

Learning From and Preparing for Traditional Airline Accident Investigations
while Transitioning to SMS Risk-Based Investigation Processes

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Abstract

United States based commercial airlines continue to experience the safest period of operations in aviation history, with the last United States commercial air carrier fatal accident occurring on Colgan Air Flight 3407 on February 12, 2009. The continuing adoption of Safety Management Systems (SMS) across the global aviation industry calls for the next generation of investigators to become proficient in tactical, risk-based investigation practices, while also staying skilled at participating in major, typically government-led investigations and able to respond to the catastrophic hull loss and multiple fatality events from which previous generations of investigators have learned.

Members of the next generation of investigators are entering an industry in which operational safety risks are more often identified through safety data and voluntary reporting programs (ASAP, FOQA, LOSA, VDRP) than accidents. Never before has the full might of the industry been able to shift towards predictive investigations rather than reactive.

The authors propose to describe how the next generation of investigators will need to transition from often years long accident investigations to quicker, tactical, risk-based investigations without sacrificing depth or quality. At the same time, this new generation of investigators must continue to be prepared to participate in major, typically government-led investigations on behalf of their organizations, and maintain preparedness for the major accident that they are also seeking to prevent. The authors will explore the complexities of this position through their respective positions: a leader of an airline Safety Department with 30 years of accident investigation experience, and a five year investigator functioning in this dual process world.

I. Introduction

The “new” airline safety investigator is entering an industry where the work of the “old” safety investigator has nearly been made self-extinct. These new investigators are tasked with upholding and continuously improving the safety record of commercial aviation, and must evolve their skills and techniques to the tasks that their organizations require of them. At the same time, these investigators and safety managers must also ensure that they and their teams are prepared for the major accident that they are seeking to prevent by learning from those that have come before them. This dual role, coupled with the ever growing supply of safety data and the demand for answers to events, presents unique opportunities and challenges for today’s airline safety investigator.

II. Airline Accident Investigations in the Past

Airline Safety organizations over the last 30 years have evolved as more information has become available on daily operations. As the safety information sources and related technology improved so did the ability of airline safety organizations to move from a reactive to a proactive methodology. This led to new roles for the traditional airline safety personnel and the requirement to adapt to the new technology.

Previously, airline safety organizations operated as internal National Transportation Safety Board (NTSB) organizations whose function was to react to known incidents and accidents and work to identify fixes to improve safety. Most of the personnel were pilots, who may have had some military safety training, but for the most part relied on their piloting knowledge to help determine the direction of their organizations.

Accident investigator training primarily came from the military or from the few schools that grew out of the military accident investigation schools. Aviation Safety degrees were virtually nonexistent.

The safety tools these organizations had were limited. Most did not have sophisticated employee reporting programs. Aviation Safety Action Partnerships (ASAP), Internal Evaluation (IEP), and Flight Operational Quality Assurance (FOQA) programs had not been developed yet. Flight Data Recorders (FDRs) had limited information on them but could be used to assist in an investigation. Most FDRs only contained between 6-17 parameters and the boxes only held data for 24 hours. For the FDRs to be useful the incident would have to be reported within a day or two so the recorder could be removed before the data from an event was lost. Recorder readout capabilities were limited, and as a result the analysis could take over a week before meaningful data was available. As a result of these limitations, incidents had to occur and be prominent enough to be known by the airline for an investigation to be initiated. The investigation of a significant event usually was a slow methodical process. The safety programs functioned as purely reactive organizations reacting to known events through a methodical NTSB like investigation process. For the most part these organizations were imbedded in the Flight Operations Departments of the airlines with limited ability to effect change in organizations such as Ground Operations and Maintenance.

Usually, these airline safety organizations worked very well with the NTSB. There was a close relationship and a large portion of the on-the-job training received by airline safety personnel was gained during their participation in NTSB investigations. Accidents were not uncommon so the majority of the time the airline safety departments moved from accident to accident with little time to focus in a proactive mode.

III. The Evolution from Reactive to Predictive

In the 1990s this all started to change. The dramatic improvements in the capability of the computer chip led to rapid developments in personal computer power and the proliferation of the internet revolutionized the airline

safety programs. The voluntary Safety programs, ASAP, FOQA, IEP, Voluntary Self Disclosure Program (VDRP), lead to a whole new source of information that fed into the airline safety organizations. This was joined with a new realization that it was important to incentivize employees to report incidents. This provided specific information on line operations that before was just hearsay, or “hangar talk.” This enabled airline safety personnel to start moving away from reactive activities and begin to initiate proactive processes that didn’t have to wait for an event to occur before corrective action could take place.

The result was a reduction in the accident rate that led to further emphasis on the proactive, with voluntary safety programs being a primary source of information used by the airline safety organizations.

As the volume and quality of voluntary safety data increased so did the realization that there must be a systematic methodology to deal with these new sources of information. Safety Management System (SMS) was developed, combining traditional safety programs approaches with a Quality Assurance aspect to form a continuous improvement process for the aviation safety organization. This approach introduced data driven, risk based decision making with a robust quality assurance function to drive safety improvements. The engine that drives this process is the safety information that now flows freely in most airline safety programs. In addition, it has driven the airline safety programs away from being Flight Operations oriented toward a systems based process that looks at organizational interfaces, organizational decision making, and organizational culture as an integral part of the proactive philosophy of SMS.

The availability of safety information and the incorporation of SMS principles have resulted in the ability of the airline safety personnel to move away from simply reacting to known events and to concentrate on proactive processes to

reduce operational risk. The focus is not on accident investigation but on preventing accidents and incidents using methodical processes to eliminate the hazards in the operation. With this fundamental shift, the personnel making up the airline safety organizations must evolve to be able to effectively manage the volume of safety information, implement corrective actions and continuously monitor the operation to measure the effectiveness of controls in place and the identification of new hazards.

IV. The New Airline Safety Employee

As previously stated, past airline safety personnel were usually pilots who may or may not have had accident investigation experience. This fit the reactive model of these programs.

Today, airline safety personnel come with varied experience and educational levels which better aligns the risk-based, safety information age of the proactive programs. College degrees in Aviation Safety are prevalent across the world. Engineering degrees, information technology degrees, risk analysis, and human factors experience are all necessary within the safety organizations to be able to extract and make sense of the voluminous amount of information now generated by the Voluntary Safety information.

A good example is found in today's FOQA programs. An effective FOQA program requires expertise in analysis of Flight Data, the ability to write analysis algorithms, and an ability to work with avionics engineers to ensure efficient acquisition of the data off of the aircraft to the analysis software infrastructure. These skills are more slated for an engineer than a pilot. The pilot role is still important but that expertise is needed at the end of the process where meaningful information is developed after the flight data is analyzed.

The airline investigators of current and future generations may be very much like the airline investigators from years ago. They, like their predecessors, may come from the ranks of commercial pilots, aircraft engineers and mechanics, or from agencies like the FAA or NTSB. However, a growing number of investigators are entering the airline safety industry directly from academia.

The number of universities offering degree programs in aviation safety continues to grow, and, coupled with internship opportunities within the airline industry, the pool of future investigators has greatly expanded. But, unlike the investigators that preceded them, many of this new generation of investigators are entering the industry without the experience of being on scene for major accident investigations.

As United States commercial airlines maintain and improve the country's low accident rate, the opportunities for the traditional "tin-kicking" accidents have naturally dropped. Investigators now learn their techniques through a series of formal training programs and on-the-job training. Professional organizations such as ISASI are a vitally important piece of an investigator's training as well; the opportunity for a new investigator to learn from those who investigated the major airline accidents of the previous decades is essential to his ability to continue the successes of accident investigation and aviation safety into the future.

Today's airline investigator will hand you a business card that is more likely to state "Safety Investigator" than "Accident Investigator". The investigator's responsibilities within his organization are expanded to include prevention and not just waiting for the proverbial bell to ring signaling the next accident. The model of an airline safety investigation has also changed and investigators must be prepared to tailor their investigations to meet this change.

V. The New Investigation Model

Airline safety investigators used to spend most of their time on major accidents and incidents - the typically government-led, potentially years long efforts that our industry is known for. In today's airline industry an entirely new form of investigation has evolved as the industry operates under the principles of SMS. The vast amount of safety data available to investigators both allows and requires them to conduct investigations of events before they rise to the level of an accident.

These new investigations must be risk-based, tactical fact findings of an event. As risk management teams are developed within the safety organization, they are able to identify the types of events that pose the greatest threat and direct investigators accordingly. These new investigations often do not have a scene for the investigator to travel to; rather the scene is a computer in an office or cubicle, a collection of images, statements, and aircraft performance data accessible within moments. Modern technology is the investigator's greatest tool and allows him to quickly determine what events have occurred and what level of investigation will be conducted.

Just as technology and rapidly accessible data is a tool for today's investigator, it can also be the greatest pitfall. Investigators must be certain that they maintain the same unbiased focus in their search for causal factors that has defined their role within their organization. The investigator will need to balance a flurry of electronic conjecture, inquiries and requests for updates from management, and perhaps even their own beliefs and opinions based on the information that they are seeing.

Another significant change and challenge presented by this new model of investigation is time. Once an event is identified as having risk and an investigation is opened, the investigator is faced with the same questions that every investigator has always faced – “what caused this to happen (or nearly happen) and how can we prevent it?” But more than ever, the organization,

the industry, and the traveling public expect that the answers to these questions will be provided just as quickly as the event itself was identified.

To combat the ever ticking clock, the investigator must quickly identify their scope, their resources, and their method of reporting. While one investigation may result in a lengthy report rich with technical analysis, another may be a condensed brief report summarizing the important facts gathered from available information. These condensed investigations and reports are often the most challenging as the investigator must determine not only what is important to include in their report but also what may be excluded. The goal is to be effective in instituting change, and a traditional “blue cover” style accident report may not always be the most impactful way to do so in today’s airline safety organizations.

The airline safety investigator is also usually tasked with upholding the carrier’s regulatory reporting requirements for incident and accidents to various agencies such as the NTSB, Occupational Health and Safety Administration (OSHA), Federal Aviation Administration (FAA), and Department of Defense (DoD). In these cases the investigator must be responsible for not only identifying those events that require notification, but also slowing the rapid pace of the airline operation to secure and preserve data for a potential investigation. This can often place the investigator in a challenging position within his organization as others not versed in the regulations struggle to understand why an event requires notification.

Airline safety investigators are likely not working on one investigation at a time, nor are they working on merely one type of investigation at a time. A single investigator may be simultaneously conducting investigations of ramp collisions, in-flight turbulence injuries, maintenance errors, runway incursions, near mid-air collisions, and a multitude of other event categories. He may be conducting the investigation with a team of subject matter experts or perhaps as the sole member of his own team. Among all these changes and challenges, the theme of the new investigation model is the same - flexibility.

The investigator must adjust his techniques and tactics to each event to achieve the ultimate goal of prevention of reoccurrence.

VI. A Watchful Eye

As much as the daily role of the airline safety investigator has changed to fit the new model of investigations, he maintains one crucial role true to his roots – the major accident investigator. So how does an investigator who has never responded to a major aircraft accident prepare for the very event he is seeking to prevent from occurring?

As our industry well knows, being well prepared for an accident will make the response and investigation much smoother. In addition to his training and the mentoring he has received, the investigator who has not responded to a major accident can ensure that he and his organization are prepared by being an effective emergency response manager. Just as new investigators at airlines may not have major accident investigation experience, they will likely find others in their organization who have not but will be called upon as technical group members should an accident occur. Investigators must work with their organization to ensure that their emergency response plan is well written, supported by all levels of management, and that trained and qualified individuals are ready and willing to assist should a major accident occur.

While the investigator may or may not be in charge of the emergency response plan, he should be its greatest champion. Participation in drills, procedural reviews, and meeting with the team members on a regular basis is crucial to a successful response and investigation.

VII. Conclusion

Airline operations are in the safety period in the history of commercial aviation. Airline safety programs have evolved from reactive processes to

being driven by proactive, data driven, risk-based approaches that lead to continuous reduction in overall operational risk.

The airline safety investigator has also had to evolve to match the dramatic changes in these safety programs. New skills and education are required and new approaches must be developed to match the speed and flexibility of modern airline operations. No longer does airline leadership have patience to wait on safety improvements. Safety metrics are measured in the same context as the airline balance sheet and with the same vigor. Airline leaders are much more engaged in their safety programs and thus hold the safety programs accountable for expected improvement. No longer is safety information hangar talk but it is the engine that drives SMS and the day to day work scope of the airline safety workforce. Accident investigation is a skill which is still needed but it is not the primary skill for today's safety investigator or manager. There must be a realization that this skill must be prepared for, trained, and practiced because when it happens it is a shock to the airline system and will impact every aspect of a continuously running SMS. To ignore it is to place in peril the success of the airline's SMS. Blending the old skills with the new is an important aspect of an airline safety investigator's tool box. Qualified safety personnel must be trained and developed for a program to be successful. Let's hope that the "new" safety investigator never has to practice the "old" skills!