INTEGRATING LEADERSHIP AND INFORMATION DISSEMINATION - A PROACTIVE FRAMEWORK FOR AVIATION SAFETY CULTURE

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DOI: 10.19062/1842-9238.2025.23.1.1

Abstract: *Safety culture is a fundamental aspect of aviation operations, promoting the risk reduction and accidents prevention through proactive measures and open communication. Each individual that takes part to the aviation process has the responsibility to understand it and make the best decisions for the smooth running of things. This article explores the multidimensional nature of safety culture in aviation by focusing on the role of effective information dissemination, but also the critical influence of leadership in shaping and reinforcing these practices. We examine various methods of promoting aeronautical safety, identifying the critical components that contribute to it, and analyze how leaders at every level create an environment where safety information is proactively shared and acted upon. In order to demonstrate the importance of proactive measures and safety information in preventing catastrophic situations, we analyze the Southwest Airlines Flight 1380 as a case study. We show that active leadership, when combined with transparent communication, is essential for preventing catastrophic situations. The lessons learned from this event highlight the necessity of more strict maintenance regulations, updating training protocols, and improving reporting systems. The study concludes with recommendations for fostering a proactive safety culture and optimizing information flow in aviation organizations through the lens of leadership.*

Keywords: *safety, aviation, information dissemination, leadership*

1. INTRODUCTION

The promotion of an aeronautical safety culture represents a mechanism though which lessons learned from the implementation of specific aeronautical safety activities are made available to all personnel involved in aeronautical operations. At the same time, this process helps in developing a positive aeronautical safety culture, which, once established, if followed, can be sustained.

Aviation is often considered as one of the safest industries in the world, due to the constant advancements of cutting-edge safety measures, rigorous training, and strict regulatory oversight. However, the maintenance and improvement of safety remain a challenge in the face of new technological advancements, complex processes, and evolving threat. Also, effective leadership and continuous education sustain and advance this safety culture. The idea of aviation safety culture, which emphasizes a proactive and positive approach to safety at all organizational levels going beyond simple regulatory compliance, is essential in tackling these issues.

According to the International Civil Aviation Organization (ICAO), safety culture is described as more than the sum of its parts.

It refers to "the commitment placed on safety by every individual and every group at every level of the organization", which highlights the need of unified approach, where safety becomes a fundamental organization value, and not just a simple operational requirement [1]. As a general rule, the safety culture refers to how an organization manages and values the safety mentality and procedures.

The study of safety culture has known a great progress from a simple analysis of technological and human errors to an interdisciplinary and systemic approach incorporating organizational, technological and psychological perspectives. Today, safety culture is viewed as a central element of global aviation safety, being a continuous process of identifying and implementing best practices to reduce risks and promote sustainable safety in the industry.

In the issue of professional development and continuous learning, there must also be a side related to monitoring progress, and in the context of this article this can be extrapolated into reference levels. In other words, the level of competence achieved by a given individual in carrying out a specific task will be reflected in the manner of execution approached in fulfilling that task and in the efficiency of achieving the expected results [2].

An organization that successfully implements a positive safety culture, is capable of attaining the goal of maximum attainable operational safety. In this regard, an organization has to focus on the five pillars that together define the safety culture according to Adjekum [3]:

-Informed culture – being aware of the current state of people, technology and relations between them for a good performance overall;

-Reporting culture – the ability to recognize and report errors and shortcomings;

-Just culture – reasoning of what is acceptable and unacceptable behavior regarding safety;

-Flexible culture – the organization needs to adapt continuously based on the evolution of technology or new requirements in the domain;

-Learning culture – the organization needs to rely on lessons learned system.

FIG. 1 Pillars of safety culture according to Adjekum

A safety culture ensures that all stakeholders, from pilots and air traffic controllers to ground crews, prioritize risk management and accident prevention. The five pillars mentioned above are dependent on the way organizations' directorate manages each aspect of its wellbeing. In this regard, leadership is fundamental whether this culture can thrive. Continuous education and progressive leadership competencies play a fundamental role in building organizations that learn from incidents, encourage open disclosure, and adapt in real time to emerging threats. In the same time, as a complementary aspect of air forces development, the continuous learning concept is turning itself into an important factor of one's leader development adaptation[4].In the general aviation context, we can apply the same principle, that well-prepared leaders across the hierarchy of each organization, either civilian or military, enable and sustain robust safety culture.

Aviation organizations with a strong safety culture report fewer incident, develop better teamwork and promote a higher level of trust. Leadership – the way managers, supervisors and officers guide, influence and inspire their crews, significantly shapes whether safety systems are effective and up-to-date.These things can only be achieved if the higher level of aviation organizations leadership has a basic understanding of what constitutes constructive dynamics, team dynamics, and much more that comes from the special quality called professionalism [5].

2. THE IMPORTANCE OF SAFETY CULTURE IN AVIATION

In aviation industry, safety culture went through a complex process, influenced by the technological progress, lessons learned from major accidents, constant changed in regulations and interdisciplinary research on human factors and organizational management. This evolution can be understood through multiple chronological phases, each of them bringing significant contributions to the safety consolidation in aviation.

Initially, aviation safety efforts focused on the development of aircraft and infrastructure in order to guarantee safe flights at all stages, from takeoff to landing. Improvements in hydraulics, avionics, materials, and system integration were all part of these endeavors. By the end of 1960s accidents had drastically decreased due to technological advancements. However, organizational and human factors, officially recognized by ICAO in 1970 and 1990 respectively, have emerged as crucial elements in comprehending and reducing failures [1].

Until the 1970s, aviation accidents were mainly attributed to technical failures, but major incidents, such as the Tenerife runway collision in 1977, radically changed this perspective[6]. This accident, one of the worst in aviation history, involved two Boeing 747 aircraft colliding on the runway, resulting in the loss of 583 lives. One of the main causes, based on the final report after the investigation was human error combined with poor communication between the crew and air traffic controllers.

The fundamentals of safety cultures were not defined very well at this point. The introduction Crew Resources Management (CRM) concept, which is used in every process of organization nowadays, following the analysis of the Tenerife accident, is a training program focused on improving communication, collaboration and decision-making processes in flight crews. This program has become a standard in flight training, being part of the safety culture currently [7]. Also, there was great attention on the awareness of operational pressures and the role of management in aviation processes. Analyses from this period have begun to explore how economic or operational pressures affect safety.Such hasty decisions and strict deadlines without considering operational risks, significantly contributed to incidents [8].

Aviation safety has increased over time as a result of ongoing analysis and integration of these factors, driving to a stronger safety culture and more flights with fewer fatal and non-fatal incidents. Human factors now account for about 80% of the primary causes of aviation accidents, whereas technical factors play a smaller role due to the technological advancements[9]. In order to improve future safety and contribute to a more developed safety culture, this high percentage underscores the necessity of a deeper understanding of the decisions and elements involved in previous accidents to improve future safety.

The 1990s' marked an important transition towards the formalization of safety culture, through the introduction of regulatory standards and structured safety management systems. The adoption of Safety Management Systems (SMS) by ICAO, came with a systematic and proactive approach to identifying and managing risks, which has become mandatory for aviation and its organizations[10]. One of the main concepts that had the attention of aviation organizations was the Just Culture, which promoted the reporting of incidents and errors without the fear of sanctions, aimingto collect and analyze necessary data to prevent future accidents [11].

The latest milestone was the integration of technology which has played a crucial role in improving safety culture, allowing for more precise monitoring of operations and data collection for risk analysis. In this regard, Flight Data Monitoring (FDM) has allowed organizations to proactively identify and prevent risks[12], through detection of deviations from operational standards and implementation of corrective measures.

Depending on the field, organization or operational context, safety culture can be defined and understood from multiple perspectives. In aviation, this concept reflects a collective effort for safety, based on standardized values, behaviors and attitudes that support accident prevention and promote a secured operational environment.

- Organizational perspective – organizations focus on processes that encourage hazard reporting and adapting to emerging risks;
- Individual perspective – each individual, as part of an organization has a commitment to responsible behaviors that support safety;
- Psychological perspective – this culture is shaped by individually of group perceptions, and attitudes that affect the way risks are managed;
- Managerial perspective – safety culture can be treated as a strategic tool in prioritizing safety in decision-making processes;
- Regulatory perspective – ICAO, FAA or EASA are responsible into defining and standardizing safety as a part of aviation, which later must be monitored and enforced;
- Technological perspective – safety is dependent of modern technology to enhance operational safety and communication of critical information.

3. DISSEMINATION OF INFORMATION IN AERONAUTICAL SAFETY CULTURE

The dissemination of information is an essential process in promoting and strengthening the safety culture in aviation. Its role is to ensure that critical information is communicated efficiently and in a timely manner, so that all parties involved can make informed decisions, avoid risks, and contribute to incident prevention. In a complex field such as aviation, where operational conditions can change rapidly, the efficiency of the dissemination process directly influences operational safety.

According to ICAO [1], the efficiency of dissemination depends on 5 main pillars:

- Relevance of the information – messages must be tailored to the target audience and reflect the specifics of their operations. In an environment where the personnel are often overwhelmed, processing a large volume of irrelevant information can lead to the ignoring or misinterpretation of important messages – for example a briefing of alternative routes in case of bad weather becomes essential if it is delivered before the flight, otherwise it might lose its utility;
- Clarity is another essential component of information dissemination. A message that is complex or ambiguous risks being misinterpreted or ignored, which can influence the operational risks. Reason[13] emphasizes that complex information must be simplified to be accessible to all levels of staff, regardless of their training or experience;
- Moment of communication – the time frame to transmit significant information influences the efficiency of dissemination. Information delivered too early can be forgotten or considered irrelevant, while information delivered too late can become useless, especially in critical situations. ICAO emphasizes that timing is crucial for maximizing the impact of the message;
- Means of communication – choosing the right channel to disseminate is essential. Documents can be considered a great method to spread information, whilst online platforms give the opportunity to access information rapidly. In case of urgent and confidential information, briefing is the most suitable way of doing it.
- Feedback – an efficient dissemination process includes mechanisms through which staff can provide feedback on the clarity and usefulness of the information received. This helps organizations improve the process.

These five pillars represent the foundation of effective information flow, but they do not operate in isolation. To apply them, there is a need of capable individuals and an aligned organizational structure. Good leadership is the guiding power that orchestrates how these five elements function effectively in day-to-day settings, ensuring that each step, from choosing the right channel to timing the message release, is executed without flaws. Different processes require different levels of expertise of the same competency to achieve performance, just as not all processes require a maximum level of manifestation of a competency.

In this context, Jim Collins, framework from his book "*Good to Great*," offers valuable insight of how leadership development process is essential for efficient information dissemination. Collins argues that leaders in most large organizations exert influence across five tiers of personal development:[14]

- Level 1 – Highly Capable Individual: Makes productive contributions through talent, knowledge, skills, and good work habits;
- Level 2 – Contributing Team Member: People who support group goals and collaborate effectively;
- Level 3 – Competent Manager: Organizes people and resources toward the effective and efficient pursuit of desired results;
- Level 4 – Effective Leader: Catalyst for a strong vision and drives higher standards of performance;
- Level 5 – Executive: This is the highest level of management in an organization, building sustainable greatness through an unusual blend of personal humility and professional will. Their determination is to do whatever it takes to make the organization "great."

Levels 1 through 4 of Jim Collins' hierarchy can be found in every organization that is made up of more than one person, including airlines, air traffic control units, and maintenance facilities. When new leaders develop in an organization, they tend to become better at what they do. They also help everyone who works with them do the same.

This continuous expansion in leadership capacity equips them to tackle increasing responsibilities, create initiatives, and guide the way information is shared [15].

Achieving a seamless correlation between who is sharing information, when and how they deliver it, requires a high level of leadership insight and precision. Related to the last level of Collins' hierarchy, the personnel at the top of aviation organizations must demonstrate the ability to drive safety measures rigorously. In practical terms, this refers to choosing the right competencies needed for each stage of an operational process, either flight planning, weather briefings, maintenance checks or after mission reports, and matching to the exact level of leadership behavior:

- Clarity and adaptability – Level 2 and 3 leaders, might be in charge of ensuring that all personnel (flight, ground crews) receive relevant updates that can be adapted to local context (ground crew supervisor tailoring maintenance or safety bulletins to a specific aircraft type);
- Strategic oversight – Levels 4 and 5 leaders have the executive authority to change the communication strategy partially or totally, by selecting platforms, allocating resources for staff training or manipulating large-scale feedback loops.

Efficient dissemination of information in a high-stakes environment such as aviation rely on the capacity of an organization to combine the five pillars mentioned by ICAO (relevance, clarity, timing, channel, and feedback) with leaders who can control them. To create this dynamic synergy, where leaders can foster a culture of clear, relevant and on time communication, aviation organizations can integrate leadership training into their safety curriculum, incorporate mentorship and continuous training, assign responsibility accordingly and apply the principles of recognizing and rewarding effective communicators. This way consists of a strong method to achieve a safety culture adapted to modern times.

Even though the dissemination of information has a crucial role in aviation safety culture, this process does not lack challenges. In this dynamic environment there are a few barriers that can affect the clarity, accessibility or applicability of messages to their full meaning. These factors that need to be managed to create a safe medium are:

- Language barrier and cultural differences -Aviation is a global industry where pilots, air traffic controllers, technicians and other professionals from different countries must communicate effectively to maintain operational safety. Differences in language and culture may lead to misinterpretations of critical messages affecting decision-making process and lastly jeopardizing flight safety. That is the reason the standard phraseology was implemented with the help of intensive linguistic courses;
- Cognitive overwhelming - Being a complex work environment, aeronautical personnel is daily exposed to a great amount of information. Depending on other factors, such as fatigue, personal problems, complexity of the mission or experience, this exposure might lead to cognitive overwhelming and ignoring of essential messages.
- Resistance to change -Another obstacle in the dissemination of information is resistance to change, especially when new procedures or technologies impose changes in the daily routine of aviation personnel. Fear of the unknown, lack of trust in the new rules, or the subjective perception that some changes are not necessary, can cause this resistance. In order to combat this, organizations have to involve the personnel in understanding the reasoning behind the changes and receive real feedback from individuals.
- Misinterpretation - A message can be misunderstood depending on the experience, preparation and context of the recipient. Ambiguity in the formulation of instructions can lead to confusion and the incorrect application of safety measures.

- Rhythm of technological and operational changes- Aviation industry knows a continuous evolution in many aspects, where the personnel must adapt to new technologies and regulations. Sometimes, some information is disseminated too quickly, not providing a sufficient foster period. This can be the case of new navigation software, or different new regulations for each airport or aircraft.

- Confidentiality - Information confidentiality and security can be a great barrier, because some safety information contains sensitive details that cannot be divulged. The management of this information must respect a balance between transparency and data protection.

The management of challenges that information dissemination presents is essential to maintain aviation safety. Through the improvement of messages clarity, implementation of new standardized processes, organizations can assure an efficient communication and a safe operational environment.

4. SOUTHWEST AIRLINES FLIGHT 1380 – INFORMATION DISSEMINATION PERSPECTIVE

On April 17 2018, Southwest Airlines Flight 1380, a Boeing 737-7H4, experienced a left engine failure, while climbing to the cruising altitude, 30 minutes after takeoff from LaGuardia airport in New York with Dallas Love Field as the destination airport. The debris from the engine caused significant damage to the aircraft, including fragments that hit the left wing, fuselage and stabilizer. One of the fragments hit the fuselage near a window, which led to an explosive depressurization. The flight crew managed to descend and land safely 17 minutes after the incident on Philadelphia International airport. Out of the 149 souls on board, 1 passenger who sat next to the window, suffered fatal injuries, whilst 8 others were injured. The flight was a regularly scheduled domestic service under Federal Aviation Regulations. The investigation of the case provided valuable lessons on incident management, the impact of effective communication, and the need for proper dissemination of safety information to prevent such events[16].

The role of information dissemination before the incident. Following further investigations, it was discovered that the incident was not an isolated event. The CFM56-7B engine used by the involved aircraft had already experienced similar issues 20 months before the event. In 2016, another Southwest aircraft (Flight 3472), as mentioned in safety data sheets, had a similar incident where a fan blade detached and caused severe damage. As a consequence, the National Transportation Safety Board (NTSB) and the Federal Aviation Administration (FAA) issued recommendations for more rigorous inspections. However, just the recommendations were not sufficiently efficient. If the information from the previous accident was enforced more through safety bulletins and regulations, maybe the Flight 1380 incident could have been avoided. This aspect emphasizes the importance of a proactive information use in the safety culture.

Regarding the relevance of information, operators knew about the engine malfunctions, but the communication of how urgent and critical those risks were remained unclear. Also, FAA made the inspections mandatory only after the second incident (Flight 1380), proving that the necessary dissemination of information after the first one was ineffective. Also, high-level organizational leaders bear the responsibility to interpret and act on hazard reports. And this incident is no exception. Failure to emphasize proactive risk management and to foster a Just culture, not only undermines information dissemination, but also directly affects the readiness to address known technical vulnerabilities.

The role of information dissemination during the incident. A positive aspect of the Flight 1380 incident is represented by the pilots' professionalism, especially the captain Tammie Jo Shults, a former fighter pilot, with great experience in aviation. The way the crew managed the situation demonstrated the efficiency of the training in application of the emergency procedures. The pilots followed the established protocol, by making an emergency descent to bring the cabin back to safe breathing altitude, maintaining clear and efficient communication with air traffic controllers. This demonstrates that efficient information dissemination during training and the use of simulators in emergency scenarios can help drastically any critical situation.

By following protocols and communicating effectively, the crew demonstrated they were involved actively in the safety culture, being flexible, based on the new circumstances. However, the aviation industry as a whole failed to learn from the past experience fast enough. Following the 2016 incident (Flight 3472), which calls into question the effectiveness of the feedback process and organizational learning in the safety culture, the FAA and airlines should have taken more concrete actions more quickly.

The role of information dissemination after the incident. This incident has become a part of safety culture in understanding the process of disseminating information, which improved, prompting the FAA and other regulatory agencies to take measures to prevent similar situations. An important initiative in this matter was the Airworthiness Directive AD 2018.09.10, which mandated frequent inspections of the fan blades of the engines that causes the two incidents. This reactive measure demonstrated the importance of fast and mandatory dissemination of safety information, assuring that the personnel involved in the industry apply stricter inspections to detect critical defects before they can become dangerous for flying.

At the same time, the NTSB published a detailed report on the causes of the incident, creating the opportunity for the aviation industry to become more transparent. As a result, Southwest Airlines and other companies implemented more frequent inspections, disseminate lessons learned, and used safety bulletins, training and simulators to improve responses to similar future situations. While these measures exemplify post-incident learning, it also highlights a missed opportunity for more proactive leadership. As Collins describes, a level 5 executive mindset would have enforced immediate changes following the first incident (Flight 3472) rather than wait for another incident.

The implementation of more stringent inspections programs enhanced the safety culture in aviation industry, encouraging a more proactive dissemination of safety related data across all operators.

Lessons learned. The Flight 1380 incident, demonstrates that information dissemination is important at all stages. All the training required before the flight, the relations between pilots, crew and ground operators, and the technical aspects are necessary for a good flying activity. What makes the difference, though, is the communication and how information gets between them. As long as there are any flaws or misunderstandings, there might be something that can jeopardize the entire activity. The Flight 1380 confirmed that someone along the communication chain has not done their job as they were instructed to. What can be learned from this incident in order to improve aviation safety culture include:

- Future dissemination of critical safety information needs to be more **proactive** and less reactive, where lessons from each incident are disseminated immediately. Rather than waiting for another incident to validate the risk, which could be more devastating, potential hazards should be taken into account and trigger immediate regulatory enforcement.

Each incident or situation should be treated as serious as possible, and all the regulations coming from aviation agencies must be enforced rather than treated as optional recommendations;

- Organizations need to treat all safety warnings with high priority and act on them accordingly. It does not matter the gravity or dimension of a flaw in the system, it might create a domino, increasing catastrophically. This requires **transparent mechanisms of sharing data** at all levels, between regulatory agencies, airline operators and manufacturers, ensuring there are no gaps in this chain of information. Real-time data analytics, continuous monitoring or predictive maintenance technologies allow aviation stakeholders to detect and address actively risks before they escalate into full-scale incidents;

- Improving **Crew Resource Management (CRM) training** is another lesson learned. Although CRM was a strong aspect of the Flight 1380 incident, it needs to be continuously expanded by including more scenario-based simulations, ensuring that crew and other ground personnel can handle any situation, regarding its complexity. By ensuring that communication during emergencies is precise and on subject, airlines can mitigate errors induced by high intensity environments and increase the safety overall;

- Aviation safety culture depends on the **ability to learn from past incidents** and implement lasting changes. To improve just culture and reporting mechanisms, aviation industry must encourage open incident reporting without fear of punitive actions. Pilots, maintenance crew or airline staff should feel comfortable to report safety concerns, such as errors or damages, knowing that their report will lead to proactive measures. Also, the transparency should not stop there, but safety reports and findings should be shared across the industry, in order for other operators to benefit.

5. CONCLUSIONS

The importance of a robust safety culture and an efficient information dissemination in aviation cannot be overstated. The Southwest Flight 1380 shows the important role that proactive communication, regulations and safety practices plays in accident prevention and improvement of operational safety. Safety culture is not a static concept, but a dynamic one where it needs to adapt to knew technologies, operational risks and human factors.

The five pillars of information dissemination (relevance, clarity, timing, appropriate channels and feedback) represent the fundamentals of how safety-related messages reach every individual or group. However, these pillars can be enforced to reach their full potential when guided by leaders who are committed to expand a Just culture and continuously adapt it to new requirements. Drawing on models, such as Jim Collins' framework, it shows clearly the role leaders from Highly Capable Individual to Executive levels contribute harmoniously to building an environment where safety is dominant.In addition to upholding procedural and technical norms, proactive leadership fosters an environment of openness, responsibility and continuous learning. When leaders at each level ensures that safety primates and lessons learned are taken into account as starting points for new changes, organizations are better equipped to diminish risks and adjust to evolving operational challenges.

Ultimately, by combining leadership skills with the core aviation safety initiatives, as improving the dissemination of information systems, organizations can develop resilient systems that prevent incidents, protect lives, support operational efficiency, and drive sustainable safety improvements.

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