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Agenda Item 4: Presentations – State / Industry / ICAO

STUDYING QUANTITATIVE RISK ASSESSMENT METHODOLOGY FOR DATA-DRIVEN SAFETY RISK MANAGEMENT

(Presented by the Republic of Korea)

SUMMARY

To more effectively apply data-based decision-making in Safety Risk Management (SRM), the Republic of Korea (ROK) has developed and is piloting a quantitative risk assessment methodology. The methodology calculates the severity of the hazard through an analysis of the aviation safety data collected in ROK. ROK would like to share and discuss its experience in improving data-based risk management.

1. INTRODUCTION

1.1 States shall establish and maintain a State Safety Programme (SSP) and should develop and maintain a process to manage safety risks at a state level, in accordance with the Article 3.3.5.2 of ICAO Annex 19 Safety Management (Second Edition, July 2016) and 2.5 of Doc 9859 Safety Management Manual (Fourth Edition, 2018). Safety Risk Management (SRM) includes hazard identification, risk assessment, risk mitigation, and risk reassessment. In addition, in accordance with Article 5.2 of ICAO Annex 19, States shall establish Safety Data Collection and Processing System (SDCPS) and a process for safety data and information analysis in the relevant safety database.

1.2 In this paper, ROK would like to share some cases of state-level aviation safety risk management through its SDCPS and discuss what would be the most effective risk management methodology.

2. DISCUSSION

2.1 ROK's Aviation Safety Data Collection and Processing System (SDCPS)

2.1.1 In compliance with Article 2. 10-4 of the Aviation Safety Act, ROK classifies aviation safety data into 12 types, including accident & incident investigation results, aviation safety mandatory reporting & voluntary reporting, data collected from aviation safety activities and etc. In addition, in accordance with Article 61-2 (System for Collecting and Processing Aviation Safety Data) of the Aviation Safety Act, ROK established the SDCPS to electronically process the collection, storage, integration, and analysis of aviation safety data and aviation safety information, thereby enhancing the aviation safety. In this regard, the Korea Aviation Safety Data Analysis Center (KASDAC) opened its doors in May 2021, consisting of experts in Air Traffic Control (ATC), Flight Operation, Maintenance, Statistics, and IT.

2.1.2 ROK utilizes the analysis results of aviation safety data for SRM while conducting aviation safety promotion activities, such as publishing Aviation Safety Circulars and holding seminars and workshops, to share aviation safety information.

2.2 For effective safety risk management (SRM), ROK conducts quarterly Risk Panel meetings with the experts in Air Traffic Control, Flight Operation, Maintenance, and the personnel responsible for identifying national hazards and risk assessment, as well as developing risk mitigation strategies. The meetings discuss the overall aviation operating environment in addition to the SSP. ROK also establishes and implements the annual SSP Implementation Plan by utilizing the list of hazards that were identified and assessed over the course of a year.

2.3 The severity assessment of ROK, detailed in its regulation called 'Regulations for processing and utilizing Aviation Safety Data', is based on the safety risk severity table (2.5.4.2) of Doc 9859. However, ROK found that the qualitative evaluation criteria, such as 'large' and 'significant', may lead to inconsistent assessment results depending on the evaluators. Furthermore, the complexity of safety occurrence factors can also result in inconsistency. In response, data-driven quantitative severity assessment has been recently developed and is now being piloted.

2.3.1 Utilizing the aviation safety data collected from the SDCPS, the quantitative severity assessment was developed to calculate the severity of a hazard (Table I). In the process of development, it was reviewed by industrial safety experts utilizing relevant statistics.

Hazard Severity Calculation Formula	
$S_i = \dfrac{\sum_{e=1}^{n}(o_e \times t_e \times c_i)}{n}$	- S_i: Severity for Hazard (i) - o_e: Event class (e) caused by Hazard (i) - t_e: SPI type (e) caused by Hazard (i) - c_i: Contribution of Hazard (i) to the occurrence of an event (e) - n: Total number of events caused by Hazard (i)

[Table I]

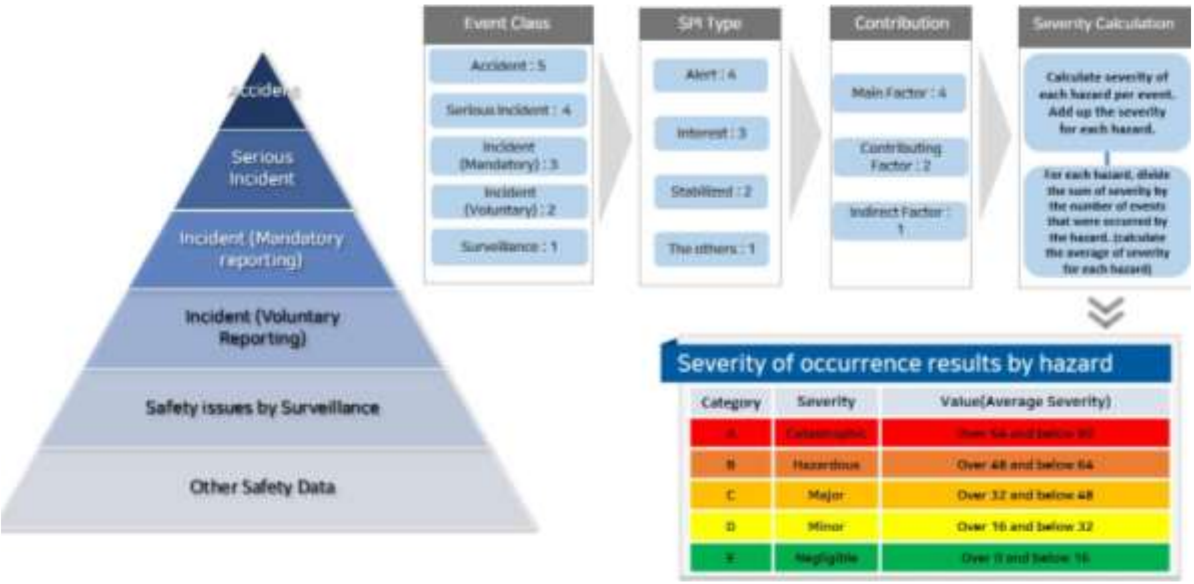
2.3.2 An Event Class, Safety Performance Indicator (SPI) Type, and Contribution to the cause are the main weighting factors in the formula.

a) Event Class: Events are classified into 5 types; Accident, Serious incident, Incident subject to mandatory reporting, Incident subject to voluntary reporting, and Safety issues identified by surveillance.

b) SPI Type: SPI Types are divided into the Alert phase, Interest phase, and Stabilized phase.

c) Contribution: It refers to the level of impact of a specific hazard on the cause of an event. It is classified into Main, Contributing, and Indirect factors.

2.3.3 The severity assessment procedure for hazards consists of 4 steps; (1) Define an event class(accident, serious incident, incident, etc.), SPI type, contributions of each hazard to occurrence and corresponding weights of above parameters. (2) Calculate the severity of each hazard by multiplying the weights of the three parameters above. (3) Repeat (1)~(2) processes for all events that occurred in recent 3 years. (4) Add up the severity for each hazard, then divide the sum of severity by the number of events that were occurred by the hazard (same as calculating the average of severity for each hazard). This whole process is as shown in (Figure I).



[Figure I]

2.3.4 This methodology can produce objective and consistent assessment results. However, there are some concerns that the result may not be useful in reflecting the on-site threat in the aviation industry and that the number of data used is limited. The regular Risk Panel meeting, which conducts a joint qualitative severity assessment, is held quarterly to resolve these concerns. In this meeting, if it is deemed necessary, the panels can further refer to the severity of the threat they experience and utilize it in the assessment. In 2022, four Risk Panel meetings were held to effectively identify national hazards; such as the dramatic increase in the number of flights, pilot capability, ground operation safety, and unauthorized unmanned aircraft, etc. These outputs are electronically managed as the national risk register on the IT system.

2.3.5 As part of an endeavour to promote effective Safety Risk Management, ROK is implementing qualitative and quantitative (prototype) assessments both at the same time. In Doc 9859, safety risk severity is defined as “the extent of harm that might reasonably be expected to occur as a consequence or outcome of the identified hazard.” (2.5.4.1) and “the severity assessment should consider all possible consequences related to a hazard, taking into account the worst foreseeable situation.” (2.5.4.2) However, since the quantitative assessment methodology that ROK is piloting is based only on data that has occurred in the past, the method of considering potential events that hazards can cause also needs to be considered continuously.

3. ACTION BY THE MEETING

3.1 The Meeting is invited to note the information provided in this paper and discuss any relevant experience.

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