

### Honeywell

## GOING BEYOND DATA TO SMARTER AVIATION DECISIONS

Data is plentiful in the aviation industry. As organizations learn to use artificial intelligence and machine learning to their advantage, though, that data is becoming something more: a way to glimpse the future and enhance flights for safety and profitability. This e-book will show you how to move from data to predictive insights and will reveal the benefits those insights could have on each aspect of your organization.

#### **NEW USES OF DATA IN AVIATION**

The use of data analytics isn't new in the aviation industry. Aircraft operators were among the first to understand the value of collecting data on every aspect of vehicle performance, for instance. What's new and exciting, though, is the evolution toward using big data to actually predict and drive outcomes for safety, efficiency and cost-effectiveness.

Imagine if you truly had a view into the future and could see what would happen next—what problems could occur or what situations you could avoid. That's the promise of predictive insights. With predictive insights, you increase your perspective on what is likely to occur, giving operators, pilots, ground crews and maintenance staff at airlines, private aviation companies and defense organizations the best opportunity to make the best decision. Predictive insights are one of the most exciting uses of data in aviation today.

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# TOTHE NEXT

Predictive insights use advanced data analytics that make use Today's onboard systems like auxiliary power units and of both new and historical data to forecast activity, behavior and environmental control systems already generate huge amounts of data. When you apply statistical analysis techniques, trends. analytical queries and automated machine learning algorithms to these collected data sets, you can create predictive models physical components and systems, and storing and aggregating that place a numerical value—or score—on the likelihood of an it. With a clean data source, you can then move to analyzing that event happening.

Taking data to the next level involves first collecting it from data. By applying outside information along with experience, artificial intelligence and machine learning, you can begin to predict outcomes.



And when you combine aircraft data with data from other enterprise systems and external data such as weather, it's possible to have a more comprehensive understanding on

## **BEYOND DATA:** FROM DESCRIPTIVE TO PRESCRIPTIVE

Data alone does not provide what's needed for action. Often, data and data collection systems reach a point of being merely descriptive: They can tell you what happened. Diagnostic systems take it a step further by telling you why something happened.

To reach predictive systems, though, you need to analyze data and patterns from past events, make assumptions, and test them to provide probabilities about the future. And in the very best predictive systems, you can even receive prescriptions that can help you address the issues.

How you go from collections of data that are descriptive or diagnostic to those that are predictive and prescriptive relies on advanced data analysis, and increasingly on the power of artificial intelligence.

Descriptive and diagnostic systems are common throughout aviation. Most aviation operators are just beginning to take the journey to predictive or prescriptive. Doing so involves tying existing systems together and working with aviation vendors who understand software and data well enough to help operators take advantage of the advanced data analysis necessary for prediction.



#### PRESCRIPTIVE

#### PREDICTIVE

What Will Happen? How to Make It Happen/ Not Happen Again?

## ALGORITHMS AND ARTIFICIAL INTELLIGENCE IN PREDICTIVE INSIGHTS



Before we look at the potential benefits of predictive insights to the aviation industry, we need to make sure we understand how these insights are generated using the underlying algorithms and artificial intelligence (AI) systems that analyze the data.

Al is one of multiple methods of analyzing data, and machine learning is one of the most exciting subcategories of Al. Machine learning systems use computational methods to "learn" information directly from data. They don't need a predetermined equation as a model. This makes them extremely valuable for finding insight in large data sets.

Indeed, with the rise in big data, machine learning has become a key technique for solving problems in areas such as finance, where it is used for credit scoring and fraud detection, and in medicine, for tumor detection, analysis of medical scans and ot uses. Energy and utility companies have begun to use machine learning to forecast prices and the load their grids will experience And it's being used across industries in use cases related to ima processing and natural language processing, making chat bots facial recognition and item sorting common in many fields.



her	Machine learning includes two major techniques: supervised
) )	learning, in which you train the machine on known data, or
ce.	unsupervised learning, where the machine finds natural
age	patterns in data without guidance. In both cases, the machine's
<b>)</b> ,	performance will generally improve as the number of samples
	available for learning increases.

## AVATION USE CASES FOR PREDICTIVE INSIGHTS



Predictive insights can be used in four main ways within aviation:

#### TO PREDICT FAILURES OR SERVICE NEEDS

One of the most talked-about uses of predictive insights is in predictive maintenance, where machines help inform users of components or systems that might fail or require service.

#### TO ASSESS THE LIKELIHOOD OF WEATHER OR TERRAIN HAZARDS

With the right data sources, systems can create predictions of weather or terrain hazards and provide guidance for how to avoid those hazards or lessen their impact.

#### TO STREAMLINE OPERATIONS

The ability to predict resource levels and aircraft arrivals and departures can help achieve more efficient operations. Ground crew can prepare ahead of time to shorten turnarounds or ensure that flights never have to wait for supplies to arrive.

#### TO PREDICT THE BEST ACTIONS FOR FLIGHT

Another use of predictive insights is to provide possible flight paths to pilots in flight and crew on the ground. These predictions can inform all involved about issues and hazards, as well as their impact on flight times, fuel use and more.

Let's look at the benefits that predictive insights can deliver for those involved in aviation. First we'll look at how each of these use cases can bring benefits for owners, operators, and the pilots and flight crew in the aircraft itself.

## **BENEFITS FOR OWNERS, OPERATORS AND FLIGHT CREW**

For airlines, predictive insights can translate into money, such as fares from returning customers who are happy with their on-time flights or lack of turbulence. Predictive insights can also help save costs and reduce safety risks by minimizing downtime and accidents.

Using big data and analytics, aircraft operators are now better able to anticipate opportunities—to avoid weather, to avoid disruption, to avoid cost, to drive faster turnaround times.

For business or personal jets, predictive insights contribute to the safety, comfort and arrival times of operators and passengers and also affect maintenance costs and scheduling.

#### MAINTENANCE AND OPERATIONS INSIGHTS

Predictive diagnostics help keep maintenance crews efficient increasing the uptime of each aircraft. Predictive insights for operations can make ground crews more efficient, decreasing turnaround time for fleets and individual aircraft.

#### SAFETY INSIGHTS

Predictive weather and radar information enable flight crews or operators to understand likely weather outcomes based on specific routes. This improves strategic maneuvering, thus reducing flight times and optimizing route miles ahead of bad weather.

Situational awareness predictions allow pilots to prepare visually and mentally for take-offs, flights and landings.

#### FLIGHT AND ARRIVAL INSIGHTS

Predictive flight planning insights improve on-time performance and reduce delays. They can translate aircraft data into actionable metrics to save money or time. For instance, optimized utilization can help you achieve up to 10% in fuel savings.

#### **PREDICTIVE INSIGHTS IN THE HELICOPTER**

Understanding issues in the moment can make all the difference for helicopters, which are often flying in adverse environments on demanding missions. Real-time health and usage monitoring transmits data directly in-flight so that operators better understand their situation. This information can provide critical insights before the situation becomes catastrophic.

#### **MAINTENANCE INSIGHTS**

Predictive maintenance insights increase uptime and reduce maintenance costs for helicopters as they do for fixed-wing aircraft.

#### SAFETY INSIGHTS

Terrain awareness in particular can provide added safety for helicopter operators.

## BENEFITS FOR MAINTAINERS AND OPERATIONS CREW

Possibly nothing is as frightening to aerospace operators as the possibility of an in-air collision. With the increase in air traffic and the coming rise in Urban Air Mobility (UAM), new technologies will be needed to maintain safety and prevent the risk of in-air accidents. By applying big data techniques and connecting various data sources together, improved predictive analysis allows ground crews to identify components that will require maintenance or replacement before the components fail. This allows crew to prepare by stocking spare parts and making them ready for installation when and where they'll be needed.

For example, capturing and analyzing aircraft data on usage and wear enables crew to more efficiently inspect auxiliary power units, wheels, brakes and environmental control systems, and to more rapidly maintain those devices when they need attention, helping to realize lower costs.

Some providers of connected maintenance solutions also use data analytics to award discounts based on flight behaviors that have been known to positively affect engine wear, including flight length, throttle settings and flight environment. This provides customers with flexibility, and allows them to earn discounts of up to 10% off their engine maintenance costs for operating their aircraft under optimal conditions.



## BENEFITS FOR PASSENGERS

#### MAINTENANCE AND OPERATIONAL INSIGHTS

Passengers benefit from predictive insights about maintenance and operations in many of the same ways that owners and operators do. Increased uptime of each aircraft and decreased turnaround time for aircraft lead to better experiences for passengers-and fewer delays.

#### SAFETY INSIGHTS

When predictive weather and radar information enable flight crews to understand likely weather outcomes based on specific routes, passengers benefit from reduced turbulence, making their flight experience smoother and more enjoyable.

While passengers are not always aware of other safety insights, these insights provide for safe travels.

#### **FLIGHT AND ARRIVAL INSIGHTS**

Predictive flight planning insights improve on-time performance and reduce delays, boosting passenger satisfaction by ensuring that they get the arrival and departure times they expect. Connected ramp solutions alone can cut delays by up to 30% by predicting events such as the arrival of incoming aircraft or the need to stock certain materials, helping ground crew prepare.

of travelers found late arrivals and departures to be the most frustrating part of flying.



1. Adam Kress, "Travelers Have Spoken! Their No. 1 Frustration Is Delays," Honeywell survey, July 17, 2017, https:// aerospace.honeywell.com/en/blogs/2017/july/travelers-have-spoken-their-no-1-frustration-is-delays.

## PREDICTIVE INSIGHTS FOR THE DEFENSE INDUSTRY



The art of war fighting has long been the art of prediction. Now the machines that the defense industry relies on can begin to contribute to providing the predictions that help war fighters and supply chain personnel fulfill their mission.

Predictive insights can help operators understand how aviation systems are performing, how they can optimize readiness and how they can control the costs of sustainment. By processing data quickly, predictive systems can enable critical insight into flight, environment and conditions that require in-the-moment decisions.

#### **MAINTENANCE INSIGHTS**

Predictive maintenance insights increase the accuracy of mission readiness assessments, increase uptime, reduce maintenance costs and keep missions running according to plan.

#### SAFETY INSIGHTS

Mission hazards often are increased or decreased based on weather and terrain. Predictive weather and radar information provides the situational awareness needed to make decisions in the moment.

#### **MISSION INSIGHTS**

While commercial flight planning must take into account weather, the task is far more urgent and challenging for mission planning in the defense industry. Operators must take into account weather conditions at take-off, engagement, pickup and landing zones, and rarely if ever have the flexibility to reroute or delay that commercial operations have. Weather can also impact how payloads, target acquisition systems and informationseeking tools like radar and cameras operate. Predictive flight planning insights can take all these factors into account to provide better information on mission timing and expectations.

## **PREDICTIVE INSIGHTS** AND UNMANNED FLIGHT

Drones are increasingly being used for inspecting and predicting issues with equipment and systems on the ground. They can easily travel over rough or dangerous terrain or features, thus protecting human inspectors from risk.

**ACCORDING TO MARK MOORE, ENGINEERING DIRECTOR OF AVIATION AT UBER, PREDICTIVE ANALYTICS IS GOING TO BE "ABSOLUTELY HUGE AND CRITICAL**" TO THE FUTURE **OF URBAN AIR MOBILITY.**<sup>2</sup>

There are dozens of other drone use cases, including package delivery and air-taxi services. Together with new on-demand manned flight options, these drone use cases are beginning to be referred to as urban air mobility (UAM). As these technologies mature and the future of unmanned flight becomes more common with UAM, predictive insights will become even more important.

The unmanned vehicles of the future will be constantly connected, sending back large amounts of data that will feed the predictive analysis that creates insights. And with no pilot on board, those insights will be all the more important for noticing issues and maximizing safe and efficient flight.



2. S.L. Fuller, "Bell, Uber, CHC, Honeywell Discuss Prognostics in Sentient Science Panel at Heli-Expo," Rotor & Wing International, Mar. 8, 2018, https://www.rotorandwing.com/2018/03/08/stakeholders-discuss-prognostics-sentient-science-panel-heli-expo/.

## **SINGLE-VIEW ADVANTAGE**

As use of data analytics grows, executives and managers will increasingly appreciate having a single view of results to aid in operational and corporate decision making. A single pane of glass, as these views are often called, is important because it can:

- Condense massive amounts of data into actionable information.
- Aid in decision making by allowing viewers to see multiple, related pieces of information at one time.
- Save time, by avoiding multiple log-ins or excessive task switching.
- Make the result of analysis more useful by placing it in a larger context.

Having a single view of predictive insights and analysis is the most valuable for executive and management personnel, who need to constantly see the big picture. In fact, while pilots and maintenance crew should also have all relevant information available to them in a single system, it's more important that software provide them with a need-to-know view that presents only the most important and actionable information.





## HONEYWELL SOLUTIONS FOR PREDICTIVE INSIGHTS

PRODUCT	WHAT IT IS	BENEFITS
		- Provides notifications with prescribed maintenance actions to help maintenance crews pinpoint the fault down to the subcomponent level
GODIRECT CONNECTED MAINTENANCE	A nose-to-tail solution that analyzes aircraft data and delivers diagnostics as well as pre- dictive and prescriptive alerts	- Ingests fault data; system performance reports; flight schedules; unscheduled disruptions; flight data; maintenance data; maintenance, repair and overhaul (MRO) shop data; and weather data
		<ul> <li>Goes well beyond the capabilities of current-generation solutions, which focus on system health monitoring and trend analysis</li> </ul>
GODIRECT FLIGHT	Designed to help airlines make flight operation decisions by collecting all flight data in one easy-to-access dashboard	- Ingests flight plans, fuel usage, navigation charts, weather, aircraft performance and more
EFFICIENCY		- Can make predictions about turbulence, runway hazards, fuel usage and route efficiencies
		- Assists the ground handler in managing the aircraft turna- round process
GODIRECT GROUND HANDLING	Built to help you manage the ground handling process effectively and efficiently	- Provides accurate, real-time information to operations on the status of each tail and the likelihood of it pushing back on time
		- Improves on-time performance, resource planning and utili- zation, and invoicing accuracy
HEALTH AND USAGE MONITORING SYSTEMS	Provides diagnostic information required for optimum performance	- Monitors and communicates the health and maintenance needs of critical components
(HUMS)		- Can detect and predict potential problems before they occur

PRODUCT	WHAT IT IS
CONNECTED RADAR	Combines information from a ran puts to create the most complete weather along an aircraft's route
AIRCRAFT DATA GATEWAY	Gives airlines an affordable and fl wirelessly transfer data on and of in real time
TRAFFIC AVOIDANCE SYSTEMS	Honeywell's CAS 67A Traffic Alert Avoidance System II (TCAS II) hel awareness further in front of the a
ENHANCED GROUND PROXIMITY WARNING	Serves as an independent monito craft's position relative to surrour
UNMANNED AERIAL VEHICLE	A data-driven analytics and inform designed to reduce inspection cos hance efficiency
(UAV) INSPECTION	

	BENEFITS
	- Collects and aggregates weather data from Honeywell's most advanced IntuVue® RDR-7000 3D weather radar system, which flies on leading commercial airliners
nge of in- e view ever of	- Can detect and predict lightning, hail, wind shear and tur- bulence, using volumetric 3-D scanning and pulse compres- sion technologies
	- Particularly valuable to helicopter pilots and dispatchers fly- ing over water where ground radar coverage doesn't exist or those flying in remote and rugged terrain where radar signals are blocked or not available
	<ul> <li>Enables connected data loading by integrating all sources of data on the aircraft and sending it in real-time to and from ground servers</li> </ul>
lexible way to	- Provides a three-in-one solution with enhanced security and integrated data services
i their aircrait	- Enables Connected Aircraft solutions such as connected data loading, connected maintenance, connected real-time weather and more
	- Keeps information secure with built-in encryption, transmis- sion and monitoring
and Collision	- Uses aircraft inputs such as position, attitude, air speed and glide slope, along with internal terrain, obstacles and airport databases to predict a potential conflict between the aircraft's flight path and an obstacle
ps extend crew	- Provides visual and audio cautions or alerts
	- When coupled with display, offers a view of the surrounding terrain relative to the aircraft position, providing strategic ter- rain information up to 30 minutes before a potential conflict
or of an air-	- Monitors and communicates the health and maintenance needs of critical components
iding terrain	- Can detect and predict potential problems before they occur
mation service sts and en-	- Leverages Honeywell's century-long experience in flight management, safety and software, and combines key insight derived from our diverse industrial portfolio
	- Offers aid in setting up the UAV's flight plan and ensuring regulatory compliance
	<ul> <li>Performs the inspection using autonomous flight manage- ment software, capturing thousands of images and raw data</li> </ul>
	- Uses machine learning algorithms to predict potential haz- ards such as vegetation encroachment or hardware defects



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