Proactive Mechanisms against Occurrences in Civil Aviation

Branko Mikula
Department of Flight Training
Technical University of Kosice
Kosice, Slovak Republic
Branko.Mikula@tuke.sk

Peter Kalavský
Department of Flight Training
Technical University of Kosice
Kosice, Slovak Republic
Peter.Kalavsky@tuke.sk

Robert Klir
Department of Flight Training
Technical University of Kosice
Kosice, Slovak Republic
Robert.Klir@tuke.sk

***Abstract*— The top priority for every organization within airline industry has always been safety. It is fundamental to the purpose of the reporting of incidents and accidents that the knowledge gained from occurrences investigations are disseminated so that all in the business involved may take a good from them. However, the current aviation safety system is mainly a reactive and prescriptive. This paper brings a brief overview on Regulation (EU) No 376/2014 of the European Parliament and of the Council of 3 April 2014 on the reporting, analysis and follow-up of occurrences in civil aviation, including categories of reportable occurrences as well as other relative legal acts. Notwithstanding, existing legislation requires to conduct the in-depth analyses of all occurrences. In this study Root Cause Analysis is described as an appropriate method for such analysis. The aim of this paper is to give an overview on selected EU legislation acts which are ruling mandatory mechanisms to collect, evaluate, process and store occurrences in civil aviation as well as a method which helps disclose hidden boosters of safety incidents and accidents.**

Keywords — Safety Management System, safety, occurrences reporting, legal act, Root Cause Analysis

I. INTRODUCTION

The airline industry market, like any other current market, represents a very competitive segment, where each day of survival could be a win. Customers always play a crucial role for airlines. A retention of existing customers, and an attraction of new ones, usually depends on how attractive a carrier becomes in their eyes. Passenger's perception of quality services differs, and that generally depends on an individual passenger´s expectations. Passenger service quality perception is shaped by many aspects which used to vary through the times. Airline´s reputation presented as a safe and reliable carrier must be imperative. Safety is not only the most important indicator for passengers´ decisions, but it is absolutely inevitable for an overall existence of an airline. A very high degree of safety assurance is necessary in civil aviation, and every effort should be taken to reduce a number of accidents and incidents with a perspective of ensuring public confidence in the aviation transport. A volume of catastrophic accidents in civil aviation has remained fairly constant over the last ten years. Nonetheless, the figures of accidents could boost over the decades to come, due to expansion in air traffic, and escalation in the technical complexity of aircraft. History has proved that airline industry accidents are often preceded by safety-related incidents, and failure revealing the presence of safety hazards. Safety information is therefore an essential source for the disclosure of potential safety hazards. Whilst the ability to pick up from an accident is crucial, purely reactive systems have been found very limited in bringing forward improvements. Reactive systems should therefore be complemented by proactive systems which apply other types of safety information to make sufficient improvements in the aviation safety. Organisations must commit to the improvement of aviation safety through launching of more proactive and evidence based safety systems which focus on accident prevention, based on the analyses of all relevant safety information, including information on civil aviation occurrences. In accordance with the Regulation (EU) No 376/2014 of the European Parliament and of the Council of 3 April 2014 on the reporting, analysis and follow-up of occurrences in civil aviation, designated authority is responsible to put in place a mechanism to collect, evaluate, process and store occurrence data. The development of databases should be compatible with software developed for this purpose. This regulation strictly prohibits disclosure of a reporter, and other individuals involved in a reportable occurrence. Main concern in relation to the occurrence reporting system is to secure free and uninhibited reporting, and avoid any policy to institute proceedings in respect of unpremeditated or inadvertent breaches of the law which come to its attention only because they have been reported under the scheme, except in cases of gross negligence. According Koscak et al (2021) civil aviation occurrences are rarely a result of a single cause. Janic (2000) summarised the causes of civil aviation occurrences as follows: pilot human error, mechanical failures, air traffic control errors, ground support failures, and dangerous weather conditions. However, the Guidance Material to Regulation (EU) No 376/2014 states that the current aviation safety system is mainly a reactive and prescriptive safety system, in which safety improvements are essentially resulting from technological progresses, compliance with prescriptive regulations and lessons learned from aircraft accidents. Antoško et al. (2020) emphasises that it is governments' responsibility to complete, publish, and control complex sets of safety and security measures applicable at airports. The author continues that such rules and norms must be in compliance with international standards and requirements.

II. OCCURRENCES PREVENTION THROUGH EU LEGISLATIONS

A mandatory reporting system is a main objective of many EU regulations. Those regulations are directly applicable in domestic legal systems of any of 22 European Union member

978-1-6654-1342-8/21/$31.00 ©2021 IEEE

states (eff. Jun 2021). This chapter brings a short overview on main EU regulations regarding aviation occurrences reporting and their further processing, and measures should be applied to prevent same or similar. Regulation (EU) No 376/2014 of the European Parliament and of the Council of 3 April 2014 on the reporting, analysis and follow-up of occurrences in civil aviation. This regulation aspires to improve aviation safety by ensuring that adequate safety information relating to civil aviation are reported, collected, stored, protected, exchanged, disseminated and analysed. The Regulation establishes the continued access of safety information by launching rules on confidentiality and on the appropriate implementation of information, and through the harmonised and enhanced protection of reporters and persons mentioned in occurrence reports. While the Regulation No 376/2014 predominately deals with reporting and analysing processes, Commission implementing regulation (EU) 2015/1018 laying down a list of classifying occurrences in civil aviation to be mandatorily reported according to Regulation (EU) No 376/2014 of the European Parliament and of the Council. This regulations according the first subparagraph of Article 4(5) of Regulation (EU) No 376/2014, adopts a list classifying occurrences to be referred to when reporting occurrences, under mandatory reporting systems set out in that Regulation, and which fall within the categories of Article 4(1) of that Regulation. Also, a second list should contain, in accordance with the second subparagraph of Article 4(5) of Regulation (EU) No 376/2014, a classification of occurrences applicable to aircraft other than complex motor-powered aircraft. Another regulation ensuring that safety investigations of aviation accidents and incidents are held, and this improves aviation safety and helps to prevent the occurrence of accidents and incidents. The above-mentioned processes are ruled by the Regulation (EU) No 996/2010 of the European Parliament and the Council on the investigation and prevention of accidents and incidents in civil aviation and repealing. The sole objective of safety investigations is a prevention of future accidents and incidents without apportioning blame or liability. The Regulation imposing that safety investigations should implement the cost-efficient utilisation of investigation resources. The Regulations requires that the safety investigation of accidents and incidents should be conducted by or under the control of an independent safety investigation authority. A high and uniform level of civil aviation safety should be ensured at all times by the adoption of common safety rules and by measures ensuring that any goods, persons and organisations involved in civil aviation activity in the EU comply with such rules. Such unification of safety rules was adopted in 2018 in the Regulation (EU) No 2018/1139 on common rules in the field of civil aviation and establishing a European Union Aviation Safety Agency. The Regulation imposing responsibility for each member state draw up a State Safety Programme in accordance with the requirements contained in ICAO Annex 19. At the EU level the Regulation requires to establish a common framework for planning and implementing safety improvement actions such as European Plan for Aviation Safety and a European Aviation Safety Programme. Following the EU approximation process, the Government of the Slovak Republic has published Order No 661/2005 covering obligatory process regarding reporting, collecting, storing, protecting, exchanging, and analysing occurrences in civil aviation. The Order was published as a response to the approximation obligation of membership states in the European Union. It means that countries aspiring to join the European Union must align their national laws, rules and procedures in order to give effect to the entire body of EU law contained in the *acquis communautair*

III. REPORTING ACCIDENTS AND INCIDENTS

Regulation No 376/2014 is based on an acknowledgement that experience has already shown that accidents are often preceded by safety-related incidents and deficiencies revealing the existence of safety hazards. Safety data are therefore important resources for the detection of potential safety hazards. In aviation business involved individuals´ ability to learn from an accident is crucial, and purely reactive systems have been found to be of limited use in continuing to bring forward improvements. Reactive systems should therefore be complemented by proactive systems which use other types of safety information to make effective improvements in aviation safety. The legislative initiations of the Regulation No 376/2014 have outcome from knowledge that it is necessary to ensure that front-line aviation professionals report occurrences that pose a significant risk to aviation safety. Voluntary reporting systems should complement the mandatory reporting systems, and both should allow individuals to report details of aviation safety-related occurrences. Objectives of Regulation No 376/2014 are dealt in Article 1. In details, objectives are described as this Regulation aims to improve aviation safety by ensuring that relevant safety information relating to civil aviation is reported, collected, stored, protected, exchanged, disseminated and analysed. Mandatory reporting lays down in the Article 4 of the Regulation. Occurrences which may represent a significant risk to aviation safety, and which fall into categories as listed in the Table 1, shall be reported by the persons listed in paragraph 6 of the Regulation through the mandatory occurrence reporting systems.

TABLE I.

CATEGORIES OF REPORTABLE OCCURRENCES [7]

Occurrences related to the operation of the aircraft	• collision-related occurrences • take-off and landing-related occurrences • fuel-related occurrences • in-flight occurrences • communication-related occurrences • occurrences related to injury, emergencies and other critical situations • crew incapacitation and other crew-related occurrences • meteorological conditions or security-related occurrences
Occurrences related to technical conditions, maintenance and repair of aircraft	• structural defects • system malfunctions • maintenance and repair problems • propulsion problems (including engines, propellers and rotor systems) • auxiliary power unit problems

Occurrences related to air navigation services and facilities	• collisions, near collisions or potential for collisions • specific occurrences of air traffic management and air navigation • services (ATM/ANS) • ATM/ANS operational occurrences
Occurrences related to aerodromes and ground services	• occurrences related to aerodrome activities and facilities • occurrences related to handling of passengers, baggage, mail and cargo • occurrences related to aircraft ground handling and related services

Also, the Regulation imposing duty on organizations, EU member states and EASA to establish a voluntary reporting system to facilitate the collection of details of occurrences that may not be captured by the mandatory reporting system, and other safety-related information which is perceived by the reporter as an actual or potential hazard to aviation safety. The handling of the reports shall be done with a view to preventing the use of information for purposes other than safety, and shall appropriately safeguard the confidentiality of the identity of the reporter and of the persons mentioned in occurrence reports. Relevant information on accidents and serious incidents collected by safety investigation authorities shall be stored in the national database. All occurrences must be also stored in the European Central Repository managed by the Commission. Each EU member state updates the European Central Repository by transferring to it all information relating to safety stored in the national databases.

IV. OCCURRENCES ANALYSES

According the above-mentioned Regulation No 376/2014 occurrences analysis and follow-up are conducted on a national level and EU level. Regarding the national level, analysed occurrences of organizations concerned, in our case airports, airlines, and airport handling services providers, develop a process to analyse occurrences collected in accordance with Articles 4(2) and 5(1) of Regulation No 376/2014, in order to identify the safety hazards associated with identified occurrences or groups of occurrences. And still, these organisations must be able to determine some appropriate corrective, or preventive actions, which are required to improve aviation safety. Corrective, or preventive actions should be implemented in a timely manner, and establish the process of monitoring the implementation and effectiveness of the actions. Employees and contracted personnel must be regularly provided with information concerning analyses and follow-ups on occurrences for which preventive or corrective actions are taken. The final results of the analysis, are reported where required, as soon as they are available and, in principle, no later than three months from the date of notification of an occurrence. At EU level, the Commission, and EASA participate in analysing of information contained in the European Central Repository. Both institutions collaborate through a network of aviation safety analysts. The network of aviation safety analysts contributes to the improvement of aviation safety in the EU, in particular by performing safety analysis in support of the European Aviation Safety Programme and the European Aviation Safety Plan. Regulation No 376/2014 does not require any specific method for analysing occurrences. Regulation´s content requires an investigation of occurrences in aviation but does not present any exact method for studying a case. There is one applicable technique called Root Cause Analysis. Root Cause Analysis (RCA) is a technique to identify the underlying causes of an incident, eliminating patching and waste, so that the most effective solution / mitigation can be identified and implemented. It helps to understand the real trigger for a problem and enables us to correct systematic errors and avoid similar occurrences and findings. RCA is structured to investigate a problem and identify which causation relations should be fixed. According Rooney (2004) the key for effective problem prevention is to know why the problem occurs. Latino (2006) states that RCA is a structured investigation of a problem to identify which underlying causes need to be fixed. Bagian (2002) describes RCA as broadly understood method of structured risk identification and management in the aftermath of adverse events. Reason (1990) assesses RCA as a range of approaches and tools drawn from fields including human factors and safety science. RCA is not only an important tool for aviation safety assurance process, but it is often also required by authorities, and therefore needs to be documented properly.

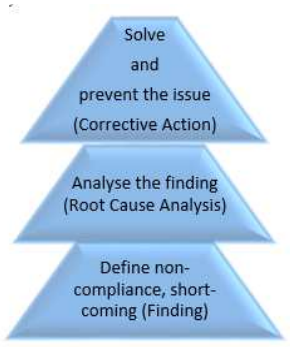

Figure 1. Basic sequence of occurrences processing [14]

Corrective actions should only be implemented after Root Cause Analysis are complete, in order to choose and implement suitable mitigations. There is no standard definition in aviation Safety Management System (SMS) what Root Cause Analysis means. Even world-wide recognized organizations such as FAA, IATA, ICAO, and EASA do not outline what that means. In general, a root cause is understood as the basis of why a certain problem can happen. A chain of "why" questions rolls out when safety specialists review, classify, and investigate occurrences with Root Cause Analysis. The questioning process might start with questions like: why did the aircraft crash or why did a mechanic followed this procedure and not other one. Managers go through this process until they feel they have reached at the "main cause" for the reported safety issues. There is " 5-Why-Menthod" which has proven to be effective method for establishing the causes by an in-depth search. The " 5 Whys " helps identify the root cause of a problem, determine the relationship between different root causes of the problem, and they are easy to complete without any statistical analysis. "5 Whys" template, as indicated in the Figure 2, helps business teams identify, analyse, and resolve the root cause of a

problem, implement long-term solutions, and avoid issue recurrence.

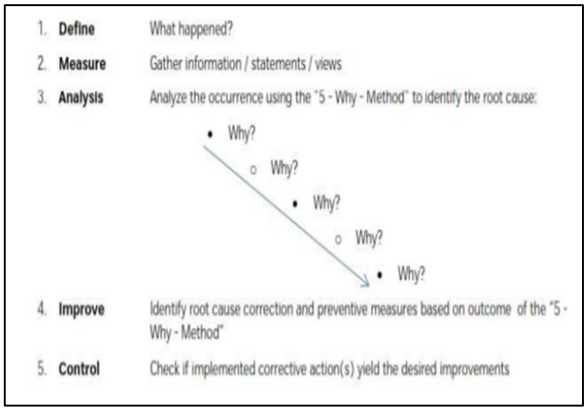

Figure 2. "5-Why-Method" steps

Nevertheless, a definition of Root Cause Analysis has not been standardized yet. Current literature sources prefer to define Root Cause Analysis rather like the intent of activities. Anyway, the most important Root Cause Analysis´s goals are (a) understanding why the safety issue happened, (b) establishing precursors to danger, and (c) setting causes for safety issues.

CONCLUSION

The practice has already shown that accidents in air transport are very often preceded by some safety-related incidents, and deficiencies thereby revealing the existence of safety hazards. Accordingly, safety data stand as an important resource for uncovering of further potential safety hazards. In addition, whilst the ability to learn from an accident is crucial, entirely reactive systems do not bring forward improvements. In aviation industry the reactive systems should be combined with the proactive systems, which use other types of safety data, to make effective improvements. The objective of occurrence reporting is to contribute to the improvement of flight safety by ensuring that relevant information on safety is reported, collected, stored, protected, exchanged, disseminated and analysed. The sole objective of occurrence reporting is the prevention of incidents and accidents, and not to attribute blame or liability. Regulations, analyses, corrective and prevention actions assist states, agencies and organisations in managing aviation safety risks. The Safety Management Systems of individual commercial entities must be complemented by the Safety Management Systems of the EU and EASA. The responsibilities of the EASA, and of the competent authorities of the member states should not exonerate organisations from their direct responsibilities in managing safety inherent in the products and in the services they provide. For that purpose, organisations collect, sort and analyse data on occurrences in order to identify and mitigate hazards and threats associated with their activities. The overall process must be monitored by a relevant competent authority, which should require actions to be taken in order to ensure that the safety deficiencies are correctly addressed. There is wide range of analytical tools that have possible use to support airlines and airports safety management activities. Some of them have specialized functions, and some require commitment of considerable resources like individuals´ skills for their proper application. Root Cause Analysis helps investigators focus on what happened and why that happened. Investigators can find objective root cause of accidents, incidents, and operational problems. Root Cause Analysis is much favourite among airlines and airports as a customizable tool where a user can add information that one thinks is important. Another beneficial feature of this analysis is structured format for consistency of investigated incidents and accidents. The objective of mandatory occurrence reporting and data recording is to prevent new events, such accidents and incidents, but never accusation and accountability. Individuals filing a safety report need to have a strong assurance from a regulatory authority and an employer that prosecution or punitive actions such as suspension of licence, will not be sought unless the unsafe act is deliberately committed or gross negligence is demonstrated. The reporting system needs to be perceived as being fair towards unintentional errors, and strict towards occurrences solving schemes.

ACKNOWLEDGEMENT

This article was supported by a grant from the KEGA agency, Project no. 051TUKE-4/2021 "Integrated laboratory for digital aviation education in selected subjects of flight training".

REFERENCES

[1] M. Antosko, M. Kelemen, R. Rozenberg, P. Kalavský, P.Klir, J. Sabo, "Letecke predpisy," 1. Vydanie, Sdružení požárního a bezpečnostního inženýrství, Ostrava, Czech Republic, ISBN 978-80-7385-232-0, 2020.

[2] J.J. Rooney and L.N. Vanden Heuvel, "Root cause analysis for beginners," QualityProgress, Vol. 7,2004, pp. 45-53.

[3] C. Johnson, "Software tools to support incident reporting in safety-critical systems," Safety Science, Volume 40, Issue 9, Glasgow, UK, 2002, pp. 765-780.

[4] J.Latino and K.C. Latino, "Root Cause Analysis: Improving Performance for Bottom-Line Results," 6000 Broken Sound Parkway NW, Suite 300 Boca Raton,CRC Press, FL, USA, 2006.

[5] J.P. Bagian, et al., "The Veterans Affairs root cause analysis system in action," Jt Comm J Qual Patient Saf, 2002, pp.531-545.

[6] J.Reason, "Human error," Cambridge University Press, UK, 1990.

[7] ICAO, "ICAO Safety Management Systems (SMS) and Cabin Safety, " 2021, Available on line: https://www.icao.int/safety/airnavigation/ops/cabinsafety/pages/safety-management-systems-(sms)-and-cabin-safety.aspx

[8] European Union, "Regulation of the European Parliament and of the Council (EU) No 376/2014 Occurrence reporting in civil aviation, " Official Journal of the European Union, 2003, L 167/23.

[9] European Union, "Regulation of the European Parliament and of the Council (EU) No 42/2003 On the reporting, analysis and follow-up of occurrences in civil aviation, amending Regulation (EU) No 996/2010 of the European Parliament and of the Council and repealing Directive 2003/42/EC of the European Parliament and of the Council and Commission Regulations (EC) No 1321/2007 and (EC) No 1330/2007, " Official Journal of the European Union, 2004, L 122/18.

[10] The Government of the Slovak Republic, "Legal Order 661/2005 On reporting occurrences in civil aviation"

[11] P. Koščak, M. Andrejiova, A.Grincova, and D.Marasova, "Civil Aviation Occurrences in Slovakia and Their Evaluation Using Statistical Methods," MDPI, Sustainability, published online https://doi.org/10.3390/su13105396, 2021.

[12] M. Janic, "An assessment of risk and safety in civil aviation," J. Air Transport Management, 2000, pp. 43-50.

[13] "Guidance material to Regulation of the European Parliament and of the Council (EU) No 376/2014 Occurrence reporting in civil aviation.EU," 2014.

[14] LHG Ground Operations Guidelines, LHG, Frankfurt, 2021.

[15] I. Vajdova, S. Szabo, L. Melnikova, P. Koscak, A. Horvat, and B.Mikula, “Analysis of Aviation Accidents in a Selected Area Aiming to Identify the Basic Parameters of Their Impact on the Environment,” Humanum Międzynarodowe Studia Społeczno-Humanistyczne, HUMANUM International Social and Humanities Studies, Warsaw, Poland, ISSN 1898-8431,2020, pp. 175-182.