

A COMPLETE GUIDE ON COMMERCIAL AVIATION SAFETY

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Abstract

This paper reviews the economic literature relating to aviation safety; analyzes the safety record of commercial passenger aviation in the United States and abroad; examines aviation security as a growing dimension of aviation safety; and identifies emerging issues in airline safety and challenges for aviation safety research. The finding that developing countries have much poorer safety records has been a persistent conclusion in aviation safety research and continues to be the case. Unfortunately, operations data are not available for many of the airlines that experience fatal accidents, so it is not possible to calculate reliable fatality rates for many segments of the worldwide aviation industry.

Introduction

When thinking about flying in today's world, most people just willingly book a ticket and hop on an airplane with the expectation that they will arrive safe and sound (and mostly on time) to their destinations. Many of those travelers even willingly, or begrudgingly, accept that the air travel is actually the safest form of transport on Earth that can quickly and efficiently take them to virtually any place in the world.

Unfortunately, that wasn't always the case and aviation safety has definitely been an ever evolving process that strives for continuous improvement. This evolution has not only lead to aviation going from the least safe form of transport to the safest, but has also developed the technology that is now finding its way into other industries, such as the medical field, to improve safety

and decrease risk where lives are also at stake.

Aviation Safety's inauspicious beginning probably started on September 17, 1908 a mere four years and nine months after the Wright Brother's first flight and only five months after the first passengers were carried by airplane. This less than momentous occasion also included the Wright Brothers when Orville Wright crashed with passenger Thomas Selfridge during a demonstration flight for the US Army. Wright was seriously injured and Selfridge was killed, leading to aviation's first fatality. Of course, as aviation grew and more planes were built, more flights were conducted and more people began to push the boundaries of the technology, there were more accidents and more fatalities until eventually industry leaders believed that some form of oversight would be needed to help aviation really reach its full potential as a mainstream form of travel; as endless crashes would not be acceptable to the traveling public. This trend of increasing travel with an expectation for a decrease in accidents has continued to this day.

These circumstances lead to the establishment of the Bureau of Air Commerce in 1926 with the passing of the Air Commerce Act as a way to oversee regulation and promotion of air transport.

The first publicly popular safety incident was the death of Knute Rockne aboard a TWA Flight in 1931. Due to his high profile as Notre Dame's football coach, the public demanded inquisition and information about what had happened. This importantly changed two major things that would determine the path of aviation safety forever. First, it changed the practice of keeping accident causes a secret. Second, it started the trend of using technology and design to improve the safety of airplanes. This was part of what prompted the move away from wood and fabric to aluminum as a main construction material.

The next watershed moment in aviation history was the fatal crash of Senator Bronson M. Cutting in 1935, which led to the creation of the Civil Aeronautics Agency in 1938. The function of this change was to separate the regulation of air travel from the Department of Commerce, and to give the ability to regulate, investigate and ensure flight safety by giving the oversight of national airspace system, air traffic control to the Civil Aeronautics Agency and aviation safety regulation, oversight and economic control of airline routes to the Civil Aeronautics Board.

In 1956 with the mid-air over the Grand Canyon as a result of lack of radar, the regulators were again reorganized into today's current FAA, which combined all regulatory, ATC, and Safety functions into one place (route regulation remained in effect until 1978 and investigation also remained independent).

With the modern regulatory framework established and consolidated, focus could

turn to emerging technologies that could be used to enhance safety in an era of jet transport and massive worldwide expansion. The first of these was obviously the widespread integration of radar into the air transport system, which would safely ensure aircraft separation even during inclement weather.

It should be noted that up to this point in time, investigation was primarily based on an understanding of forensic evidence available to investigators, and in those cases where there were survivors and eye witnesses, information that could be provided by those people to help piece together the chain of events that led to an accident. Of course this typically did little to answer the how and why of accident causal factors, not to mention contributing factors that may have played a role such as electrical failures, etc. This made it difficult to incorporate lessons into new technologies or ways of doing things once an accident was investigated. This led to the next big push in safety, the Cockpit Voice Recorder and Flight Data Recorder which both became mandated in the US in 1967. For the first time ever, investigators had a first-hand look into the operating parameters of an airplane prior to the crash, as well as some insight into what the crew was doing, thinking, or saying during the accident events. This revolutionized air safety because it allowed investigators to glimpse details of the accident that might be able to be used to prevent future occurrences.

Of course, the now widespread usage of these technologies highlighted the fact that the vast majority of aviation accidents were related to human error. This rendered the

next step also revolutionary for aviation safety. By identifying the details of the human role in aviation accidents safety professionals could, for the first time, identify trends and problems in human behavior and interaction and begin to educate and train pilots to work together to achieve the common goal of a safe flight. This was the birth of Cockpit Resource Management; later revised to Crew Resource Management (CRM) when it became apparent that “all resources” were not just limited to the flight deck. This technology alone had the single greatest benefit so far to improving the safety of aviation because it specifically taught personality and decision making norms that not only included everyone, but also got those crew members working with the same tools and technologies and improving coordination as a team.

By the mid-1990's, CRM had more or less become a mature technology, it had been widely implemented, and was directly credited with avoiding or preventing many accidents or incidents that could have been far worse. However, CRM could only do so much toward preventing future accidents because it was still fundamentally being updated and improved based on events that had already happened and could not necessarily predict or prevent accidents that could happen in the future. In order to move safety to the next level, a system to prevent accidents would need to be developed.

In the late 1990's the implementation of Flight Operations Quality Assurance, or FOQA, became the first push in a system that would be able to predict developing trends or problems. Essentially, computer

technology had come to a point on most airplanes where it could actually keep track of data not just on accident or incident flights, but on the thousands of other flights that occurred between such flights. This allowed investigators, safety people, maintenance and flight ops personnel to download and track flight data over thousands of routine flights and monitor trend data such as unstable approaches, which could then be integrated into training, newsletters, policies, etc. In addition to the front line usage, it allowed the FAA to be able to identify problem trends with things such as structural design issues which in turn allowed them to make more effective rules and regulations regarding aircraft design and certification standards, airmen training requirements, etc.

Now that trend data could be readily identified, safety professionals realized that in order to get to the root causes behind the trends identified under FOQA, they needed to get first hand insight into the actions of crew members. As any aircrew member knows, no crew member will willingly trust divulging what mistakes they made or procedures they violated to management or the FAA knowing that they could be prosecuted or disciplined for it. In general, all successful safety programs require a system of openness and protection in order to get all parties to actually participate seriously. Of course there are exceptions for intentional and willful violations, but overall, the FAA, safety professionals, the airline flight departments and employee representatives sat down and designed the Aviation Safety Awareness Program, or ASAP system to encourage participation and protect those who report openly. In

fact, open reporting actually has strict guidelines for protections that aren't necessarily provided if someone fails to report. ASAP was eventually expanded to maintenance technicians, ground crew, flight attendants, dispatchers, ATC professionals, etc. to address trends in all areas of aviation.

Now that the aviation safety system was inclusive of all disciplines and constituents who openly reported and identified operational data, mistakes, challenges, violations or anything else of note, the safety system can finally evolve into a system that is able to actually identify accidents before they happen, which really is the end goal. The name of this system is a Safety Management System or SMS. SMS is a term that leaves most people saying "what?" but is essentially just a structured hierarchy to identify and classify trends, problems, changes, system issues, or any other problem that may require attention. It relies heavily on data and input from multiple data systems and reporting systems to help identify things that require attention either through training, policy, procedures or systems modification. It functions based on the reality that very seldom do accidents just happen. There are usually dozens if not hundreds of incidents prior to an accident that had similar symptoms, inputs or behaviors to the accident flight without actually resulting in an accident. By identifying these common links, safety people, flight ops and training people can preemptively employ tools to try and mitigate and reduce these occurrences before the accident ever occurs, and thus aviation has pro-actively become the safest form of transport the world has ever seen,

despite flying higher further, faster and more often than ever before.

Aviation safety refers to the measures taken to ensure the safety of passengers, crew, and aircraft. Key aspects include:

Regulatory Framework

1. International Civil Aviation Organization (ICAO)
2. Federal Aviation Administration (FAA)
3. European Aviation Safety Agency (EASA)

Safety Components

1. Aircraft Design and Manufacturing
2. Maintenance and Inspection
3. Pilot Training and Qualification
4. Air Traffic Control and Management
5. Weather Monitoring and Forecasting
6. Emergency Procedures and Response

Safety Metrics

1. Accident Rate
2. Incident Rate
3. Fatality Rate
4. On-Time Performance
5. Safety Management System (SMS) implementation

Safety Initiatives:

1. Advanced Weather Radar Systems
2. Collision Avoidance Systems
3. Enhanced Vision Systems
4. Automated External Defibrillators

5. Crew Resource Management (CRM) training

Challenges:

1. Cybersecurity threats
2. Drone integration
3. Weather-related risks
4. Human factors and fatigue
5. Increasing air traffic and capacity

Organizations:

1. International Air Transport Association (IATA)
2. Flight Safety Foundation (FSF)
3. National Transportation Safety Board (NTSB)
4. Aviation Safety Network (ASN)
5. European Aviation Safety Agency (EASA)

Recent Developments:

1. Artificial Intelligence (AI) in aviation safety
2. Blockchain for aviation security
3. Electric and Hybrid-Electric Propulsion
4. Urban Air Mobility (UAM) safety considerations
5. COVID-19 pandemic's impact on aviation safety

Pilot Safety

A thrilling adventure awaits those who embark on the path to becoming a certified pilot. Deep commitment and a passion for flying are essential on this journey. Theoretical knowledge and practical skill

development are intertwined in the art of flying. Safety, precision, and professionalism are the cornerstones of pilot training, laying the foundation for a pilot's entire career. A lifetime of growth and discovery unfolds for those who embrace this transformative journey.

Pilot training initiatives that blend theory and practice provide the essential building blocks for molding aspiring pilots into competent flight professionals. A comprehensive curriculum, comprising classroom instruction, flight simulators, and real-world flying experience, forms the nucleus of this transformation. At its core, the program aims to foster a deep understanding of aircraft systems, meteorology, navigation, and flight regulations, complemented by the development of essential hands-on skills to operate an aircraft with precision and safety.

The path to becoming a pilot is marked by stringent requirements and a relentless pursuit of excellence, demanding that students demonstrate unwavering discipline and adaptability. As the aviation landscape continues to shift and evolve, the training curriculum is continually refined and updated, ensuring that each new generation of pilots is prepared to meet the challenges of the skies. The unshakeable emphasis on safety throughout the training process is a powerful testament to the aviation community's dedication to safeguarding life and property.

Flight Safety: The Top Priority for Air Travel

The aviation industry's cornerstone is flight safety, a vital component that safeguards

the lives of passengers, crew, and aircraft. The importance of flight safety is unequivocal, as it is crucial for upholding the trust and confidence of the traveling public. A robust safety culture is the backbone of the industry, ensuring that every facet of flight operations is executed with precision and care, prioritizing safety above all else.

Ongoing efforts to enhance flight safety are a top priority, with the aviation community dedicated to driving progress and improvement. Identifying and addressing potential risks is a constant focus, with a range of strategies in place to minimize threats and ensure the highest levels of safety. This includes comprehensive training programs, strict regulatory compliance, and the leveraging of cutting-edge technology to monitor and optimize safety measures.

The aviation industry's unwavering dedication to safety has yielded a remarkable achievement: an exemplary safety record that serves as a testament to its unrelenting efforts. The rarity of accidents and incidents is a direct result of the industry's pervasive safety culture, which permeates every aspect of pilot training and flight operations. Safety remains the paramount concern for all stakeholders in the aviation community, a commitment that will continue to guide the industry's progress.

Fundamental Factors in Pilot Training

The development of a skilled pilot involves a multifaceted approach, with a thorough understanding of aviation theory serving as the cornerstone. Key aspects of this theoretical knowledge include

aerodynamics, aircraft systems, meteorology, and navigation, all of which are essential for making informed decisions during flight. By grasping these fundamental concepts, pilots can navigate the cockpit with confidence and precision.

Pilot training also emphasizes the importance of hands-on flying skills, where students must hone their ability to control the aircraft, navigate in-flight scenarios, and respond to emergency situations. This necessitates numerous hours of practice, both in the air and on the ground, utilizing state-of-the-art flight simulators. These simulators are indispensable resources, affording students the chance to experience a wide range of flight conditions and system failures in a secure and controlled environment.

The third critical component of pilot training is the development of vital non-technical skills, such as effective communication, teamwork, and sound decision-making. In the high-stakes environment of the cockpit, pilots must be able to work seamlessly with their co-pilots, air traffic controllers, and other personnel to ensure the safety of all on board. Pilot training programs strive to cultivate attributes like workload management, conflict resolution, and situational awareness in their students.

Charting Your Course: The Journey to Certified Pilot

Pursuing a career as a certified pilot is a thrilling adventure marked by challenges and accomplishments. The journey commences at a reputable flight school or aviation academy, such as Positive Attitude Aviation, where a rigorous selection

process evaluates candidates' aptitude, medical fitness, and psychological preparedness. Following acceptance into a pilot training program, students progress through a well-structured curriculum that transforms them from beginners to competent pilots.

In the early stages of training, aspiring pilots develop the essential skills of flight. Under the guidance of seasoned instructors, they master the art of taking off, navigating, communicating, and landing. As they advance, they're introduced to more sophisticated aircraft and scenarios, which helps build their confidence and competence. With each achievement, they move closer to the coveted milestone of solo flight – a defining moment in every pilot's journey.

Following solo flight, the training program becomes even more rigorous, with students delving into advanced navigation strategies, instrument flying, and multi-engine operations. To demonstrate their expertise, they must successfully complete a series of written and practical exams. The ultimate reward for their hard work and perseverance is the commercial pilot's license, a credential that opens doors to a career in aviation and serves as a testament to their unwavering dedication and exceptional skill.

Pilot Training's Safety Protocols

The safety of students, instructors, and equipment is the top priority in pilot training, with a rigorous framework of protocols in place to ensure a secure learning environment. This all-encompassing approach to safety encompasses a broad spectrum of

measures, including thorough pre-flight checks and effective emergency procedures, all aimed at minimizing risk and maximizing safety.

Pre-flight checks are a critical ritual for pilots, involving a thorough examination of their aircraft to confirm all systems are functioning as expected. They must also carefully assess the weather and plan their flight accordingly, taking into account variables like wind patterns, visibility, and airspace restrictions. Should an in-flight issue arise, pilots are trained to follow established emergency protocols to ensure a safe and successful outcome.

Safety protocols in aviation extend far beyond the cockpit, encompassing every aspect of ground operations. Aircraft maintenance, for instance, is conducted with precision and rigor, while airport design prioritizes safety through clear signage, well-maintained runways, and state-of-the-art air traffic control systems. This all-encompassing approach to safety underscores the aviation industry's unwavering commitment to upholding an unblemished safety record.

What to Anticipate in Pilot Training

Embarking on pilot training can be a daunting yet exhilarating adventure. Aspiring pilots should prepare themselves for an intensive learning odyssey, characterized by a demanding curriculum that requires unwavering commitment and effort. The training is meticulously structured to sequentially build expertise, beginning with the fundamentals and advancing to complex theories and procedures.

Throughout their journey, pilot trainees are surrounded by a nurturing yet challenging environment that fosters growth and learning. They benefit from the guidance of seasoned instructors, cutting-edge facilities, and a vibrant community of like-minded individuals who share their passion for flight. The bonds formed among trainees are often a highlight of the experience, creating a sense of belonging and collective purpose.

Pilot trainees can expect to undergo a range of evaluations that measure their progress and readiness for advancing to the next stages of training. These assessments are designed to be comprehensive, covering both the theoretical aspects and practical applications of flight. By providing constructive feedback on their performance, these evaluations enable trainees to identify areas for improvement and adjust their training accordingly.

Final Thoughts

The outlook for pilot training and safety is optimistic, with continuous innovations in technology and educational methods poised to elevate the training experience to new heights. Advances in simulation technology, for instance, are enabling more authentic and diverse training scenarios, better preparing pilots for real-world challenges. Moreover, the forthcoming integration of virtual and augmented reality tools promises to revolutionize pilot training, introducing novel and engaging ways to acquire critical skills.

To recap, pilot training plays a vital role in the pursuit of flight safety. The industry's future looks bright, thanks to the joint efforts of regulatory bodies and training

institutions. A relentless focus on safety, excellence, and continuous improvement will undoubtedly lead to a safer flying experience for all.

Another major contributor to the improved safety record can be traced to the careful investigation of past accidents to determine what led to the accidents and what needs to be done to prevent such events from occurring again. This reactive approach to improving aviation safety has been enhanced by the thorough analyses of data from numerous accidents, which has aided in the identification of recurring patterns or risk factors that are not always apparent when individual accidents are investigated. More recently, proactive approaches to determining ways to improve safety have become increasingly popular. An example of such a proactive approach is the analysis of incident data to identify areas of increased risk that may lead to an accident.

Conclusion

Commercial airline safety has improved dramatically since the industry's birth over a century ago. Fatal accident rates have fallen to the level where (along many dimensions) aviation is now the safest mode of commercial transportation. The next generation of safety challenges now require development and understanding new forms of data, and moving from a reactive, incident-based approach toward a more proactive, predictive and systems-based approach.

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