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# A Study on the Observer Training and Implementation for Effective Normal Operation Safety Survey (NOSS)

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## ABSTRACT

Normal Operation Safety Survey (NOSS) is a safety management tool used by air traffic control organizations to measure data related to threats and errors to proactively prevent accidents before they occur. NOSS was developed to be applied to the air traffic control field according to the concept of Line Operation Safety Audit (LOSA) conducted by airlines to reduce human errors in the cockpits. Safety management based on data is crucial for the prevention of control-related accidents, and the competency of observers for this is important for the successful implementation of NOSS. Based on LOSA implementation experiences and expert interviews, this paper introduces the international NOSS methods and discusses the key factors required for effective observation and the implementation methods and implications of NOSS observer training.

**Key Words** : Normal Operation Safety Survey(NOSS, 정상운영 안전표본조사), Safety Management System (SMS, 항공안전관리시스템), Air Traffic Management(ATM, 항공 교통관리), Threat and Error Management (TEM, 위협 및 오류관리)

## I. INTRODUCTION

In 2002, Bashkirian Airlines flight 2937 and DHL cargo flight 611 collided mid-air over Uberlingen in southern Germany, and the accident investigation report emphasized the importance of the management through Safety Management System (SMS) (Eurocontrol, 2004). In this tragic accident, all 71 passengers and crew aboard the two planes were killed.

The International Civil Aviation Organization (ICAO) recommends the collection of safety data using NOSS through Doc 9859, Safety Management Manual to prevent aviation accidents (ICAO, 2018). The ICAO publishes the NOSS manual to provide a method, in which the contracting countries can implement the NOSS and the air traffic control organizations can use the Threat and Error Management (TEM) for safety management (ICAO, 2008).

Following the recommendation of ICAO, South Korea is also implementing proactive safety management by conducting the NOSS once or more every three years to identify potential risk factors under Article 30 of the Air Traffic Safety Management System Operation Guidelines (MOLIT, 2015). The specific procedures of NOSS are provided in detail through the Normal Operation Safety Sample Survey Guidelines (MOLIT re-

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gulations), and based on risk assessments, risk mitigation measures are established and confidential measures are taken, which are improved by sharing with other agencies or departments (MOLIT, 2019).

Based on expert interviews, this study aims to investigate the need for NOSS and the improvement measures of the observer training and NOSS implementation.

## II. BODY

### 2.1 Overview of NOSS

#### 2.1.1 Definition of Terms

NOSS is a safety tool that collects safety data by deploying trained observers based on the TEM framework during normal air traffic control (ATC) operations. It provides the strengths and weaknesses in the management of threats and errors of an air traffic control organization, and is defined as a regular safety program that provides the strengths and weaknesses of a control organization in the management of threats and errors, which can be used to set goals for safety improvement, improve the safety programs in the organization, and operate resources efficiently (ICAO, 2008).

TEM refers to a method that promotes safety by clearly identifying and managing threats and errors that may lead to undesired states (MOLIT, 2019). Observers are agents who have completed professional training required for NOSS operations and observe and record normal ATC operations (MOLIT, 2019).

#### 2.1.2 Ten Characteristics of NOSS

NOSS has ten characteristics that distinguish it from other safety data collection tools, and it is possible to implement the NOSS and acknowledge the quality by complying them. (ICAO, 2008). Efforts to satisfy these characteristics

suggested in the NOSS manual must be fully made to ensure that the NOSS is implemented successfully to serve its purpose.

- (1) Over-the-shoulder observations, with clearly defined stop rules, during normal shifts
- (2) Joint support between management and controller association
- (3) Voluntary participation
- (4) De-identified, non-punitive data collection
- (5) Systematic observation based on the TEM framework
- (6) Trained and standardized observers
- (7) Trusted data collection sites
- (8) Data verification process
- (9) Data-derived targets for safety management
- (10) Feedback of results to the controllers

#### 2.1.3 NOSS-Implementing Countries

Eleven countries have implemented the NOSS: Australia, Canada, Hong Kong, Ireland, New Zealand, South Africa, South Korea, Thailand, Trinidad & Tobago, the United States of America, and the United Arab Emirates.

The NOSS Collaborative, a collaboration organization of NOSS, keeps the observation report data of about 5,000 cases implemented in the above countries. Since the reports are written in English, there are some difficulties in writing and using them, but there are some advantages that the comparison with the treats and error status of other countries is possible.

### 2.2 Need for NOSS

The NOSS data are used to improve the safety of air traffic organizations, and as a result of consultation with LOSA experienced safety experts on the necessity of NOSS, the following opinions were found. For the expert consultation, interviews were conducted with a total of five experts, including three professors specializing in ATC and two control experts. The selected

experts had at least ten-year experience and discussed the feasible implementation measures for NOSS.

### 2.2.1 Safety Management based on Data

SMS requires a system that collects data systematically, diagnoses risks, and makes improvements to reduce human errors. NOSS is a safety tool that uses safety data obtained by observing and measuring the human errors of controllers in the normal operation [2]. Safety management is continuously performed, but practical safety management is difficult due to the lack of self-reporting or human factor data. Therefore, the NOSS must be implemented because safety management is possible as recommended by ICAO by identifying data related to human factors existing in the organization.

### 2.2.2 Effective TEM Training

TEM is used to improve the ATC training, aviation safety and efficiency, NOSS, a TEM-based safety tool, is operated to monitor the normal operation, as one of the safety management systems in the ATC field (ICAO- TEM, 2008). NOSS is an essential tool in the TEM training programs because it measures the TEM quantitatively and observes the management situation and actual condition of threats and errors.

In other words, the implementation of NOSS is required to conduct the TEM training to identify, understand, and respond to threats and errors, which occur most frequently in the ATC organizations but are frequently failed to manage.

### 2.2.3 Practical Competency-based Training (CBT)

In 2017, ICAO published Doc 10056, Manual of ATC CBT and Assessment, which recommends the ATC organizations of the contracting countries to use the CBT required for training the next generation of aviation professionals (NGAP).

NOSS analysis data are used in CBT to improve the competency of controllers for performing their duties, which can be effectively trained only when these data capture threats and potential weaknesses. When data are collected and analyzed, potential problems are identified and provided, and this requires the involvement and cooperation of the safety and training department (ICAO, 2017).

To provide safe control by managing threats and errors occurring in the complex environment of flight operations, such competency and resource management are required. Since actual CBT is possible only when the management status and related information are identified, the implementation of NOSS is required.

## 2.3 Observer Training Improvement Measures based on NOSS

As a result of gathering advice from the safety experts regarding the observer training, the following opinions were found.

### 2.3.1 Importance of Observation Narrative

Air traffic organizations (ATO) aim to reduce errors continuously and are required to reduce the operation errors by analyzing threats and human errors through NOSS data (Bailey, 2010). It is recommended to implement the controller training programs in the CBT format to increase the training efficiency (ICAO, 2017). For this, the narrative about the observation of NOSS plays a very important role.

If there is a detailed description of the observations, it is possible to judge the suitability of the data by reflecting it. and it can be used for improvement. Thus, education and training should be provided as much as possible.

### 2.3.2 Enhancing Observer Training Contents and Period

The CBT manual published by ICAO and the

NOSS guidelines provided by the Ministry of Land, Infrastructure and Transport (MOLIT) in South Korea require the following training contents for the observers. Experts recommended that sufficient time should be allocated to the training because successful observer education is possible only when the content is sufficiently educated.

- (1) Introduction to NOSS
- (2) Roles and effects of NOSS in safety management activities of control organizations
- (3) Detailed explanation of TEM model
- (4) Case studies to increase understanding of the TEM model
- (5) Explanation of observation report forms, including the codebook
- (6) Examples of excellent narratives and insufficient report narratives
- (7) Explanation of observation protocols including stop rules
- (8) Assignment of observation targets and work seats
- (9) Contact system with NOSS operator during the observation period
- (10) Matters regarding support for observers (if necessary)

Furthermore, since the NOSS is conducted on a every three years, there may be some observers with previous experiences, but new observers appointed as a result of personnel changes are unfamiliar with the NOSS and observer training.

NOSS observers are usually put in after five days of training. In terms of the NOSS and observer training period, the experts recommended that a five-days or longer preliminary training on NOSS should be provided, in addition to the existing five-days curriculum, like the LOSA training. So they can perform the observation work with sufficient knowledge and understanding for the successful operation of NOSS.

### 2.3.3 Need for Preliminary Training for TEM and CBT

The airlines in South Korea that operate the LOSA, a safety improvement tool similar to NOSS, provides Crew Resource Management (CRM) training to teach the basic concept for the TEM theories, including the concept and codes of TEM, which is the basic framework of observation. Nevertheless, reinforcement training on TEM is also provided, judging that there is a lack of experience in TEM codes or specific cases of applying TEM. A Airlines and J Airlines in South Korea who conducted the LOSA conducted the SMS, TEM, and CRM training courses additionally when training the observers before implementing the LOSA. As the observers had sufficient understanding of the TEM theories, the LOSA was successfully operated.

#### 2.3.3.1 TEM Reinforcement in Observation Training

LOSA, which improve the cockpit safety using TEM, has expands to M-LOSA in the maintenance field and R-LOSA in the ramp field, along with the NOSS of control field, which are operated in the safety improvement using the analysis of safety data required in the ATC systems (Ma, and Rankin, 2010). When observers are trained, reinforcement training is required to understand TEM.

#### 2.3.3.2 Reinforcement of CBT Competency for Observation Report Forms and Training

In the current trend, CBT is required when training controllers, and since the training on the competency used in CBT has to be completed in advance to be able to describe the observation of managing each threat and error during NOSS. Therefore, the information related to competency should be reflected in the observer report forms and included in the training curriculum.

## 2.4 NOSS Observation Improvement Measures

We asked the experts for advice regarding the conditions or methods of effective NOSS observation to collect appropriate NOSS data when the NOSS is conducted. As a result, the following five opinions were received. If they are applied and implemented, useful observation information will be gathered for the SMS, facilitating the safety improvement of ATC organizations.

### 2.4.1 Clear Goals and Motivation of Observation

The experts advised that before conducting the NOSS, each organization should clearly establish the goals of NOSS and provide the motivation for the implementation of NOSS to select the period of NOSS and facilitate proper observations. Furthermore, there was an opinion that the observers must be trained on goals and needs in the observation training because the NOSS can be implemented successfully as intended.

### 2.4.2 Publicity Improvement for NOSS

NOSS requires the voluntary participation to obtain observations closely matching the actual situations and conditions. NOSS does not aim at improving or correcting individuals to increase the participants' interest and confidence in NOSS. It should be publicized that NOSS aims at system-based safety improvement and is non-disciplinary to encourage the voluntary participation of organization members.

### 2.4.3 Feedback for NOSS Improvement

Airlines sometimes think that conducting the NOSS every three years adds a burden on work in the relevant departments and personnel or is an unnecessary effort. However, efforts have

been made to eliminate unnecessary misunderstandings for these, and they have helped the implementation of NOSS. As such, positive expected benefits of NOSS or practical feedback on specific improvements through NOSS will help improve the perception of the organization members.

### 2.4.4 Securing Objectivity of Observers

It is difficult to observe the outside objectively because it consists only of observers belonging to the same organization.

When the NOSS is conducted, it is difficult to observe the outside objectively because it consists only of observers belonging to the same organization. Furthermore, if the observation period is selected differently among the organizations in accordance with the goals of each organization, rather than having a uniform observation period, the observation results of NOSS will be more likely in line with the safety goals.

### 2.4.5 Need for NOSS Committee and Advisers

Since the NOSS has different characteristics from conventional safety tools, it is essential to operate a committee as a company-wide SMS tool including experts. NOSS is not a short-term safety management tool. A safety improvement committee should be organized on a mid-to-long-term basis to proceed with the safety improvement.

## III. CONCLUSION

The purpose of this study is to investigate the Need for NOSS and improvement measures of observer training and NOSS implementation. As a result of gathering advice from the experts for the use of NOSS, the following conclusion were reached for the needs of NOSS and improvement measures of NOSS observation and

observer training.

First, since NOSS can provide data necessary for safety management by data, effective TEM training, and practical CBT training, it was found to be an essential safety tool because the safety management of air traffic control institutions is possible only when NOSS is used.

Second, successful NOSS observer training requires the following: sufficient training period reinforcement for the importance of observation narratives and the observer curriculum; preliminary training for TEM and CBT; reinforcement training for TEM; reinforcement training on competency for observation report forms and CBT. Thus, they should be strengthened in the observer training.

Third, the NOSS observation improvement measures include the clear goals and motivation for observation, publicity improvement for NOSS, feedback on NOSS improvement, securing objectivity of observers, and NOSS committee and advisers.

The limitation of this study is that it was conducted as a qualitative study based on the interviews with a small number of experts because there are not many expert samples for NOSS. In the future, if the number of samples increases, it will be possible to obtain more reliable data. If the training systems, such as TEM and CBT required for training the NGAP are improved based on the continuous implementation of NOSS, safer control systems will be built and safety culture will be firmly established, enabling practical accident prevention. We pay our respect to the efforts and commitment for the safety of ATC in South Korea, in which the NOSS is

continuously implemented. The NOSS is expected to be firmly established in the future based on continuous progress.

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