RISK MANAGEMENT IN REDUCING THE OCCURRENCE OF AVIATION EVENTS

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***Abstract**. The aim of this paper is the evolution of system safety approach in aviation, which consists in three main research areas: technical factors, human factors and organizational factors. As the airline traffic has risen rapidly in the last years, in countries around the world, there is a need to employ new methods and programs to drive down accident rates. Related to safety, major airlines have employed programs and activities to ward off accidents, in order to make better their records. This difficulty to assess the risk focuses in searching an equilibrium between reality and measurements and also in deciding which settlements have to be made, to reach the objectives.*

***Keywords**: safety managements systems (SMS), human factor, safety risk management, management of change, safety performance indicators (SPIs), crew resource management (CRM), safety performance measurement (SPM).*

1. INTRODUCTION

With the emerging of air traffic growth, we are witnesses of great errors and even human losses. Most of the countries across the globe persists into fighting against these errors and to improve their rates. There are many regions which have high rates of fatal accidents, like those from Central Asia, Africa, Eastern Europe, and America. Considering all of these, it was identified the need of a common initiative at a national and international level to keep air transportation in a both safely and sustainably manner. For the last decade, important airlines have begun to use safety management activities such as preventing accidents and flight safety programs, desiring to have better records regarding safety.

The *Safety management systems (SMS)*, has deep roots in the theory of organizational behavior. *SMS* is based on the principles of *quality management systems (QMS)*. Stolzer (Stolzer et al, 2010) define SMS as ”*a dynamic risk management system based on quality management (QMS) principles in a structure scaled appropriately to the operational risk, applied in a safety culture environment*”.

There has been identified differences between quality and safety. Quality according to International Standards Organization (ISO) 9000:2005, defined as "*the degree to which a set of inherent characteristics fulfils requirements*".

These principles are in a strong relationship but not identical. While quality refers to accomplish requirements, safety is looking out to prevent people and property from harm (Mario Periobon in *Aerosafetyworld* June 2012 p. 46-47).

Quality system (QS) is to ensure safe operations, and the approach is Safety Assurance /Compliance Monitoring. Safety management System is to reduce or maintain risk of injuries to persons or property damage at or below an acceptable level, and the approach is risk-management & Safety Assurance / Compliance Monitoring (ICAO, 2009).

Reason (2009), say that a SMS provides the administrative structures necessary to drive good safety practices. It focuses upon the technical and managerial factors associated with hazards.

The airline traffic has risen rapidly in the last few years; therefore, there is a need to employ new methods and programs that can drive down accident rates. It is also vital to develop methods that not only maintain the current safety records but also to be cost-effective. Furthermore, there are airline operations and still many countries that are struggling with bad safety records that now have the option of adopting a more integrated system. The increase of airline departures naturally means an increased in volume and capacity for the other sectors of the airline industry. It is also important service providers are involved and they meet the business demands and safety standards that the airliners are operating.

2. EVOLUTION OF SYSTEM SAFETY APPROACH IN AVIATION

In aviation three main research areas have influence the development in system safety. It can be divided as studies in technical, human and organizational factors. The development in research areas can be divided into three time periods:

- 1940s -1970s the focus was on technical factors.
- 1970s- 1990s, the focus was on Human Factors.
- from the early 1990s the focus was on Organizational factors. Today, it is a combination of the three factors.

Technical factors

From the very first appearance of the aviation until the 70s, most of the safety issues were connected to technical related factors. It was an era described as being a technical one. Although aviation took its place in the industry of in mass transportation, technology that supported the operations did not keep the pace, and did not reach the level necessary to eliminate the repetitive factors that induced malfunctions into the safety area. Focusing safety on technical factors, brought improvements in recognizing and investigating technical factors.

Human factors

The 70s made multiple steps in major areas such as, airborne and ground radar, navigation and communication, autopilots, FD (flight director) and other similar technologies that were centered on human, to improve performance, and to develop automation. This started an era oriented on human, and also safety turned its attention to human, with the appearance of line training, automation, CRM (crew resource management). The time period between the 70s until the 90s was identified as being a golden one of Human Factors, according to the strive of controlling the evasive and omnipresent human error. Although it is well known the huge investment of money and resources in error prevention, by the second half of the 90s, human performance still was a repetitive element malfunctioning safety mechanisms.

From the beginning of the 1990s it was first realized that persons are not acting in a void, but within specific operational context. Although scientific information was accessible regarding how characteristics of such a context can give shape to events, outcomes and influence human performance, people in aviation industry acknowledged that fact only from 1990s. This announced the start for the organizational context, and therefore safety was seen from a systemic view, encompassing all the other factors technical, human and organizational [5].

Organizational factors

The idea of organizational accident, aviation-wide accepted, was materialized by an explicit model demonstrated by Professor James Reason [6], that made possible the understanding of the way that aviation works in a successful manner or it is failing. This model describes the fact that accidents could happen if there are met a series of enabling elements which, taken alone could not break the system. Single point failure is infrequent in complicated domains like aviation and extremely well protected by walls of protection. Equipment breakdown or operational errors are not the source of breaks in safety defenses, but the activation. Breaks in safety defenses are consequences of solutions taken at the top levels of the system, that stays latent until the destructive capability is triggered by a series of circumstances. Taking those facts at the operational level, human or active failures work as an activator of the latent conditions favorable to ease a break of the system's safety defenses [2].

In the concept promoted by the *Reason* model, an accident involves a mixture of both latent and active conditions (*ICAO 2009*).

SMS has different interpretation specific for different organization or industry. From the perspective of civil aviation, the SMS components may include general characteristics allocated to it. Taken from SMS manual built up by ICAO (International Civil Aviation Organization) in 2009, SMS is constructed around four basic pillars. Each basic pillar is divided by segments, that enclose particular tasks or processes to run the safety management. They are [3]:

- Safety risk management
    - hazard identification
    - risk evaluation and reduction

- Safety assurance
    - measurement and safety performance monitoring
    - MOC - the management of change
    - continuous upgrade of the SMS

- Safety objectives and policy
    - responsibility and commitment
    - safety accountabilities
    - engagement of the essential safety personnel
    - coordination of emergency response planning
    - SMS documentation

- Safety promotion
    - training and education
    - safety communication.

EPAS (European Plan for Aviation Safety) is an important part of the SMS, continuously improved and reviewed at the European level. It is introduced voluntary by the *European Aviation Safety Agency (EASA) Member States* through their *State Programs* and *Plans*.

On the last ten-year period, the number of fatal accidents has slightly decreased and the number of fatalities varies more. This is because the number of fatalities is principally related to the size of the aircraft implicated and the type of flight, cargo or passenger, and therefore the occupancy of the aircraft (FIG. 1) [1,7].

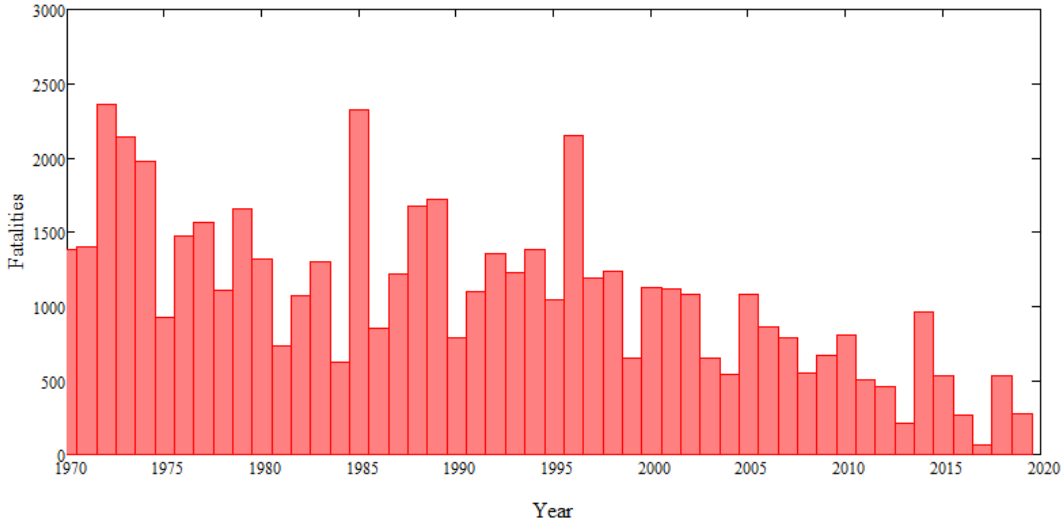

FIG. 1 Fatalities over years for global airline

The evolution of *EPAS* has been made possible by the *European Safety Risk Management (SRM)* process, and can be found described in five particular steps below [1].

***Recognizing of Safety Issues*:** Primary step in the SRM process is identifying of safety issues and it is developed by analyzing the occurrence data and contributing information by the Collaborative Analysis Groups (CAGs). The identified issues regarding safety get the attention of the Agency and after that analyzed for the first evaluation. The evaluation shows the way on how this safety issue must be formally introduced in the relevant safety risk database or prone to something else. Guidance is given by the NoA (Network of Analysts) and *CAGs*. The result of this particular segment of the process are the domain safety risk database. In this database are sorted by importance the principal areas of risk and most issues regarding safety.

***Evaluation of Safety Issues*:** As soon as identified and included in the safety risk database, a safety issue is prone to an initial safety evaluation. These evaluations are sorted by importance in the database. The evaluation is conducted by *EASA*, and aided by the *NoA* and the *CAGs*. Additionally, group members are invited to take part in the evaluation itself; this outer aid is essential to reach the greatest results. In conjunction they are forming the *SIA (Safety Issue Assessment)*, that is giving guidance to EPAS to take the action.

Immediately after this, is the *Best Intervention Strategy (BIS)* evaluation, which takes into consideration the larger interest, the involvement of the indicated actions and gives information for the appropriate measures that must be included in the EPAS.

***Programming and Defining Safety Actions*:** Using the mixt *SIA/ BIS*, the advisory bodies receive formal proposals action from *EPAS*.

As soon as established and settled, the actions are introduced into the newer form of *EPAS*. Before publishing it, *EPAS* gets approval through EASA Board of Management. Actions that are low cost or require more rapid intervention, are often fast-tracked and appear in the next available update of the *EPAS*. In some cases, more immediate actions are needed that may be completed before the next *EPAS* would be published, naturally these are not included within *EPAS*. Such actions could include a *Safety Information Bulletin (SIB)* or *immediate Safety Promotion activities.*

***Implementation and Follow Up*:** The succeeding move in the process implies the execution and the constant review of the actions or activities to be introduced into *EPAS*. We can enumerate several distinct types of actions that can be found within the EPAS, encompassing exploring, safety, promoting, rulemaking and focused oversight.

Quantification of Safety Performance: Quantification is the last phase in the process of safety performance. It is done for the following reasons, in the first place to surveil the changes that have derived from the introduction of safety actions. In the second place, it also serves to surveil the aviation system in order to identify the new safety issues. A *Safety Performance Framework* has been introduced that identifies distinct layers of *Safety Performance Indicators (SPIs)* to establish that there is a step by step work in this step of the *SRM* process.

In parallel, EASA is also reviewing systemic issues that may have contributed to the accidents so as to identify improvements that will contribute to a more resilient European and international certification framework. Under requirements laid down by ICAO, aviation accidents must be investigated with a view to understanding the causes and preventing similar accidents in the future. Based on the information from accident reports and from preliminary information where the investigations are ongoing, the accidents between 2015 and 2019 had the following characteristics:

- aircraft upset, terrain collision and runway excursion were the most common accident outcomes. Runway excursion is most common during the landing phase of flight.
- the most common underlying cause to these accidents is associated to the flight crews' management of challenging circumstances created by technical failures or poor weather conditions, including wind shear, during approach. Safety management continues to emerge as a key factor in preventing accidents.
- cargo flights formed a third of the fatal accidents, forming a greater proportion of fatal accidents than commercial air transport flights.

3. CONCLUSIONS

The difficulty to assess the risk focuses in searching an equilibrium between reality and measurements and also in deciding which settlements have to be made, to reach the objectives. [4].

Reaching a thorough knowledge of human and technical behavior and influences that govern such behavior, qualitative analysis is necessary before measuring any risk type.

This paperwork presents a view of where measurements need to be developed to tell us what the highest risks are. The aviation system has many distinct but interrelated parts.

Developing efficient measurements requires a proper comprehension of the aviation system and the risks in individual processes in the domain of manufacturing, operations, air navigation, and training. Quantifications should conduct to identifying the existing and emerging risks in each of these parts and to see whether regulatory actions have the expected effect on controlling or eliminating hazards. Although there is regulation to control the risk, there are hazards that cannot be identified. Development in safety aviation have to rely on structured and systematic hazard recognition and control, to monitor and understand what are those causes and the factors that lead to failure in aviation.

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