UNITING the WORLD in WONDER

The Endeavor and Vision

Advancing Maintenance through Innovation

1. About ANA: Company Profile
2. Speaker Introduction
3. What is Predictive Maintenance(PdM)?
4. Our Journey in Predictive Maintenance
5. Organization and Capabilities
6. ANA’s PdM: Concept & Strategy
7. ANA’s PdM: In-House Model Performance
8. ANA’s PdM: Case Studies
9. Our Future Vision
10. Conclusion & Key Takeaways

1. About ANA: Company Profile

Company ALL NIPPON AIRWAYS CO., LTD.

Foundation December 27, 1952

Number of Employees 13,636 employees (42,196 employees, ANA Group)

Principal Purpose

- Air Transportation Business
- Aircraft and Parts Sales, Leasing, and Maintenance
- Airport Ground Handling Services

Number of Aircraft 278 aircraft (267 passenger + 11 cargo)

(as of March 31, 2025)

Flights

(as of August 1, 2024)

	Routes	Airports
Domestic	142	61
International	52	38

2. Speaker Introduction

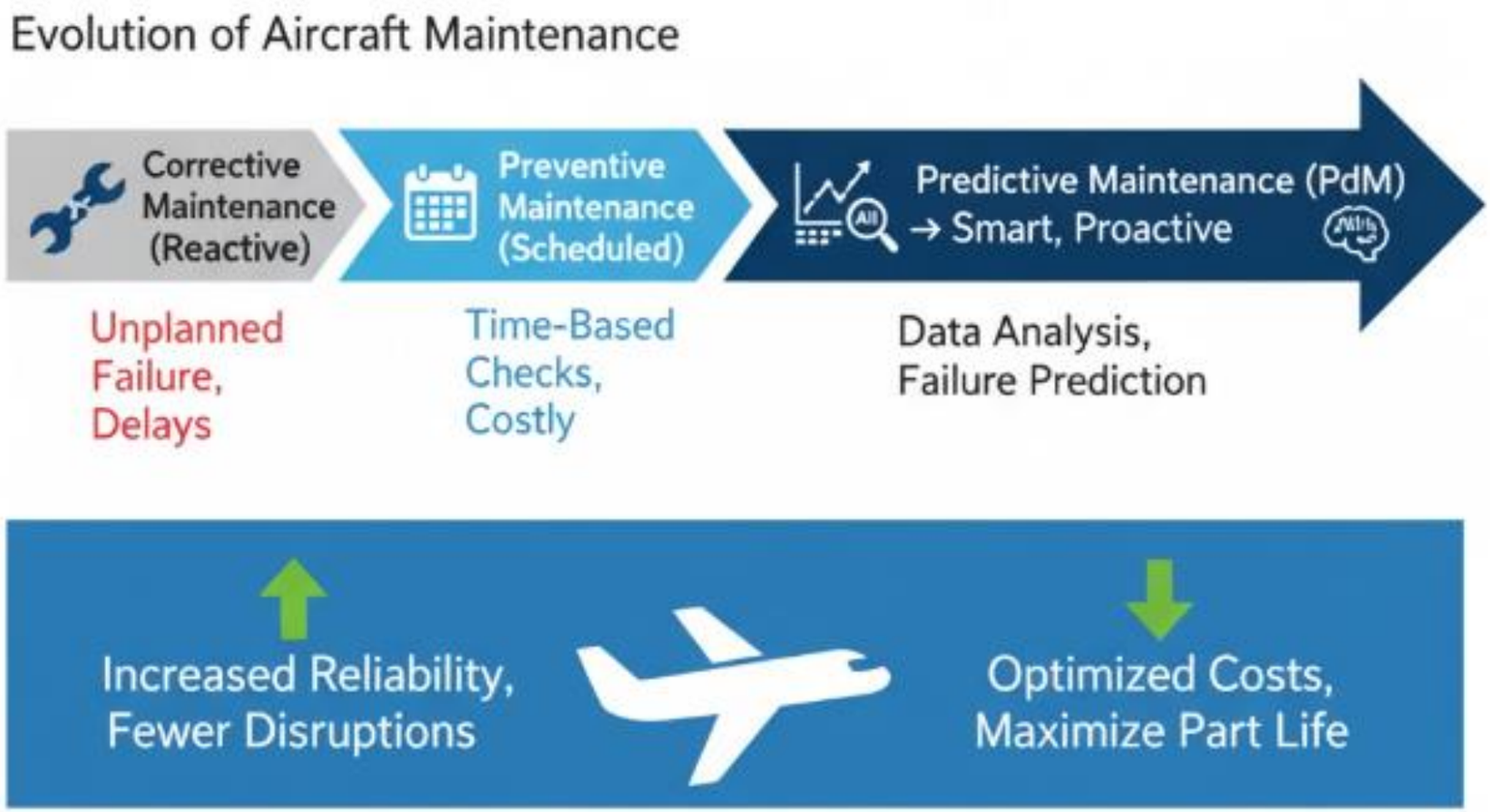
Makoto Taniguchi

Director

- Component Maintenance(In-House)
- Component Outsource Repair Control
- ACMS* Software Development
- Flight Data Analysis
- Data Science

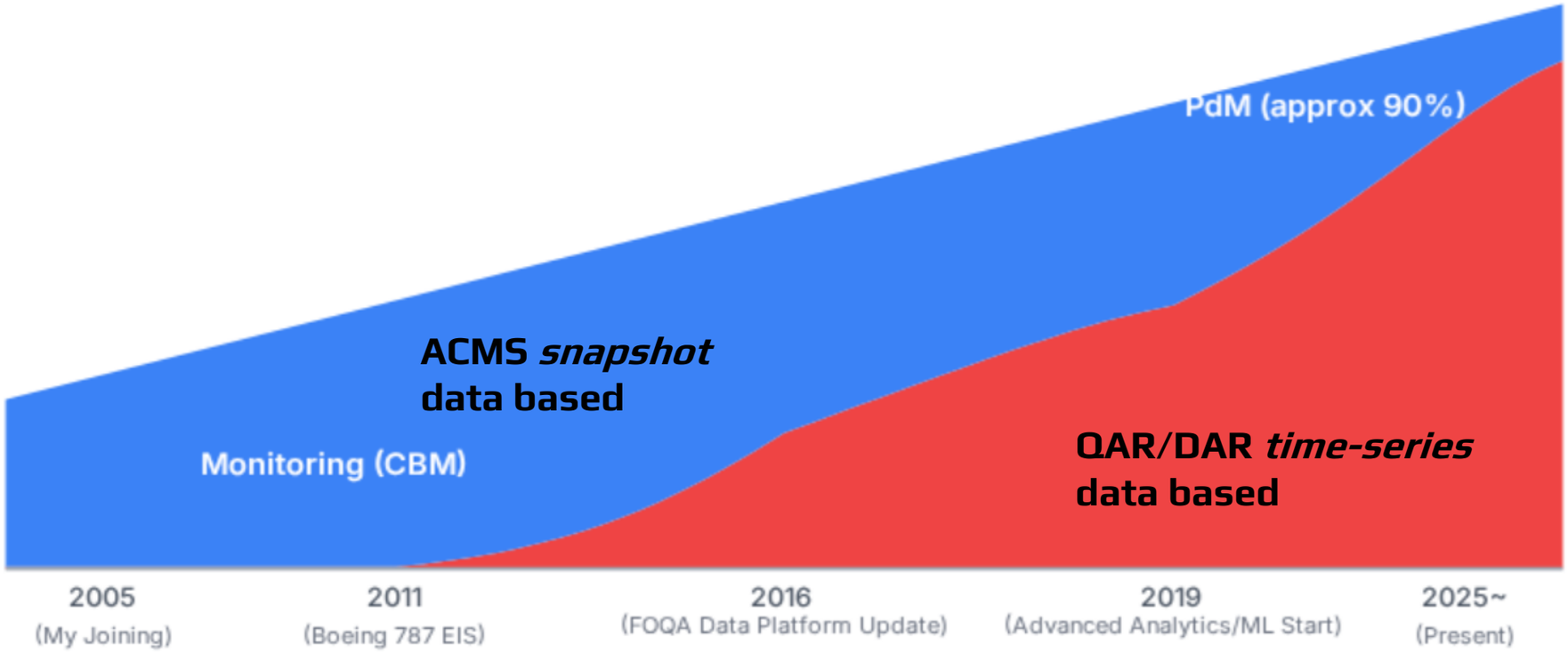
***Aircraft Condition Monitoring System**

3. What is Predictive Maintenance(PdM)?



- Corrective (Reactive) maintenance causes **unplanned failures and delays.**
- Preventive(Scheduled) maintenance prevents disruptions, but **becomes costly due to replacing still usable parts**
- PdM uses data analysis for failure prediction, which **optimizes costs and increases reliability.**

4. Our Journey in Predictive Maintenance



Analysis Team Resources: Constant Size(5-6 people), Upgraded Capability

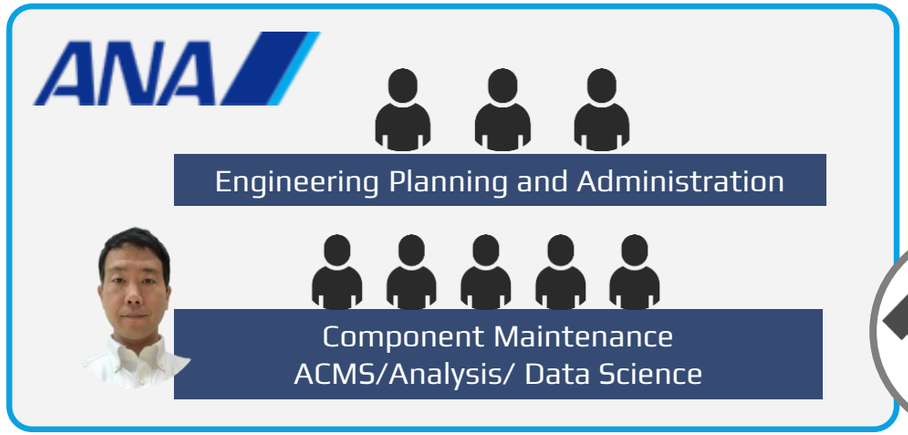
Team size remains stable (100% in-house), while skills are continuously enhanced for Data Analytics & AI over time.

PdM Implementation Effects:

- Reduction in Delays & Cancellations
- Leveling of Line Maintenance Workload
- Prevention of Catastrophic Component Failures

5. Organization and Capabilities

Organization



Partners

Collins Aerospace An RTX Business
Ascentia®
BOEING ANALYTX

Collaboration through data & idea exchange

Capabilities

Airborne Segment

Deep technical knowledge of on-board data acquisition systems (FDAU, ACMS, QAR) and how flight data is recorded.

Key Systems:
FDAU / ACMS
QAR (Quick Access Recorder)

Ground Segment

Extensive experience with ground analysis platforms (FDM/FOQA) for data processing and event detection.

Key Systems:
FDM/FOQA Platforms (AGS)
Data Processing & Validation

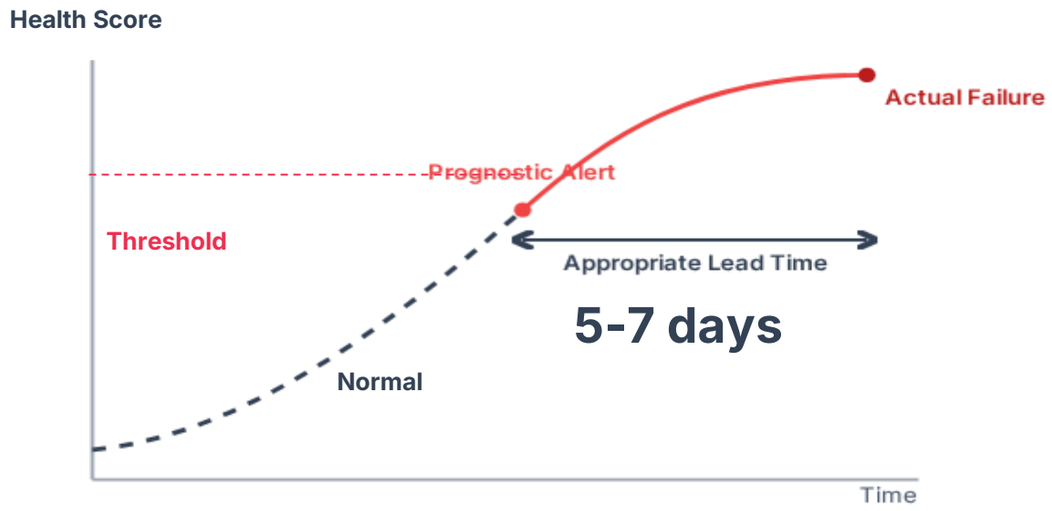
Advanced Analytics

Specialized expertise in leveraging modern data science techniques to move from monitoring to prediction.

Key Techniques:
Machine Learning (ML)
Multivariable Anomaly Detection

6. ANA’s PdM: Concept, Strategy & Utilization

Conceptual PdM Timeframe



Model Performance Strategy

RECALL Safety-Driven

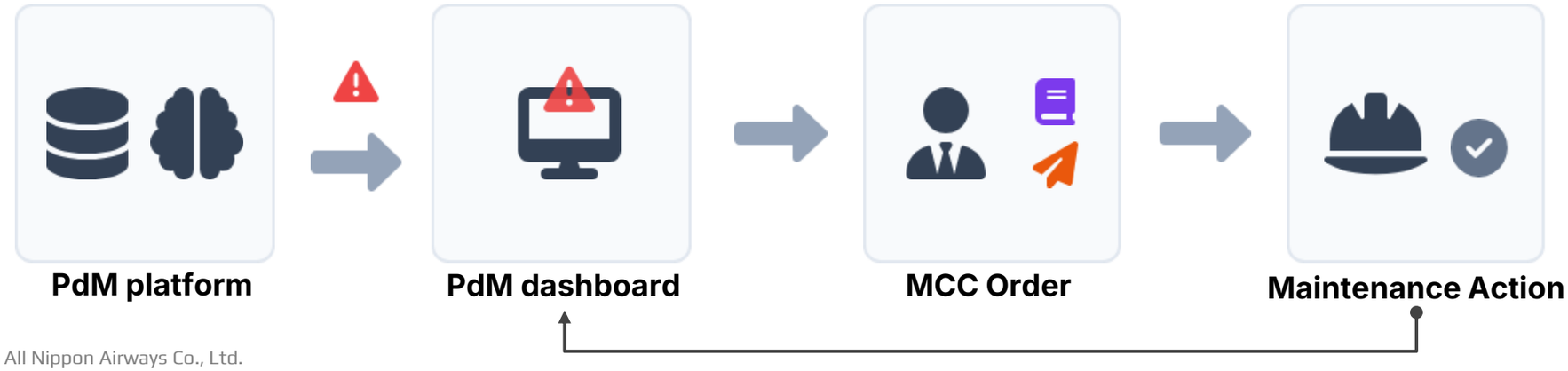
"How many relevant cases are detected?"
Prioritized for **non-redundant systems** to prevent any missed failures, even at a higher cost.

PRECISION Cost-Driven

"How many detected cases are truly relevant?"
Prioritized for **redundant systems** to reduce unnecessary maintenance (Target: ≥80% precision).

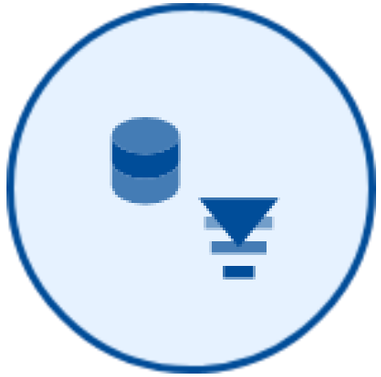
The optimal **Threshold** is set by balancing the needs of both, based on the system's characteristics.

PdM Alerts as an Operational Authority



6. ANA's PdM: Concept, Strategy & Utilization

ANA's environment



FOQA/FDM platform
(Database + Extraction Algorithms)

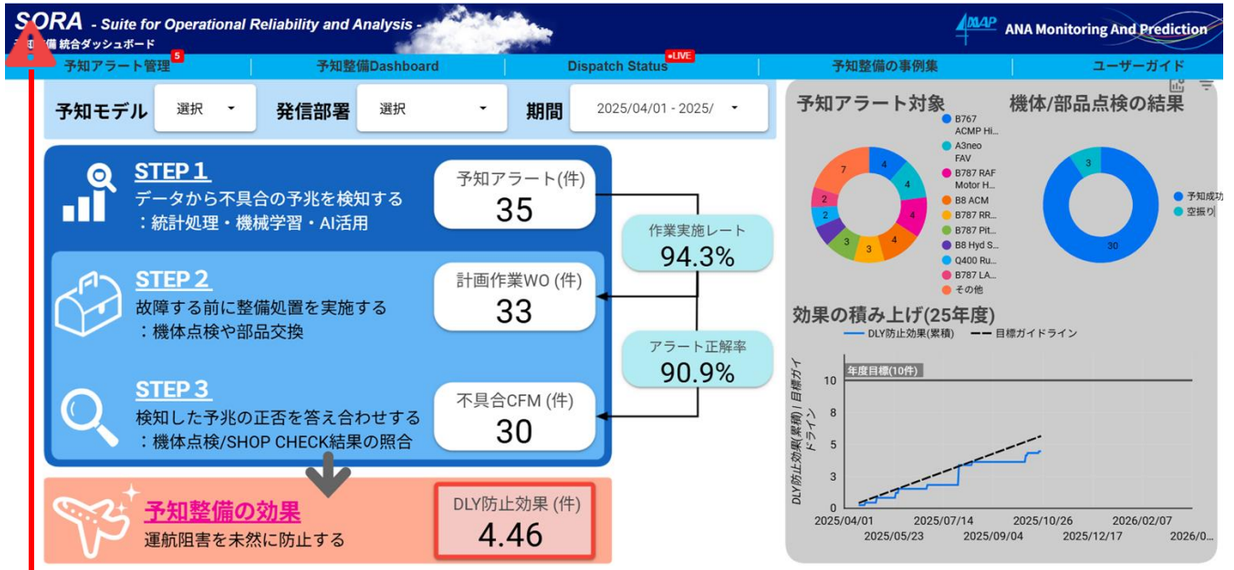
Snapshot　Time-series

PdM platform
(Advanced Analytics + ML)

(Tracks alert volume + Measures Proactive Actions + Monitors Model Precision + Measures Effectiveness)

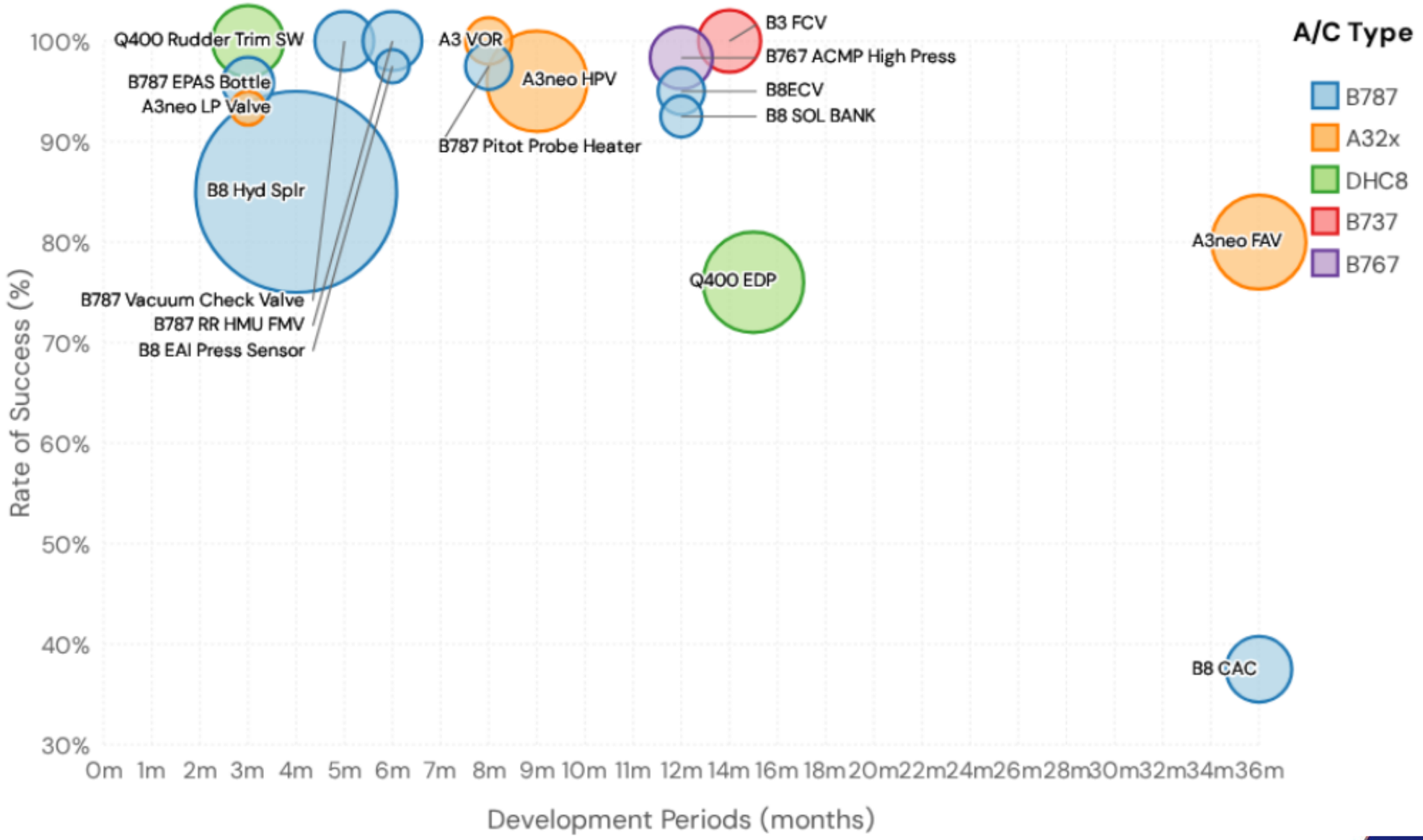
Prognostic Alert Sign

PdM dashboard



Prognostic Alert Lists

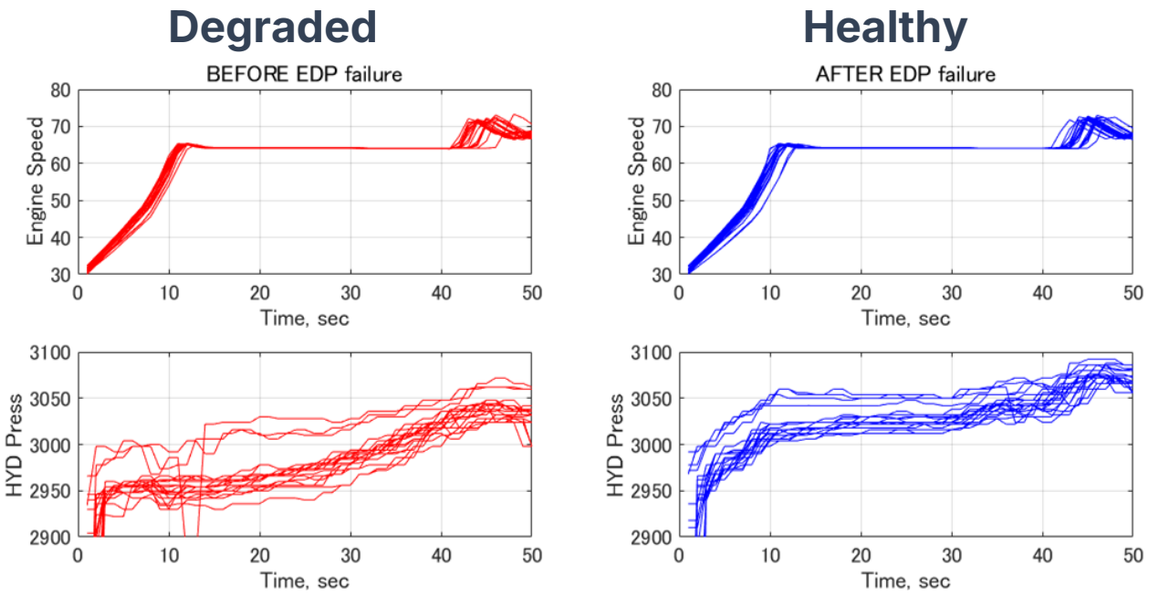
7. ANA's PdM: In-House Model Performance



8. ANA's PdM: Case Study

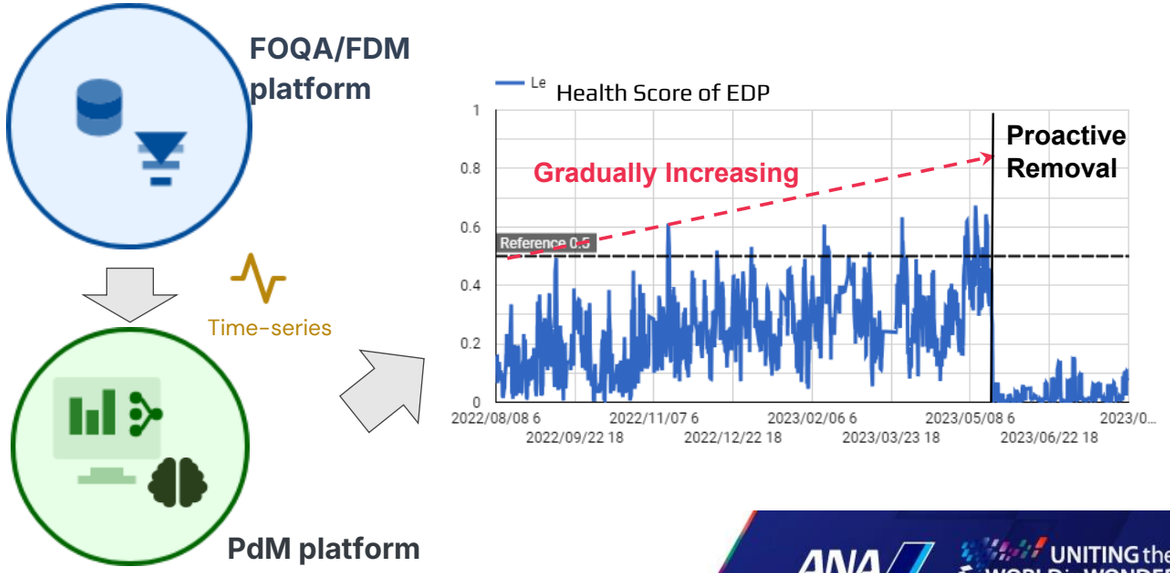
The Challenge: EDP Failures

- In 2022, ANA faced multiple Engine Driven Pump (EDP) failures on DHC-8-400s, causing flight disruptions.
- **Investigation:** Analysis of 30+ waveforms revealed a key feature: a "delay in pressure rise" in degraded pumps.



The Solution: Predictive Model

- A machine learning model was built to output a "Health Score" from pressure waveforms.
- Fine Tuned to prioritize **Recall (Safety-driven)** over **Precision (Cost-driven)** to catch all potential issues.



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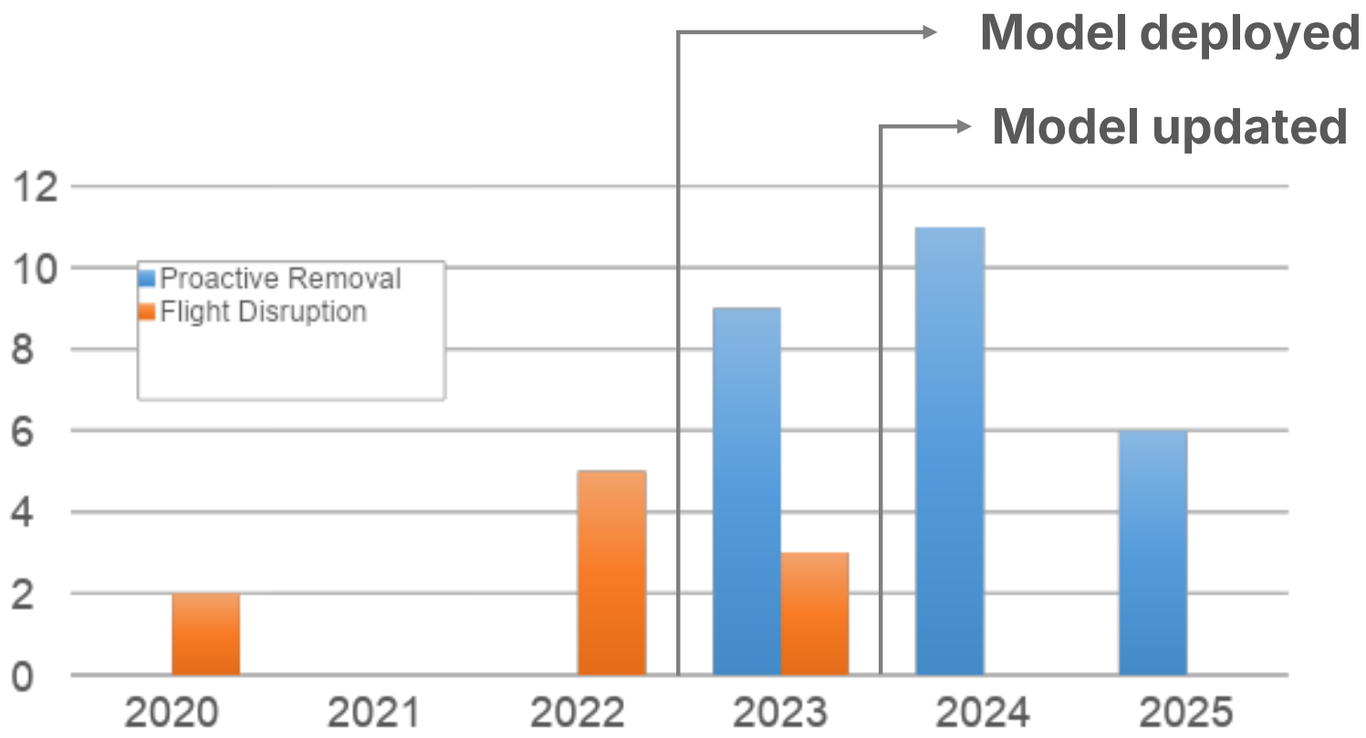

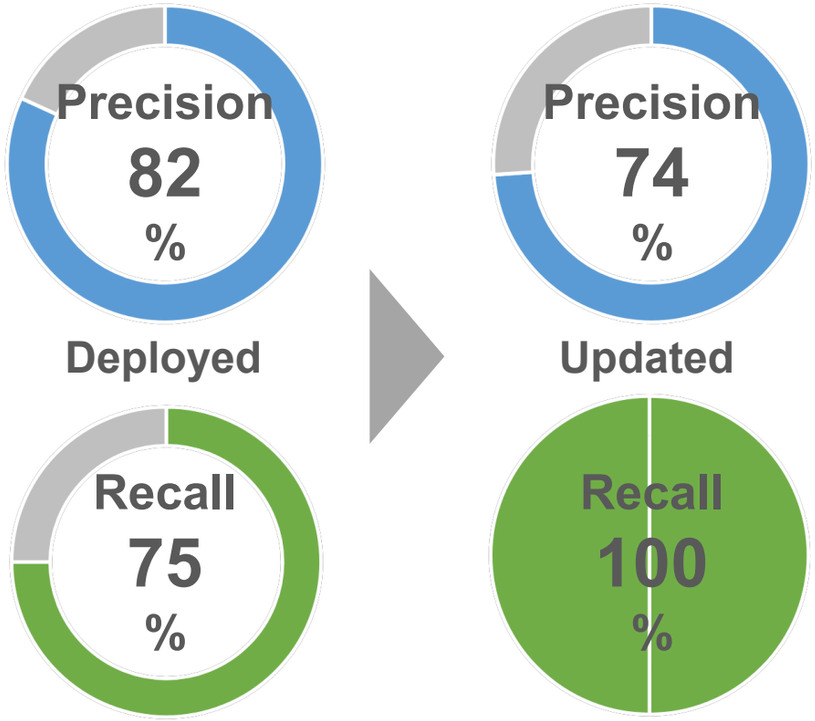

*After one year, the model was updated by relaxing thresholds. This achieved **100% Recall**, successfully capturing all potential failures and **eliminating flight disruptions** by 2024.*

*And also **no catastrophic failure found** in our shop.*

Our Future Vision

Vision 1: Strategic PdM Investment

Physical modifications demand significant time, cost, and human resources. In contrast, PdM offers **rapid implementation** with a lean, specialized team. We aim to strategically invest in PdM to maximize this potential.

Vision 2: Digital Twin & Generative AI

Combines **Digital Twin** tech with **Generative AI** to accelerate model development and improvements with unprecedented speed and accuracy.

Drivers of PdM Growth

1. Quality of Alerts:
"Explainability" and "Actionability" are key for effective utilization.

2. Close Collaboration:
Tight integration between the Airline, OEM, and MRO is essential for optimal results.

Conclusion & Key Takeaways

Proven & Operationalized Value

PdM is fully operationalized at ANA, delivering measurable value. Our in-house models achieve an average precision in the 90% range, and we maximize our value as an airline by strategically controlling **Precision** and **Recall** based on specific equipment and system characteristics.

Strategic In-House Capability

Our lean, expert in-house team is our key advantage. It gives us the agility to build, tune, and deploy models, strategically balancing **Safety (Recall)** with **Cost (Precision)**.

Future: Invest & Collaborate

We view PdM as a high-ROI strategic investment. Future growth will be powered by new tech (**GenAI, Digital Twin**) and deep **collaboration** with our OEM/MRO partners.


Thank you for your attention