

Approaches to aviation safety management



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Benefits and Drawbacks of the Predictive, Proactive and Reactive

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Introduction

Safety management in aviation is not a new 21st century topic. In the past aviation safety improvement was characterized by a fly-crash-fix-fly approach. We found fly airplanes that have the occasional unfortunate crash and we would investigate the cause(s) to prevent it from happening again. Sometimes the causes would be weather related or mechanical failures, but more often the main cause would be human error usually “ the pilot”. Essentially, the prevailing philosophy was once determined to be the pilot; therefore, other pilots were simply encouraged to not make the same mistakes that happened before. Safety management should not be viewed as simply a means to an end or a blind adherence to industry standards, but rather as a company and industry wide commitment to the best practices and continuous improvement of everything safety related. In an effective safety management system, the focus is shifted from a reactive to proactive method of managing risk. The prevailing view of risk should be professional and realistic, focusing on eliminating or maintaining optimum levels of acceptable risk using past incidents, professional’s perspectives and insights. The aviation industry has in the past been comfortable maintaining a reactive position to safety regarding occurrences as isolated accidents, and consistently taking actions only when something happens. The introduction of safety management systems is shifting the focus from enforcement centered to a more proactive approach which can establish the perception

that safety is simply the best and the most effective and most profitable way to do business.

The Benefits and Drawbacks of the Reactive, Proactive and Predictive Approaches to Aviation Safety Management.

Safety means different things to different people in relation to their circumstances. The Merriam Webster online dictionary defines safety as the “ condition of being safe from undergoing or causing loss, injury or hurt” (Merriam Webster Online Dictionary, 2017). The International Civil Aviation Authority defines safety as “ the state in which the risk of harm to persons or of property damage is reduced to, and maintained at or below and acceptable level through a continuous process of hazard identification and risk management” (ICAO, 2006).

Aviation safety management is described as a planned, documented and verifiable method of managing hazards and associated risks (Bottomley, 1999). It is a strategic process that identifies and addresses safety issues. It includes the important organizational structures, accountabilities, policies and procedures. (ICAO, 2009). ICAO has required its member states to develop and implement SMS programs to improve safety and the FAA is encouraging aviation service providers to develop an SMS. Of course, the overarching goal is to improve safety while the experts of ICAO believe that deployment of an SMS is the best means of achieving that goal. The transformation of the aviation industry from what it was to what it is at this present time is as a result of continuous investment in aviation safety. These efforts made by the aviation community as safety have been the highest

priority for the aviation industry over the past 100 years. Developments in technology, training and risk management have resulted in commendable improvements.

The Aviation Safety Management concept represents the transition from a reactive culture to a proactive culture. Globally, the accident rate will never be zero because human error will always be a component of nearly every operational activity. However, the accident rate can be reduced by implementing proactive and predictive methods into the organizations management system. The safety management concept shows a progression from a reactive culture driven by investigating the most recent smoking hole to a proactive environment of identifying and resolving operational hazards associated with significant changes in the operation before they are implemented.

Approaches to Aviation Safety Management

ICAO identified three approaches to Aviation Safety Management as follows:

- Reactive approach
- Proactive approach
- Predictive approach

The Reactive Approach

The term ‘ Reactive’ means being responsive to something. The reactive approach entails action after an accident has taken place to either minimize its effects or to take advantage of the event. It involves responding to accidents as they occur. This was how the early aviation system did risk

management because they did not have enough experience and technological knowledge. The reactive approach to aviation safety management is often equated with the well known “ fly-crash-fix-fly” adage. There is an accident or incident and we use investigative tools to try to determine what the contributory factors that caused the problem. ICAO uses the term to include “ incident analysis, determination of contributory factors and findings as to risk”. This approach involves the analyses of outcomes or events. Incidents and accidents are clear. Correcting the deficiencies found using standard reactive measures should reduce and manage errors that led to a particular incident.

This approach is used in new SMS programs that do not have the requisite safety data to practice proactive or predictive safety management.

Benefits of the Reactive Approach

- Accident investigation is an important reactive component of the aviation safety management system. Accident investigation contributes to the continuous improvement of the aviation safety system by providing the root causes of accidents and incidents. Finally, lessons are learned from analysis of events.
- Information received from the reactive approach can support decisions regarding the development of corrective actions and corresponding allocation of resources and may identify necessary improvements to the aviation system.
- Most investigation exercise also uncovers hazards or threats. An effective investigation process includes the identification and

discrimination of the immediate, underlying and root causes of an aircraft accident as well as the active and latent errors leading to an accident.

- This approach through analysis of data from numerous accidents has aided in the identification of recurring patterns or risk factors that are not always apparent when individual accidents are investigated.
- It provides the motivation and opportunity to identify and collect safety data.

Drawbacks of the Reactive Approach

- According to the NTSB, due to the complex nature of accident investigations, providing timely accident reports has been challenging. Thus, it can be said that the reactive approach is time consuming.
- This approach requires a lot of resources for its successful completion. It is a result of the resource constraints that the NTSB has developed the accident launch criteria to determine which accidents to investigate (largely related to the number of fatalities or other risk factors).
- Modern safety theory would suggest that relying on correcting deficiencies found through incident investigation as a means to reduce error is somewhat restrictive (Weigmam & Shappel 2003, Reason 2000, Wood 1997, Kleitz 1994).
- The NTSB has long realized the need for less reactive approach to identify safety issues and in aviation safety management because not all aircrafts are equipped with Cockpit Voice Recorder and Flight Data

Recorders and those with these can become severely damaged and useless during the course of an accident.

- The reactive approach to Aviation Safety Management is very expensive to carry out as it leads to high incremental costs and increased risks.

The Proactive Approach

Proactive means being prepared even before an incident takes place. It is more or less like anticipating what is going to happen and working accordingly to minimize the effects of the event or work to take advantage of the event. Proactive safety management involves the analysis of existing or real time situations. It actively looks for potential safety problems through trend analysis, hazard analysis, and other methods of scientific enquiry. It includes data inputs such as near miss events, voluntary safety reporting, and flight data monitoring that can potentially identify safety hazards before they cause a serious accident or incident. Although, the reactive approach involves accident investigation to identify and collect safety data, safety studies go beyond the investigation and recordation of accident circumstances to proactively pursue peripheral information and focus on detailed attention to the issues that may identify the effective safety mitigations or previously unidentified safety hazards. It is more like “accident investigation without the accident”; the proactive methodology enforces the fact that we do not have to wait for an accident to achieve improved safety.

Benefits of the Predictive Approach

There is no doubt that the proactive approach to aviation safety that leads to overall safety is beneficial for the system and can be measured in both tangible and intangible means. We should not wait for accidents to learn about safety improvement. We can address the latent conditions that we know about and incur fewer accidents in the future. The following are the benefits of the proactive approach:

- The proactive approach enables the precursors to occurrences to be identified and remedied prior to an actual occurrence thereby saving time, money and perhaps life.
- This approach to a large extent will sustain future profitability and growth in the aviation industry since we are able to identify accidents before they occur thereby reducing the effects that are associated with a crash.
- It helps to reduce financial, environmental, reputational and safety risks in the aviation industry as it provides safety learning without the cost associated with an accident.
- The proactive method allows the system to move from investigation findings to preventive safety.
- By designing an error tolerant system that will reduce error, the aviation organization has the potential to mitigate error consequences and therefore proactively prevent accidents.

Drawbacks of the Proactive Approach

- Adopting the proactive approach to aviation safety is a complex endeavor (Roelen, 2008).

- This approach takes skill and a thorough understanding of root causes, cause-effect analysis, and how available variables work together to produce outcomes.
- It requires thoughtfulness and is prone to being flawed if great care is not taken during analysis.
- It requires costly monitoring equipments.

The Predictive Approach

This approach involves attempting to foresee concerns that have not occurred in the aviation industry and also it attempts to review and analyze historical data. This approach seeks to understand the existing system and through the use of various forms of modeling, determine where and when the system is likely to fail. The predictive approach to aviation management involves gathering data in order to identify possible negative future outcomes or events by analyzing system processes and the environment to identify potential future hazards and initiating mitigating actions.

The predictive approach is often confused with the proactive approach. While there can be an overlap between the two, they are for the most part distinct. The predictive approach attempts to identify possible risks in a situation based on given circumstances, identifying new threats in hypothetical scenarios and anticipating the needed risk controls. This approach is based on nominal data as opposed to accident data and potentialities that have not yet occurred. It can be summarized as a luxury of a mature safety management system using robust SMS databases to manage lots of collected safety data.

Benefits of the Predictive approach

- The predictive approach helps in identifying safety issues that have not happened yet but probably will happen if unaddressed issues and not acted upon accordingly by updating risk control repertoire.
- It is unique from other approaches to aviation safety management. It does not directly use safety data from incidents, it is not a response to anything (such as to data or incidents) and is also used to verify the effectiveness of risk controls.
- Predictive safety methods will enable us to find those failure points and eliminate them thereby allowing us to change the future.

Drawbacks of the Predictive Approach

- The predictive approach provides just an expected ‘range’ of safety performance and to a large extent should not be fully trusted.
- There is a great tendency for miscalibration as what is being predicted, may not reflect what normatively matters for a particular issue in the aviation industry
- The predictive approach to aviation safety management cannot anticipate the future with certainty. Most times this approach only produces predictions that come close to reflecting expected values.
- There is always a tendency to over predict or under predict hence making this approach unreliable.
- Prediction requires resources and these resources entail some costs which are mostly on the high side.
- It requires strong historical data to support predictive findings, strong policies and procedures to analyze, well developed risk analysis

techniques, time, manpower and resources needed to spend on predictive activities makes it hard or impossible to practice.

Conclusion

We have all heard the truism that travelling by air is safer than driving. Aviation is a safe field because far more than any mode of transportation it is run by professionals using various approaches and methodologies. While accident rate has improved considerably, questions remain over the ability of the aviation industry to maintain safety improvements in the future. Safety Management Systems are a product of continuing evolution of aviation safety. Early aviation pioneers had little safety regulation, practical experience and engineering knowledge to guide them. Today, careful regulation of aviation activities, experience and technological improvements has contributed to significant gains in safety. Now, we have the reactive approach to aviation safety which is used to examine past events one at a time, the proactive approach which has encouraged aggregate analysis to determine trends and the predictive approach which feeds on more scientific methods all with the aim of improving safety. The NTSB is an organization with a proactive mission and a reactive process, its primary role is to investigate accidents yet its mandate is to prevent them.

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