

Combatting the MRO brain drain in commercial and defense aviation



Where AI meets digital to bridge the Experience Gap!





Today's Maintenance, Repair, and Overhaul (MRO) operators in defense and commercial aviation must adopt innovative strategies to meet the challenges of an aging workforce and address a growing skills shortage—all this while simultaneously maintaining older aircraft and adopting new platforms.

The challenges facing aviation Maintenance, Repair, and Overhaul (MRO) organizations, whether in the commercial or defense industry, are mounting—exacerbated by the untimely convergence of an aging workforce, legacy technology platforms, and the need to maintain older aircraft as supply chain issues slow the delivery of new aircraft.

At the same time, new aircraft and engine platforms are coming through as new technologies, from AI to composites, add to the headache for MROs to keep up.

The MRO industry needs to reskill, retrain, and attract new technicians while modernizing and deploying new digital tools and processes to meet demand.

Read on as we examine:

Section One: Persistent challenges facing the aviation industry

Section Two: Rising global challenges in MRO

Section Three: Evolving tools of the MRO technician – beyond the torque wrench

Section One: Persistent Challenges Facing the Aviation Industry

Labor shortages: A growing concern

In commercial aviation, even before the pandemic, 35% of maintenance workers were between 55 and 64 years old, with over a third of the workforce approaching retirement. The challenges that MRO organizations were facing pre-pandemic quickly became a reality as the world became open for business once again. Today, the percentage of mechanics aged 18 to 30 is in the single digits.

The defense sector is similarly affected, a recent report found that 48% of defense employers are reporting a shortage in engineering skills. Among these deficiencies, cyber and digital skills are particularly acute, with 33% of employers noting a lack of qualified candidates. Additionally, 25% report shortages in manufacturing and mechanical expertise.

An overriding reason for the labor shortage across both the commercial aviation and defense industries is that the recruitment of new technicians to the industry has been unable to meet demand. Key reasons for this failure include levels of remuneration and less desirable working models such as shift work. Alternative career choices can be more lucrative or provide more appealing conditions to the younger generation compared to the current technician career path.

The pandemic in the short-term hid and, in the long-term, heightened labor shortage issues

With many organizations facing financial challenges during the pandemic, many turned to furloughing staff, and in many cases, older technicians were offered early retirement. As a

result, many furloughed employees had the time to reevaluate their lifestyles leading some to transition from technician roles to less labor-intensive jobs, while others seized the opportunity to retire.

During this time, organizations also put a pause on hiring new technicians due to financial and workload reductions. Many MROs were content to remain with their existing workforce during the pandemic, leaving a gap in hiring, which exacerbated the generational divide we now see in the industry.

Experienced legacy knowledge can't be easily replaced

For MRO organizations, the answer to the labor shortage is not as simple as replacing experienced technicians with junior technicians. Experienced technicians demonstrate greater efficiency at troubleshooting, with an intuitive understanding of the solutions to complex issues. This knowledge enables them to quickly identify and resolve problems, streamlining the repair process. In comparison, junior technicians often lack the experience or knowledge of which procedures to reference to address aircraft issues independently, so they may be more reliant on painstakingly searching through manuals or require help from more experienced colleagues—making their troubleshooting process more resource-intensive and time-consuming.

When an experienced technician consults a manual, they have the knowledge to quickly navigate to, understand, and implement the correct procedure. This legacy knowledge is acquired through years of hands-on experience. This expertise is typically only hard-won firsthand, or shared in realtime, as seasoned technicians mentor junior colleagues on the job.

Aging fleets and increased demand exacerbate the labor shortage

Meanwhile, aircraft fleets are getting older, requiring more maintenance to keep them up in the air as parts start to age, decay, and fail. It was estimated that in 2023 there were over 30,000 commercial aircraft in operation. Of these 30,000, at least one-third are more than 20 years old. In the commercial aviation sector, this issue was heightened because of the pandemic as many commercial airlines put a pause on their flights, and as a result, many aircraft were either retired or put into storage, to be reactivated later. New aircraft purchases and fleet renewal programs were also put on pause to limit expenditures; this meant aircraft that might have otherwise been retired kept flying.

Section Two: Rising Global Challenges in MRO

Older aircraft are almost invariably less efficient than new aircraft. In an industry driven by efficiency and managing tight margins, the increase in the age of the fleet has a serious impact. Commercial airlines therefore are seeking to replace them with newer, more efficient models to meet growing capacity demands and to reduce operating costs. Newer aircraft, however, do not necessarily mean smoother sailing for aviation maintenance organizations.

Manufacturer failures to meet targets for new aircraft leaves commercial airlines in a bind

Major aircraft manufacturers like Boeing and Airbus are struggling to meet both current demand and their own initial projections. Boeing has faced numerous challenges including supply chain disruptions and significant issues during the testing phase of their aircraft, as well as several in-flight incidents. In January of 2024, following the blowout of a [737-9 MAX door plug during Alaska Airlines flight 1282](#), the FAA temporarily grounded all 737-9 MAX aircraft. Subsequently, the [Federal Aviation Administration \(FAA\) forced Boeing to halt the production of the 737 MAX](#), then capped production rates as a result of its production quality issues. Further compounding delivery pressure, a 7-week strike by 33,000 Boeing factory workers in late 2024 further delayed production.

As an alternative to the 737 MAX, many commercial airlines pivoted to the Airbus A320 Family aircraft, yet [Airbus](#) itself faced its own major supply chain issues for engines, aerostructures, and cabin equipment. Meanwhile, demand surged beyond initial manufacturing projections, resulting in a substantial gap in new aircraft supply, leaving many commercial airlines with no other option than to keep older aircraft flying.

How commercial airlines are skipping the queues and getting passengers in the air again

As a result of the ongoing challenges at Boeing, many airline organizations are pivoting and switching to Airbus. However, this situation has led to longer wait times for airlines, causing a significant backlog.

While awaiting new aircraft deliveries, many airlines are reactivating those aircraft that were previously retired or stored to help manage renewed demand. For instance, during the COVID-19 pandemic, many airlines opted to retire the A380 aircraft due to the operational cost and lack of route flexibility inherent in the world's largest passenger aircraft's size and 4-engine design. However, as demand has surged and replacement aircraft remain unavailable, airlines are now reintroducing the A380 to help meet needed operational capacity.

Challenges mount for MRO technicians

Older aircraft need more maintenance. Bringing these older aircraft out of retirement and storage increases the total amount of maintenance that needs to be performed. This has led to increased demand and workloads for MRO technicians, as they are tasked with maintaining older aircraft while new, less maintenance-intensive models are still in production. For example, when [Etihad Airways returned their Airbus A380s](#) back into service, their MRO technicians had to complete a six-year heavy maintenance check on their aircraft.

Safety problems can also arise from increased demand and workloads as new procedures and protocols put strain on existing systems. With MRO technicians under pressure, they may look to cut corners and take risks to reduce their time spent on certain maintenance tasks and increase their output.



New platforms make for a new MRO headache

The commercial aviation sector is in the midst of a shift in engine types. The 737NG was the most popular commercial aircraft platform in the world. Powered by CFM56 engines, that made the CFM56 family the most common engine globally. The A320 family, the next most common platform, was typically powered by the IAE V2500 series engines. The advent of the 737-MAX powered by the CFM Leap 1 engine and the A320 neo (new engine option) powered by either the Pratt & Whitney PW1000G GTF (geared turbofan) or the CFM Leap 1 means that all that built-up capacity for the CFM56 and the V2500 needs to shift. This has caused major headaches for MROs geared towards the legacy platforms, forcing reskilling and re-certification.

Due to Boeing's issues, the A320 neo has taken the lead but their Geared Turbofan (GTF) engines, have had their own issues due to [defects in metallic components in manufacturing](#). As the A320's market share and deployment continue to grow, the demand for technicians to service these aircraft will increase. However, many of these technicians currently lack the necessary training and skills to work on the A320 neo's engines.

The story is also very similar for defense MROs, where there has been an influx of new aircraft platforms flown by military fleets. The [Polish Armed Forces just received their first batch of F-35s and the Canadian](#)

[Armed Forces are introducing the F-35](#) starting in 2026, as both nations aim to increase the survivability, connectivity, and operational effectiveness of their respective militaries. The F-35 platform is significantly more sophisticated compared to previous generation fighters which introduces new maintenance complexities. With new transport and reconnaissance aircraft also entering service around the globe, similar challenges will arise. Defense MROs need to determine how to handle vastly more complex aircraft software landscapes and health monitoring capabilities than on the previous platforms.

Although an early adopter of most next-gen platforms, the United States is not immune from new platform challenges. The B-2 Spirit and B-1 Lancer strategic bombers will soon enter retirement, being replaced by the [B-21 Raider](#), which is currently undergoing testing. The B-21 Raider is a more technologically advanced subsonic strategic bomber, smaller than the B-2 spirit but with a longer range, greater payload, and increased surveillance capabilities.

Similar to commercial aviation maintenance technicians, defense maintenance technicians will need to retrain and certify to carry out maintenance work on these new assets—further adding to MRO headaches. This will be the case across the globe for military forces as the F-35 and other modern aircraft become staples within more and more military fleets.

Section Three: Evolving tools of the MRO technician – beyond the torque wrench

Maintenance technicians need reskilling to deal with the rise of new platforms

As new airframes enter the fleet, more technicians will be required to carry out maintenance on them and their associated engines. This means that MROs now need to proactively ensure they and their technicians are certified to work on the new engine types—that they have built out sufficient capacity and capability.

Managing the training of their current technicians will be key for MRO organizations. This heightens the issues around labor shortage since, while maintenance technicians are already in high demand, the working technicians will need to be taken away from existing work on legacy platforms for training on the new platforms. MROs will need to plan for these extractions as they are challenged to match the demand of today but also plan to train their technicians for tomorrow.

The MRO skills shortage is a wakeup call to the needs of the new generation of workers

The current labor shortage challenge facing the MRO is not going to go away by itself. To improve recruitment and retention rates, MROs need to understand and empathize with the new generation of technicians.

The new generation of workers are looking for more tools than just a torque wrench or even a borescope. We now live in a digital world—they have AR and VR on their personal devices, and they have AI assistants on their new phones. Legacy thinking of just paying technicians more money is not all it will take to pull in the new

generation of workers. They are looking for more. The industry needs to:

- Make being a maintenance technician cool again!
- Provide a new set of incentives—such as working conditions, modern technological tools and systems, job flexibility, work-life balance, and bonuses.
- Promote the attraction of being an aviation maintenance technician from a younger age—all the way down to grade school, to ensure younger people consider aviation maintenance technician as a possible career.
- Make the industry more attractive and promote it to a more varied and diverse potential workforce.
- Make working conditions favorable to female employees and promote careers to young women and girls—in 2023 only 3% of all aircraft mechanics in the U.S. were female.

The labor shortage issue is not going away – MROs need to do more and better with less.

Recruiting the next generation of workers takes time. Meanwhile, MRO workforces remain strained, and it is under pressure that mistakes happen. MRO organizations continue to need to find a way to increase their maintenance capacity with fewer resources. Ultimately, they must use technology to automate the dull and boring jobs and make the technician's life easier and thereby, happily, also make the job more appealing to a younger workforce with the new generation of digital skills and new priorities.



To do so, MROs can employ two different groups of digital technology solutions—AI-based solutions and non-AI solutions. AI-based solutions will take over or support some of the more unattractive, dull, and monotonous tasks such as procedure research and data entry with the support of an AI Copilot, but also provide optimized task scheduling, planning, and assignment. Non-AI digital solutions can improve other processes such as increasing the use of mobile devices, enhancing engineer support with augmented video calling, enhancing precision and speed with embedded measurement tools, and making supply chains more efficient with e-paper labeling.

Both sets of solutions are essential to helping MRO organizations continue to ensure safety is a top priority. MRO technicians will no longer be faced with unreasonable pressure to meet demand. These digital solutions will help ensure work continues to be carried out with a safety-first mindset while ensuring workflows are optimized. At the same time, it will take away the dull and monotonous tasks, reducing another safety risk, boredom.



1: Maximize each technician's hands-on metal time by improving mobility

Some MRO leaders may argue that paper manuals and job cards are more efficient because they can quickly fill one in and move on to their next task. But if the MRO organization is set up correctly then mobility can make technicians far more efficient—technicians can request materials from their device on the aircraft and the warehouse team can gather them and send a runner to bring the required material straight to the technician.

Technicians can be armed with a device and software platform with an aviation-specific language model, that, when a fault is being raised, can in real time identify potential sources of the failure, suggest troubleshooting activities, and propose repairs. By presenting these options to the technician, the model reduces unnecessary noise and enables them to use their time more efficiently as they will not need to leave the aircraft to research the correct solution.

2: Never waste technician time with context-switching

By empowering technicians to proactively take on work, MRO organizations can allow technicians to pause one task when they need to wait for materials or parts to be delivered and switch to another job card in the same location. With mobile devices, they will be able to do this without leaving the area because they will know instantly what other jobs need doing, instead of having to leave the aircraft to go back and find a job card on the wall.

To support this organizational shift, adequate training, and support need to be put in place so that technicians can take advantage of the benefits of mobility underpinned by pre-planned organizational change, not by simply implementing these new technical devices and systems.

3: All-in-one mobile device for digital and physical tasks

To take full advantage of mobility, MRO organizations need to increase the use of the inherent capabilities of the devices technicians are using. For example, mobile devices can be used for Lidar measurements giving technicians the ability to take live measurements whenever needed, even on tricky curved surfaces.

The devices can also help less experienced junior technicians. The device can be used to initiate an augmented reality call with a senior technician to show them the problem—from there the senior

technician can tell them where they need to go for the cause of the problem or send them specific instructions or the right procedure they need to solve each problem. These marginal efficiency gains will stack up over time to make technicians even more efficient.

4: The two shifts MROs can make to optimize maintenance with AI

To help increase efficiency MROs can look to optimize their operations by utilizing AI tools to analyze data in two different areas of their operations:

1. **Task Sequencing Optimization:** AI can analyze data to ensure tasks within a given work package are scheduled in the most optimal way. This scheduling can take into account task dependencies, required conditions, and the availability of parts and labor all through the sequencing, condensing the length of the visit and reducing non-productive time.
2. **Technician Optimization:** MROs use AI-driven optimization engines to even optimize the assignment of the technician to the task, depending on the technician's skills and experience, and even geography/location on the aircraft. This way MROs can maximize their workforce's productivity based on the skillsets of the available technicians.

And of course, AI's power to help technicians isn't going to stop there with new AI functionalities constantly coming to the fore.

5: The AI copilot is here to help navigate reference materials

One use case for early AI adoption involves the use of an AI copilot by technicians to help answer questions, find procedures, and pull up reference materials that they would otherwise have to painstakingly search for through manuals and other documentation. Copilots can massively reduce the time technicians would spend in this way.

In a more advanced application of an AI Agent, the agent can be used to automate failure, troubleshooting, and repair identification. As a technician raises a fault, the AI agent can use natural language processing (NLP) to match previously recorded faults or troubleshooting manuals and make suggestions to the technician. The agent can review the symptoms of a fault and match it to a failure and propose it to the technician for their approval along with possible troubleshooting tasks or repair suggestions.

Given access to the right data, it can even increase first-time fix rates and average times to execute the repairs. A simpler case, in use today is for an AI agent to propose the ATA classification of the fault – a tricky process, particularly for inexperienced technicians, and a source of many errors, often requiring after-the-fact action. [American Airlines](#) has already been using NLP to more accurately identify which ATA code is to be used when classifying faults.

Where AI meets digital – a partnership that can only get better

The labor challenges facing both commercial and defense MRO organizations are not going away, if anything they are mounting. The industry needs to move beyond more of the same in order to make headway in recruiting. In the meanwhile, for MRO organizations to drive improvements and tackle immediate challenges they must employ new digital tools and processes including both non-AI and AI-based solutions, capable of easing the pressure on their current workforce and mitigating the growing skills shortage.

Arming technicians with fully loaded mobile devices empowers automated workflows, provides AI-driven insights into manuals, and data, unshackles greater efficiency, and eliminates monotonous and time-consuming tasks. With one eye on the future, MRO organizations must now embrace the new generation of workers and the aircraft they will work on, to become more accommodating of their needs, and help turn the tide on the rising skill shortage in the MRO sector.

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