

# A Study on Legal and Institutional Improvement Measures for the Effective Implementation of SMS\* -Focusing on Aircraft Accident Investigation-

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\* This research was supported by the Kwangju Women's University research grants in 2017(KWUI17-001).

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## I . Introduction

Global air transportation volume has been increasing rapidly in recent years and it is likely to be doubled within less than 20 years, expecting 7.2 billion passengers to travel in 2035.<sup>1)</sup> This non-braking growth raises new challenges to aviation safety in a highly complex aviation environment of technical, human, industrial, social and political issues, even extending to resources harvested in outer space.<sup>2)</sup> As a way to face and resolve the concerns over the safe operation of aircraft, ICAO introduced Annex 19 “Safety Management” to the Convention on International Civil Aviation.<sup>3)</sup> This Annex addresses how to take up accident prevention measures in a proactive manner by means of hazard identification and safety risk management, attaining strategic regulatory and infrastructure developments.

There are two audience groups in “Safety Management” that are States and Service Providers. A State needs to establish and implement State Safety Program(SSP) in order to achieve an acceptable level of safety performance in civil aviation. SSP is a platform for the State to apply the two basic safety management principles of safety risk management and safety assurance throughout its civil aviation service providers.<sup>4)</sup> Service Providers need to establish and implement Safety Management System(SMS) that is a systematic approach to managing safety, including the organizational structures, accountabilities, policies and procedures in a same manner required for SSP.<sup>5)</sup>

In a practical term, SMS functions significantly on the basis of reporting of hazards for risk management. SMS represents accident prevention measures, and when it breaks down somewhere, starting from the organizational level to all the

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1) IATA, Press Release No.: 59, Date: 18 October 2016.

2) Young Ju Kim, “The Korean Journal of Air & Space Law and Policy”, volume 32, No.1, 2017, p.476.

3) First edition was published in 2013, second edition in 2016.

4) Eduardo Chacin, Flight Safety Officer ICAO NACC Regional Office, ICAO State Safety Programme (SSP) Introduction, 2014, p.4.

5) Ibid, p.15.

other levels of flight operations, it may lead to an accident occurrence. It can be translated that the proactive accident prevention was performed or implemented less than what it should have been done. The implementation of SMS is a legal requirement internationally and nationally, and it has been in practice worldwide. Nevertheless, reporting of hazards on voluntary basis is scarce and also the aircraft investigation procedure does not include the components and elements of SMS, leaving the system failure of preventive measures unattended.

Thereby this study intends to analyse the SMS implementation in terms of the organizational factors and aircraft accident investigation procedure, and suggests a necessity to have the key personnel of the organization substantially involved in SMS and to investigate SMS failures in a systematic way. The purpose is to enhance aviation safety through the identification of deficiencies embedded in SMS practices and the suggestions of the legal and institutional improvement of SMS implementation.

## II . Theoretical Study of SMS

### 1. Aviation Safety and SMS

Aviation safety is the state in which the possibility of harm to persons or of property damage is reduced to, and maintained at or below, an acceptable level through a continuing process of hazard identification and safety risk management.<sup>6)</sup> Whether through data or through the input of employees and others, recognizing that many opportunities exist to stop an accident is the first step in moving from reactive to predictive thinking, assuring safety.<sup>7)</sup> In this sense, it

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6) Annex 19, Second Edition, Chapter 1, Definitions, July 2016.

can be also said that aviation safety is the planning and implementation of the necessary policies to ensure the safety of aircraft with regard to the related activities such as aircraft operations and maintenance, installation and operation of airport facilities, and other related resources such as crew. It is a management system for the entire aviation industry.<sup>8)</sup>

One of the most important aspects of aircraft accident prevention and aviation safety system is comprehensive analysis and systematic approach.<sup>9)</sup> The focus on aviation safety has been evolved over the years: from the early 1900s until the late 1960s, the focus of safety endeavors was on technical factors, from the early 1970s until the mid 1990s, on human factors, from the mid 1990s to the present day, on organizational factors, considering the impact of organizational culture and policies on the effectiveness of safety risk controls.<sup>10)</sup> Some aviation safety professionals have contended that SMS is arduous, cumbersome and expensive while in a more practical term, SMS can be simply referred to as a business approach to managing safety that happens when an organization manages and values safety in the same ways as other business functions that it considers vital.<sup>11)</sup>

## 2. Structure of SMS

### (1) SMS Components and Elements

SMS has four component pillars of safety policy and objectives, safety risk management, safety assurance and safety promotion, including an aspect called safety culture. And each component consists of its own elements.<sup>12)</sup>

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7) FAA, "Safety Management System Basis", 2016, p.1.

8) Jae Seon So & Chang Gyu Lee, "The Korean Journal of Air & Space Law and Policy", volume 29, No.1, 2014, p.4.

9) Koo Hee Lee, "The Korean Journal of Air & Space Law and Policy", volume 30, No.2, 2015, p.415.

10) ICAO, Doc 9859 Safety Management Manual(SMM), Third Edition, 2013, p.p.2-1~2-2.

11) Sumwalt, R, "Safety Management Systems are Proving Their Value in Fixed-wing and Helo Flight Ops", Professional Pilot, NTSB, May, 2013, p.10.

12) FAA, "Safety Management System, Components", Sept. 2017, p.1.

### **1) Safety Policy and Objectives**

The elements are management commitment and responsibility, safety accountabilities, appointment of key safety personnel, coordination of emergency response planning, SMS documentation.<sup>13)</sup> Generally safety policy includes the safety objectives of an organisation, the commitment of senior management to provide the resources necessary for effective safety management in order to achieve the desired safety outcomes, and responsibility and accountability for safety at all levels of the organisation. The safety objectives should state an intended safety outcome in terms of short, medium and long-term safety goals that are measurable and attainable.<sup>14)</sup>

### **2) Safety Risk Management**

This is a distinctive feature of SMS, and safety risk is a composite depiction of the probability of a hazard manifesting itself in a mishap—and the severity of the mishap, should it occur.<sup>15)</sup> Hazard is referred to as a condition or an object with the potential to cause or contribute to an aircraft incident or accident. Risk management is a process of identifying hazards and then assessing the risks associated with those hazards. ICAO contracting States shall develop and maintain a process that ensures the assessment of safety risks associated with identified hazards.<sup>16)</sup> The elements are hazard identification and safety risk assessment and mitigation. Risk management helps with identifying, assessing and controlling safety risks, which is the core of the SMS. This approach enables the proactive and predictive identification of operational hazards.<sup>17)</sup> There are three types of risk managements of reactive risk management, proactive risk management and

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13) ICAO, SMM,, Third Edition, 2013, p.4-App 9-1.

14) Australian Government, Civil Aviation Safety Authority, SMS 1, 2014. p.8.

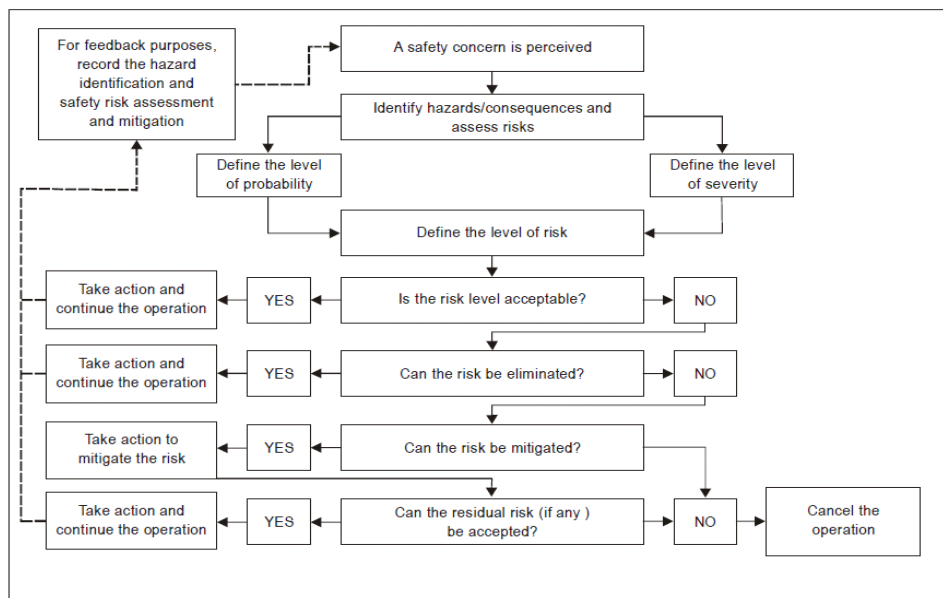
15) Sumwalt, R, “Safety Management Systems are Proving Their Value in Fixed-wing and Helo Flight Ops”, Professional Pilot, NTSB, May, 2013, p.11.

16) Annex 19, Second Edition, July 2016, para 3.3.4.2.

17) New Zealand Government, Civil Aviation Safety Authority, “Aviation Risk Management, An Introduction”, Booklet 4, 2013, p.7.

predictive risk management. ‘Reactive’ risk management is managing the risks identified as part of an accident investigation, using accident and injury reports to determine risks, that triggers a risk management plan only when a project has run into problems. ‘Proactive’ risk management is using a risk assessment checklist before each operational activity to highlight risks, developing a risk management plan for a planned change. ‘Predictive’ risk management is using predictive analytic tools and techniques that enable organisations to identify patterns in data that can be used to make predictions of future outcomes.<sup>18)</sup>

〈Fig. 1〉 Safety Risk Management Process<sup>19)</sup>



When risks have been assessed, a decision-making process will be performed to determine the need to implement risk mitigation measures on the basis of risk probability and risk severity as seen in the following example assessment matrix made.

18) Ibid, p.12.

19) ICAO, (SMM, Third Edition, 2013, p.5-19.

〈Table 1〉 Example of a Safety Risk (index) Assessment Matrix<sup>20)</sup>

| Risk probability       | Risk severity     |                |            |            |                 |
|------------------------|-------------------|----------------|------------|------------|-----------------|
|                        | Catastrophic<br>A | Hazardous<br>B | Major<br>C | Minor<br>D | Negligible<br>E |
| Frequent 5             | <b>5A</b>         | <b>5B</b>      | <b>5C</b>  | <b>5D</b>  | <b>5E</b>       |
| Occasional 4           | <b>4A</b>         | <b>4B</b>      | <b>4C</b>  | <b>4D</b>  | <b>4E</b>       |
| Remote 3               | <b>3A</b>         | <b>3B</b>      | <b>3C</b>  | <b>3D</b>  | <b>3E</b>       |
| Improbable 2           | <b>2A</b>         | <b>2B</b>      | <b>2C</b>  | <b>2D</b>  | <b>2E</b>       |
| Extremely improbable 1 | <b>1A</b>         | <b>1B</b>      | <b>1C</b>  | <b>1D</b>  | <b>1E</b>       |

The mitigation actions are to be taken in three generic ways of avoidance due to intolerability, reduction requiring mitigation, and segregation of exposure requiring isolation for the potential consequences. These mitigation actions should be planned in consideration of effectiveness, cost/benefit balance and practicability.

### 3) Safety Assurance

The elements include safety performance monitoring/measurement, the management of change and continuous improvement of SMS. Safety assurance consists of processes and activities undertaken by the service provider to determine whether the SMS is operating according to expectations and requirements.

### 4) Safety Promotion

This component is comprised of training/education and safety communication, encouraging to foster a positive safety culture and environment for the achievement of the service provider's safety objectives. It can be attained through technical

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20) Ibid. p.5-20.

competence, effective communications and information sharing. 21)

## 2) Domestic Legal Requirement for SMS<sup>22)</sup>

Korea Aviation Safety Act stipulates that any persons who fall under any of the following sub-paragraphs(service providers) shall establish an aviation safety management system for the prevention of aircraft accidents and ensuring flight safety prior to the commencement of manufacture, training, flight operation or business:

1. A holder of a type certificate, a supplementary type certificate, a manufacture certificate, a technical standard product type certificate or parts, etc. manufacture certificate;
2. A training organization designated for the purpose of training aviation personnel;
3. A person who has been certified for air traffic services;
4. Air carriers, commercial aircraft operators and owners of aircraft operating overseas, etc.;
5. An aircraft maintenance person who has received maintenance organization certification;
6. Those who have received the airport operation certification;
7. Those who have installed air navigation safety facilities.

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21) Ibid. p.p 5-2~5-25.

22) Korea Aviation Safety Act, Article 58, Paragraph 2, March 2017.



### III. Aircraft Accident and Safety Management System

#### 1. Aircraft Accident and Causal Factors

In accordance with Annex 13 to the Convention on International Civil Aviation, aircraft accident is defined as an occurrence associated with the operation of an aircraft which takes place between the time any person boards the aircraft with the intention of flight until such time as all such persons have disembarked, where a person is fatally or seriously injured, the aircraft sustains damage or structural failure, the aircraft is missing or is completely inaccessible.<sup>23)</sup> In terms of the accident causation, between 70 and 80 percent of aircraft accidents can be attributed to human error, commonly referred to flight crew member error, though human error is merely a symptom of some trouble deeper in the human performance system.<sup>24)</sup> However, at this level, most causal factors are uncovered while aircraft accidents are the end result of a number of causes, only the last of which are the unsafe acts of the flight crew members as shown in the Reason's accident causation model.<sup>25)</sup> However, latent conditions in the system may include those created by poor equipment or procedural design; conflicting organizational goals; defective organizational systems or management decisions. The perspective underlying the organizational accident aims to identify and mitigate these latent conditions on a system-wide basis, rather than through localized efforts to minimize active failures by individuals. And aircraft accident causal factors can be analyzed directly or indirectly in this aspect as a root cause.<sup>26)</sup>

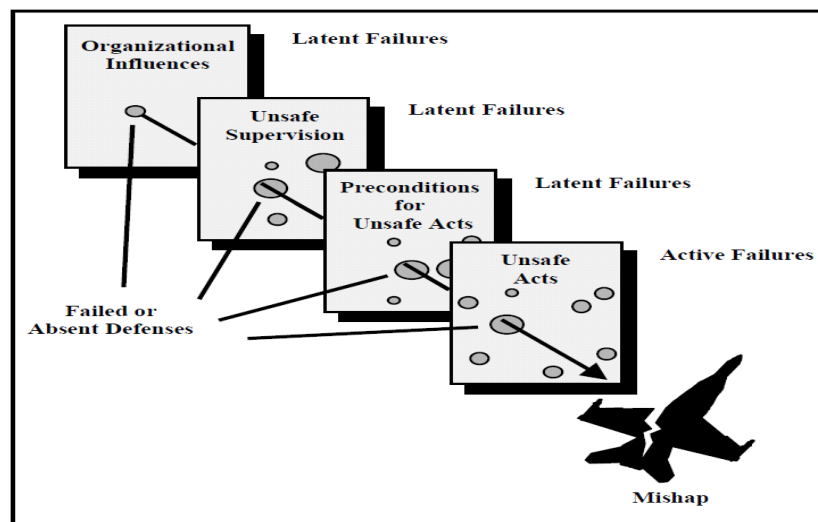
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23) Annex 13, 11<sup>th</sup> Edition, Chapter 1, Definitions, July 2016.

24) Wachter, J.K. & Yorio P.L., "A System of Safety Management Practices and Worker Engagement for Reducing and Preventing Accidents: An Empirical and Theoretical Investigation", 2014, Accident Analysis and Prevention, Elsevier p.118.

25) Shappell S.A. & Wiegmann D.A., "The Human Factors Analysis and Classification System-HFACS", DOT/FAA/AM-00/7, 2000, p.1.

〈Fig. 2〉 The “Swiss Cheese” Model of Human Error Causation  
(adapted from Reason, 1990)



Aviation organisations design safety management systems with the view that there will always be threats to safety, ensuring safety by identifying and managing risks before accidents occur. The effectiveness of a safety management system depends on how well the components of safety culture permeate in the organisation so that a positive safety culture is generated and maintained in an ongoing manner.<sup>27)</sup> Culture can be explained as what is socially learned and transmitted by members that provides the rules for behavior within an organization.<sup>28)</sup> Mainly organizational culture of organizational influences or organizational factors reaches out to all the latent failures and all the SMS components and elements. They can be combined as safety culture, along with other most influential cultures known as professional or national cultural components and a reporting culture is a key component of these different cultures.<sup>29)</sup>

26) ICAO, SMM,, Third Edition, 2013, p.p. 2-3~2-10.

27) Gilla G. K & Shergill G. S, “Perceptions of Safety Management and Safety Culture in the Aviation industry in New Zealand”, *Journal of Air Transport Management* 10, 2004, Elsevier, p.233.

28) Yang J.T, “Knowledge Sharing: Investigating Appropriate Leadership Roles and Collaborative Culture”. *Tourism Management*. 2007;28:530 - 543. doi: 10.1016/j.tourman. 2006.08.006.

## 2. Safety Culture

Safety culture means how safety is recognized, valued and prioritized within an organization as a mixture of organizational culture, professional culture and national culture. It represents a collective consciousness and a measure of organizational culture that allows each member of an organization to be assigned responsibility for safety and to identify how the organization behaves.<sup>30)</sup>

### (1) Organizational Culture

The definition of organizational culture is of the belief that can guide staff in knowing what to do and what not to do, including practices, values, and assumptions about their work.<sup>31)</sup> The core values of an organization begin with its leadership, which will then evolve to a leadership style. Subordinates will be led by these values and the behavior of leaders, such that the behavior of both parties should become increasingly in line. Leaders have to appreciate their function in maintaining an organization's culture. This would in return ensure consistent behavior between members of the organization, reducing conflicts and creating a healthy working environment for employees.<sup>32)</sup> When strong unified behavior, values and beliefs have been developed, a strong organizational culture emerges.<sup>33)</sup> Therefore, Organizational culture establishes the norms and limits, providing the base for managerial and employee decision making. Organizational culture is likely affected by and affect various factors as follows:<sup>34)</sup>

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29) ICAO, SMM,, Third Edition, 2013, p.2-10.

30) Korea Ministry of Land, Infrastructure and Transport, Notice No.2017-182, "Korea Aviation Safety Program", Article 45. 2017,

31) Staniland M. "What Is Political Economy? A Study of Social Theory and Underdevelopment". Yale University Press, 1985.

32) Urrabazo C.K. "Management's Role in Shaping Organizational Culture". *Journal of Nursing Management*. 2006;14:188 - 194. doi: 10.1111/j.1365-2934.2006.00590.x.

33) Tsai Y, "Relationship between Organizational Culture, Leadership Behavior and Job Satisfaction", *BMC Health Serv Res*. 2011; 11: 98. Published online 2011 May 14. doi: 10.1186/ 1472-6963-11-98.

34) ICAO, SMM,, Third Edition, 2013, p..p. 2-10~2-11.

〈Table 2〉 Affecting and Affected by Factors of Organizational Culture

| Affecting  | Affected by   |
|--|---|
| interactions between senior and junior members of a group  | business policies and procedures  |
| interactions between industry and regulatory authority personnel   | supervisory behaviour and practices   |
| the degree to which information is shared internally and with the regulatory authorities   | safety improvement goals as well as minimum tolerance levels                          |
| the prevalence of teamwork in the regulatory authority or industry organization  | management's attitude toward quality or safety issues                                 |
| reactions of personnel under demanding operational conditions  | employee training and motivation  |
| the acceptance and utilization of particular technologies  | the relationship between the regulatory authorities and product and service providers |
| the tendency to take punitive measures in reaction to operational errors within a product or service provider or by the regulatory authorities | policies on work/life balance   |

## (2) Professional and National Culture

Professional culture represents the characteristics of particular professional groups. A healthy professional culture may be characterized as the ability for all professional groups within the organization to collaboratively address safety performance issues. National culture differentiates the characteristics of particular nations, including the role of the individual within society, the manner in which authority is distributed, and national priorities with respect to resources, accountabilities, morality, objectives and different legal systems. Therefore, organizational culture may be significantly affected by the national cultures present among the members of its workforce.<sup>35)</sup>

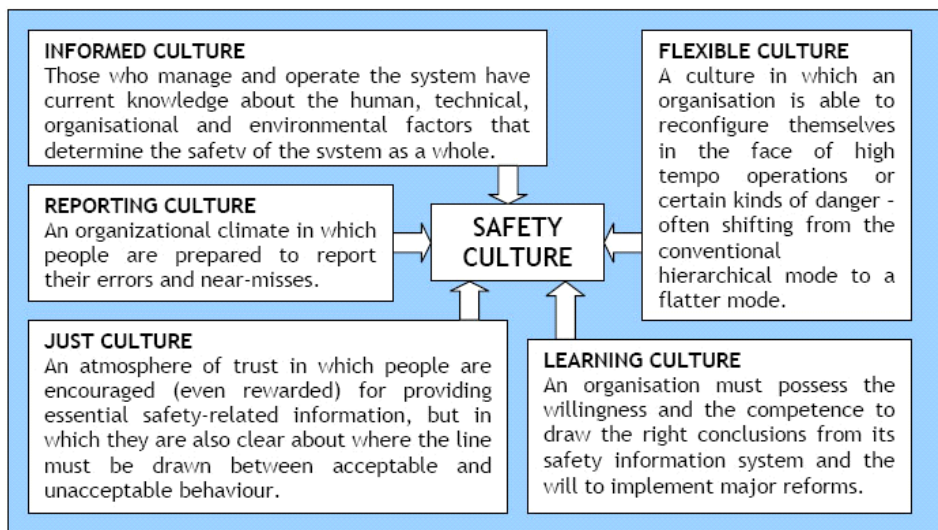
## (3) Safety culture components

Having organizational culture, professional culture and national culture in the

35) ICAO, SMM,, Third Edition, 2013, p.p. 2-11~2-12.

background, safety culture comprises 5 core components of just culture, reporting culture, informed culture, learning culture and flexible culture as the following:

<Fig. 3> The Components of Safety Culture (Based on Reason <1997>)



All these cultures interact one another on the basis of just culture. Just Culture is a culture in which front-line operators and others are not punished for actions, omissions or decisions taken by them which are commensurate with their experience and training, but where gross negligence, wilful violations and destructive acts are not tolerated.<sup>36)</sup> When they fail to interact, hazards cannot be reported, and subsequently risk management will not take place, leading to an accident or an incident. Under-reporting of hazards appears to be a common problem for all domestic aviation service providers. Employees have fears of recrimination or disadvantages, and there is a obvious lack of trust towards their own organizations. SMS is the formal, top-down, organization-wide approach to managing safety risk and assuring the effectiveness of safety risk controls. It includes systematic procedures, practices, and policies for the management of safety risk.<sup>37)</sup>

36) Eurocontrol "Just Culture - Safety First!", 2014: <http://www.eurocontrol.int/articles/just-culture>.

To ensure the commitment to safety, organizational leaders must show that safety is their priority.<sup>38)</sup> This necessitates the organizational leaders, starting from the CEO, to have training on SMS, as they are to be involved in all components of SMS. However, referring to training organizations running SMS courses over the years from 2010 until present time, hardly any CEOs or senior managers, except those representing small aviation organizations, have attended the SMS training, though a Korea Ministry of Land, Infrastructure and Transport's Order, "Guidance on SMS Implementation", states the required training for accountable executive(CEO) and senior managers as follows<sup>39)</sup>:

〈Table 3〉 SMS Training Required For Accountable Executive & Senior Managers

|              | CEO              | Senior Managers                                      |
|--------------|------------------|--|
| SMS Training | Safety policy    | Organizational safety standards                      |
|              | Safety culture   | Safety assurance                                     |
|              | SMS standards    | Legal requirements related to one's own organization |
|              | Safety assurance | -  |

As this Order does not carry a legal binding force, the implementation of the mentioned training is not in place. In view of the author's teaching experience on SMS since 2011 until present time, about 700 training participants from various service providers so far either have suggested or agreed that such training completion should be included in SSP as a required document for SMS Approval Application. Currently required documents to be submitted for the application are as the following:

37) FAA, AC 120-92B, "Safety Management Systems for Aviation Service Providers", Definitions, 2015.

38) Eurocontrol, "Safety Culture in ATM", December, 2008, p.2.

39) Ministry of Land, Infrastructure and Transport Order No.916, "Guidance on SMS Implementation" Article 45, Para 2, No.4, 5, August 2017.



through the investigation. Ill formation of safety culture acts as latent failures in most aircraft accidents and needs to be investigated. The following accident case clearly indicates the pathological safety culture, and demands the necessity to be investigated:

According to an official accident investigation report, on November 16, 2013, around 08:54, a rotorcraft crashed into an apartment in downtown Seoul while approaching to land on a helipad. It was a private aircraft operating under visual flight rules(VFR). There were 1 captain and 1 co-pilot on board who were found all fatally injured and the aircraft was totally destroyed at the accident site. On the day of the accident, the flight was scheduled to transport the company's senior managers including their vice chairman. Prior to the flight, the captain determined that the flight would not be made possible due to adverse weather conditions, however, it was not accepted and the secretary office wanted to reconfirm the flight possibility. The main cause of the accident was a flight enforced in dense fog that did not allow visibility to the ground. Safety recommendations issued to the operator included measures to be taken for the improvement of rigid safety culture, though the safety culture was mentioned rather briefly in the analysis and safety recommendation sections. A safety culture encompasses the commonly held perceptions and beliefs of an organization's members pertaining to the public's safety and can be a determinant of the behaviour of the members. It is stated by ICAO that a healthy safety culture actively seeks improvements, vigilantly remains aware of hazards and utilizes systems and tools for continuous monitoring, analysis and investigation. It must exist in a State's aviation organizations as well as in product and service provider organizations.<sup>41)</sup> Nonetheless, the investigation was carried out in accordance with the guideline given in Annex 13 that does not specify safety culture or SMS as an investigation item, thus it is believed that no investigation agencies worldwide carry out safety culture or SMS investigations in a systemic manner, leaving the root cause identification unattended.

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41) ICAO, SMM,, Third Edition, 2013, p. 2-10.



## 2. Annex 13 Final Report Format

Annex 13 stipulates that the sole objective of the investigation of an accident or incident shall be the prevention of accidents and incidents. It is not the purpose of this activity to apportion blame or liability.<sup>42)</sup> And all of 191 contracting States are required to comply with its SARPs. Though not Standards or Recommended Practices, Annex 13 gives a guideline to present the final report in a convenient and uniform manner. This guidance on final report composition has been utilized for all government aircraft accident investigation agencies as the criteria of the investigation that can be reduced or expanded according to the scale or characteristics of the accident. The final report format consists of title, synopsis, body and appendices, and body includes factual information, analysis, conclusions and safety recommendations.<sup>43)</sup> When it comes to ICAO's aircraft accident investigation manuals, in reflection of SMS, currently it is mentioned that under organizational investigations, corporate culture and safety management are included in investigation items (when deemed necessary) as the following<sup>44)</sup>:

- Corporate culture

Does the organization condone risk taking?

Is safety an important goal of the organization?

Does the organization have a history of correcting problems?

Does the organization have a history of ignoring or covering up problems?

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42) Annex 13, 11<sup>th</sup> Edition, Objective of the Investigation, Article 3.1, July 2016.

43) Annex 13, Appendix 1, Format of the Final Report: Factual information contains: history of the flight, injury to persons, damage to aircraft, other damage, personnel information, aircraft information, meteorological information, aids to navigation, communications, aerodrome information, flight recorders, wreckage and impact information, medical and pathological information, fire, survival aspects, tests and research, organizational and management information, additional information, useful or effective investigation techniques. Human factors issues are addressed in medical and pathological information and also in the personnel information.

44) ICAO Doc 9756 First Edition, Manual of Aircraft Accident and Incident Investigation, Part 3 Investigation, 2011, p.III-3-10(para.3.5.21).

- Safety management

Does the organization have a safety management programme?

Does the organization have a quality assurance programme?

Is there a safety department? If so, to whom does it report?

Has the organization recently been subject to an outside audit?

Has there been a formal hazard analysis of the operation?

In a different part of the same manual<sup>45)</sup>, under organizational and management information, it provides an investigation guidance on safety culture, resources and financial viability, management policies and practices, internal and external communications and certification, safety oversight and regulatory framework. These manuals were published in 2011 and 2014 respectively while hardly any Annex 13 (non-blame) investigation agencies worldwide including NTSB add them in their investigation process, according to their investigation reports. In Annex 13, there is no guidance provided on SMS implementation investigations. In Appendix 1, Format of the Final Report, under the title of organizational and management information, it details the investigation items such as pertinent information concerning the organizations and their management involved in influencing the operation of the aircraft.<sup>46)</sup> Thereby it needs to be revised by deleting management policies and practices and replacing with SMS. Also in order to investigate a service provider's SMS implementation, more detailed SMS investigation guidelines need to be developed in ICAO Manuals of Aircraft Accident and Incident Investigation.

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45) ICAO Doc 9756 Second Edition, Manual of Aircraft Accident and Incident Investigation, Part 4 Reporting, 2014, p.IV-1-15(para.1.17.2).

46) The organizations include, for example: the operator; the air traffic services; airway, aerodrome and weather service agencies; and the regulatory authority. The information could include, but not be limited to, organizational structure and functions, resources, economic status, management policies and practices, and regulatory framework.

## V. Conclusions

The focus on aircraft accident causal factors has shifted from technical factors to human factors, from human factors to organizational factors over the years, that makes possible the root cause identification more closely. In line with that, following the drastic increase of air transportation volume, a proactive and predictive accident prevention method has been developed as Safety Management System(SMS). The SMS enables to gather safety hazards, accumulating them to analyse risks to be managed based on the occurrence probability and severity. Through this mechanism, the risks can be maintained to an acceptable level and below. Korea achieved national air carriers' non-fatal accident records for 10 years from 1999 to 2009, but again, fatal and other major aircraft accidents have been occurring. Since the SMS's poor performance tells the failure of the accident prevention and vice versa, it is necessary to identify the deficiencies of the system implementation and resolve the problems systematically and legally. In particular, the collecting of hazards requires active participation of practitioners on the frontline, but there is little or none reporting of their own errors due to their fear of disadvantages, punishment and basically their lack of trust in their own organizations. This shows an inadequate just culture presence of what is not a non-punitive, confidentiality assuring and welcoming voluntary reporting spirit. In SMS, all members of an organization have the right and responsibility to participate, but it needs a frame of top-down starting from the top management(CEO) who is in control of finances and staffing. Nonetheless, seemingly the CEO and senior executives do not seek to know about SMS enough, as they have not visibly utilized SMS training opportunities. It can lead them to a lack of awareness of SMS and also negatively affect each part of safety culture. As an alternative to this, it is suggested that service providers should submit the proof of SMS training completion of the accountable executive (CEO)

and senior managers when applying for the SMS approval. This application is mandatory under Article 58 of the Aviation Safety Act. Their understanding of the basic concept of SMS will enable them to have the organization balance between production and protection, rejecting bureaucratic, pathological cultures that operational failures are to be concealed. By means of their awareness of SMS components and elements, the culture can be generative for safety that employees can freely report hazards and their own errors without fear of disadvantages, criticism or blame.

Another issue to be resolved regarding SMS concerns is that it is not included in the aircraft accident investigation carried out by non-blame investigation agencies operating under Annex 13. This serves as an impediment to a wider scope of aircraft accident prevention in connection with safety threats or latent failures. Though ICAO aircraft accident investigation manuals state SMS investigations, it is not reflected in investigation practices for the time being. At the moment, the aircraft accident investigation is not progressing forward to organizational factor phase from that of human factors. This is because SMS is not stated in Annex 13 in Format of the Final Report, thus it is suggested that SMS be included in the format under organizational and management information. Also since all the States have shown a tendency to adopt the investigation procedures of NTSB, NTSB needs to actively investigate on SMS for the root cause analysis and the identification of latent failures.

Domestically Korea Aircraft and Railway Accident Investigation Board(KARAIB) needs to consider including SMS in the investigation items. It is suggested to revise the KARAIB's Operating Regulation, "Aviation Accident, etc. for the Investigation Report Format, organizational and management information" as such for Annex 13, Format of the Final Report. Thereby the investigation on safety culture and risk management will make possible the further enhancement of aviation safety.

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## 초 록

가장 진보된 항공기술의 발전에도 불구하고 항공기사고는 지속적으로 발생하고 있는 반면 승객수송 항공교통량은 향후 15년간 갑절로 증폭할 것으로 예상되고 있다. 항공기사고 발생 후에 안전조치로 수행되는 항공기사고조사만으로는 항공안전을 확보할 수 없기 때문에, 선제적이고 예측적인 사고예방대책의 필요성에 대한 공감대가 형성되었다. 이러한 명목으로 항공안전관리시스템(SMS)이 2008년부터 도입되어 2011년부터 본격적으로 수행되고 있다. SMS는 선제적이고 예측적인 항공기사고 예방대책으로서, 항공안전과 관련된 기술적 요소, 인적요소를 넘어 조직적 요소에 접근함으로써 근원적인 위험요인을 차단할 수 있는 메커니즘이다.

방법론적으로는 항공기운항에 필요한 모든 현장에서 잠재되어 있는 위험요소를 수집하여 데이터베이스를 구축하고, 위험을 분석하여, 위험을 관리함으로써, 위험을 수용가능하거나 그 이하로 유지하는 방법이다. 따라서 SMS의 부적절한 이행은 항공기사고 예방의 미흡함을 나타내며 항공기사고와 직결된다. SMS에 있어 자신의 실수를 포함하여 업무상 발생하는 위험요소의 보고가 필수적이고, 가장 중요한 요소로 간주된다. 이를 위하여 자발적 보고에 대한 공정문화의 정책 하에, 정보제공자의 익명성, 비처벌 및 비문책 보장이 기본적인 것으로 되어있으나, 조직에 대한 신뢰의 부족으로 보고는 미미한 수준으로 정체되어 있는 상황이다. 최고관리자가 고위관리자와 더불어 자신의 조직에 대한 안전과 수익의 균형을 유지할 수 있는 안전의식을 갖고, 공정문화가 주축이 된 안전문화의 주도적 역할이 필요하다. 이에 대한 법적·제도적 근거는 국토교통부 훈령인 “항공안전관리시스템 인 및 운영지침”에 최고관리자가 및 고위관리자가 받아야할 교육이 명시되어있으나, 법적 구속력이 없는 상태이다. 따라서 법적 구속력이 있는 고시인 “국가항공안전프로그램”의 항공안전관리시스템 승인신청서의 구비서류에, 최고관리자 및 고위관리자의 SMS 교육이수증명서가 추가되어야 할 필요가 있다.

또한 항공기사고조사에 SMS항목이 누락되어 있어 안전문화와 관련된 조직적 요소 및 위험관리 부분에 대한 조사가 수행되지 않고 있다. 이는 근원적인

원인에 대한 규명이 불가능하여 향후 사고예방에 장애요인으로 작용된다. ICAO가 발행한 항공기사고조사매뉴얼에는 SMS조사가 포함되어 있지만, 국제민간항공조약 부속서 13의 최종보고서 양식에는 포함되어있지 않다. 또한 전 세계적으로 항공기사고조사의 실질적 표본이 되고 미국교통안전위원회가 SMS조사에 미온적인 것으로 나타나고 있다. 이러한 이유들로 부속서 13에 의거 조사를 수행하고 있는 조사기구들은 SMS조사를 조사항목에 포함시키지 않고 있는 상황이며, 항공기사고 조사관들은 SMS 조사방법이나 기법에 노출되어 있지 않다. 이러한 맥락에서 부속서 13의 최종보고서 양식 중 조직 및 관리정보 목에 SMS조사를 포함시킬 필요가 있다. 국내적으로는 항공·철도사고조사위원회의 운영규정 중 최종보고서양식에 동일하게 SMS항목을 추가되어야 한다. 이러한 법적·제도적 개선방법이 보완되면 SMS의 이행이 효율적으로 이행되어 향후 항공안전증진에 기여하리라고 기대한다.

**주제어** : 항공안전관리시스템, 항공기사고, 항공기사고예방, 위험요소, 위험, 보고, 공정문화, 안전문화, 최고관리자, 국제민간항공조약부속서 19, 국제민간항공조약부속서 13, 항공기사고조사.



## **Abstract**

### **A Study on Legal and Institutional Improvement Measure for the Effective Implementation of SMS -Focusing on Aircraft Accident Investigation-**

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Even with the most advanced aviation technology benefits, aircraft accidents are constantly occurring while air passenger transportation volume is expected to double in the next 15 years. Since it is not possible to secure aviation safety only by the post aircraft accident safety action of accident investigations, it has been recognized and consensus has been formed that proactive and predictive prevention measures are necessary. In this sense, the aviation safety management system (SMS) was introduced in 2008 and has been carried out in earnest since 2011. SMS is a proactive and predictive aircraft accident preventive measure, which is a mechanism to eliminate the fundamental risk factors by approaching organizational factors beyond technological factors and human factors related to aviation safety.

The methodology is to collect hazards in all the sites required for aircraft operations, to build a database, to analyze the risks, and through managing risks, to keep the risks acceptable or below. Therefore, the improper implementation of SMS indicates that the aircraft accident prevention is insufficient and it is to be directly connected with the aircraft accident. Reports of duty performance related hazards including their own errors are essential and most important in SMS. Under the policy of just culture for voluntary reporting, the guarantee of information providers' anonymity, non-punishment and non-blame should be basically secured, but to this end, under-reporting is stagnant due to lack of trust in their own organizations. It is necessary for the accountable executive(CEO) and

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senior management to take a leading role to foster the safety culture initiating from just culture with the safety consciousness, balancing between safety and profit for the organization. Though a Ministry of Land, Infrastructure and Transport's order, "Guidance on SMS Implementation" states the training required for the accountable executive(CEO) and senior management, it is not legally binding. Thus it is suggested that the SMS training completion certificates of accountable executive(CEO) and senior management be included in SMS approval application form that is legally required by "Korea Aviation Safety Program" in addition to other required documents such as a copy of SMS manual.

Also, SMS related items are missing in the aircraft accident investigation, so that organizational factors in association with safety culture and risk management are not being investigated. This hinders from preventing future accidents, as the root cause cannot be identified. The Aircraft Accident Investigation Manuals issued by ICAO contain the SMS investigation whereas it is not included in the final report form of Annex 13 to the Convention on International Civil Aviation. In addition, the US National Transportation Safety Board(NTSB) that has been a substantial example of the aircraft accident investigation for the other accident investigation agencies worldwide does not appear to expand the scope of investigation activities further to SMS. For these reasons, it is believed that investigation agencies conducting their investigations under Annex 13 do not include SMS in the investigation items, and the aircraft accident investigators are hardly exposed to SMS investigation methods or techniques. In this respect, it is necessary to include the SMS investigation in the organization and management information of the final report format of Annex 13. In Korea as well, in the same manner, SMS item should be added to the final report format of the Operating Regulation of the Aircraft and Railway Accident Investigation Board. If such legal and institutional improvement methods are complemented, SMS will serve the purpose of aircraft accident prevention effectively and contribute to the improvement of aviation safety in the future.

**Key words :** SMS(Safety Management System), Aircraft Accident, Aircraft Accident Prevention, Hazards, Risks, Reporting, Just Culture, Safety Culture, Accountable Executive, Annex 19 to the Convention on International Civil Aviation, Annex 13 to the Convention on International Civil Aviation, Aircraft Accident Investigation.