

NEW SAFETY INVESTIGATOR PROFILE

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Introduction:

As we know, aviation accident investigation arises from the need to seek a response to the events and to be able to establish the immediate causes of them.

Across the years, aviation increased in volume and with each war new challenges of primacy and improvement emerged. From the development of commercial passenger aircraft, to jet fighters and unmanned drone systems it became more complex in technology, in operation and in context.

The theories that explain the processes involved in accidents and incidents are becoming more complex as well.

This paper features a brief of the Investigation Process evolution and Paradigms as its focus on the Investigator's profile as part of that historical process.

It will then list and describe the fundamental concepts and skills needed for the Future Investigator profile.

Lastly, why is so important to consider this context as the conducive one to redesign this profile as "Safety Investigator"

The most relevant paradigms:

(1931) Heinrich - Domino Model:

1-where in an unsafe action having the potential to become an incident / accident had to be prevented / interrupted in order to avoid the domino effect that ends in an occurrence.
2-The observation that a succession of causes that precipitate each other give rise to accidents. A failure in some of the elements of the prevention system, triggers a system crash or loss: accident or incident.

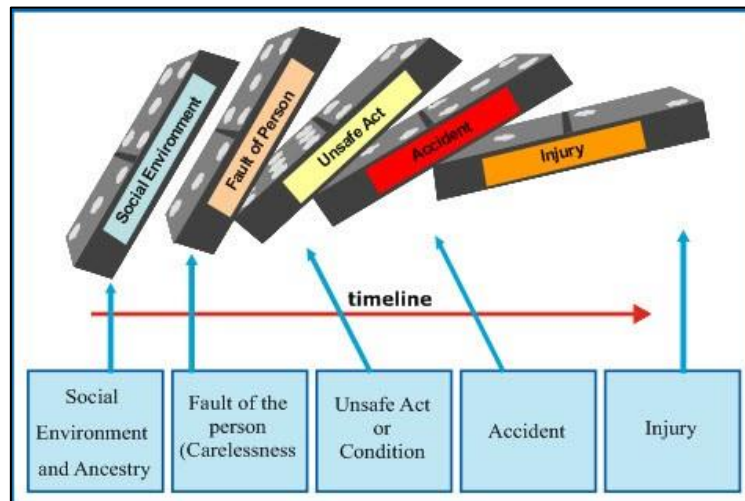


Figure 1. Heinrich -Sequential Model¹

(1997) Reason: the theory of multiple causes / Swiss Cheese model

According to this theory there are latent conditions in the organizations that act on defense vulnerabilities and, when aligned and associated with an active failure, cause the accident.

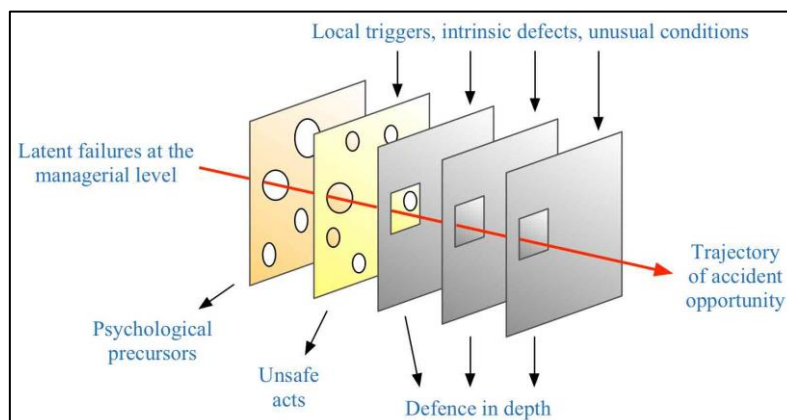


Figure 2. James Reason - Swiss Cheese Model²

Present Time Systemic Approach

Where it is no longer a matter of attributing guilt, but rather implementing the investigation as a mechanism for identifying factors which leads to issue recommendations that remedy errors and improve aviation safety.

Where the entire aeronautical system can learn from those errors and is back-fueled for continuous improvement.

Operational Safety evolution

The history of Safety can be divided into three eras and current challenges.

Technical age: from the 1900 to the late 1960s.

Aviation emerged as a revolutionary massive transport mode, in which accident and incident investigation identified that deficiencies were initially referred to technical factors and technological failures. The results of the investigations were aimed at improving the technical aspects.

In the 1950s, technological improvements led to a gradual reduction in the frequency of accidents and safety processes were expanded to cover regulatory compliance and surveillance.

In the early Commercial aviation era, 70% of accidents were related to technical aspects (focused on those aspects), then accident investigators were required of a clearly technical profile, with the capacity to accurately determine the failure of a component to the smallest detail.

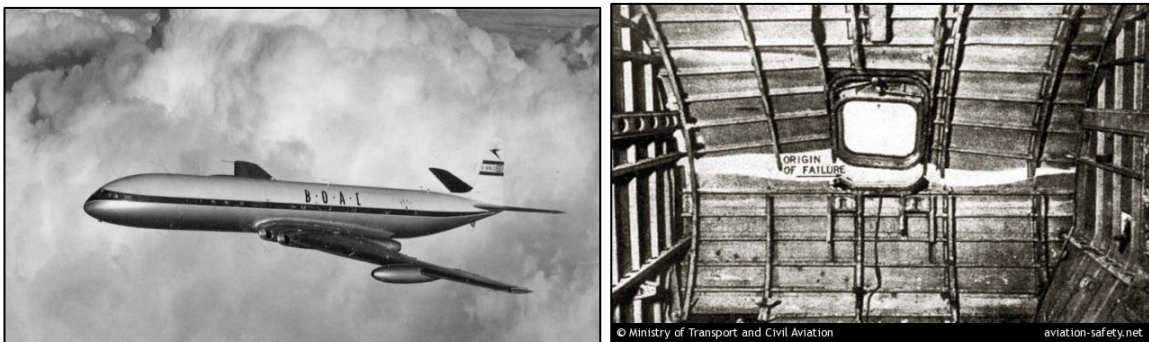


Figure 3. De Havilland Comet- window failure³

[The results of the investigation determined that the structural problems were the result of the concentration of stresses at the vertices of the square-shaped windows. This gave rise to the oval shape of the current windows equipping aircraft]

Human Factors Era: from the early 1970s to the mid-1990s:

In the early 1970s, the frequency of aviation accidents was significantly reduced by technological advances and improvements in operational safety regulations. Aviation became the safest mode of transport and the safety approach was expanded and aimed at including the "human factor" as the human-machine interface.

This required a redesign of the accident investigator's profile into a more closely related to the HHFF aspect.

A new search for information beyond the usual investigation processes became necessary. Despite the investment of resources for "error mitigation", human performance continued to be cited as a recurring factor in accidents.

The application of human factor science tended to focus on the person, without fully considering the operational and institutional context.

It was not until the early 1990s that it was first recognized that human being operates in a complex environment, which includes multiple factors that have the potential to affect the human demeanor and performance.



Figure 4. Los Rodeos, Canarias – accident⁴.

The institutional Era: from the mid-1990s to the present

During the institutional era, research began to be seen through a systemic approach, which addressed institutional factors in addition to human and technical factors. As a result, the notion of "institutional accident" was introduced: it considered the impact of culture and institutional policies on the effectiveness of safety risk controls. In addition, traditional data collection and analysis efforts, which were limited to the use of data collected through the investigation of accidents and serious incidents, were complemented by a new proactive approach to safety.

This new approach was based on routine data collection and analysis using proactive and reactive methodologies to control known safety risks and detect emerging safety issues. These improvements made the logic of moving towards to a safety management approach.

This new evolution in the complexity of accident investigations required continuous support in updating and training investigators to acquire the necessary and appropriate knowledge and skills, to carry out the results of these effectively contribute to improving safety.

New challenges:

According to global reports, the accident rate remains at low levels, while aviation is constantly growing. There are more than 200,000 flights (daily) and 19000 aircrafts are flying at approximately the same time. On the other hand, technological advances and innovations, applied to aircraft, such as ADS-B that transmit real-time IN-OUT information of aircraft positions, weather information, flights details, engines; among others can be sent in real time to the operator's base of operations. In addition to being equipped with different storage systems that record all kinds of data and images. Tools that provides a lot of information that facilitates the process of investigating an accident or incident.

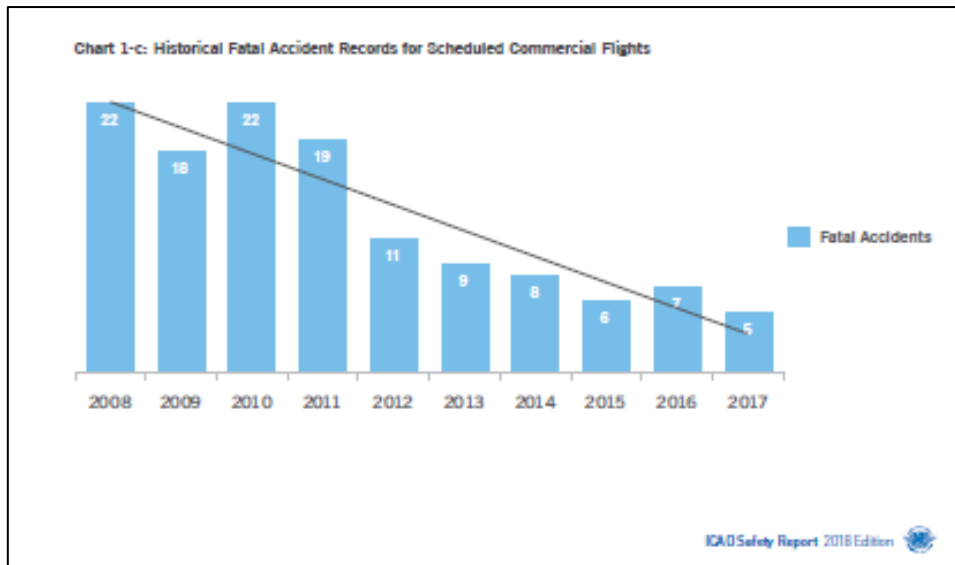


Figure 3. worldwide Fatal accidents 2008-2017⁵

During the investigation of accidents and incidents, in addition to the source of reactive information related to the occurrence of the event, there is an additional data that must be considered and analyzed, whether or not it is related to the event.

An accident or incident is a source of information with a high potential to be explored and exploit, then requires additional skills and competencies to identify, record, analyze and interpret these to transform it into Intelligent Data, foundation for improvement and management of safety.

This new scenario, which is faced with the investigation of accidents and incidents; In addition to the State and Qualified Research Authorities performing their task as set out in Annex 13, new requirements set out in Annex 19 are added. This obliges the authorities AIA, ICAO, Qualified Agencies, to redesign the new role of Investigation agencies, and to deepen the profile of the accident Investigator.

New scope of AIA agencies

Annex 19 in Chapter 5 - Collection, Analysis, Protection, Sharing and Exchange of Data and Information on safety:

Note.— This chapter is intended to ensure the continued availability of operational safety data and information to serve as the basis for safety management activities.

Chapter 5:

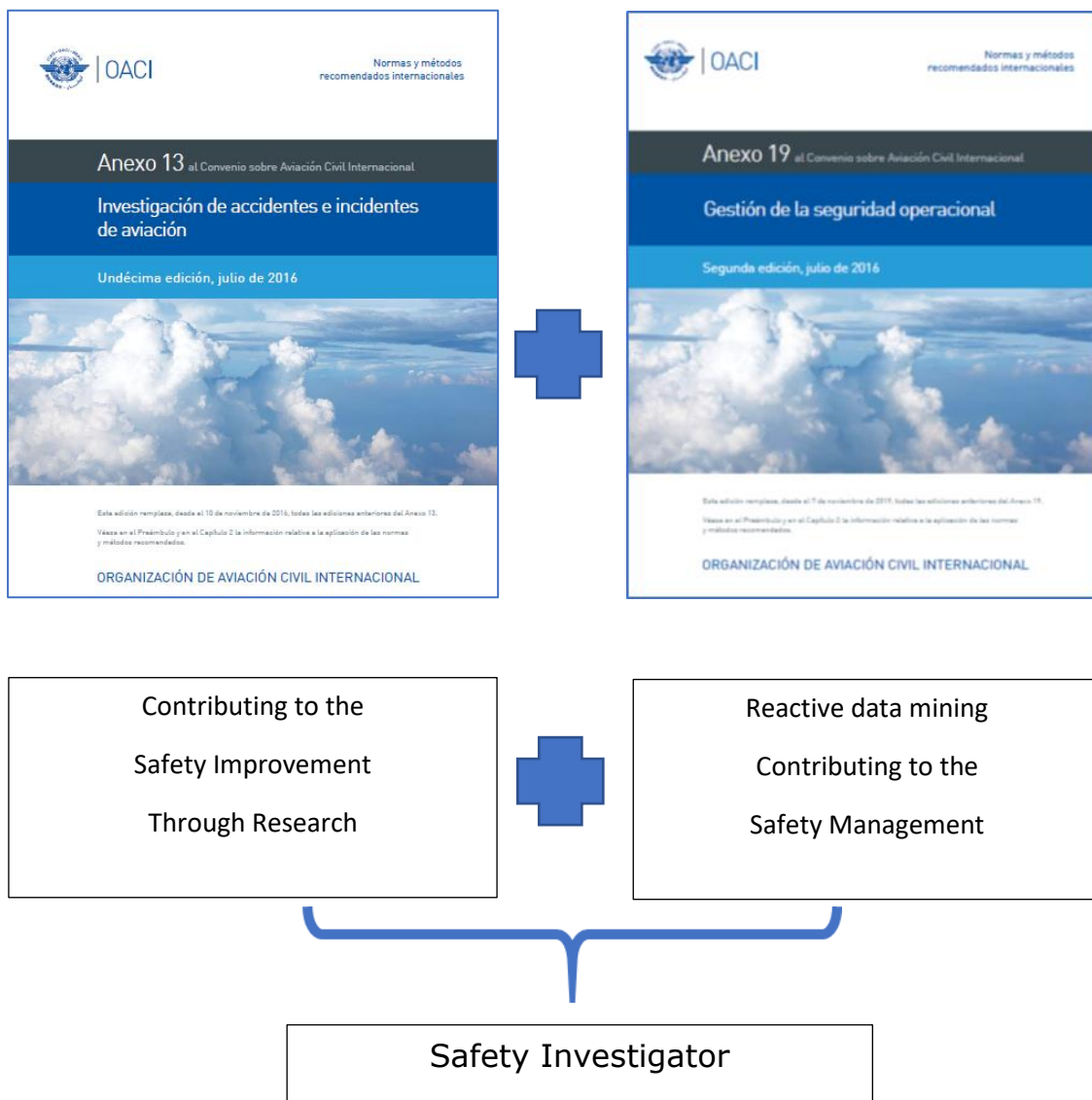
5.1 Operational safety data collection and processing systems

5.1.1 States shall establish safety data collection and processing (SDCPS) systems to capture, store, aggregate and enable safety data and information analysis.

Note 1.—SDCPS refers to processing and reporting systems, safety databases, information exchange schemes and recorded information, and includes, but is not limited to:

- (a) data and information relating to accident and incident investigations;
- (b) data and information relating to safety investigations carried out by State authorities or aviation service providers;

Scheme



Current Regulatory Framework -ICAO Circular 295-

Since the outcome of an accident investigation is largely dependent upon the aviation knowledge, skills and experience of the assigned aircraft accident investigators, they should have:

- ✓ an understanding of the depth of investigation that is necessary in order of the investigation to conform with the legislation, regulations and other requirements of the State for which they are conducting the investigation;
- ✓ a knowledge of aircraft accident investigation techniques;
- ✓ an understanding of aircraft operations and the relevant technical areas of aviation;
- ✓ the ability to obtain and manage the relevant technical assistance and resources required to support the investigation;
- ✓ the ability to collect, document and preserve evidence;
- ✓ the ability to identify and analyze pertinent evidence in order to determine the causes and, if appropriate, make safety recommendations; and
- ✓ the ability to write a final report that meets the requirements of the accident investigation authority of the State conducting the investigation.

In addition to technical skills and experience, an accident investigator requires certain personal attributes. These attributes include integrity and impartiality in the recording of facts; ability to analyze facts in a logical manner; perseverance in pursuing inquiries, often under difficult or trying conditions; and tact in dealing with a wide range of people who have been involved in the traumatic experience of an aircraft accident.

Addition to the regulatory framework

A Safety investigator's profile, in addition to the skills of being an accident investigator, should deepen other skills and competencies, namely:

Leadership

Given the complexity of the current aeronautical system; characteristics of the accidents / incidents; and the consequent interaction between different States (manufacturers, operators, technicians, etc.; ACCREPs and advisors); research teams become multidisciplinary and cosmopolitan. In order to work assertively and optimize time, resources and human capital, Safety Investigator must be trained, acquire skills and work on its own skills to exercise effective leadership management in that context and to develop the teamwork.

Leadership is easy to define as "Ability to influence a group to achieve its goals," or the "Process of influencing others and supporting them to work motivated enthusiastically, in achieving common goals." but hard to execute if there is no training, self-knowledge, and application tools.

It is as much an inherent personal quality as a set of skills learned. To achieve good leadership, the elements of effective leadership must be understood as well as the consequences of poor leadership.

Leadership levels

If we consider leadership as a qualification, we could mention three levels:

- 1) Decision-making, in coordination with its superior and autonomously.
- 2) Organization and coordination, of your own work and the work of your team.
- 3) Development and evaluation of performance, in relation to its collaborators.

The success of the work is measured in the scope of objectives, as well as in the way they are achieved and for this, leadership during teamwork is key.

In our field, we have that same possibility to change the reality surrounding us, beginning with what happens, what we see and what can be identified to be changed.

It is imperative to consider leadership as a key factor in the profile of the Safety Investigator for the future of research and for the success of improving Aviation Safety.

SMS (Safety Management System)

When an accident or serious incident occurs, the accident investigation process is initiated to find any possible failure within the aeronautical system, its motives, and generate the necessary countermeasures to avoid recurrence. Therefore, in an operational safety management environment, the accident investigation process plays a distinct role, as it is a fundamental process that applies when operational safety defenses, barriers, revisions, and compensations in the system.

As an important reactive component of the elements included in the SMS framework, accident investigations contribute to the continuous improvement of the Aviation System's Operational Safety by providing the origin causes of accidents/incidents and lessons learned from events.

This can support decisions on the development of corrective measures and; It can also identify the necessary improvements to the aviation system, such as SMS, as well as the state's accident investigation process.

In addition to establish the findings and causes of origin of accidents/incidents, most investigations identify hazards and threats. An effective and comprehensive research process includes the identification and differentiation between a final consequence, an insecure event and hazards/threats that contribute to occurrences.

This can include any systemic, latent, or institutional factors within the entire aviation system framework. In today's proactive operational safety management environment, there is an important and necessary integration between an accident/incident investigation process and an organization's hazard identification/reporting process.

The final report format of the investigation should clearly state the hazards / threats encountered during the investigation process, which may require a separate follow-up measure through the hazard identification and mitigation process of the organization's risks.

This is why the Safety Investigator will need to acquire the knowledge regarding:

The concept of Safety

Integration of management systems

Notification and investigation of safety

- Collection and analysis of operational safety data
- Operational safety indicators and performance control
- Operational safety risks
- Operational safety risk management

In addition to achieving the SMS analyses of operators and service providers, relating to Hazard / threat identification processes, the risk analysis matrix and understanding the mitigation measures developed from hazards identified, safety and performance indicators.

SSP (State Safety Program)

As of Annex 19, the investigating body becomes a new role within the State's aeronautical system, its work is not only limited to the investigation of accidents/ incidents but is called upon to be part of the State Safety Program Operational providing all safety information obtained from the exploitation of reactive data from an investigation of an occurrence or from safety studies. In addition to providing a different look for not being the implementing authority.

In order to meet this new challenge, the investigator has a broader role than the technical research of an event, the latter, has new competences to participate in the state safety program. For this new competence of the AIG body, the investigator must know clearly this new relationship of the AIG body within the SSP its interrelationship with other aeronautical authorities, operators and service providers and the contribution that the AIG to this new modality of Safety management at the State level.

For which he must acquire new knowledge regarding

SSP Framework

State operational safety policies and objectives

State Safety Responsibilities

Contribution of Accident and Incident Investigation to the SSP

Sharing operational safety information

State Safety risk management

- Collection, analysis and exchange of operational safety data
- Operational safety data and information analysis

State Safety Assurance

- Data protection and operational safety information

Operational safety indicators

Data analysis: the systemic approach in an accident and incident investigation, allows us a broad and deep view of the aeronautical system, identifying during the investigation process real identified or identified safety hazards and deficiencies potential to affect the Safety of the system. This hard data goes a Safety Data Collection and Processing System (SDCPS), all this happens to be data mining that must be exploited and transformed into Data Intelligence as being: Statistic.

For which you will need to acquire basic knowledge regarding

- Descriptive and Inference Statistics
- Central trend and dispersion measures
- Probabilistic analysis

By last but not the least

Knowledge of the Aeronautical System:

A full knowledge of the aeronautical system in order to generate, coordinate and participate in Working Groups with everyone involved in the aeronautical system, taking into clear what is the scope of competence that each one has within the system.

As well as, be able to work in conjunction with those involved in the search for mitigation measures against each safety deficiency identified. It is not enough to develop the recommendations in an isolated area of the AIA organism. The recommendation to be acceptable, feasible and applicable should be dealt with in an area of collaboration, exchange of ideas, concepts and approaches with all those involved in the recommendation, from the aeronautical authority, the service provider, the operator, etc. led by the Investigator in charge of Safety.

CONCLUSION

Today we cannot imagine an investigation procedure without analyzing regulations, technology, technical, operational, and in consideration of its context, culture and institutional policies- SOPs.

Impossible not to speak about SMS, risk management or operational safety culture.

We cannot even think about the analysis of a commercial aviation accident without having shredded the FDR/CVR data until it is brought to its most minimal expression in time and variables.

We seem to have a well-established influence of this in our professional practice, with our own context, region and culture identity.

But, even if the investigation protocols, methods and systems have reached a level of global standardization where we all speak the same language and can visualize the fruits of our work: the decrease in the rate of accidents and incidents in relation to the volume of flights / day and "Continuous Safety improvement" is our daily motto.

Today and looking ahead, a new challenge arises... we see clearly the evolution of aviation and the research along with it.

We need to think about ourselves and redesign our investigation profile based on the modern scenario. Adapt to it in a functional and effective way.

AS INVESTIGATORS WE HAVE A NEW CHALLENGE:

IT IS NOT ABOUT CHANGE...IS ABOUT ADAPTING, KEEP GROWING, IMPROVING, MAKING THE MOST OF US AS A SAFETY KEY IN AVIATION. LEARNING FROM PAST, WORKING HARD IN PRESENT, LOOKING TO THE FUTURE

References

¹ Heinrich Sequential Model

² James Reason Swiss Cheese Model

³ De Havilland Comet- window failure- picture downloaded from <https://aviation-safety.net/photo/3748/de-Havilland-DH-106-Comet-1-G-ALYU> - <https://www.baesystems.com/en/heritage/de-havilland-comet-3---4>

⁴ Los Rodeos, Canarias (Spain) Accident – picture downloaded from <https://vecamspot.com/facts-about-tenerife-airport-disaster-deadliest-air-crash-in-history/>

⁵ Safety Report ICAO 2018