Predictive Insights: Aircraft Landing Gear Prognostics

At a Glance

Airline Industry

Challenge
Prevent flight delays resulting from problems with landing gear

Solution
Add sensors to landing gear and analyze sensor data to minimize unplanned downtime through predictive maintenance

Technologies

Predix

- Asset Data Service
- Time Series Service
- View Service
- Analytics Service
- PostgreSQL as a Service

Infosys

- Infosys Information Platform (IIP) (Big Data Analytics platform from Infosys)

PREDIX

Problem

Before takeoff, crew members run through a number of checks to ensure that the aircraft is ready. Typically, problems with landing gear can't be detected until after pushback from the gate. Uncovering problems with the landing gear at this late stage usually results in a flight delay. Each flight delay costs the airline between $25,000 and $40,000, not to mention the impact on customer satisfaction. And if the delay occurs in the morning, it can have a cascading effect that impacts the entire day's flights. In addition to this, when problems are detected with the landing gear, minimal information is provided and the exact cause cannot be determined until repair crews begin working.

Solution

Creating an efficient asset solution starts with studying the various failure modes of a critical asset (in this case, aircraft landing gear). Infosys engineering services team studied these failure modes and identified various locations where sensors could be applied to provide data for early detection of wear or malfunctions. The landing gear was enriched with 34 sensors such as hydraulic pressure and brake temperature sensors. Data was gathered from the sensors and analyzed in order to determine the landing gear's remaining useful life. The approach led to the creation of a digital twin (a cyber model) of each aircraft's physical landing gear. This digital twin models one asset instance and is continuously updated. With this digital twin, current issues can be diagnosed and the remaining useful life can be predicted based on historical data.

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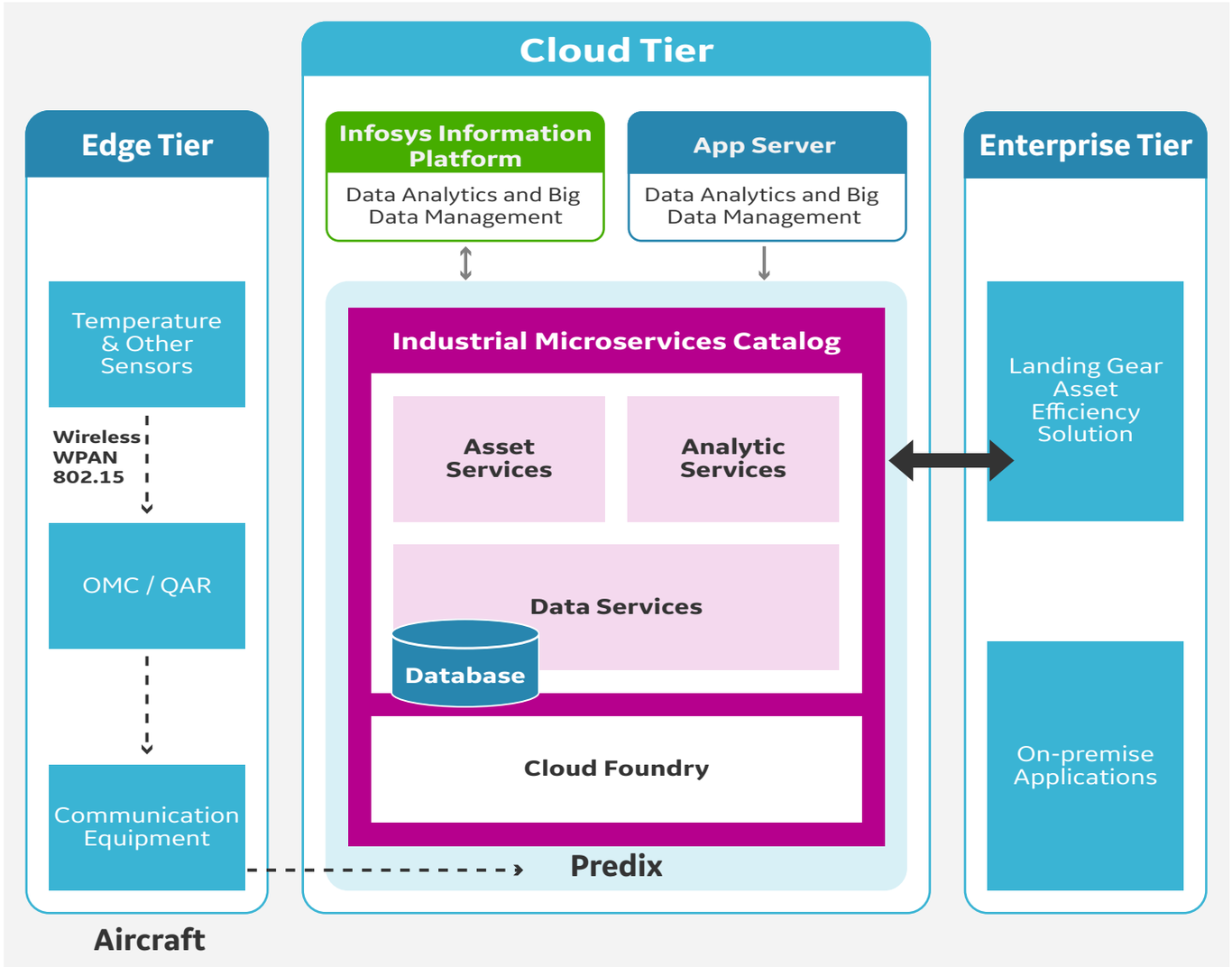

High level architecture of the system

During takeoff and landing, data is collected an average of once per second from each of the 34 sensors on the landing gear. On board the aircraft, data is communicated using WPAN 802.15 to a Quick Access Recorder (QAR) – an on-board industrial device for data ingestion and storage. If connectivity is available from the aircraft to ground, the data is sent to the cloud in real time; if it is not available, the data is copied from the Onboard Monitoring Computer (OMC) to the cloud after touchdown using a USB flash drive.

The data is stored in the Predix Time Series store, and Predix Analytics Services are used to diagnose anomalies and to determine fixes for any issues. Predictive analytics is run on the historical data of all such landing gear to determine the remaining useful life for each subsystem of every landing gear. The Infosys Information Platform (IIP) interfaces with Predix Data Services, acquires historical data, and performs predictive analytics. Predix Analytics services can also be used to develop these algorithms and estimate the remaining useful life to prevent unplanned downtime. The results are stored back in the Predix Data Store.

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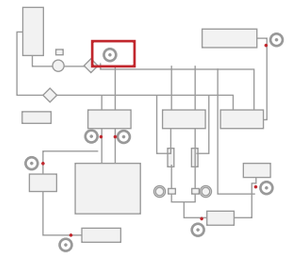
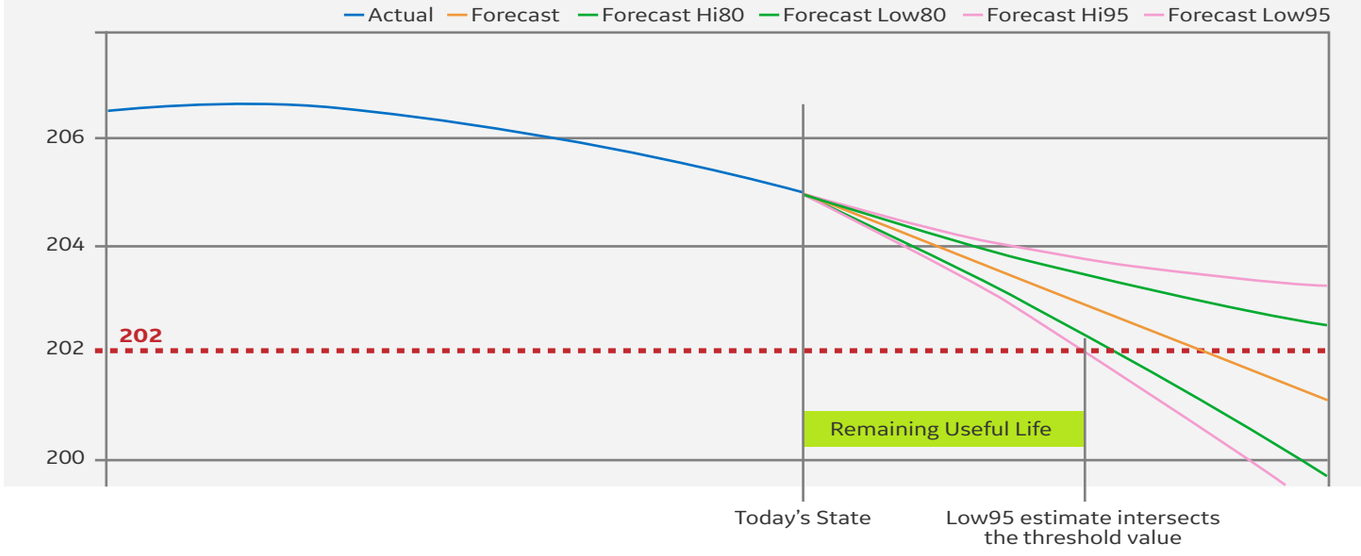
The Predix-based application continuously compares actual data with predicted data based on the digital twin (defined via the Asset Data service and the Time Series service). For example, actual brake pad temperature is compared against brake pad temperature threshold. Deviations from normal operations can be used to modify and continuously optimize prediction models for required maintenance intervals, and catch outlier problems when they are small so that maintenance can be scheduled proactively.

In the dashboard, a graph illustrates actual values along with predicted values to show when critical thresholds will be met. The aircraft engineers can see how much useful life remains and determine when maintenance should be performed.

Aircraft Landing Gear: Pump Sensor Dashboard

Trip Start (Date)	Trip Latest (Date)	Current Trips
6/30/2014	5/26/2015	850
Threshold $_{min}$202-2011$_{max}$ (bar)	Estimate End of Life (Date)	Remaining Useful Life (Trips)
	10/7/2015	540





To Learn More

- IIC Asset Efficiency Testbed
- Infosys Information Platform
- White Paper on Aircraft Landing Gear Health Management
- Predix Developer Tutorials
- Video: The Asset Efficiency Testbed (Courtesy of Infosys)

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