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Mastering Spare Parts Management

Having enough spare parts is a never-ending concern for OEMs and MROs. This is because the shortage of parts stretches back a long, long way.

"From the end of the 2008 financial crisis to the beginning of the pandemic, the commercial aviation sector dealt with an unprecedented 12 years of growth," said Robert Mather, Vice President of Aerospace & Defense at IFS, a company that provides specialised ERP platforms and warehouse management solutions for the aviation industry. "Then, when the pandemic hit, instead of bending, the system broke. Today, six years later, we are still dealing with the aftermath."

This aftermath is due to the aviation industry trading "lower costs for resiliency, and since 2020, the new normal has been disruption, be it disease, war, or politics," he told Aerospace Innovations. "Furthermore, when a system is under pressure, that's when bad behaviour starts creeping in. When you're scrambling to deliver, you aren't maybe as careful as you might otherwise be about your suppliers. Same thing when you're struggling to find spare parts: you might buy from shadier vendors than you would when times are good out of desperation."

Factors such as these are making it difficult for airlines, MROs, and OEMs to control their spare parts inventories. Thankfully, technology is providing some solutions to ease their pain.

Supply Chain Challenges

When it comes to inventory control, aviation parts managers are facing a long list of supply chain challenges.

"The aviation sector faces two interconnected challenges in spare parts inventory control: unreliable inventory visibility and increasingly complex decision-making demands,"

Credit: AJW

said Chris Clements, a Senior Sales Representative at Swiss Aviation Software (Swiss AS), which produces the AMOS maintenance and engineering software solution for airlines and MROs. "Real-time accuracy is difficult to maintain because parts constantly move between warehouses, hangars, aircraft, and external repair shops, causing digital records to fall out of sync with physical reality. This leads to parts appearing available when they have already been used or remaining physically present but 'invisible' in the system due to delayed or missing updates—resulting in unnecessary emergency


Chris Clements, Senior Sales Representative at Swiss Aviation Software

orders, excess stock, wasted labour searching for components, and even aircraft-on-ground situations."

Beyond the day-to-day physical tracking of inventory, the strategic side of the equation has also grown significantly more complicated.

"At the same time, spare parts management has evolved into a multidimensional decision challenge driven by ageing fleets, volatile demand, longer and less predictable lead times, rising repair complexity, and pressure on capital efficiency," Clements added. "Airlines must now continuously evaluate whether to buy, repair, exchange, scrap, sell or rebalance stock, with each decision directly affecting aircraft availability, operational resilience, and financial performance."

Saravanan Rajarajan is AVP and Head of Consulting for Aviation, Aerospace & Defense at Ramco Systems, a company that develops a web-centric software platform for aviation material planning, demand forecasting, and MRO management. He agrees with Clements that parts visibility is the aviation industry's "first major issue. The second issue is demand unpredictability: Non-routine findings during scheduled checks drive unplanned parts requirements that are nearly impossible to forecast with manual tools. The third issue is compliance complexity: Every rotable and life-limited part carries a traceability obligation under regulators and managing that documentation manually introduces significant error risk."

New parts availability is yet another supply chain challenge, said Bob


Bob Loycano, VP of Supply Chain at FDH Aero

Loycano, VP of Supply Chain at FDH Aero, a global supply chain solutions partner. "Hardware manufacturers have limited capacity and, currently, demand is exceeding supply, draining inventory levels globally," he said. "The lack of capacity has caused lead times to increase dramatically, requiring more inventory on hand to support customer requirements."

Furthermore, delays in new aircraft and engine deliveries mean that airlines are keeping older aircraft in service longer, with the average fleet age having risen to about 15 years. "As a result, these fleets require more frequent maintenance which consumes more spare parts, and with the supply chain constraints and parts shortages tied to raw materials like aluminium, electronics, semiconductors, key components, etc, this puts more pressure on TATs and causes backlogs in service delivery," said Scott Symington, Chief Commercial Officer at AJW Group, an independent provider of component parts, repair services, and outsourced inventory management solutions. "A further issue is the difficulty in hiring enough qualified workers to meet production and maintenance demand. This is exacerbated by an increase in regulatory and quality requirements brought about by events such as those impacting the Boeing 737 fuselage failure in 2024, amongst others."

Coping with Supply Chain Challenges

Ongoing supply chain issues are forcing MROs and OEMs to become creative in their quest for critical, hard-to-source spare parts. "They're

being forced into streamlining their operations and inventory strategies to minimise overstocking and understocking," Symington said. "As an MRO, AJW has adopted a multifaceted approach to its stock management by putting resilience measures in place and improving collaboration with our partners and suppliers. As an example, we've implemented automated inventory tracking systems. These forecasting tools can improve our ability to meet customer needs effectively, reducing errors and delays."

Improved forecasting tools can help, but industry experts say more is needed—including a move away from "just-in-time" minimally-stocked parts inventories to cope with supply chain issues. This is why "the industry has made a decisive shift from just-in-time to just-in-case for most of the critical components," said Rajarajan. "That forces planners to hold deeper safety stock on sole-sourced and hard-to-source items."

"Lean operating models are great, but the prerequisites need to be in place for it to work and one of those prerequisites is stability, a commodity in short supply nowadays, so we need a different answer," Mather said. "That means MROs and OEMs are looking to ensure that they have a minimum amount of stock of critical and long lead time parts on hand at all times, to ensure service levels are maintained."

Unfortunately, longer lead times from OEMs are causing more buffer stock to be held in the pipeline. "Distributors typically hold this

Credit: Swiss AS AMOS mobile

stock," Loycano said. "But with many parts running out completely, and the replenishment taking longer to occur, OEMs and MROs must reconsider stocking their own parts, especially the sole-source and critical items necessary to maintain their production lines."

"It's not always possible, but where it is, MROs and OEMs are looking to avoid sole-sourced parts," observed Mather. "Sole-sourcing can reduce costs through bigger production numbers or volume discounts, and is less challenging to manage, but it leaves you vulnerable. Sharing demand across suppliers helps keep the ecosystem healthy, and we're also seeing near- and ally-shoring used to reduce exposure to geopolitical disruption."

Given these factors, today's minimum stock levels must reflect criticality, lead-time risk, and operational impact rather than purely cost-based optimisation. They must also address fuel cost volatility, which can amplify inefficiencies across technical operations.

"Poorly positioned parts lead to emergency logistics, duplicated infrastructure, and avoidable operational costs, often multiplied across airline groups," said Yannick Hertzog, Swiss AS' Senior Product Lead & Team Lead for Inventory Optimization & Supply Chain Solutions. "AMOS supports advanced inventory concepts such

Jason Lewis, COO of FDH Hardware, a division of FDH Aero

Matthew Tailby, Swiss AS' Senior Product Owner

as multi-location stock control, repairable management, pooling, and group-wide visibility. Material Companion extends this by dynamically reassessing stock targets and proposing stock balancing actions across locations and airline groups. This allows operators to protect availability where risk is highest while avoiding blanket overstocking."

One solution to rising fuel costs is to buy larger quantities of spare parts less often, assuming that large volumes are available to purchase. "As fuel and shipping costs rise, purchasing parts in bulk becomes more cost-effective than relying on just-in-time delivery, since fewer shipments are required and transportation costs are spread across a larger volume of parts," Loycano said. "Customers that have moved to Vendor Managed Inventory (VMI) solutions, such as those offered by FDH Aero, are shielded from these day-to-day fuel and shipping cost changes because the third-party logistics provider holds the inventory until it is needed by the customer."

Why Aviation is Still Struggling to Go Paperless

To navigate the many issues associated with spare parts inventory management, aviation companies are increasingly turning to advanced digital solutions. Platforms like IFS Cloud and IFS Softeon, Ramco Systems' Route Anywhere and Mechanic Anywhere, and Swiss AS' AMOS and Material Companion provide airlines, MROs, and OEMs with comprehensive inventory management capabilities that are vastly superior to legacy methods. So,

Credit: AJW

given the clear advantages of these modern systems, why are so many facilities still reluctant to go paperless?

"The main barrier is operational trust under pressure," replied Hertzog. "In busy shops, teams rely on expedited procurement, substitutions, and cross-station stock balancing. If digital systems do not capture these actions seamlessly, paper persists."

"The most significant hurdles are cost, process change, and organisational readiness," said Jason Lewis, COO of FDH Hardware, a division of FDH Aero that supplies fasteners, fittings, and other small hardware parts to aerospace OEMs and the aftermarket. "For smaller facilities, in particular, the upfront investment in software, hardware, integration, training, and process redesign can be substantial relative to their operating budgets."

Then there's the cultural challenge. Moving from paper-based processes to digital workflows goes beyond system implementation in companies where paper is 'the way we've always done it'. In many organisations, the real barrier is not whether the right paperless technology is available, but whether the workforce is willing to adopt it and leadership is prepared to support it.

"The biggest hurdle is rarely technology — it's trust and habit," Rajarajan said. "Certifying staff have signed paper job cards for decades and understand the legal weight of their signature. Persuading them that an electronic equivalent carries identical regulatory standing requires both regulatory clarity and user experience design that makes the digital process feel more trustworthy. The second hurdle is data migration: Historical records, fleet configuration data, and maintenance programme definitions sitting in paper files or legacy systems must be converted accurately. Any gap creates compliance risk."

If there is a silver lining to this cloud, it is that the retirement of the Baby Boomers is helping to lessen resistance to going paperless. "I used to say that the most significant hurdle was change aversion from the senior staff on the ground, but that's simply not the case anymore," said Mather. "The generational turnover of staff means that it's a more tech-savvy workforce. In fact, the tech is expected and if you're not giving your team modern tools, you're not likely attracting or retaining the top talent."

Inventory management scaled warehouse walkthrough. Credit: xsAviation

Saravanan Rajarajan. AVP and Head of Consulting for Aviation, Aerospace & Defense. Credit: Ramco

Scott Symington, CCO, AJW Group. Credit: AJW

Curing the "Lost in the Hangar" Syndrome

Modern, cloud-based software solutions are now solving the notorious 'lost in the hangar' tracking

problems that plague so many spare parts management systems.

"Cloud-based platforms address this problem by creating a single, real-time source of truth that keeps maintenance teams aligned on parts availability and work progress," Lewis said. "These systems improve visibility into where work stands in the workflow, where parts are located, what tasks are blocked, and what actions need to happen next. In a large maintenance environment, small tracking issues can create delays in multiple areas, so better visibility helps keep work moving and reduces the chances of work stalling for avoidable reasons."

AMOS tackles the persistent 'lost in the hangar' problem by digitising the movement of parts and tools, ensuring every transaction is recorded in real time within a single, tightly integrated system. To minimise the chances of

Project Accounting and Reporting. Credit: Ramco

parts mixups, "every item in AMOS is assigned a unique identifier linked to its serial or batch number, making it nearly impossible for a part to disappear, as each has a last known location and a clearly recorded transaction history," said Swiss AS' Senior Product Owner Matthew Tailby.

"The core problem is that parts exist physically but are invisible to the people who need them," Rajarajan said. "Ramco's cloud platform solves this by tracking the complete movement of every part from the moment it leaves the warehouse shelf, through transit across the hangar floor, all the way to point of use—and critically—through to physical attachment on the aircraft. This end-to-end chain is managed through Ramco's Route Anywhere functionality, which assigns dedicated logistics roles within the facility and records every handoff in real time. Tools are RFID-tagged enabling the system to identify the exact physical location of an item at any point in the process."

As effective as tagging parts is for digitised inventory tracking, it does require some time and effort on the behalf of staff. This is why "the next evolution is computer vision, which has the possibility to eliminate the need for tagging entirely, thereby reducing the costs associated with the process," said Mather. "You still need your system to interact with the physical world – in this case through cameras, but sophisticated AI tools can recognise specific serial numbers visually and can triangulate locations anywhere in view."

Putting Inventory Control in the Mechanic's Hands

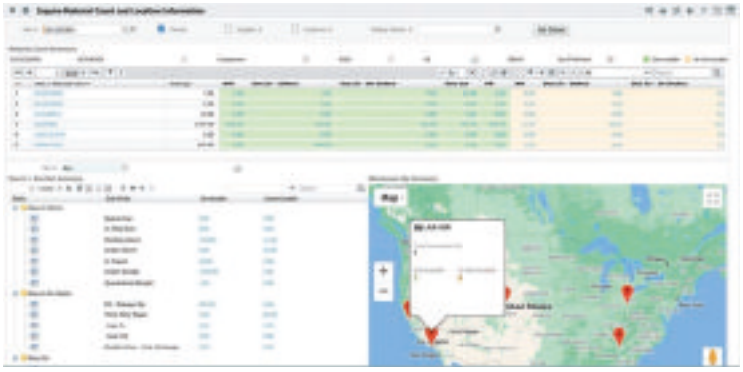
One of the best features of digitised parts inventory management software is its ability to be shared with ruggedised tablet computers. As the experts explain, these units can be distributed to mechanics on the shop floor to order, track, and manage parts in real-time, which can help to reduce aircraft turnaround times (TAT).

"Ruggedised tablets put critical information directly in the hands of mechanics at the point of maintenance," Lewis said. "Instead of leaving the aircraft or work area every time they need to check inventory or request parts, or even review documentation, technicians can access all that information in real-time directly from the shop floor, improving coordination between teams. Mechanics can confirm part availability and request them without unnecessary delay, which also allows the broader team to adjust and sequence work more effectively. As a result, turnaround times are reduced, which is critical in aviation. The goal is to return the aircraft to an airworthy condition and back into revenue-generating service as quickly as possible, and real-time part visibility is a major advantage in that process."

"The simplest TAT improvement comes from eliminating the walk—the trip back to a workstation to check part availability, refer to the maintenance manual, raise a parts request, or sign off a task," said Rajarajan. "Ramco's Mechanic Anywhere app puts all of those actions in the mechanic's hand at the aircraft. A discrepancy can be logged, OEM reference manuals can be accessed, a parts request raised, and the warehouse pick list generated before the mechanic has left the bay. The Route Anywhere app assigns dedicated logistics roles within the hangar—effectively a water-spider function—ensuring that picked parts are delivered to the right work centre and mechanic, rather than waiting to be collected. In operations with mature mobile adoption, this alone can reduce parts cycle time by 30–40%. On a complex heavy check running hundreds of concurrent tasks, those savings compound significantly."

"Enabling production staff to both access and update data in AMOS in

Global Inventory Visibility



Critical Components Analysis and Optimization

End To End Parts Movement Tracking and Visibility

Digital Enablement of Front-Line Teams

Spare parts inventory management tracking and visibility digital interfaces. Credit: Ramco

real-time allows them to determine what events can be worked on due to material availability," Clements said. "Removed components can also be processed immediately due to the real-time removals. AMOSmobile/EXEC has been optimised to ensure that the mechanics can perform all their daily tasks directly at the aircraft, from receiving their assigned tasks for the day or shift, to creating findings and electronically signing off completed work, to checking available inventory and requesting additional material."

Making the Old Play Nice with the New

When adding digitised parts inventory management systems to an existing shop, it is vital to ensure that 'the old play nice with the new'. So what are the best practices for ensuring that these new mobile inventory apps integrate smoothly with older, established ERP systems?

"As with all digitalisation drives, the ability to deliver an intuitive and comprehensive solution relies on integrating the core ERP with mobile devices, as well as the capacity to continuously connect with the ever-expanding solutions and technologies being adopted by inventory teams," said Clements. "These take many forms, such as smart tool systems, vertical storage units, fully automatic warehouse management systems, and robots for inventory delivery."

It's best to connect new mobile tools to legacy ERP systems through a well-structured integration layer, rather than relying on fragile point-to-point customisations. Organisations that stick to this approach can modernise the user experience without disrupting the integrity of core enterprise systems. "None of that works, though, without clean and standardised master data," Lewis said. "Part numbers, locations, serial numbers, units of measure, and transaction rules must align across systems. And system ownership must be clearly defined. The ERP should remain the system of record for core inventory and financial data, while mobile applications can serve as the point of execution for scanning and status updates."

The rollout of such integrations should be phased to avoid catastrophic failures. "A pilot programme in one area of the business can uncover workflow gaps and data issues before broader deployment," said Lewis. "The implementation itself must be designed around the realities of the maintenance environment, from connectivity limitations and regulatory requirements to the need for reliable, user-

Inventory Management. Credit: Veryon

Efficient Aircraft Work Order Management. Credit: Veryon

friendly tools on the floor."

When such integrations are being planned, their potential impacts should be assessed and mitigated across the whole organisation. "Just because one team likes a shiny new solution, doesn't mean that there aren't significant implications to other teams upstream and downstream," Mather said. "You need to understand the needs of each stakeholder throughout the entire process and make sure that every team's needs are accounted for."

The Future of Parts Management

We have seen what digital parts inventory systems can do to address spare part shortages for airlines, MROs, and OEMs. So what improvements are coming next? Here is what the experts had to say.

"The industry is heading toward a fully connected digital thread, where maintenance, materials and compliance data flow through a single environment with full traceability from the point of receipt through installation and record retention," said Lewis. "AI will likely play an increasingly important role, especially in predictive maintenance and inventory optimisation, but also in areas like workflow prioritisation and intelligent search across maintenance records and technical data. These capabilities can help organisations make faster, better-informed decisions while reducing administrative burden. Blockchain also has potential here, particularly for end-to-end traceability

Yannick Hertzog, Senior Product Lead at Swiss AviationSoftware

and secure record validation across multiple parties in the supply chain. It is gaining attention among larger organisations that want greater confidence in component history."

"Two developments will reshape spare parts management in the years ahead," Rajarajan said. "First is agentic AI, which is software that doesn't just recommend actions but executes them within defined guardrails. Ramco's Chia platform, launched in early 2026, is already moving from conversational assistance to autonomous agents capable of raising purchase orders and repair orders without waiting for human initiation. Second, predictive parts forecasting for non-routine maintenance, using AI trained on fleet-wide maintenance histories to anticipate non-routine findings before they occur and feeding that intelligence directly into parts planning. This converts reactive procurement into a structured, forecastable activity."

"We already talked about AI and computer vision solutions that are here today," said Mather. "So are warehouse optimisation systems, part prepositioning optimisation, stock-level optimisation and automated replenishment. These tools continue to get better and better. They just need to get rolled out."

The final word goes to Chris Clements, who sees big possibilities ahead. "Where next? While AMOS already offers integration with automated warehouse solutions, there has been interest in using robots to deliver material to the hangar," he said. "How this might be realised in such a dynamic environment, with many movements already happening in a safety-critical space, will be interesting to see."

Thanks to digitisation, the days of relying on "just-in-time" paper trails and hoping for the best are on their way out. Granted, the aviation supply chain may never return to the predictable stability of the pre-pandemic era, but with the right technology, it doesn't have to. By embracing digitalisation, right-sizing buffer stocks, and looking ahead to AI-driven forecasting, airlines, MROs and OEMs are actively engineering their own solutions to supply chain challenges. The parts themselves might still be hard to source, but managing them doesn't have to be.

By James Careless