

CAAC, the top regulatory authority responsible for civil aviation issues in China, has been actively engaged in maintaining and improving civil aviation safety for a long time. New aviation safety management framework is under research since 2000. In 2003, with the last airport transited from an operation unit directly under central government administration to a regional business enterprise in market, the management system reform of all civil airports in China was completed. It means no more direct investment from the government and mandatory operation by the government in the future; only regulation, guidance, and oversight of civil airports are provided by specified government authority, in this case, the Airport Department of CAAC. More power and duties are released to and to be born by airport operators.

After the reform of delegating the power of airport management to local authority, the Airport Department of CAAC adjusted and strengthened its safety management function and put much effort into helping local operators to build up SMS and improve their safety management activities for ICAO requirements and the increasing aviation throughput.

After reviewing previous implementations of SMS in other countries and combining the ideas from other aviation sectors with airports' own perception of modern SMS and the national situation, an airport SMS structure model has been designed to suit China's circumstances. Different from other SMS models, this model has a two-level management pattern (from the administering authority's view and from the on-site operator's view). The interfaces between airports and other aviation segments, and their regulatory authority are considered. The integration of safety management into the

airport general management is emphasized and discussed, too. This model could also be adapted or employed by other segments of aviation industry, and as SMS reference to other safety-critical industrial sectors for establishing and implementing airport SMS.

2 System Analysis

Just like all management systems, a safety management system provides for goal setting, planning, and measuring performance. SMS concerns itself with organizational and public safety rather than the conventional health and safety at work concerns [1]. It is also said that the airdrome SMS focuses on the human and organizational aspects of an airdrome rather than the product side [2]. ICAO has defined an aerodrome SMS as a 'system for the management of safety at an aerodrome, including the organisational structure, responsibilities, procedures, processes, and provisions for the implementation of aerodrome safety policies by an aerodrome operator, which provides for control of safety at, and the safe use of, the aerodrome'[3].

Thus it can be seen that it is common to treat Airport SMS as a system run by airport operators in service time. But as for the higher-level administering authorities, safety management tasks also call for concern. The safety management tasks and responsibilities of this kind of user are different from those of the airport-level user. For them, SMS function should be expanded to life-cycle guidance, certification, regulatory supervision, inspection, mediation of safety management activities, results, and disputed issues for various airports under administration. These authorities provide safety management for a system of airports.

In addition, most SMS concept now concentrated on safety during operation of an airport. Safety management activities are also needed in the design, construction, and modification stages of airports. For both kinds of users, SMS should provide life-cycle safety management, either for a single airport or for a system of airports, from birth to death (including design, construction, opening, running, maintenance, selling, merging, and closing). Generally, in the construction-related stages, airport safety management could find detailed baseline requirements from ICAO Annex or national standards; and formal assessment and certification of a new airport are strictly performed before operation. But exclusion of the non-operation stage of airport from SMS is not appropriate, since that stage is a foundation for future SMS in operation and many safety management supportive resources are set at that time.

The expanded life-cycle SMS concept for two types of users is described in Fig. 1. SMS functions for government-level user and airport-level user have similarities and differences. One is for macro administration, control and guidance; the other concentrates on implementation and specific performance improvement. The subject of government-level safety management is a system of airports in operation or under construction; and the subject of airport-level safety management includes almost everything at operation sites—people, cargo, facility, tasks, cooperating units etc. During non-operation stage, safety management responsibility is more on planning and setting, assessment and certification. During service time, safety management responsibility is more on the control and safe use of airports.

System safety is usually influenced by many factors that vary with time and interact with each other. It's impossible for an airport to prevent and solve safety problems alone. Interfaces between various management and operation units are critical for successful SMS. The internal and external interfaces of airport SMS are also shown in Fig. 1.
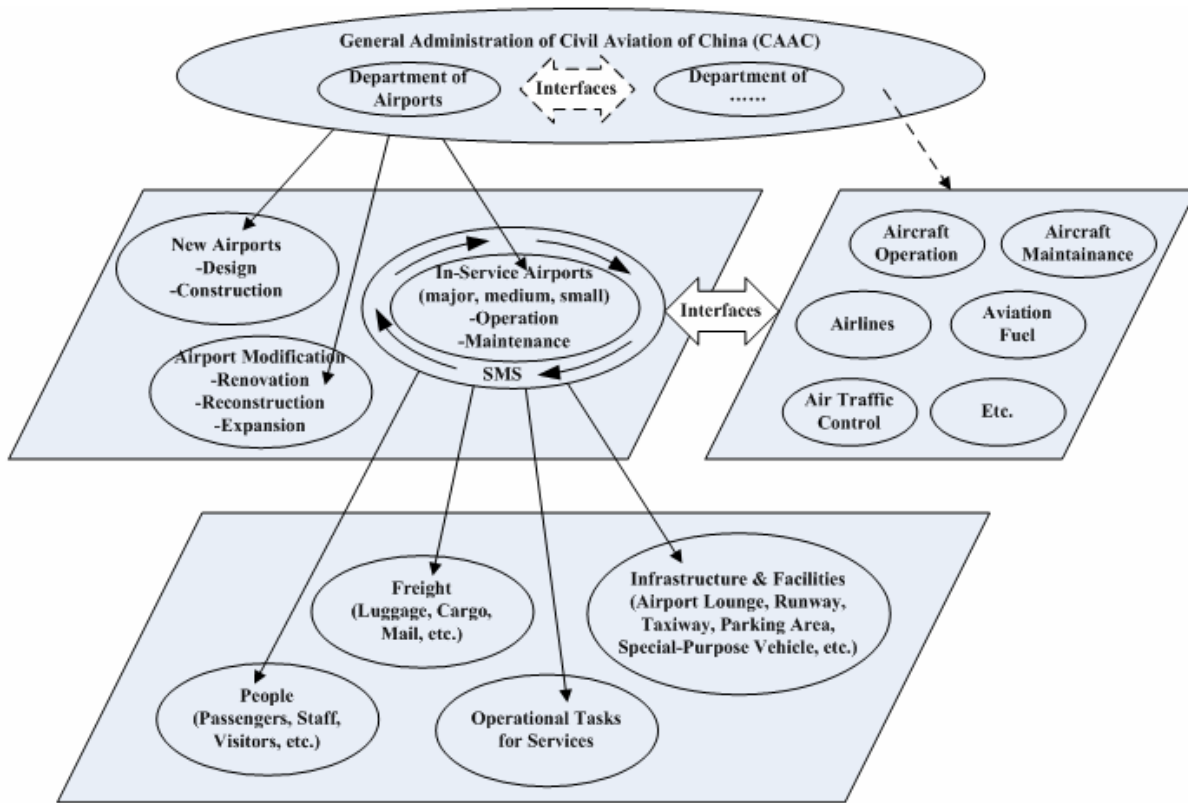
Figure 1 Airport SMS Function and Interfaces

From CAAC authority's view, its airport SMS covers management of a system of airports. Airport department of CAAC is responsible for administration of around 140 airports, 40 of which are international ones. Airport SMS at CAAC level needs to be in line with the whole aviation safety management system, and it is based on appropriate work-allocation and coordination with other CAAC divisions.

From the operator's view, SMS is for the safety of one airport, especially during operation. Safety responsibility assignment, cooperation, and agreement between in-service airports and other on-site aviation segments are essential to achieve safety goals.

Different from traditional safety management which lack problem-forecast capability and composed mainly of make-up activities instead, the modern SMS, which is based on sense for emergency and incidents as well as plans for change and cooperation, is proactive, dynamic and flexible. The main safety management activities are precautionary measures instead of rescue and corrective efforts in accidents and afterwards.

Airport SMS is far more than a set of documents, a safety information system alone, or routine safety activities by specified department or people. Since airport-level SM subject includes almost everything at operation sites, all parts of airports, and everybody concerned should be involved, so that they are capable of reducing safety risks to a level as low as reasonably achievable. Work habits of staff shape safety culture, and determine airport safety greatly. Past safety management by specified department or people is too limited and isolated to integrate with airport general management and daily operation for best safety results.

In summary, features and requirements of airport SMS include:

- A proactive system for accident-prevention
- Different SMS functions for two different user levels
- Life-cycle management with multiple internal and external interfaces
- An integral part of the general airport management based on whole staff participation.

3 System Structure Model

In the area of aviation, there exist several models with different elements and emphases. FAA introduces a SMS consisting of 4 components [4]; Ras Al Khaimah International Airport adopts another that has 23 blocks [5]. With reference of these models as well as safety management systems adopted in other fields, and in light of the specific circumstances in China, a two-level airport SMS structure model is suggested, as is shown in Fig. 2. The elements of the structure of each level are similar or identical in name, but the content and the responsibility of elements are not exactly the same, which have their respective features.
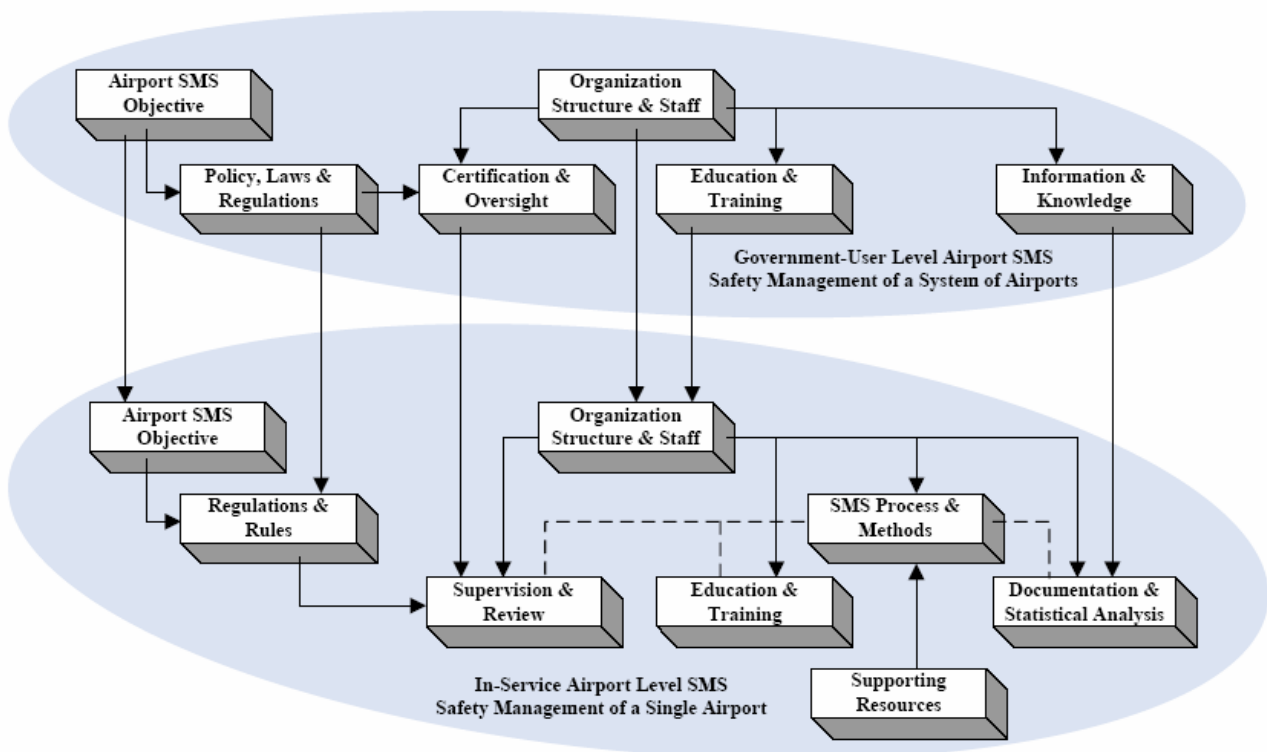

Figure 2 Two-Level Airport SMS Structure Model

Airport SMS objective: For the government-user level, it is for macro control of a system of airports; for the airport level, it is more specific on safety achievements of a single airport, and detailed or quantified goals could be set and adjusted to guarantee government level objective.

Airport SMS policy, laws, regulations, and rules: These are all requirements which must be met or followed. Higher level ones are for guideline direction and bottom-line limits; lower level ones are specific for a certain airport, an operation division or even a particular job position to follow during routine operation. Lower level requirements must be in accordance with or even stricter than upper level requirements.

Organization structure and staff: This block is essential for a good SMS. Organization structure should be built up to guarantee safety and facilitate its integration with general management. Lower level managers need strong support from upper ones. The Government level should vest airport operators with the rights to control all on-site units while planning and handling safety-related issues. Airport safety managers should have permission from top airport management to supervise other airport divisions in terms of safety. The format of this block is flexible and has no rigid fixed form. It is mental consciousness and real action that

matter. Clear work process and responsibility, familiarity of job procedure and key points, alertness, attention and perception for incidents and potential effects, right and good work habits, positive implementation attitude should be achieved after a period to ensure the long-term success of an airport SMS.

Education and training: The upper level is to educate lower-level safety specialists to understand fundamental requirements; the lower level is to train the whole staff to know what to do. The emphasis of education and training program varies according to SMS maturity level, from systematic and detailed courses to short reviewing and supplementary lessons at regular intervals.

Certification, oversight, supervision and review: The upper level concentrates on certification to guarantee the achievement of basic SMS requirements, and regular supervision as well as random inspections is performed, too. The lower level concentrates on daily supervision and regular reviews by airport safety specialists. Self-inspection in divisions and audits by external safety experts are carried out at the same time and the results will lead to rewards or punishments. The emphases of supervision by each of the two levels vary according to airport SMS maturity level.

The two blocks mentioned above are to help to build up good habits of the way people work in the long run. These safety activities are fundamental to the formation of safety culture of enterprises.

Information, knowledge, documentation and statistical analysis: Raw data from SMS are meaningless unless being filtered and processed. For the lower level, it is possible to learn airport safety performance and make future safety plans by collecting and analyzing data to get useful information. For the upper level, safety information from many airports gives a general view on safety of the whole airport system. Knowledge comes from lessons learned and experience extracted. CAAC can summarize and spread the acquired knowledge to guide all airports for all similar situations. Moreover, airport operators who are found to be weak in

safety management by CAAC can be provided with more help and supervision.

There are two more blocks in the lower level structure. One is *SMS process and methods*. Many research results have been achieved on this part. Feedback is stressed for SMS process [4] and evaluation indicators are suggested [6]. This block could be set according to airport management and operation situation, with reference to risk management process and assessment techniques. The other is *Supporting resources*, which mainly refer to hardware resources. Usually, these resources are configured and prepared during airport design and construction, and later renewed and complemented according to need.

In China, people and information are the most important elements in an airport SMS. Find the right people to do things right, and learn from the past and from others, then airport SMS improves as a favorable effective spiral.

4 Application and Discussion

The structure model described in this paper is based on field SMS experience of Changsha Huanghua International Airport China. A prototype airport-level SMS has been run there. The following are some hints that may be beneficial to SMS application in other airports throughout China.

- For a newly-built SMS at the early stage, strict inspection and compulsory requirements are indispensable. It's necessary to "say with fact" and to put punishments and awards into effect.
- Rigorous criteria for selecting safety managers and supervisors are crucial. Right people will do things right.
- Delegation of power to lower levels and support from top airport management are critical to successful SMS implementation.
- For a SMS that has been run for a period, self-awareness and self-discipline are basic mechanism to keep SMS effective. Further education and training, and better information utilization capability

will be more important than inspections and reviews when SMS is more mature. The non-punitive principle should be employed and voluntary reports are encouraged.

Traditional approaches to airport safety management are undergoing radical changes worldwide these years. New SMS is increasingly developed for government-level and airport-level users. The model in this paper takes different user requirements into consideration. It can serve the needs for airport safety management and aviation safety management. Besides, it is found that airport SMS is dynamic and flexible, instead of remaining unchanged from the initial state. For airports of various sizes and characteristics, airport SMS elements are to be set for different scales (stringent or loose). It is also acknowledged that SMS is a long-term improvement process and establishment of safety culture based on people and information is the key to long-term effectiveness and success.

Acknowledgement

References

[1] Transport Canada, Notice of Proposed Amendment (NPA 2002-048), Safety Management Systems, 2002.

[2] Australian Government, Civil Aviation Safety Authority, AC 139-16(0), Developing a Safety Management System at Your Airdrome, 2005.

[3] ICAO Annex14, Volume 1, Section 1.3, 2003.

[4] Steven D. Smith. Safety Management Systems-New Wine, Old Skins. *Proceedings of the 51st Annual Reliability and Maintainability Symposium (RAMS 2005)*, Alexandria, Virginia, USA, pp596-599, 2005.

[5] Airport SMS. *Ras Al Khaimah International Airport Safety Newsletter*, Volume 1, Issue 1, pp8-9, February 2005.

[6] Terry Kelly, Bill Boucher. Measuring Safety Performance. *Proceedings of the 21st International System Safety Conference*, Ottawa, Ontario, Canada, pp1010-1018, 2003.