The Future of Maintenance: AI-Driven Failure Prediction & Anomaly Detection

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A section of power
Tuas West Extensio
affected three MRT
123,000 commuters. Many were stuck in tra
During the accident, th
because o
offloaded, except for a
Investigations into the incident found that a
Bishan and Braddell MRT stations – design
maintenance,
switches.
East-West Line MRT disruption: How a faulty train left a trail of destruction
Train services along a stretch of the East-West Line (EWL) have been disrupted since Sept 25, affecting more than 1.3 million passengers. What exactly happened?
a faulty circuit breaker
massive disruption on Oct 14 that
than three hours, and affected
hours when the power went out.

$1,300,000 / h

Reference: https://www.mdpi.com/2076-3417/12/9/4221

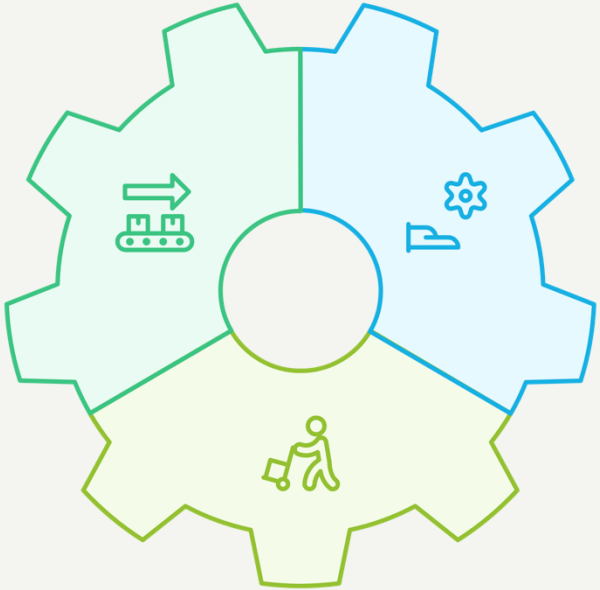
Objectives

How to predict machine failures?

How to detect anomalies in machine?

Stakeholders

Operation Manager



Equipment Engineer

Supply Chain Manager

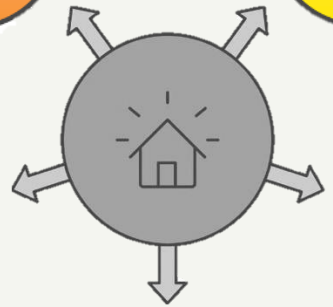
Agenda

- Maintenance Explained
- Data Summary
- Failure Predictions
- Detecting Anomalies
- Business recommendations

What is Maintenance?

Maintenance involves the regular actions taken to **keep equipment or systems in working condition**, prevent failures, and optimize performance, ensuring longevity and reliability. It aims to **reduce downtime** and **improve operational efficiency**.

What are the different types of Maintenance?



Deferred Maintenance

Delays changing of car tires due to cost/time constraints

Preventive Maintenance

Changing car tires every 10,000 km regardless of condition

Condition-Based Maintenance

Changing car tires Only if crack is observed

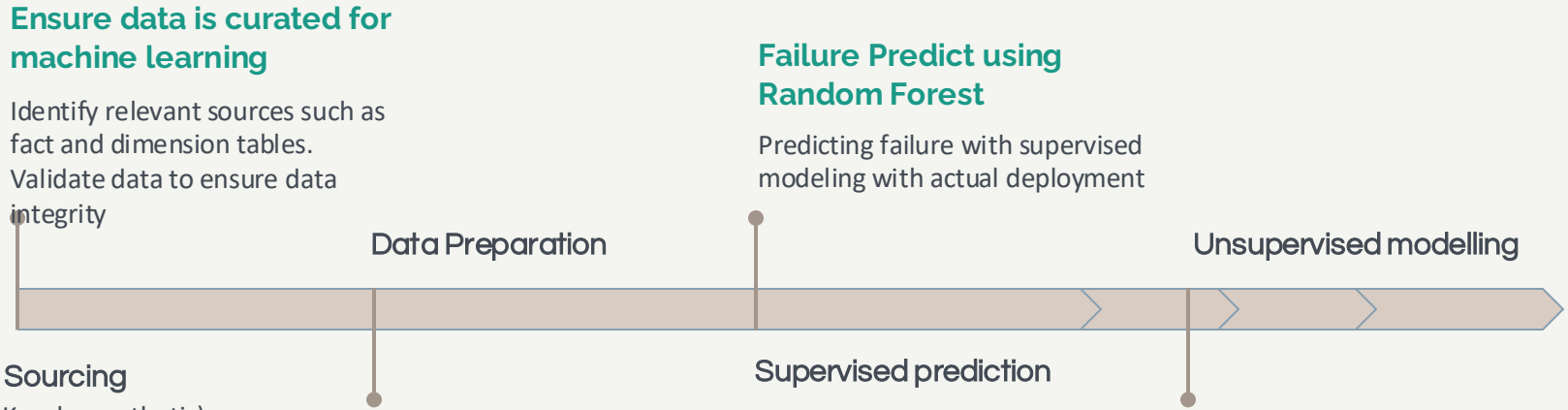
Predictive Maintenance

Tracking car tires condition and replacing it Before failure occurs

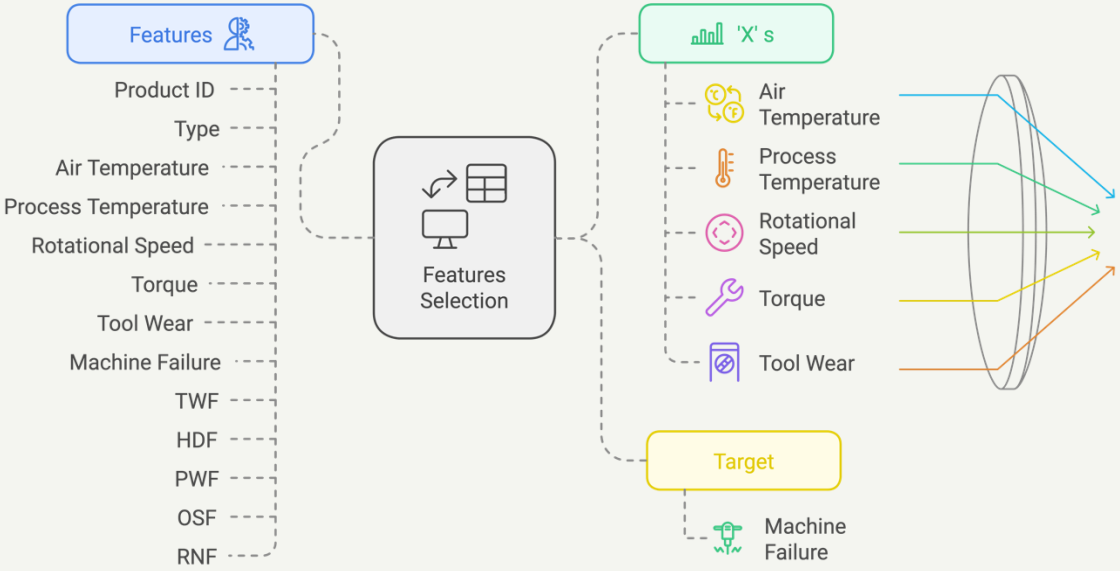
Corrective Maintenance

Changing car tires after it goes flat

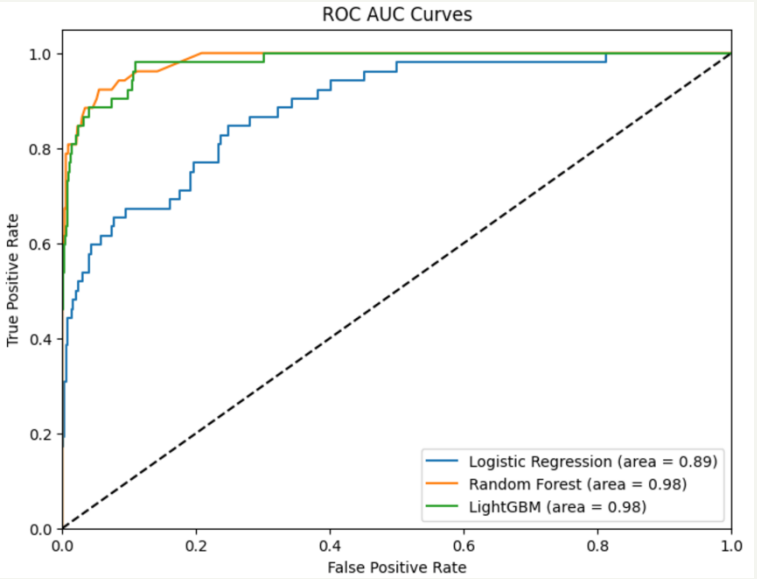
Data Summary

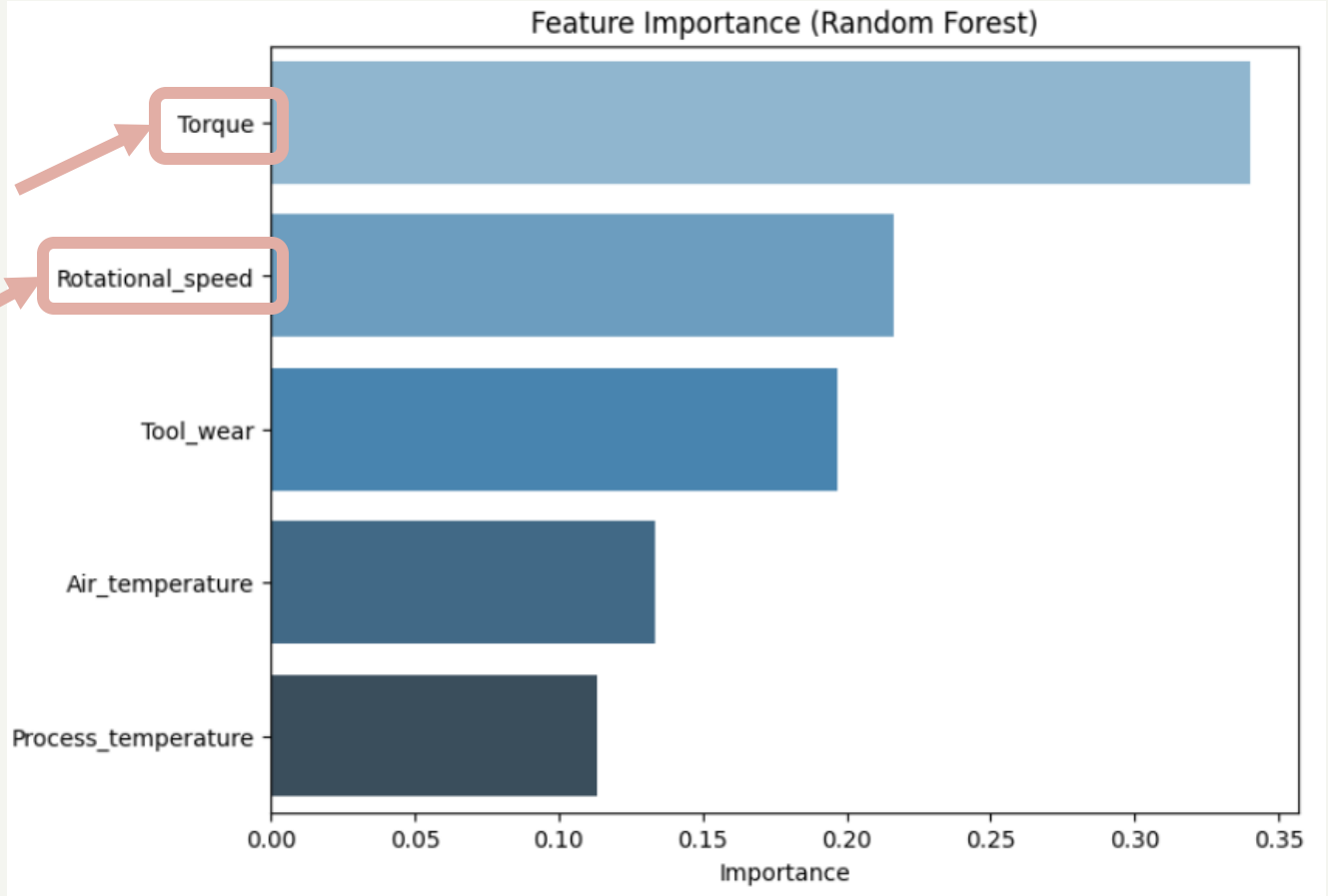


Failure Prediction

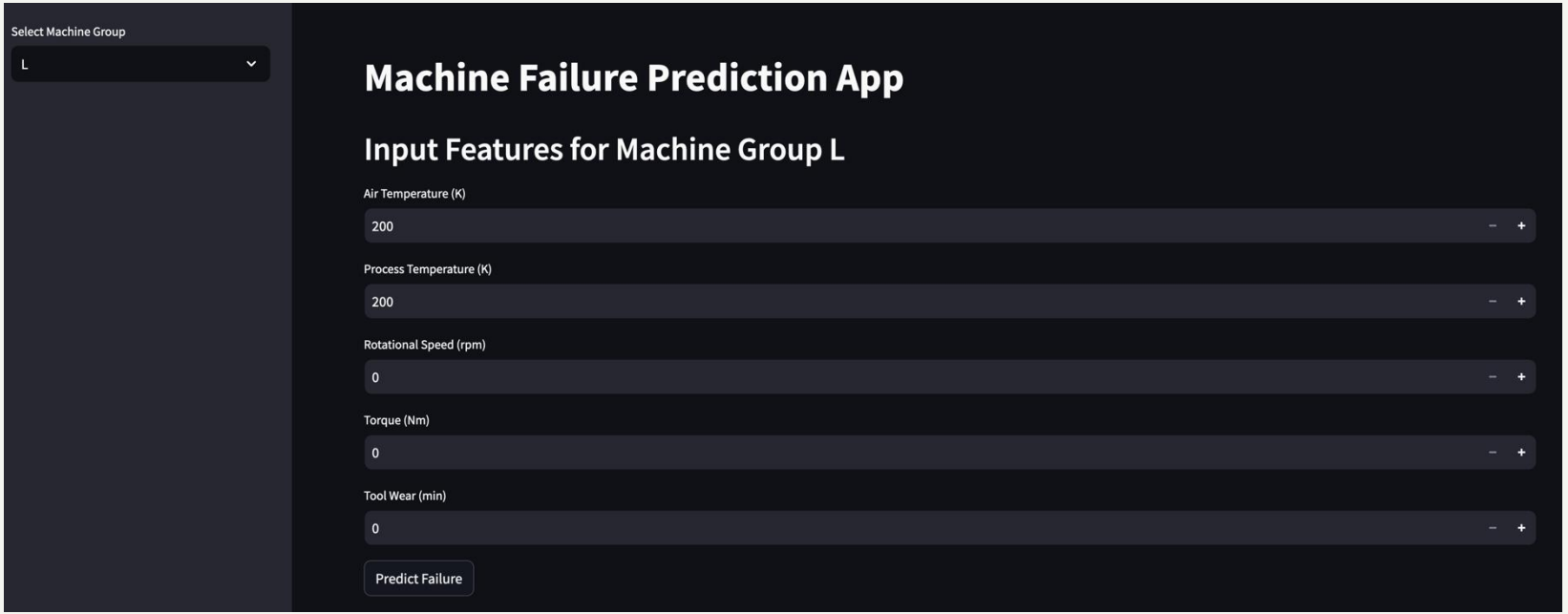


	Model	Precision	Recall	F1-Score	Accuracy
0	Random Forest	0.980159	0.980833	0.978770	0.980833
1	LightGBM	0.977803	0.979167	0.977208	0.979167
2	Logistic Regression	0.960905	0.965833	0.958135	0.965833



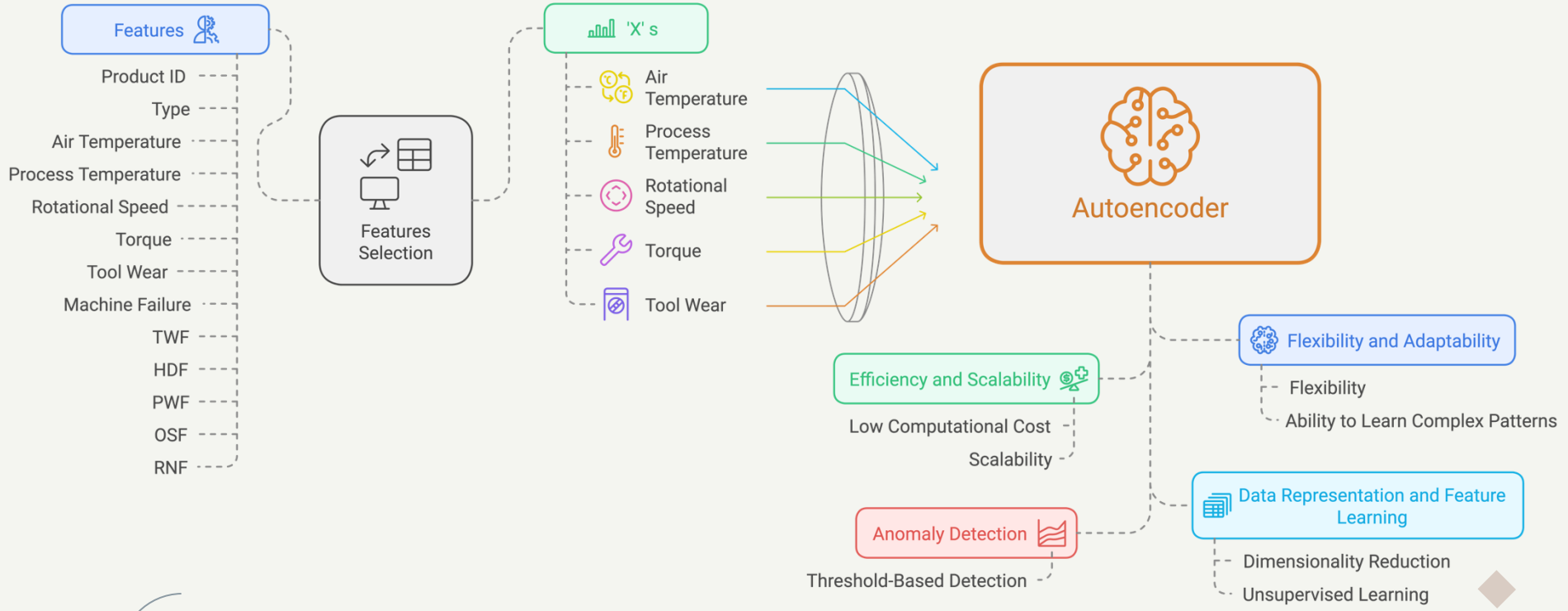

Feature Importance (Random Forest)
Torque
Rotational_speed
Tool_wear
Air_temperature
Process_temperature
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
Importance

Demo – Predicting Failure

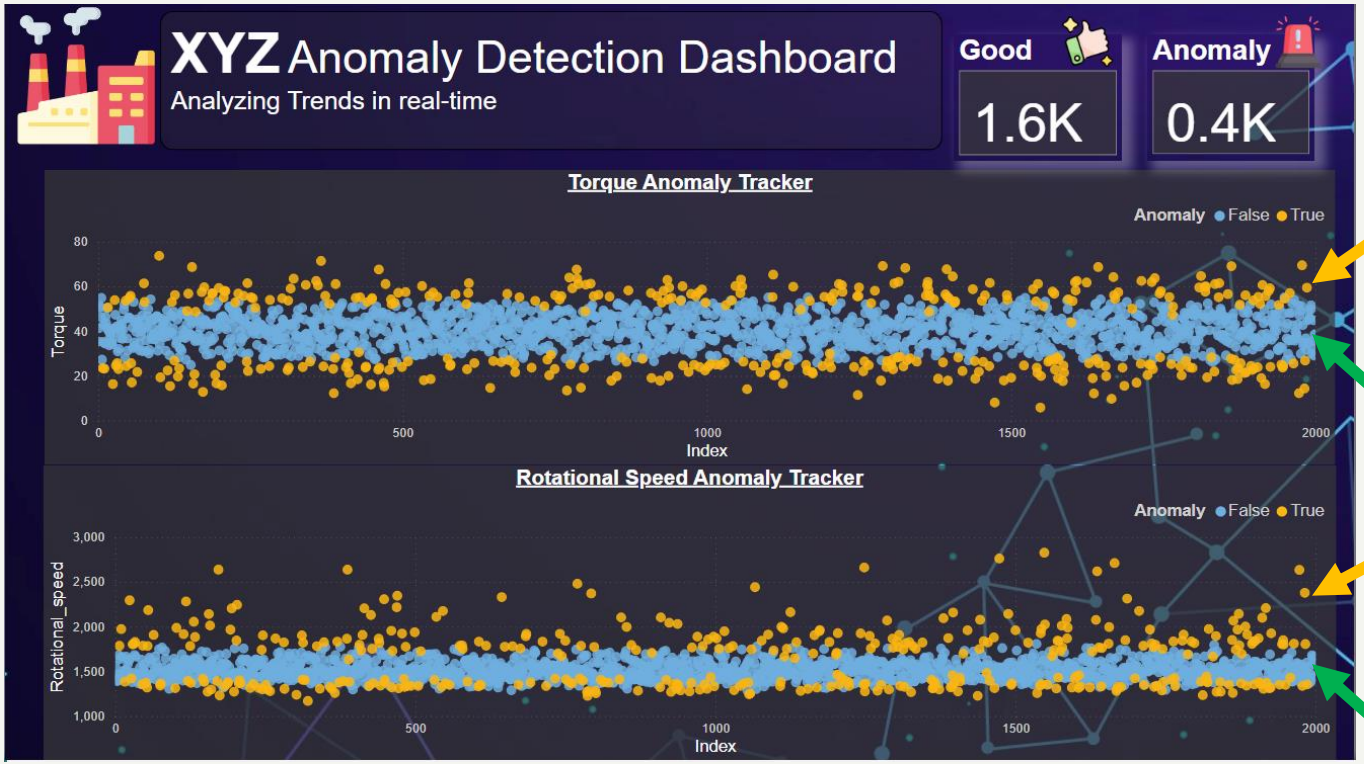


https://machine-prediction.streamlit.app/

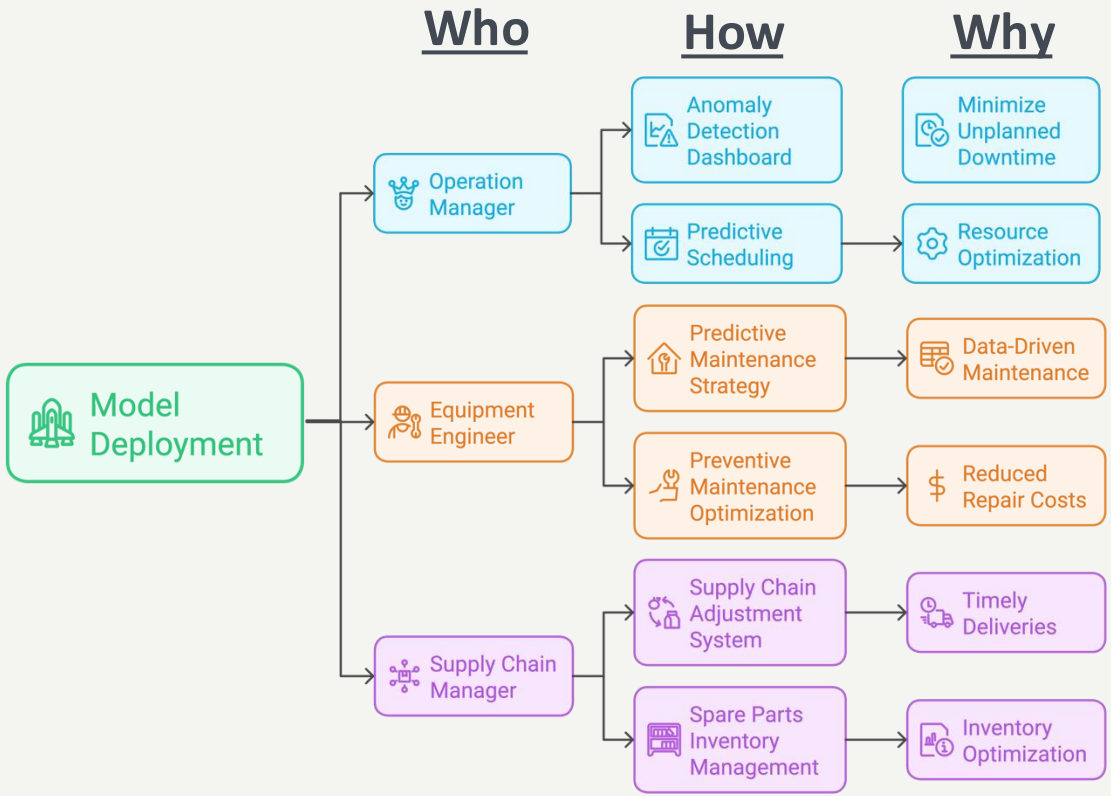
Anomaly Detection



Dashboard Deployment (PowerBI)



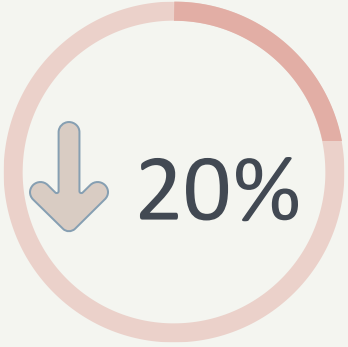
Enhancing Business Strategies



Next Steps

Machine Downtime

Maintenance Cost



1. Incorporate **time-series features** to make **time-to-failure predictions**.

2. Integrate **sensor data & IoT technologies** to collect real-time data. **Automated maintenance alerts** could be setup to notify the stakeholders when certain threshold are exceeded.

3. Expanding the dashboard features that facilitates **decision-making**. Features such as past **historical trends** and **visualization of the machine health** can be included.

Let’s build smarter solutions for a brighter tomorrow!

Professional in Data Science & Artificial Intelligence

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