Experience Levels Forcing a Change in Aviation Planning

Jason A. Powell MAS, ATP, CFMEI
Embry-Riddle Aeronautical University, powel55d@my.erau.edu

Elizabeth Crockett MS, AAS, A&P,
Embry-Riddle Aeronautical University, crockete@my.erau.edu

Abstract

This theoretical article evaluates the changing dynamics caused by high turnover in aviation and how the lower level of experience impacts aeronautical companies' organizational strategic planning and partnerships. The aviation organization must adapt managerial practices and alter training capability and procedures to ensure appropriate skill levels. Without proper strategic planning, the company will have an imbalance of skills and accept more risk to operations. The aviation organization may be unable to adapt current scheduling practices to properly prepare the aircrew for challenging situations or sufficiently train maintenance personnel. The result is a need to leverage strategic partnerships, alter management practices toward personnel development, and increase retention of mid-career aviators and maintenance technicians.

   Keywords: aviation planning, changing experience levels, pilot requirements, aircraft maintenance technician requirements

Strategic planning in the aviation industry examines the national and international status of passenger traffic, contribution to the gross domestic product, and employment (Itani et al., 2014). The importance of the employment variable is a driving factor in the current aviation market that will become a determinant for the strategic objectives in the aviation industry. The United States Bureau of Labor Statistics (USBLS, 2022a) reports that the number of pilots required in the US alone will increase by nearly 13% between 2020 and 2030, or approximately 14,700 pilot positions. Ryder (2017) points to increasing demand worldwide, with Asia accounting for 40% of the pilot demand, roughly 253,000 pilots by 2036.

Similarly, the USBLS (2022b) reports that the aircraft maintenance career field will grow by 11% between 2020 and 2030, or 17,400 personnel. With more than 14,000 vacancies in aircraft maintenance every year and the overall growth of the profession (USBLS, 2022b), an impact on aviation organizations, such as regional and legacy airlines that rely on professional maintenance personnel, will occur. When these personnel leave, they take valuable knowledge and experience with them, which in turn, increases risk and drives down overall experience levels when combined with the new hiring.

Legacy airlines rely on personnel who spent years developing skills and gaining experience in the regional and mid-tier aviation professions. Now, the recruits to many airlines do not have the same level of expertise due to earlier opportunities to work for legacy airlines that typically have better pay and higher quality of life (Terry et al., 2019). With a changing employment environment, aviation organizations must alter their current models to adapt by increasing their ability to develop their employees, or they will increase risk and decrease the likelihood of executing their strategic vision. Aviation organizations must adjust their strategic planning to adapt to changing experience levels and development due to the lower levels of

experience entering the aviation industry. This theory paper highlights the attributes of strategic planning in the context of aviation, defines pilot and maintenance experience, examines the requirements to gain experience for both pilots and maintenance personnel, and examines the impact of experience levels on an aviation organization and considers why aviation organizations need to make investments in deliberate personnel development programs and strategic partnerships.

Strategic Planning

Strategic planning in the airline industry does not necessarily take into consideration personnel development outside of the required FAA training (Itani et al., 2014). Organizations that do not properly align strategic plans with employee work experience and goals fail at a higher rate than those who successfully integrate personnel into their planning (Ouakouak, 2018). With the shifting dynamic caused by earlier transitions in the aviation industry, airlines and aviation organizations that utilize maintenance will need to adapt their strategic plans and strategic planning processes. This section details the importance of strategic planning and the different processes available to the aviation industry.

The ability of an organization to succeed requires the ability to strategically plan through a constantly changing environment and make tactical decisions today that affect the outlook of the organization in the future (Ouakouak, 2018). Operational planners must make decisions based on certain assumptions and avoid a completely reactive planning method (Mazarr et al., 2019). A vague strategy that does not provide operational objectives prevents proper execution and having a substantial strategy model helps to develop an excellent strategic plan (Hrebiniak, 2006; Mazarr et al., 2019). Although a data-centric rational planning process may seem best, an emergent approach combined with the rational approach to strategic planning may be more

appropriate to the dynamic situation within the aviation industry (Ouakouak, 2018). A data-centric rational approach is not as flexible as an emergent approach where decisions and actions affect the strategic vision from the bottom up. The strategic planning process should align employee development, training, and expectations with the organizational objectives to obtain the organization's strategic vision (Ouakouak, 2018). To address the experience levels within the aviation industry, planners require a combination of the emergent planning process that considers the change and the data-centric method that takes more time.

Ouakouak (2018) found that organizations that do not adequately align employees fail at a higher rate than organizations that successfully plan for employee alignment. For informed decisions, managers must analyze internal and external data, within and between offices and outside industry factors that align with the rational planning process (Honda, 2018). There are many methods to analyze data; however, senior management must develop or agree on a process for consensus without overemphasizing one issue and ignoring other potential threats to the strategic vision (Mazarr et al., 2019). Otherwise, the organization's personnel may not have ownership and will not properly execute the tactical operations to achieve the overall strategic plan or vision (Honda, 2018; Hrebiniak, 2006; Ouakouak, 2018). The movement from a data-centric planning process to a combination of emergent and rational planning will require engagement from all levels of management and may require proper change management skills.

One limitation middle managers may encounter is the limited skill sets taught in many business management programs. Managers are not good at execution as most business degrees focus on planning; however, the planning is focused within categories (marketing, financial, human resources, etc.) and not on holistic planning that accounts for the entire organizational objectives (Hrebiniak, 2006). Effective implementation of a holistic plan that incorporates both

rational and emergent planning requires change management skills that must be deliberately utilized as a part of an emergent strategic plan (Hrebiniak, 2006). Thus, the development of middle management through the implementation of a new planning process will require a change in culture, which drives the requirement for proper change management within the organization. The most common issue with successful change management is the manager pushing speed instead of having a quality plan (Hrebiniak, 2006). Solving strategic problems requires research and adequate time to implement and execute the strategy (Hrebiniak, 2006)

Managers who receive education in planning tend to step back and allow lower levels to execute the plan, which becomes a problem when strategic plans go awry, as caused by outside influences such as COVID-19, the 2008 economic crisis in the US, and after the terrorist attacks on September 11, 2001 (Hrebiniak, 2006). A more engaged leadership that understands the assumptions of the strategic plan, as well as operational impact, will have a greater ability to adapt to a changing environment (Mazarr, 2019). Everyone within the organization must have ownership and work to implement the strategy for the successful implementation of the strategic plan (Hrebiniak, 2006). To ensure execution, planning and implementation are co-dependent(Hrebiniak, 2006). The dependency develops from the manager's need to consider execution during the planning phase (Hrebiniak, 2006).

Aviation organizations' leadership must gather data on personnel moves, experience levels, and capability, then build a strategic plan that includes personnel development. The literature suggests a short-term method to manage change while developing organizational *"buy-in"* to the strategic alignment of pilot and maintenance personnel (Honda, 2018; Hrebiniak, 2006; Ouakouak, 2018). Better definitions of what exactly is experience and what the organization needs will help define the development and implementation of the strategic plan.

Defining Experience

Defining experience is one of aviation's most challenging and highly debated topics. Maintenance experience is defined by documented performance on acceptable repairs, demonstrating a well-defined skill set. Pilot experience is typically defined by documented hours and ratings, which assumes that those with more hours and ratings developed better judgment and decision-making (Bell et al., 1995). The definition of experience is essential for aviation organizations to identify whom to hire and what type of training to provide. The simple flight hour equals experience formula does not indicate whether a pilot has a skill or, more importantly, the competencies of a good pilot.

Pilot Experience

The International Civil Aviation Organization (ICAO) Annex 1 requires member states' flight hour certification process as the basis for pilot experience. However, like the Federal Aviation Administration (FAA), the ICAO recommends a competency-based instructional program outside the minimum flight hour requirements for certification (FAA, 2017b; ICAO, 2006). Competency-based training is based on the theory that pilots can obtain a skill in their own time (Todd & Thomas, 2013). A pilot's experience level directly relates to the perception of the individual understanding, judgment, and reliable behavior of the person (Bell et al., 1995). However, utilizing a competency-based training model to train pilots is difficult for an aviation organization due to the complexity of identifying competencies and creating adaptive lessons that ensure a pilot can demonstrate said competency.

Problem-solving and decision-making are also essential parts of experience; however, deliberate practice is better than routine performance to achieve proficiency and experience beyond the routine situations presented in aviation (Vidulich et al., 2010). One of the most

significant hazards in aviation is a lack of quality training and a shortage of experienced personnel (Bent & Chan, 2010). Nearly 20 mishaps identified by Dismukes et al. (2007) were caused by insufficient knowledge and experience and insufficient training, significantly impacting aviation organizations' profit margins.

A review of safety mishaps by Todd and Thomas (2012) found a significant relationship between mishaps and flight hour experience only in reference to instrument flying and decision-making and not in cognitive and technical areas. They recognize that other areas of flight safety do not have a solid relationship with flight hours. To operate an aircraft, a pilot must be competent in cognitive and technical areas (Todd & Thomas, 2012). In higher certifications, there is little difference in the demonstrated behavior between professional captains and first officers in reference to flight time, except in the altitude at which they disengage the autopilot, which drives the definition of experience away from flight hours (Todd & Thomas, 2012). Considering the limited correlation between flight hours and mishaps, a professional pilot's flight time level may not be the best definition of experience. A better definition would include both the cognitive and technical competence to operate the aircraft. The definition of experience impacts an aviation organization because of training availability for both maintenance and pilots as well as how organizational structures of its operation.

Maintenance Experience

The Code of Federal Regulations (CFR) part 65 requires all maintenance personnel to be appropriately certified and for the organization to maintain documentation of the training and certifications for work on the aircraft systems for which they maintain (Certification: Airman Other Than Flight Crew Members, 1962). Maintenance technicians must maintain these certifications and operate in accordance with technical instructions (advisory circulars,

airworthiness directives, or manufacturer procedures; Wang et al., 2016). Training for

technicians once in the field typically occurs through paper-based instruction in classrooms.

However, many maintenance programs utilize digital media for education on new procedures

and continued training (Wang et al., 2016). The methods for training and documentation drive

cost and personnel. The more inexperienced the personnel, the more supervision is required to

perform maintenance tasks.

Required Experience Levels

Pilots

Professional pilots have several categories of certifications, with the highest being an

airline transport pilot at a major airline (Terry et al., 2019). A pilot can take a few paths to

achieve this certification status: international flight training, accredited undergraduate part 141

school, civilian part 61 school, or military flight training (Terry et al., 2019). To transition from

an initial student pilot through the various levels or stages of private, instrument, commercial,

multiengine, and airline transport pilot, a pilot must build experience through flight hours and

evaluations which takes time (Terry et al., 2019). It takes approximately ten years for a pilot to

reach the proficiency level required for the highest certification of the airline transport pilot,

which is a line check pilot (LCP: Strauch, 2017). Before a pilot reaches this level at a major

airline, the pilot must complete multiple stages of training and certification at the airline, which

takes time and resources for the organization (FAA, 2010).

Airlines in the CFR 14, Parts 121, and 135 operations can utilize an Advanced

Qualification Program (AQP) to integrate training and evaluate cognitive skills (Esser, 2005).

The AQP structure is a basic proficiency-based concept, requiring the pilot to have a higher level

of proficiency and knowledge before beginning training, which differs considerably from an

individual training model (Esser, 2005; FAA, 2017b). The speed of the AQP and basic level of proficiency reduces the pilot's opportunity to work towards higher levels of skill and build expertise (Petitt, 2019).

With AQP standards requiring such a basic level of proficiency, learning through repetition and feedback as well as assessment must occur during effective line operations as they directly affect the knowledge, performance, and confidence of the pilot (Dekker, 2000, as cited in Harris, 2012; Pettit, 2019). The lack of development in the AQP requires the organization to create a process whereby the pilot gains experience during operations and not in training, which increases the risk to the passengers and jeopardizes the organization's ability to generate a profit. Any mishap negatively affects the airline operation and the best tool for mishap prevention is a well-developed training program (Ryder, 2017). Maintenance personnel are better positioned organizationally to develop operations skills during operations than aircraft pilots due to the amount of supervised on-the-job training the career field offers.

Maintenance Technicians

Aircraft maintenance personnel perform immediate repairs, routine depot maintenance, and inspections to keep aircraft air-worthy (Terry et al., 2019). Maintenance fields require various levels of education and training, achieved through multiple part 147 schools (FAA, 2022). For example, an avionics technician typically has an associate's degree and a radio operator's certificate before applying for the aircraft electronics technician (AET) certification (USBLS, 2022c). Whereas mechanics must have at least 30 months of experience to qualify for their airframe and powerplant (A&P) rating and pass all knowledge tests within a 24-month period (USBLS, 2022c). The varied levels of education and training as well as supervised on-the-job training provides avenues for aviation organizations to build a certified maintenance

department; however, a basic A&P or AET training graduate will require several years of supervision before working independently.

The aviation maintenance organization has several options post-certification for their maintenance personnel. Advancement to obtain an inspection authority (IA) requires holding an A&P license for at least three years, which allows the mechanic to inspect the work of others, but not necessarily supervise other maintenance technicians (USBLS, 2022c). Most organizations have supervisory or management positions such as lead mechanic, lead inspector, and supervisor (USBLS, 2022c). It is up to the organization to develop the technicians into supervisors and create the personnel management processes to obtain these objectives. The ability of the aviation maintenance organization to provide these development and advancement opportunities to its maintenance personnel directly affects retainment (National Business Aviation Association [NBAA], 2018).

Impact on the Organization

Aviation organizations strategically plan around international air travel's external political and economic demands, requiring the industry to evaluate markets to prioritize revenue generation (Itani et al., 2014). One of the steps to developing a strategic plan is an awareness of internal strengths and weaknesses and external threats (Itani et al., 2014). A global pandemic, though relatively rare, creates a massive environmental shock to the organization. This shock can drastically disrupt an organization's current strategic plans (Linden, 2021); however, the COVID-19 pandemic only exacerbated an already developing issue with workforce staffing. By proactively managing uncertainty, an organization that implements internal strategy as practice can quickly adapt internal processes to the changes in the external environment and impacts from such a large market disturbance can become an avenue for change (Linden, 2021). Retiring

personnel and expanding post-pandemic travel require adjustment to the workforce development and retention strategy.

Employee Retention

Employee retention significantly impacts the organization's cost of recruiting and training as well as socialization, and disruption (Phillips & Connell, 2003). Lower turnover results in higher operational success with fewer failures, better customer service, and higher production quality, which are all critical to airlines that must have an impeccable safety record to operate (Pasztor, 2021; Phillips & Connell, 2003). Increasing monetary compensation, as the regional airlines have done, is not always the solution to high turnover. Excessive spending to prevent turnover can cause more issues because individuals often stay at organizations but leave because of poor management (Phillips & Connell, 2003).

With an understanding of the internal and external issues affecting the performance of an organization, strategic planners can structure processes to cope and react proactively (Linden, 2021). By reducing turnover by 10%, a company can improve its profits more than by increasing production by 10% (Phillips & Connell, 2003). Enormous incentive packages, a reactive measure, result in severe stresses and an increased budgetary impact on the organization. In contrast, a proactive step through strategic planning by aligning personnel needs and changing paradigms in a changing industry is a better path to handling turnover (Ouakouak, 2018; Phillips & Connell, 2003).

Quality Management

Turnover that causes a decrease in experience levels is a top priority in aviation. The importance of quality management processes in retaining personnel cannot be stressed enough. To appropriately react to the external environment, an organization must respond in the short

term and develop a long-term plan to adapt the crises into an opportunity (Linden, 2021). Only

through applying procedures and responsibilities can management achieve a positive outcome

through a quality management system (Smith et al., 2017). The overall ability of a company to

focus on quality, customer care, and factual data demonstrates a commitment to management

(Smith et al., 2017). Aviation organizations can utilize a process where step-by-step changes in

the organizational system lead to strategic and operational change as defined by continuous

improvement models (Smith et al., 2017). Organizations must implement quality-oriented

strategies to establish an environment where employees can consistently perform their jobs,

which requires personnel capable of inspecting and ensuring proper execution in aviation (Smith

et al., 2017). Consistent quality in production is a byproduct of training and the goal of any

management system (Smith et al., 2017).

Errors during maintenance do have safety-related consequences and economic loss due to

aircraft returns, engine shutdowns, equipment damage, and public perception (Dalkilic, 2017).

One of the highest risk factors in aviation mishaps is aircraft maintenance, with 112 worldwide

mishaps attributed to maintenance errors from 2003 to 2017 (Insley & Turkoglu, 2020). A

violation of a technical procedure caused by improper documentation accounted for 45% to 60%

of safety incidents (Wang et al., 2016). The highest error rate occurs in equipment installation, an

error of commission caused by improperly or incompletely following procedure (Insley &

Turkoglu, 2020; Reason, 1997). Dalkilic (2017) found that 15% of commercial jet aircraft hull

loss mishaps were maintenance-related.

Ensuring that there are enough experienced maintenance personnel to accomplish and

inspect work is paramount to a thriving aviation organization. Maintenance operations require

direct contact between an experienced technician and the equipment, in effect increasing the

likelihood of a human error caused by a lack of processes to improve safety (Lind, 2008).

Maintenance depends considerably on the facility's working environment and organizational

culture (Lind, 2008). Lind (2008) found that most unsafe acts were attributable to risk-taking

behavior without the appropriate planning or managing of work. Maintenance technicians who

work in substandard or inadequately staffed facilities do not recognize the lack of supervision

(Reason, 1997). It takes several years to qualify someone as an IA, and with a growing

organization, it is not easy to build a maintenance capability within a few short years. However,

the difference between pilots and maintenance personnel is that an aviation organization can hire

outside maintenance personnel to repair aircraft, perform inspections, or do supervisory work

while the organization grows. The organization can avoid losses through appropriate strategic

planning and growth management.

Training

Economic conditions significantly affect retention as companies look for ways to cut

costs in areas such as training (Phillips & Connell, 2003). Phillips and Connell (2003)

highlighted 11 areas where organizations are impacted by high turnover. Of particular interest to

aviation are loss of productivity, lower service quality, and loss of expertise (Phillips & Connell,

2003). Training a workforce is as significant an issue as absorption in the fleet or repair facility

(Terry et al., 2019).

The initial training of new airline pilots utilizing an AQP similar to the example in FAA

Circular 120-54A (2017b), takes approximately 25 days per student. Suppose the simulators can

train two people, each running the recommended four hours with one period as downtime for

maintenance. In that case, each simulator can operate for 600 hours per month and generate a

total of 12 students (25 days at four hours per simulator). If the organization has enough access

to simulators to compensate for the loss of personnel, the second issue is the initial operating experience (IOE) and absorption into the fleet.

The AQP requires a line-oriented evaluation by a line check pilot (LCP) and an evaluation following IOE (FAA, 2017b). For each student trained, Circular 120-54a (FAA, 2017b) shows five days of flights with an LCP that results in a line evaluation. An LCP can only evaluate a maximum of four students per month, realistically two to three, given a 20-day work month. The production of new pilots by an LCP does not account for the FAA LCP currency requirements or other training the LCP must accomplish, and it does not account for failure to complete IOE in five days (FAA, 2010). However, with each student requiring the LCP for flying, the new pilots must wait until an available LCP can fly, resulting in diminished skills. Suppose the organization exceeds its capacity for the LCP to train the new pilots in the allotted 90 days. In that case, they will have to allocate more funding to retrain the new pilots and ensure they have the required cognitive and technical skillset (FAA, 2017b).

Aviation organizations must strategically plan to have enough LCPs available to handle the training of newly-hired pilots. LCPs must meet minimum experience levels, including flight time and demonstrated proficiency (FAA, 2010). These individuals leave or retire and must be replaced but cannot be replaced by a newly hired pilot. The need for LCPs drives strategic planning. Otherwise, there will be inexperienced LCPs with inexperienced pilots, which results in a higher risk to operations.

The greatest safety tool for an airline is a well-trained and experienced pilot (Ryder, 2017). For example, some airports have challenging terrain and air traffic control processes. These processes require effective mitigation tools gained through training, experience, and operations under the FAA special airfield qualification program (Esser, 2005; FAA, 2017a).

Furthermore, increased technological advances caused by increased complexity drive pilot errors in the next generation of aircraft (Petitt, 2019). Pilot experience during operations is essential for cost savings. For example, understanding how the automation works dictates how the pilot will utilize flight controls such as flaps, speed brakes, and gear extension to manage energy, which directly relates to the cost of the flight (Petitt, 2019). One misapplied technique could result in a costly missed approach that increases the likelihood of a mishap (Petitt, 2019). To mitigate these types of errors, the airline needs to identify areas of weakness through a proactive safety program, such as flight operations quality assurance (FOQA) or line operations safety audit (Esser, 2005).

Due to the growth within the aviation industry, pilots are not staying at the lower tiers of aviation as long and, therefore, not developing the skills previous generations acquired. If the airline wants to ensure a pilot has a set of skills and cognitive abilities, they have to accomplish a line-oriented evaluation to assess those skills in accordance with the AQP (Esser, 2005). This process would further require the airline to develop an FAA-approved terminal proficiency standard (TPO) and continual qualification program (Esser, 2005). The new TPO is part of the continual loop of the AQP quality assessment program. However, increasing data analysis and building and adapting FAA-approved programs requires personnel, funding, and other resources that may hinder an organization's profit margin, which drives costs for services provided.

Discussion

A mix of emergent and data-centric strategies is essential to the success of flexible and adaptive strategic plans. The personnel issues driven by the current aviation industry require aviation organizations to make short-term and long-term adjustments in planning while developing management processes that attract and retain personnel. Linden (2021) advocates for

strategic investments, partnerships, and staff development to build a resilient organization that can adapt to market changes. Ouakouak (2018) focuses on personnel alignment in strategic planning to build a stable workforce. Furthermore, organizations benefit enormously from strategic partnerships to sustain growth and adapt to changing environments by leveraging the capabilities of similar organizations (MacDonald et al., 2019). Building partnerships between companies is about profitability (Frailey, 2014) and not about personnel management; however, strategic objectives may require emergent partnerships to provide opportunities for personnel development and training. Itani et al. (2014) found that public-private partnerships within the industry help drive growth and facilitate operations, which may help stabilize aviation organizations for both the short-term tactical environment and long-term strategic plan.

Aviation organizations are developing better methods to prevent the workforce talent and demand imbalance from affecting airlines' ability to train pilots efficiently. Each corporation's systems can improve communication and development, providing essential capabilities to adapt to external threats (MacDonald et al., 2019). One example is the United Airlines Aviate program. United Airlines (2022) created the Aviate Academy to generate pilots for themselves and their regional carriers, where the airline can create a strategic pool of future pilots and , Terry et al. (2019) argue, where pilots develop critical experience. Although not as thorough as the Aviate Academy, whereby pilot development is controlled at all levels, American Airlines (2022) has partnered with regional carriers to help motivate less experienced pilots to stay in place and not move to legacy carriers, and American Airlines has temporarily increased regional airline compensation through their wholly owned regionals. These programs help build the experience base and ensure that the organization will have the best candidates with the appropriate cognitive and technical skills without cutting requirements. These programs enable an emergent and data-

centric strategic plan to stabilize the airline while reducing risk by providing personnel with a deliberate development process. However, the development needs to continue beyond the initial training phase and needs to include maintenance personnel.

Conclusion

The United Airlines Chief Executive Officer told CNBC in an interview that in June 2022, approximately 150 regional aircraft were grounded due to a lack of qualified pilots (Josephs, 2022). Josephs (2022) reported that regional airline bonuses are insufficient due to the lack of qualified pilots. Some regional airlines want the FAA to remove the flight hour requirement for their pilots due to the quality of their AQP. Without short-term strategic interventions through emergent strategic planning, regional carriers that move passengers from smaller markets to central hub locations would not survive in an environment where significant carriers are hiring (Josephs, 2022). Airlines that rely on the service of these regional carriers will have to alter operations to ensure passengers arrive at hub locations, which may not be profitable due to the higher cost of larger aircraft or low passenger demand.

The shrinking of service reduced profits and the inability to provide training demonstrate the importance of strategic planning for training and personnel levels of pilots and maintenance technicians in an aviation organization. An aviation organization that can properly develop experienced personnel in both operations and maintenance will mitigate risk and increase stability in turbulent markets by having a balance in experience levels. By ensuring the proper balance between LCP, maintenance supervision, and development opportunities for both pilots and maintenance personnel, an airline can ensure they do not accept extra risk by preventing development in the early years of a person's career. The airline industry can redefine operations

throughout the next decade by developing a strategic plan that involves the short-term implementation of strategic partnerships while aligning experience levels in critical career fields.

This paper highlighted the need to better plan for instability in the aviation industry through a deliberate change in the planning process. Planners must make changes in their planning processes to increase retention and adapt to a different level of proficiency in both pilots and maintenance technicians. Effective implementation of these changes requires integration at every level of leadership and management. Better management of personnel issues can improve quality of life over monetary compensation. However, making these changes and altering operations due to emerging threats takes time. Only through better planning and strategic partnerships can organizations within the aviation industry create a quality system that can withstand increased risk caused by the variability in the experience of pilots and maintenance technicians.

References

American Airlines (2022). *Regional partner operations fact sheet*.

https://s21.q4cdn.com/616071541/files/doc_downloads/FactSheets/2017/2017_Regional_

Fact_Sheet.pdf

Bell, B., Robertson, C., & Wagner, G. (1995). Aviation safety as a function of pilot experience:

Rationale or rationalization? *Journal of Aviation/Aerospace Education & Research, 5*(3).

https://doi.org/10.15394/jaaer.1995.1154

Bent, J., & Chan, K. (2010). Chapter 10 - Flight training and simulation as safety generators. In

E. Salas & D. Maurino (Eds.). *Human factors in aviation* (2nd ed., pp. 293-333).

https://doi.org/10.1016/B978-0-12-374518-7.00010-9

Certification: Airmen Other Than Flight Crewmembers, 14 CFR § 65 (1962).

https://www.ecfr.gov/current/title-14/chapter-I/subchapter-D/part-65

Dalkilic, S. (2017). Improving aircraft safety and reliability by aircraft maintenance technician

training. *Engineering Failure Analysis, 82*, 687-694.

https://doi.org/10.1016/j.engfailanal.2017.06.008

Dismukes, R. K., Berman, B. A., & Loukopoulos, L. D. (2007). *The limits of expertise:

Rethinking pilot error and the causes of airline accidents*. Ashgate Publishing Co.

Esser, D. A. (2005). *Advanced qualification program training in threat and error mitigation: An

analysis of the use of line check safety audits for validation*. (Publication number

304911251) [Doctoral dissertation, Capella University]. ProQuest One Academic.

Federal Aviation Administration (2010). *General Technical Administration*, Volume 3. (8900.1,

CHG 0). U.S. Department of Transportation.

hhttps://drs.faa.gov/browse/excelExternalWindow/DRSDOCID10795098632022110314584 6.0001

Federal Aviation Administration (2017a). *Special pilot-in-command qualification airport list: Updates* (Notice N8900.304). U.S. Department of Transportation. https://www.faa.gov/documentLibrary/media/Notice/N_8900.304.pdf

Federal Aviation Administration (2017b). *Advanced qualification program* (Advisory Circular AC 120-54A). U.S. Department of Transportation. https://www.faa.gov/documentLibrary/media/Advisory_Circular/AC_120-54A_CHG_1.pdf

Federal Aviation Administration (2022). *Aircraft Maintenance Technician Schools (AMTS)*. US Department of Transportation, Washington, DC. https://www.faa.gov/licenses_certificates/airline_certification/amts/

Frailey, S. (2014). The benefits of partnerships between small and large businesses. *Floor Trends, 16*(7), 35A.

Harris, D. (2012). 7-The human factors that relate to technological developments in aviation. In T. M. Young & M.& Hirst, M. (Eds.). *Innovation in aeronautics* (pp. 132- 154). Woodhead Publishing. https://doi.org/10.1533/9780857096098.1.132

Honda, H. (2018). Why do data and decision often disagree? Analytical framework to facilitate organizational dynamics. *New Directions for Institutional Research, 2018(178),* 71–84. https://doi.org/10.1002/ir.20268

Hrebiniak, L. G.. (2006). Obstacles to effective strategy implementation. Organizational Dynamics, 35(1), 12–31. https://doi.org/10.1016/j.orgdyn.2005.12.001

Insley, J., & Turkoglu, C. (2020). A contemporary analysis of aircraft maintenance-related accidents and serious incidents. *Aerospace, 7*(6), 81. https://doi.org/10.3390/aerospace7060081

International Civil Aviation Organization. (2006). Annex 1—Personnel licensing. *The convention on international civil aviation: Annexes 1 to 18.*

Itani, N., O'Connell, J. F., & Mason, K. (2014). A macro-environment approach to civil aviation strategic planning. *Transport Policy, 33*, 125-135. https://doi.org/10.1016/j.tranpol.2014.02.024

Josephs, L. (2022). A severe pilot shortage in the US leaves airlines scrambling for solutions. CNBC. https://www.cnbc.com/2022/05/15/us-pilot-shortage-forces-airlines-to-cut-flights-scramble-for-solutions.html

Lind, S. (2008). Types and sources of fatal and severe non-fatal accidents in industrial maintenance. *International Journal of Industrial Ergonomics, 38*(11-12), 927-933. https://doi.org/10.1016/j.ergon.2008.03.002

Linden, E. (2021). Pandemics and environmental shocks: What aviation managers should learn from COVID-19 for long-term planning. *Journal of Air Transport Management, 90*, 101944. https://doi.org/10.1016/j.jairtraman.2020.101944

MacDonald, A., Clarke, A., & Huang, L. (2019). Multi-stakeholder partnerships for sustainability: Designing decision-making processes for partnership capacity. *Journal of Business Ethics, 160*(2), 409-426. https://doi.org/10.1007/s10551-018-3885-3

Mazarr, M. J., Best, K. L., Laird, B., Larson, E.V., Linick, M. E., & Madden, D. (2019). *The U.S. Department of Defense's Planning Process.* RAND Corporation. https://doi.org/10.7249/RR2173.2

National Business Aviation Association. (2018). *Investing in the aviation maintenance workforce*. National Business Aviation Association. https://nbaa.org/professional-development/workforce-initiatives/missing-persons-business-aviation-must-adapt-changing-labor-market/

Ouakouak, M. L. (2018). Does a strategic planning process that combines rational and adaptive characteristics pay off?: Evidence from European firms. *Australian Journal of Management, 43(2)*, 328–349. https://doi.org/10.1177/0312896217721589

Petitt, K. (2019). *Safety culture, training, understanding, aviation passion: The impact on manual flight and operational performance*. (Doctoral dissertation, Embry-Riddle Aeronautical University), https://commons.erau.edu/edt/436

Pasztor, A. (2021). The airline safety revolution. *The Wall Street Journal.* https://www.wsj.com/articles/the-airline-safety-revolution-11618585543

Phillips, J. J., & Connell, A. O. (2003). *Managing employee retention: A strategic accountability approach* (1st Ed). Routledge. https://doi.org/10.4324/9780080510873

Reason, J. (1997). *Managing the risks of organizational accidents* (1st ed.) [E-book]. Ashgate.

Ryder, P. (2017, August 14-16) *Airline Pilots Supply and pilot experience* [PowerPoint Slide]. National Training Aircraft Symposium, Daytona Beach, FL, USA. https://commons.erau.edu/ntas/2017/presentations/21/

Smith, J., Anderson, S., & Fox, G. (2017). A quality system's impact on the service experience. *International Journal of Operations & Production Management, 37*(12), 1817-1839. https://doi.org/10.1108/IJOPM-12-2015-0737

Strauch, B. (2017). The automation-by expertise-by-training interaction: Why automation-related accidents continue to occur in sociotechnical system. *Human Factors: The Journal of the*

Human Factors and Ergonomics Society, 59(2), 204, 228.

https://doi.org/10.1177/0018720816665459

Terry, T. L., Eckhause, J. M., McGee, M., Bigelow, J. H., & Emslie, P. (2019). *Projecting Air Force rated officer inventory across the total force: Total force blue line model for rated officer management.* RAND Corporation. https://doi.org/10.7249/RR2796

Todd, M. A., & Thomas, M. J. W. (2012). Flight hours and flight crew performance in commercial aviation. *Aviation, Space, and Environmental Medicine, 83*(8), 776-782. https://doi.org/10.3357/ASEM.3271.2012

Todd, M. A., & Thomas, M. J. W. (2013). Experience, competence, or syllabus? influences on flight hours at licensing of commercial pilots. *The International Journal of Aviation Psychology, 23*(2), 169-180. https://doi.org/10.1080/10508414.2013.772851

United Airlines (2022). *Aviate*. https://unitedaviate.com/

U.S. Bureau of Labor Statistics (2022a). *Employment projections, National Employment Matric: 53-2010 Aircraft pilots and flight engineers*. United States Department of Labor. https://data.bls.gov/projections/nationalMatrix?queryParams=53-2010&ioType=o

U.S. Bureau of Labor Statistics (2022b). *Aircraft and Avionics Equipment Mechanics and Technicians*. United States Department of Labor. https://www.bls.gov/ooh/installation-maintenance-and-repair/aircraft-and-avionics-equipment-mechanics-and-technicians.htm#tab-6

U.S. Bureau of Labor Statistics (2022c). *Occupational Outlook Handbook: How to become an aircraft and avionics equipment mechanic and technician*. United States Department of Labor. https://www.bls.gov/ooh/installation-maintenance-and-repair/aircraft-and-avionics-equipment-mechanics-and-technicians.htm#tab-4

Vidulich, M. A., Wickens, C. D., Tsang, P. S., & Flack, J. M. (2010). Chapter 7 - Information

processing in aviation. In E. Salas & D. Maurino (Eds.), *Human factors in aviation* (2nd ed.,

pp. 175-215). Academic Press – Elsevier. https://doi.org/10.7249/RR2173.2

Wang, Y., Anne, A., & Ropp, T. (2016). Applying the technology acceptance model to

understand aviation students' perceptions toward augmented reality maintenance training

instruction. *International Journal of Aviation, Aeronautics, and Aerospace, 3*(4), 3.

https://doi.org/10.15394/ijaaa.2016.1144