AIRCRAFT UPTIME

Fresh Thinking and the Future of Aircraft Uptime



The cost of aircraft downtime can reach thousands of dollars per hour, but for many operators, financial cost is not the most important factor. For air rescue, aerial firefighters, defense agencies and others who rely on aircraft for critical services, aircraft delays can mean mission failure or the loss of human life.

For business aviation or airlines, downtime can lead to crippling reputational damage and the loss of future business.

Naturally, maximizing uptime has always been a focus for the aviation industry. Yet despite these efforts, the average airliner operates only 10.5 hours a day.

The industry has seen the need for improvement. To maximize mission readiness, deliver profits or return shareholder value, organizations are finding new and better ways of optimizing their aircraft. This paper will explore the new thinking that is transforming the future of aircraft uptime.

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NEW THINKING ON THE THREE MAJOR ELEMENTS OF UPTIME

The uptime of any individual aircraft is the result of hundreds of small details coming together in exactly the right way - which makes uptime analysis a complex prospect.

To understand the big picture of uptime and how to influence it, you can think of it as being composed of three basic elements:

- Unscheduled maintenance issues
- Maintenance operations
- Aircraft turnaround times

Minimizing or streamlining these elements has long been a goal for aviation organizations, but new technologies are providing new tools to approach each. New thinking, new data and Connected Aircraft solutions are challenging long-held assumptions about how you can best achieve these goals.



UNSCHEDULED MAINTENANCE

In a perfect world, highly-reliable equipment and scheduled maintenance would eliminate any need for unscheduled maintenance. But no aircraft operates in a perfect world. Weather and other variables can produce unpredictable wear on aircraft, particularly those operating in harsh environments.

Nonetheless, eliminating as much unscheduled maintenance as possible is still a worthy and necessary goal. Unscheduled maintenance threatens mission readiness and operations in ways other downtime does not, making any reduction well worth the effort.

Today, minimizing unscheduled maintenance happens in two ways:

THINKING DIFFERENTLY ABOUT RELIABILITY

OLD: What matters is the reliability of individual components

NEW: What matters is the interreliability of components

Interreliability refers to how well all the parts of an aircraft work together. In today's increasingly connected, complex aircraft, no individual part determines overall reliability.

Aircraft manufacturers and purchasers need to adopt new ways of measuring reliability in a connected craft, and of ensuring that parts work reliably together. Smart sensors and monitoring tools will be the foundation of these solutions.

THINKING DIFFERENTLY ABOUT WHEN MAINTENANCE HAPPENS

OLD: The best way to avoid unscheduled maintenance is routine scheduled maintenance.

NEW: The best way to avoid unscheduled maintenance is predictive and prescriptive maintenance.

With the rise of the Connected Aircraft, the aviation industry is developing powerful new predictive and prescriptive tools that fix issues before they become problems – and before they become an unscheduled maintenance event.

While predictive tools are key for minimizing unscheduled maintenance, in the future they may also become sophisticated enough to minimize the need for "soft-time" checks, or operatordefined scheduled maintenance checks.

With the Connected Aircraft, the aircraft can report on its health continuously. Specific aircraft could come out of service only when they need to, at the point that a specific issue needs addressing. This will all be easier to do when health information can be correlated with other data in integrated software sets or dashboards.



of respondents labeled maintenance as an "Extremely Important" or a "Very Important" benefit from their investment in Connected Aircraft solutions in Honeywell's 2018 Connected Aircraft Report. ¹

STREAMLINING MAINTENANCE OPERATIONS

Making even modest reductions in maintenance spending can have major benefits for an operator's bottom line or ability to maintain mission readiness.

Improving maintenance operations is spurring a reevaluation of long-held beliefs.

THINKING DIFFERENTLY ABOUT WHAT MAINTENANCE ENTAILS

OLD: Maintenance is what happens inside the maintenance facility.

NEW: Effective maintenance requires visibility into events far upstream and downstream of the aircraft's actual time in the maintenance facility.

Previously, improving maintenance efficiency focused on getting better at all the activities that determined how fast an aircraft could go through maintenance. Now it is becoming clear that maintenance teams need a view into what happens outside the shop.

This requires not only synchronization of various maintenance systems, but also synchronization with systems that haven't been traditionally thought of as maintenance, such as flight operations. It also requires sensors that continually monitor component health and report back to maintenance teams - ideally in the same dashboard as flight operations data - so they can watch an aircraft even when it's not in the shop.

THINKING DIFFERENTLY ABOUT PARTS INVENTORY

OLD: Maintenance operations need to choose between keeping costs down and increasing inventory. **NEW:** This is a false choice. Advances in technology mean airlines can more effectively balance costs and parts availability.

Having parts on hand speeds maintenance, but also costs money. Today there are multiple ways to address this challenge. One is through additive manufacturing, also known as 3D printing, which enables shops to manufacture parts as needed. Another method is through predictive, prescriptive maintenance. Predictions of maintenance needs can allow shops to order parts so that they arrive at the moment the plane arrives – no warehousing or waiting necessary. Prescriptive alerts tell crews how to make those repairs.

OLD: What matters most are performance metrics that focus on parts availability.

NEW: What matters are performance metrics that directly tie maintenance to fleet uptime and profitability.

Intense focus on mission readiness led the United States Air Force to pioneer a method known as high-velocity maintenance, or HVM, to speed up maintenance operations and increase aircraft availability.

Since the most frequent sources of work stoppages and missed targets for maintenance teams relate to parts availability, most organizations focus their metrics on parts availability. But in HVM, the Air Force started first by setting a target fleet-availability rate. By working back from this, forecasting demand for parts and considering the many interrelated systems involved, the maintenance shops could focus their work in a way that led to faster turnaround times and increased fleet uptime.





Every year, the world's airlines spend an estimated \$70 billion on maintenance - twice as much as they make in profit. Collectively, they hold some \$50 billion in spares and inventory, yet are still plagued by technical problems and poor availability.²

TRANSFORMING AIRCRAFT MAINTENANCE WITH BLOCKCHAIN

Blockchain is a kind of digital ledger that can be used by multiple parties to create a shared database. In terms of aircraft maintenance, it can become a single, incorruptible source that brings together manufacturer, distributor, installer, inspector and operator. It can clean up the jumble of parts data and maintenance logs (which even today can be found in paper format in some shops) while creating a detailed history of every part that goes into an aircraft.

REDUCING AIRCRA TURNAROUND TIMES

Rapid turnarounds benefit everybody. For owners, they keep valuable assets usable. In fields such as defense and air ambulance, turnarounds often determine mission success. For airlines, turnarounds determine on-time performance (OTP), which in turn determines passenger loyalty and profits.

\$10million

Shaving one minute off the time each aircraft is on the ground between flights can save \$5 million to \$10 million a year in freed aircraft time and hidden costs.³

For airlines and business jets, more passengers and busier airports can lead to longer turnaround times. Generally, though, it is the complexity of ground handling - loading fuel, cargo or passengers; changing crew; and performing many other tasks that determines how long it takes to get back in the sky. Increased outsourcing at airports means many more different entities have to work together to achieve a quick turn.

Even small hiccups among all the separate entities have immediate repercussions on mission success or OTP. Turnarounds are also an area where one small issue can compound dramatically. A small delay in the morning can turn into an unsalvageable schedule by the end of the day.

As with the other two tenets of uptime, smart operators are bringing new thinking to traditional problems in aircraft turnaround and OTP.

THINKING DIFFERENTLY ABOUT ORCHESTRATION

OLD: What matters most is that	NEW: What matters most is
everyone involved in aircraft	not how individuals perform
turnaround does their job as	in isolation but how they wo
efficiently as possible.	together.

THINKING DIFFERENTLY ABOUT SHORT-**TERM VS. LONG-TERM APPROACHES**

OLD: One of the best ways to improve OTP is building buffer time into schedules and building up reserve capacity.

NEW: Buffers are a short-term exercise in "buying" OTP. More difficult but more effective than building buffers is addressing root causes, which requires a long-term approach to rethinking and reorchestrating processes.



3. https://www.bcg.com/en-us/publications/2016/operations-improving-airlineson-time-performance.aspx

TRANSFORMING UPTIME WITH HONEYWELL

Traditional approaches to quality and performance aren't enough to transform aircraft uptime. Just as Honeywell is helping define the new Connected Aircraft, we're redefining the way aviation gets the most out of its aircraft investments.

Throughout our 100-plus-year history in aerospace and aviation, we've focused on helping everyone in the aviation ecosystem maximize their investments - in part by maximizing the time aircraft spend in the air. We've done so by investing in quality. Every aircraft component we manufacture and every service we offer is designed with reliability and performance in mind.

ELEMENTS OF UPTIME	MINIMIZING UNSCHED ULED MAINTENANCE
KEY HONEYWELL UPTIME SOLUTIONS	- GoDirect Connected Maintenance
	- Sky Connect Flight Data Monitoring
	- Health and Usage Monito Systems



- STREAMLINING MAINTE-NANCE OPERATIONS

REDUCING TURNAROUND TIME

- GoDirect Trade
- GoDirect Flight
- Performance-Based Maintenance Contracts
- GoDirect Ground Handling



STOPPING **BEFORE THEY** START WITH HONEYWELL SOLUTIONS

The best way to avoid unscheduled maintenance is predictive maintenance. As a part of our focus on the Connected Aircraft, we're providing a new generation of analytics that can help you implement predictive maintenance today.

PRODUCT SPOTLIGHT: GODIRECT CONNECTED MAINTENANCE

Our GoDirect Connected Maintenance is a nose-to-tail solution that analyzes aircraft data and delivers diagnostics as well as predictive and prescriptive alerts.

you: - Provides notifications with prescribed maintenance actions to help maintenance crews pinpoint faults

Goes beyond the capabilities of solutions that focus only on system health monitoring and trend analysis

> REDUCE **OPERATIONAL** DISRUPTIONS 35%4



PRODUCT SPOTLIGHT: ONBOARD MAINTENANCE SYSTEMS

Our onboard maintenance systems monitor the health of your aircraft and diagnose issues quickly and accurately. They offer continuous monitoring of aircraft avionics during flight to give

- Faster diagnosis of faults and repair of affected systems
- Lower maintenance costs
- Improved system reliability

REDUCE AIRCRAFT TURN TIMES BY 50%⁵

PRODUCT SPOTLIGHT: SOLUTIONS FOR HELICOPTERS

monitor and communicate the health and maintenance needs of critical components.

- Increase aircraft availability.
- Reduce maintenance costs.
- Optimize parts inventory management.

Sky Connect Tracker III collects data from onboard systems to record and communicate aircraft performance and potential maintenance needs. Alert messages are communicated to the ground operations center using the Iridium satellite network.

- Flight data monitoring capabilities
- Worldwide text and voice
- Digital mapping

4.https://aerospace.honeywell.com/en/~/media/aerospace/files/brochures/n61-1905-000-001_connectedmaintenance-br.pd 5. https://aerospace.honeywell.com/en/products/cockpit-systems/onboard-maintenance-systems

STREAMLINING MAINTENANCE OPERATIONS WITH HONEYWELL SOLUTIONS

Rethinking maintenance is an opportunity to save costs and boost efficiency. Helping the aviation industry do just that has long been a focus for Honeywell.

"These upgrades not only make maintaining our new fleet easier and more efficient, they also bring extra reliability to our aircraft. That translates to reduced delays and an overall better experience for passengers." - Scott Sheldon; Executive Vice President, Chief Operating Officer and Chief Financial Officer; Allegiant Air; on his company's decision to use Honeywell maintenance, repair and overhaul services for auxiliary power units and select avionics.⁶

PRODUCT SPOTLIGHT: PERFORMANCE-BASED MAINTENANCE CONTRACT

Our Performance-Based Maintenance Contract offering allows you to lock in savings while taking advantage of our full-service maintenance, repair and overhaul shops.

- Service on equipment from any manufacturer

- Ongoing reliability program to increase on-wing component performance

- Incidental coverage options to mitigate "over-and-above" impacts



6. https://www.honeywell.com/newsroom/pressreleases/2018/07/honeywell-awarded-exclusive-maintenance-contracts-for-allegiant-airs-power-and-avionics-systems

PRODUCT SPOTLIGHT: GODIRECT TRADE

PRODUCT SPOTLIGHT: HONEYWELL FORGE FOR AIRLINES

GoDirect Trade brings the ease and convenience of online buying to the aircraft parts market.

Using Blockchain, the platform ensures that every listing includes images and quality documents for the exact part being offered for sale.

- No waiting to confirm availability
- No need to get a quote on the price

- No fear of questionable parts or incomplete documentation

Honeywell Forge is a service that constantly collects, cleans and analyzes streams of disparate data from a wide variety of airplane, airport, government and Honeywell sources - and immediately offers actionable insights to improve an airline's bottom line and passenger experience.

It is a monitoring dashboard for all of Honeywell's software solutions, helping you see into maintenance, ground handling and flight operations.

OPTIMIZING TURNAROUND TIMES WITH HONEYWELL SOLUTIONS

Reducing turnaround times is vital to achieving mission success or hitting financial targets. Honeywell offers new and innovative products and services to minimize turnaround times and optimize on-time performance.

"With more accessible data, we can create a safer and more efficient ramp environment, drive better on-time performance, and lower fuel and maintenance costs." - David Burgess, Vice President Global Fleet, Swissport International, on the benefits of working with Honeywell to create a connected ramp solution.⁷



7. https://www.prnewswire.com/news-r connected-service-300761832.html

PRODUCT SPOTLIGHT: GODIRECT GROUND HANDLING

GoDirect Ground Handling can help you manage the ground handling process effectively and efficiently. It is intuitive and user friendly, with simple-to-use screens and graphical prompts. It assists the ground handler in managing the aircraft turnaround process, while providing accurate, real-time information to operations on the status of each tail and the likelihood of it pushing back on time.

- Smoother control and coordination
- More on-time performance
- Better gate and ground traffic planning

7. https://www.prnewswire.com/news-releases/swissport-international-to-improve-ground-operations-at-airports-with-honeywell-



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