Inquiry

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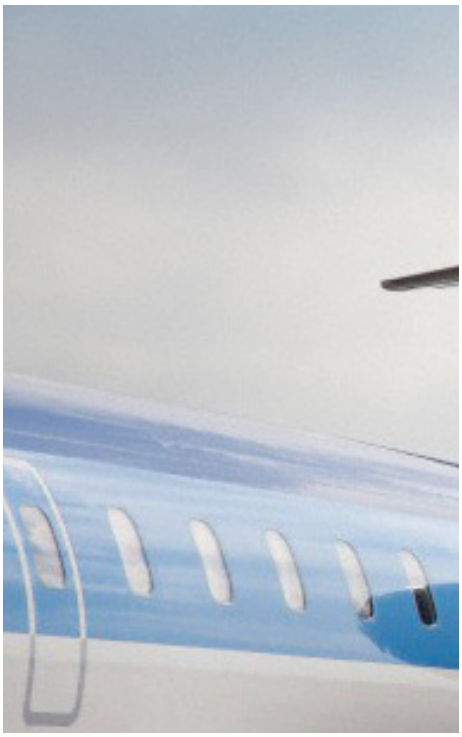
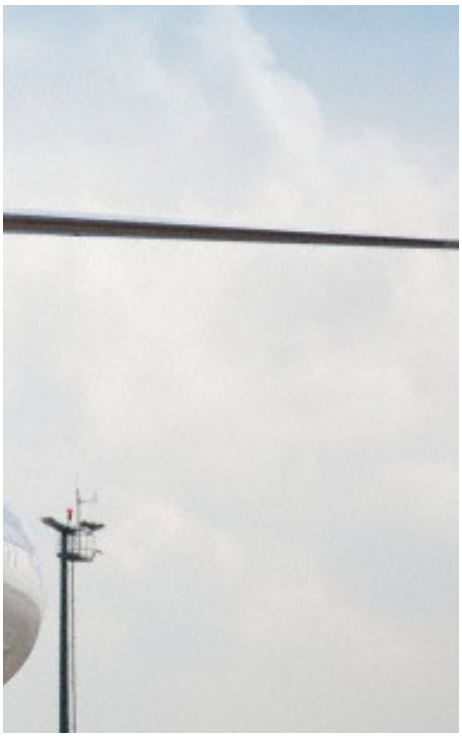
Flying Blind

AIRLINES HAVE THE DATA THEY NEED TO REDUCE DELAYS FROM EQUIPMENT PROBLEMS—AND EVEN TO STOP PROBLEMS BEFORE THEY OCCUR—SAVING BILLIONS AND MAKING CUSTOMERS HAPPIER TO BOOT. HERE'S HOW TO DO IT.

For any industry that invests in expensive and complex equipment—from locomotives and container ships to mining equipment and oil rigs to nuclear reactors and chemical plants—maximizing the lifetime return on those assets is critical.

Every minute that a multi-million dollar piece of equipment isn't functioning impacts the bottom line.





Perhaps the clearest example of this is the commercial airline industry. When American Airlines or Lufthansa acquires a $200 million Boeing 787 or a $390 million Airbus A380, the goal is to keep that aircraft up and running for 18 hours a day and generating profitable revenue for as many years as possible.

At the heart of that effort is the airlines' maintenance, repair, and overhaul (MRO) organization, charged with handling both routine and nonroutine issues to keep that fleet up and running. Unfortunately, today's commercial airline MRO operations aren't nearly as effective or efficient as they could be. Aircraft delays cost the industry $8.3 billion annually. Maintenance and other airline-controlled issues cause 42 percent of all delays in commercial airlines.

Such service interruptions impact more than just the bottom line. Every passenger has an arsenal of war stories of being trapped on the tarmac due to a maintenance issue. It's little wonder that airlines are just behind newspapers for the lowest customer satisfaction score among 47 industries tracked by the American Customer Satisfaction Index. Even more importantly, inefficient maintenance operations can create safety hazards for airlines and passengers. The US Office of Special Counsel recently chastised the Federal Aviation Administration (FAA) for years of inattention to "lax airline maintenance." Then there's the wasted fuel and increased pollution caused by poor maintenance information.

The Data Is There, But It's Not Being Used

Aircraft service lifecycle management is a $109 billion industry, but one that has remained unreformed by emerging technology. The data to improve maintenance turnaround times for airlines exists, but the carriers must be willing to invest in new systems and processes to collect, filter, analyze, and disseminate it in real time.

Having real-time data available would significantly reduce the time it takes to fix problems. For example, a maintenance planner could download a defect notification from a plane as the problem occurs and have the maintenance crew and replacement parts ready by the time the plane pulls up to the gate.

Even better, airlines could use the data to predict and take action before the problem occurs. By crunching the data on part failures and average life spans, airlines could build predictive maintenance programs—fixing components that are about to fail—while improving the lifetime utilization of their multi-million dollar planes with the least maintenance and downtime possible.

What's needed is a way to gather all the data coming from the ground and the air and keep it fresh—not just for individual aircraft but for the entire fleet. If airlines had access to all that data at once, maintenance planning could happen in real time and maintenance processes could become more dynamic.

Of course, there are also some major challenges to making this scenario happen, as we'll see. But the payback is so clear that the industry is beginning to show an appetite for the transformation required to make airline travel faster, happier, more profitable, and, ultimately, safer.

The Causes of Aircraft Delays

An analysis of International Air Transport Association (IATA) delay codes shows that airline-controlled processes, such as maintenance, ground handling, and supply chain, are the leading cause of late flights.

42% Airline-related
(maintenance, supply chain, operations, ground handling)

33% Air traffic & flight control

11% Weather

6% Miscellaneous

5% Airport operations
(non-airline or cross-airline)

3% Airport security

Source: InfoTrust Group, 2012

Waiting for Planes to Fail

Many airlines today are essentially flying blind when it comes to keeping their expensive planes in the air. Most maintenance orders are run in overnight batches. That's tolerable for routine maintenance. But equipment problems like an unforeseen engine fault or a tire that wears out prematurely don't have a schedule; they can happen at any time.

There are several information channels related to aircraft condition, including pilot's reports, crew reports, and maintenance notes. Those aircraft that have electronic flight bags (EFBs) are sitting on a mountain of data. And the latest generation of aircraft are generating huge quantities of data with their built-in health monitoring systems – up to several terabytes on a single transatlantic flight. But precious little of that information makes it to the maintenance crews. And by the time it does, it's often late. "Some airlines are filling up their databases with all of this data and maybe the engineers go back and do something with it," says Michael Denis, vice president of customer engagement at InfoTrust Group, a software and engineering consultancy in the aerospace, defense, manufacturing, electronics, and automotive industries. "And that's a best-case scenario."

Trouble is this is just the beginning of the data explosion. Besides the plane itself, other sources of data include the airline, aircraft manufacturers, external maintenance providers, regulators, and spare parts suppliers. Some of the data are traditionally structured data sitting in relational databases, but a significant subset is unstructured, such as a pilot's handwritten logbook entries and a technician's notes. The unstructured data, while the most challenging to interpret and most prone to errors like incorrect tail numbers or missing part information, is nonetheless essential.

The information that does get passed on via computer is only used to generate notifications to the ground crews, who then dispatch the people and parts to fix it. That data is tracked over time, but only for regulatory purposes.

Power by the Hour

Rolls-Royce coined the term power by the hour more than 20 years ago to describe a new kind of performance-based contracting for the aircraft engines it sells to commercial airlines. Instead of paying $10 million for a Rolls-Royce IAE V2500 engine with its lifetime of parts and services invoices, a commercial airline could literally pay by the hour.

Since then, General Electric, Airbus, and Pratt & Whitney have also introduced performance-based contracts in which the cost of the asset is determined by its availability.

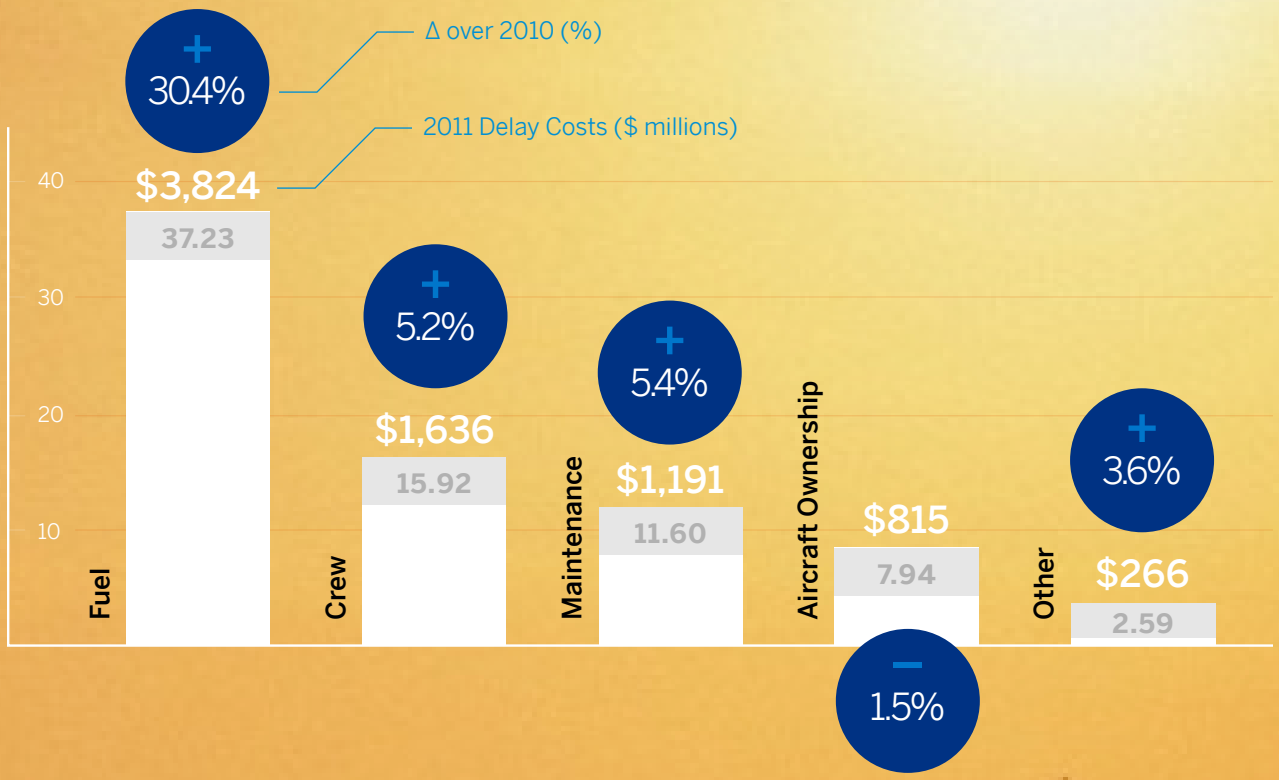
But with new sources of performance data and analytics, a time could come soon when the whole plane—nose to tail—can be obtained on a power-by-the-hour basis. And that, ultimately, could benefit both the equipment manufacturers and the airlines, creating incentives to reduce costs, share risk, and improve lifetime performance.

The model certainly makes sense for the airlines as they attempt to cut maintenance costs, increase profitability, and improve overall customer satisfaction. Performance-based contracting can deliver more predictable maintenance costs, though customers must expect to pay more when manufacturers outperform.

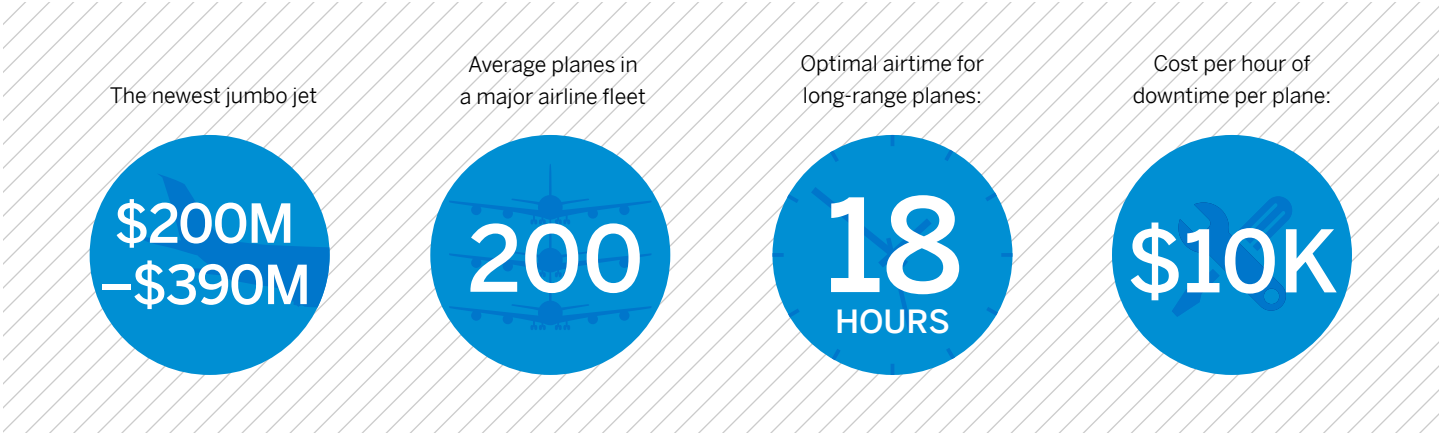
For the equipment manufacturers, it's a trickier proposition. They need to be able to accurately predict their products' performance to make a profit.

If power-by-the-hour takes off in aviation, there could be implications for other industries. But like the engine makers, they'll have to give up their robust after-sales revenues. Services and parts account for 25 percent of revenues—and as much as 50 percent of profits—across manufacturing industries, according to an Accenture study.

In 2011, 103 million delay minutes cost US airlines $7.7 billion in direct operating costs, 15 percent more than in 2010.



Why Airlines Need to Keep Planes in the Air



Sources: The Boeing Co.; Airbus; Wolfgang Ullwer, SAP, 2012

Next-Generation Maintenance: Dynamic, Opportunistic, and Real Time

A new kind of data analysis could change all that. For example, with the right maintenance program and information, airlines can perform dynamic maintenance packaging. Instead of taking a plane out of service for 10 days for maintenance, they could break it into 10 overnight checks when the plane is on the ground in non–revenue-generating mode anyway. They can also adopt opportunistic maintenance scheduling. If a maintenance engineer has to open the wing to deal with an unexpected fault, he could proactively perform upcoming routine maintenance while he's in there.

However, doing that requires lots of data analyzed really quickly. "If you put the data from the data warehouse into in-memory systems, you can handle vast amount of data in a very short time," says Peter Kearns, senior manager with Accenture. "Then you start to think about systems that can guide the engineer to where the next fault might be."

In-memory analysis could incorporate all that unstructured data as well. While there are codes and categories for all kinds of information coming from the aircraft, airlines still rely heavily on recorded and text descriptions of an error—a mechanic's note or a pilot's voice transmission. Running text search analysis across the data will make identifying and incorporating the relevant information much easier.

If airlines can churn the data quicker, they can reduce guesswork throughout the system, for example giving a plane exactly the fuel it needs rather than weighing it down with an extra buffer that is based solely on a lack of information or alerting a maintenance planner to a plane fault as it occurs.

And as the foundation of analysis grows over time, the airlines can analyze faults and defects to begin anticipating when a part will fail. That could automatically kick off other processes, such as increasing the warranty coverage on certain equipment in the supply chain, introducing new maintenance programs for assets with similar traits, reporting the outcomes to the manufacturer, or beginning the warranty process. Airlines already do all this today, but they don't have a view across all the steps at once, nor do they have a view across the entire ecosystem of participants in the maintenance process, including original equipment manufacturers and third-party MROs.

The Roadblocks to Maintenance Nirvana

The savings for airlines from this kind of big data analysis could be huge. But there are jumbo jet–sized challenges, too:

- **The glory days are gone.** Cost is a huge factor for asset-intensive industries, and they're often technology laggards. Airlines have powerful computer systems left from their salad days before deregulation, but today the operating margins for an airline are slim, and they like to say that whatever cash they have they want to invest in "the passenger experience."
- **Who owns—and pays for—the data?** The greatest benefits will be achieved if historical data on each aircraft model are collected not just across each airline but industry-wide. However, the costs of gathering that data could be significant. The questions of who pays for that and who benefits are up in the air. Ultimately, air carriers may be willing to pay for services based on the data. Boeing, for example, provides fleet-wide analysis of the data collected from its Aircraft Health Maintenance systems to customers via the cloud.
- **The danger of malware at 30,000 feet.** If airplanes have become flying data centers, can they be hacked? Some next-gen aircraft may have network vulnerabilities that would allow passengers to access control systems, according to the FAA. Airlines, software makers, and aircraft manufacturers are working on data filters and segregation that have been deployed for military aircraft to isolate critical data and mitigate the risk that they will upload viruses or malware when they transfer data from back-end systems to the aircraft.

- **Wi-Fi is everywhere—except where it's needed.** The Aircraft Communications Addressing and Reporting System (ACARS) used to deliver information from plane to ground is incapable of handling the volume of data necessary to do serious maintenance data distribution. And cellular networks could prove too slow. Ideally, all airports would have wireless connectivity for this purpose but they don't. The airlines and MRO providers could set up private networks specifically for MRO data transmission but that costs money.
- **Not everyone follows the rules.** There's just one problem with data standardization in the aircraft manufacturing industry: nobody sticks to the rules. When push comes to shove, as often as not, the aircraft manufacturers stray from standardization. And so do airlines. Fortunately, that's something that software makers are used to dealing with. They can harmonize the data themselves.
- **Humans aren't perfect.** In many cases, the person who identifies a fault or defect is not the person who enters it into the maintenance system. Some things get mistyped. Others are never entered at all. Mobile solutions will go a long way to increasing data reliability on the line and in the hangar. The engineer actually performing the maintenance could enter information using a smartphone or tablet. While veteran airline maintenance employees resist new technologies, the younger professionals entering the airline maintenance workforce could change the game.

Taking a Load Off in the Cockpit

Some of the earliest work to harness aircraft data took place in the heart of the plane—the cockpit. For years, pilots have lugged around a 40-pound case of documentation known as the flight bag, overflowing with unstructured data—the pilot's handwritten logbook, navigational charts, equipment manuals, and weather and radar maps.

When the first electronic flight bags (EFBs) (ruggedized laptops) were introduced, they cost thousands of dollars, offered limited functionality, and did little to lighten the load. Fast-forward to 2012 and a pilot can access all the documentation on a 1.5 pound Wi-Fi–enabled tablet costing a few hundred dollars.

Late last year, United Airlines deployed 11,000 iPads to pilots operating its 21,000 daily flights, a move that will make the pilot's plane-to-plane commute easier but also save the airline 16 million sheets of paper and 326,000 gallons of jet fuel a year. Meanwhile, the US Federal Aviation Administration has granted American Airlines the first approval to use iPads in all phases of flight—meaning its pilots can put away the leather bag and paper documentation for good. (United has not yet received gate-to-gate approval for iPad use.)

Simplicity makes tablets easier to use than previous EFB iterations. One-click–update management for manuals and charts and the potential to cross-check critical flight data increase both efficiency and safety. And new EFBs could lead to fewer flight-bag–related delays; planes don't take off if any documents have gone astray.

Further, by connecting tablets directly to an airline's computer systems, carriers can improve operations and planning. And if those tablets are loaded with mobile versions of the computer apps used on the ground, the cockpit can become another always-on node in the airline's information network.

Despite the critical data generated by an airplane in flight, most aircraft are largely out of touch with airline operations except for the occasional system message, which can lack the context necessary to proactively solve an equipment problem. With an integrated EFB, airline maintenance engineers could access the latest data from the pilots' logbooks while planes are in flight, planning work orders for quicker plane turnarounds. That could ultimately lead to fewer equipment failures and better flight planning.

The Payoff

New sources of information and emerging systems to make sense of the data could result in a sea change in airline maintenance and operations from a highly inefficient, firefighting mentality to a forward-looking focus on maximizing asset utilization. The data is available to keep the next generation of aircraft flying as long as possible with the fewest people, parts, and downtime.

Fortunately, the industry is showing commitment to solving these problems because the return is clear. For example, if an airline increased the airtime for a fleet of 70 aircraft by just 70 hours a week, it would save $150 million a year. Reduced schedule interruptions, not to mention fewer nickel-and-dime fees to make up for them, will net better brand images, higher customer satisfaction, and safer, longer-lasting planes as well.

"There's no telling what we could discover if we did a mash up of all these sources of latent and real-time data" says Denis. "There's huge potential in increasing the revenue-generating capability of assets, and not just revenue—profitable revenue."

FORTUNATELY, THE INDUSTRY IS SHOWING COMMITMENT TO SOLVING THESE PROBLEMS BECAUSE THE RETURN IS CLEAR.

Airlines Land Low Customer Satisfaction Scores

Airlines scored only slightly better than newspapers among industries with the lowest customer satisfaction scores overall in 2011.

1. Newspapers
2. **Airlines**
3. Subscription TV Service
4. Internet Social Media
5. Wireless Telephone Service
6. Health Insurance
7. Internet News & Information
8. Motion Pictures
9. Fixed-Line Telephone Service
10. US Postal Service

Source: 2011 American Customer Satisfaction Index

An Electronic Health Record—for Your Plane

Want to know what big data looks like? Take a gander at the newest jumbo jets in commercial service.

These next-generation aircraft have self-monitoring systems built in, almost like an electronic health record for each asset—if electronic health records were continually updated with information from internal sensor readings, external conditions, and operating performance. These systems, whether Boeing's Airplane Health Maintenance or Airbus's Airman, can generate thousands of messages per flight hour—from engine temperatures and fuel flows to pilot inputs and component faults—that could streamline airplane maintenance and operations, increase asset utilization, and decrease flight delays.

To date, locating that specific data has been difficult. For one thing, the relevant data is mixed in with all sorts of digital information that the flying computer called an airplane is collecting, such as text messages sent over its Wi-Fi or software updates. Much of the data is unstructured or non-standardized.

And then there's the sheer volume of information. If you've got 100 aircraft flying ten hours a day, that's a million messages flying around—more than would make sense to upload.

That's why airlines have been very careful about what they offload from such onboard systems, extracting only the data necessary for manufacturers to address engine issues and structural health management services or simple performance data, like flight hours, engine operating hours, or the number of start and landing cycles. But there are emerging tools that could enable the air carriers themselves to capture, filter, and perform predictive analytics on that data.

A combination of in-memory analytics and business intelligence software could not only identify and interpret the information generated in flight to better plan the maintenance work that will take place after touchdown but could also be used to the predict the future behavior of its parts and pieces to address maintenance issues before they happen. Data on in-flight fuel performance could empower airlines to better manage consumption. In an ideal world, a single system would capture relevant events and make recommendations for changes in ordering and inventory, maintenance planning, and even flight scheduling.

Aircraft manufacturers would like to offer that kind of analysis, but their customers won't buy it. No airline wants to put all of its eggs in one basket and become beholden to a single equipment manufacturer. Although they could look across a wider set of data than any individual airline, the air carriers—who maintain assets from several manufacturers—naturally prefer a single solution for their entire fleet. Enter enterprise software makers who can partner with the manufacturers to integrate the onboard health records with back-end tools and bring their experience in data security, standards, and analysis to bear.

There's more.

TO LEARN MORE ABOUT HOW AIRLINES COULD IMPROVE MAINTENANCE OPERATIONS, READ OUR Q&A, *HOLDING PATTERN.* PDF

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