The Dangers of Reduced Crew Operations

BACKGROUND

Commercial aviation is the world's safest mode of transportation, with a record that continues to improve even as airline flying steadily grows. The public has many factors to thank for this, but at the top of the list are highly trained pilots who fly through increasingly crowded skies at all hours of the day and night and in all types of weather.

Despite this enviable safety record, various commercial aviation interests are actively considering and planning to remove pilots from airline aircraft. They are advocating for systems which will reduce the number of pilots down to a single pilot, or in some cases, no pilot at all.

Advances in aviation technologies have led to systems that aid pilots in managing workload and improving flight path efficiencies. These systems cannot replace the training, flying skills, judgement, and experience of pilots in emergency situations or the dynamic environment of the complex airspace system.

Some companies argue that reducing the number of pilots aboard aircraft could increase profits for airlines and their financial investors without compromising safety. The current body of evidence and experience shows otherwise. The safety and security risks, as well as the challenges associated with reducing flight deck crews, far outweigh the potential benefits.

Reduced Crew and Single-Pilot Airline Operations: A Risk Not Worth Taking

There are numerous risks associated with reduced-crew and single-pilot operations. Most prominently, these risks stem from the increased workload for the remaining pilot, the elimination of a critical layer of monitoring and cross-checking and operating redundancy on the flight deck, and compromising the safety and security beyond acceptable levels of risk given the many variable emergency situations that may occur during a flight.

Under reduced-crew or single-pilot operations, a combination of integrated systems with varying levels of automation and ground-based pilots with the ability to control the aircraft would be expected to partially offset the extra workload. However, National

Aeronautics and Space Administration (NASA) and others[1] indicate that these proposed solutions do not provide the same safety margin as having a second qualified pilot physically on the flight deck.

In addition to increasing workload, single-pilot operations negatively impact communication and pilot performance and do not defend against pilot incapacitation. There are many examples of incidents where two pilots on the flight deck were needed to recover from equipment malfunctions that otherwise would have likely resulted in disaster.

The following statements summarize IFALPA's position against reduced crew operations. To learn more about IFALPA's position on each of these topics, please select the links below the respective topic, or refer to Appendix A – Expanded Details (p. 4-9, herein):

SAFETY BENEFITS OF MULTIPLE PILOTS

- Workload Sharing and Crosschecking
- Flight Deck Coordination
- Rapidly Adapting to Changing Conditions
- Emergency Response, including those that are not aircraft systems related

SIGNIFICANT RISKS OUTWEIGH THE PERCEIVED ADVANTAGES

- Cybersecurity on the Flight Deck
- Inflight Security: Risk of Insider Threat
- Increased Workload
- Reduced Coordination
- Overreliance on Automation
- Technological Hurdles

PUBLIC POLICY AND OPINIONS ON REDUCED CREW OPERATIONS

- Regulatory Requirements Mandate Two or More Pilots
- Public Opinion Supports Two Pilots on the Flight Deck

IMPROVEMENTS IN INFORMATION TECHNOLOGY A HIGHER PRIORITY

- Upgrading Airspace Systems
- Alternative Research Avenues

[1] San Jose University/NASA, *Toward Single Pilot Operations: The Impact of the Loss of Non-Verbal Communication of the Flight Deck* (2014).

ECONOMIC JUSTIFICATIONS ARE ABSENT

- Overall Operating Cost Savings Insignificant / No Change to Ticket Prices
- Qualified Pilots are Required Regardless of Operation Type
- Environmental Cost

CONCLUSION

IFALPA fully supports any developments that improve the current safety and security standards in commercial air transport. Our enviable safety record and culture is based upon at least two properly rested, fully qualified, and well-trained pilots at the controls on the flight deck during all phases of flight. It is imperative that any future evolution of this benchmark improves upon it and does not degrade the safety and security level in any area.

It is IFALPA's position that because reduced crew operations carry significant additional risks over existing two-or-more pilot operations, such operations will result in a serious reduction in flight safety and security. It is essential to fully address the risks and shortfalls in safety and security that lie within those reduced crew concepts before the industry accepts changes to the standards which have built the safest transportation system in history.

APPENDIX A – Expanded Details

SAFETY BENEFITS OF MULTIPLE PILOTS

Worldwide, current aviation laws and rules require at least two qualified pilots at the controls on the flight deck at all times during flights of large passenger and transport aircraft. Extra relief pilots are required to be onboard long-haul flights. Typically, at any given time on the flight deck, one pilot (the "pilot flying") is actively flying the aircraft, while the other (the "pilot monitoring") is responsible for monitoring the instrumentation and the flying pilot, checklist management, and communicating with air traffic control.

While the modern cockpit features many automated systems, the pilot flying is always actively engaged and responsible for flying the aircraft; flight deck automation is merely a tool at their disposal. Reduced crew concepts would eliminate one or more relief pilots on long-haul flights potentially resulting in only one pilot remaining at the controls while the other rests, or in the remaining pilots simply spending more time at the controls. Despite recent technological advances, the aircraft designers remain far from proving a level of automation that would provide a level of safety equivalent to having two well-rested, well-trained, and qualified pilots on the flight deck at all times.

Workload Sharing and Cross-Checking

In standard two-pilot operations, the tasks are shared between a "pilot flying" and a "pilot monitoring," which is especially important during the work-intensive taxi, takeoff, and landing phases of flight. On every flight, both pilots must verify the lateral and vertical trajectory of the aircraft.

Starting from the pre-flight planning stages, pilots must agree on the routing and challenges associated with weather along the route, and the fuel necessary to balance safety and contingencies versus safety. Once on the flight deck, one pilot enters the route in the flight management computer while the other independently verifies and cross-checks the accuracy of the data to prevent any lateral route excursion. This is accomplished throughout the entire flight.

Single-pilot operations employ only the pilot flying, who must assume some share of the functions of the pilot monitoring, while other tasks are offloaded to computers and ground-based pilots. The result, inevitably, is a significantly increased workload for the pilot flying. Moreover, there is a clear inverse relationship between pilot workload and safety, particularly during unusual or non-normal conditions. Flight path performance was also better during studies for two-pilot operations compared to reduced or single-crew operations.

Flight Deck Coordination

Two pilots seated side-by-side on the flight deck can closely coordinate their actions via Crew Resource Management (CRM). CRM is a proven and effective use of all available resources for flight crew to assure a safe and efficient operation, reducing errors, avoiding stress, and increasing efficiency. This is an overall strategy of flight deck resources.

CRM is not about the technical knowledge and skills required to fly and operate an aircraft but rather the cognitive and interpersonal skills needed to manage the flight. These include, but are not limited to, briefings, constant effective communication, which may include nonverbal cues such as head nods and other gestures that indicate a message has been heard or a task is being performed.

The pilot monitoring also plays an important role monitoring the pilot flying, watching out for errors or declines in alertness or cognitive ability. Should the pilot flying become incapacitated for health reasons during a flight, the pilot monitoring can quickly take control of the aircraft.

Rapidly Adapting to Changing Conditions

Pilots mitigate safety, security, and operational risks on a frequent basis by the situational awareness they develop firsthand on the flight deck, adapting to changes in circumstances including direction from air traffic control, weather, equipment malfunctions, airport congestion, flight diversions, as well as the dynamic of supporting the cabin crew with passenger issues. This ability to adapt to a dynamic environment is critical. Single-pilot operations or reduced crew operations would compromise that layer of safety, posing an unacceptable risk.

Emergency Response

There are numerous documented incidents in which two or more pilots were necessary to avert disaster following major in-flight equipment malfunctions. Examples include the 2009 incident in which a US Airways flight crew successfully ditched an Airbus 320 into the Hudson River after multiple large bird strikes caused a dual-engine failure shortly after takeoff, and the 2018 incident where a Southwest Airlines flight suffered a catastrophic engine failure and debris shattered a passenger window in the cabin. A 2017 NASA/FAA study[2] concluded that single-pilot operations pose an unacceptable safety risk in an emergency situation. The paper

[2] NASA Technical Reports: An Assessment of Reduced Crew and Single Pilot Operations in Commercial Transport Aircraft Operations. https://ntrs.nasa.gov/citations/20170009542

also said a pilot incapacitation incident during single-pilot operations could be catastrophic.

SIGNIFICANT RISKS OUTWEIGH THE PERCEIVED ADVANTAGES

Cybersecurity on the Flight Deck

The enhanced air-to-ground communications and automation capabilities necessary to implement reduced-crew or single-pilot operations could leave aircraft vulnerable to new forms of tampering or attack. Hackers might, for example, jam signals being used to remotely operate an aircraft, or even commandeer a flight via cyberattack.

Signal encryption and authentication are the best defense against such attacks. However, adequate encryption requires high-tech solutions and infrastructure, both of which are expensive and not available worldwide. Moreover, countries have different laws governing the use of encryption technology, and some have banned it altogether.

Inflight Security: Risk of Insider Threat

Reducing the number of crewmembers, in particular crewmembers on the flight deck, makes an aircraft more vulnerable to an insider threat. With fewer people monitoring and checking each other, a rogue individual could find it significantly easier to take over an aircraft for malicious purposes.

Increased Workload

NASA studies have shown that without a pilot monitoring in the cockpit, the pilot flying would face a substantially higher workload, especially under off-nominal flight circumstances. Numerous NASA simulations have demonstrated this phenomenon, along with an associated rise in task shedding and pilot errors. Studies also show that ground-based assistance does not offset the increased workload.

Reduced Coordination

Having pilots seated side-by-side on the flight deck facilitates the close coordination that is essential to smooth and safe flight operations, especially in non-normal circumstances. NASA simulations indicate that when the pilots are not co-located, as would be the case if one pilot was on the flight deck and another was monitoring from the ground, coordination suffers due to the loss of nonverbal communication.

These studies found that instances of confusion increase and situational awareness is reduced when pilots are not co-located, and that replacing nonverbal cues with verbal communications adds an impractical number of tasks to the pilot's workload.

Overreliance on Automation

Excessive reliance on automated systems can negatively impact pilot performance. Automation can lead to complacency on the flight deck, as pilots become less vigilant in their monitoring. Automated systems can also degrade pilot situational awareness by masking changes in aircraft system health and performance, as well as eroding pilot skills, as many of these can fall into disuse.

When unexpected events requiring human intervention occur, pilots who have been using autopilot for an extended period can have difficulty transitioning back to manual flight. This is even more challenging when there is a non-normal event or automation failure.

Technological Hurdles

While automation and other technologies have advanced considerably over the years, they have not reached the point of enabling single-pilot operations without compromising safety. To truly replace the second pilot on the flight deck, machines will need to replicate the sensing, assessing, reacting, adapting, and interacting capabilities of a human in a complex and dynamic environment. This level of automation is still decades away. Current automation technology is capable of handling specific, limited tasks. Even these systems are prone to errors, which, if undetected, can be compounded over time. Moreover, current technology is incapable of remotely detecting subtle indicators of health complications in a human pilot that could be an indicator of impending incapacitation.

PUBLIC POLICY AND OPINIONS ON REDUCED CREW OPERATIONS

Regulatory Requirements Mandate Two or More Pilots

Aviation regulations governing commercial aviation are clear: At least two pilots must be present on the flight deck of large passenger or cargo transport aircraft. Further legislation requires the presence of additional relief pilots to maintain pilot alertness on long-haul flights and to achieve the necessary functionality and safety required of aircraft designs to obtain certification for operation. Regulations reinforce the guarantee of safety provided by human pilots.

Public Opinion Supports Two Pilots on the Flight Deck

Recent polling data indicates that the public disapproves of reduced-crew or single-pilot operations. In one poll conducted by the Air Line Pilots Association, International, 80% of respondents agreed that at least two pilots working together on the flight deck are best equipped to handle flight emergencies, and 96% said federal aviation research dollars should be directed at projects other than those

aimed at eliminating pilots from the flight deck. This preference was confirmed in a similar poll conducted by the market and social research firm Ipsos.

IMPROVEMENTS IN INFORMATION TECHNOLOGY A HIGHER PRIORITY

Upgrading Airspace Systems

Several countries are engaged in significant expenditures on airspace modernization programs. Pursuing reductions to flight deck crews at this time would be an unnecessary distraction and drain on resources from the pressing task of upgrading the global Airspace Systems. A coordinated overhaul is necessary to ensure safe and efficient operations in increasingly congested airspace, which is seeing steady growth in commercial aviation plus the entry of new vehicles, including UAS, suborbital space and reentry vehicles, and air taxis.

Alternative Research Avenues

Funding research into reduced-crew and single-pilot operations would divert scarce resources from other, more widely beneficial areas of aviation research, such as NASA's Aeronautics Research Mission Directorate (ARMD), or EASA projects under the European Union Horizons 2020 program. These organizations engage in research that benefits not only the airlines and air transport operators but also the public at large.

The research typically supports one of the following goals: enhanced safety, reduced fuel consumption and overall environmental impact, reduced travel times, and increased efficiency in the airspace system. Specific projects being pursued by ARMD include new batteries that would enable all-electric aircraft propulsion, reduced-noise supersonic travel, and hybrid wing-body aircraft designs that use far less fuel than current aircraft. Fuel now represents a substantial portion of airline costs, so reduction in fuel consumption would go straight to the companies' bottom lines.

ECONOMIC JUSTIFICATIONS ARE ABSENT

Overall Operating Cost Savings Insignificant / No Change to Ticket Prices

Reducing the complement of flight deck crews would save airlines and air transport operators money on salaries, benefits, and other expenses, but some, if not most, of those savings would be offset by costs associated with reduced crew. These costs include outfitting or retrofitting aircraft with the necessary automation, sensor, and communications systems; ground infrastructure costs; salaries and benefits for

remote ground-based pilots who would be needed to support single-pilot operations; and certification costs. There is no evidence that reducing the number of pilots would result in lower ticket prices for the traveling public.

Qualified Pilots are Required Regardless of Operation Type

Significant advances in automation and other technologies in recent years have led some in the aviation industry to suggest that reduced-crew or single-pilot operations could save money without compromising safety. Automation, communications, and sensor technologies are decades away from being able to provide the same level of safety as a second pilot on the flight deck. It is doubtful that technology will ever reach the same level of safety that two pilots provide. Efforts to implement single pilot operations would also need to overcome regulatory constraints, cybersecurity concerns, and economic drawbacks.

Environmental Cost

Another aspect to consider is the enormous energy costs involved in the data-transfer. The significant energy and economic burdens involved with large amounts of data are just now beginning to be understood in the case of so-called autonomous and self-driving automobiles. To facilitate reduced crew operations, huge amounts of data would have to be transferred and processed in a robust, integrated, protected and expeditious manner – resulting in a significant rise in energy consumption. The human brain, with all its shortcomings, is still by far the most energy efficient processor on the planet[3].

[3] G. Marcus & E. Davis, Rebooting AI: Building Artificial Intelligence We Can Trust. Pantheon Books, New York (2019)("...(human) brain the most complex system in the known universe, and rightfully so. The average human brain has roughly 86 billion neurons, of hundred if not thousands of different types; trillions of synapses and hundreds of distinct proteins within each individual synapse - vast complexity at every level. There are also more than 150 distinctly identifiable brain Areas, and a vast and intricate web of Connections between them").