LEONARDO

Digital Twin for Predictive Maintenance in Aircraft

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ISD
Cyber-Physical & IoT Systems Design

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Digital Twin for PdM

Real Asset(s)

Data transmission to the virtual replicas
Sensor fusion, data filter, security

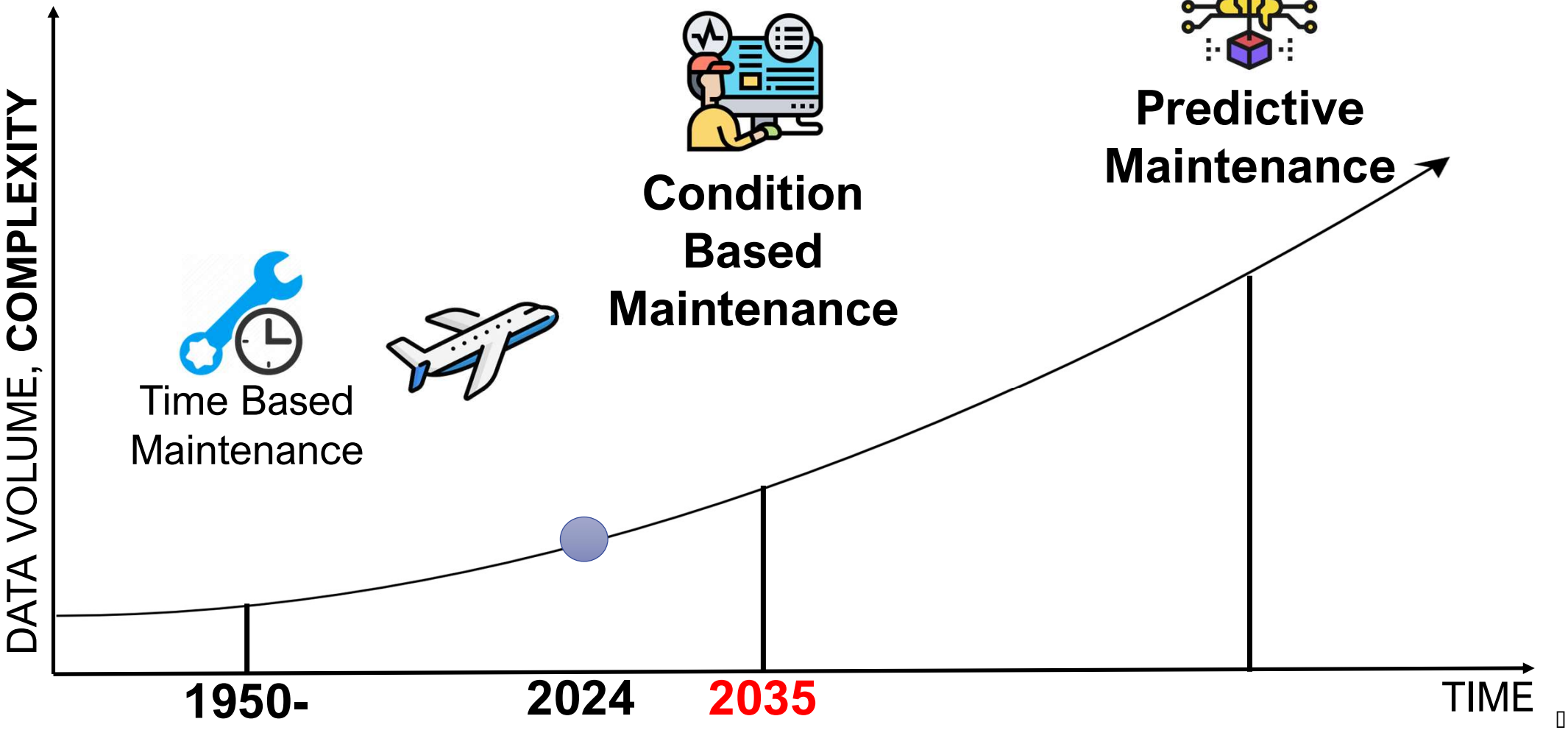
SAFETY

MAINTENANCE COST

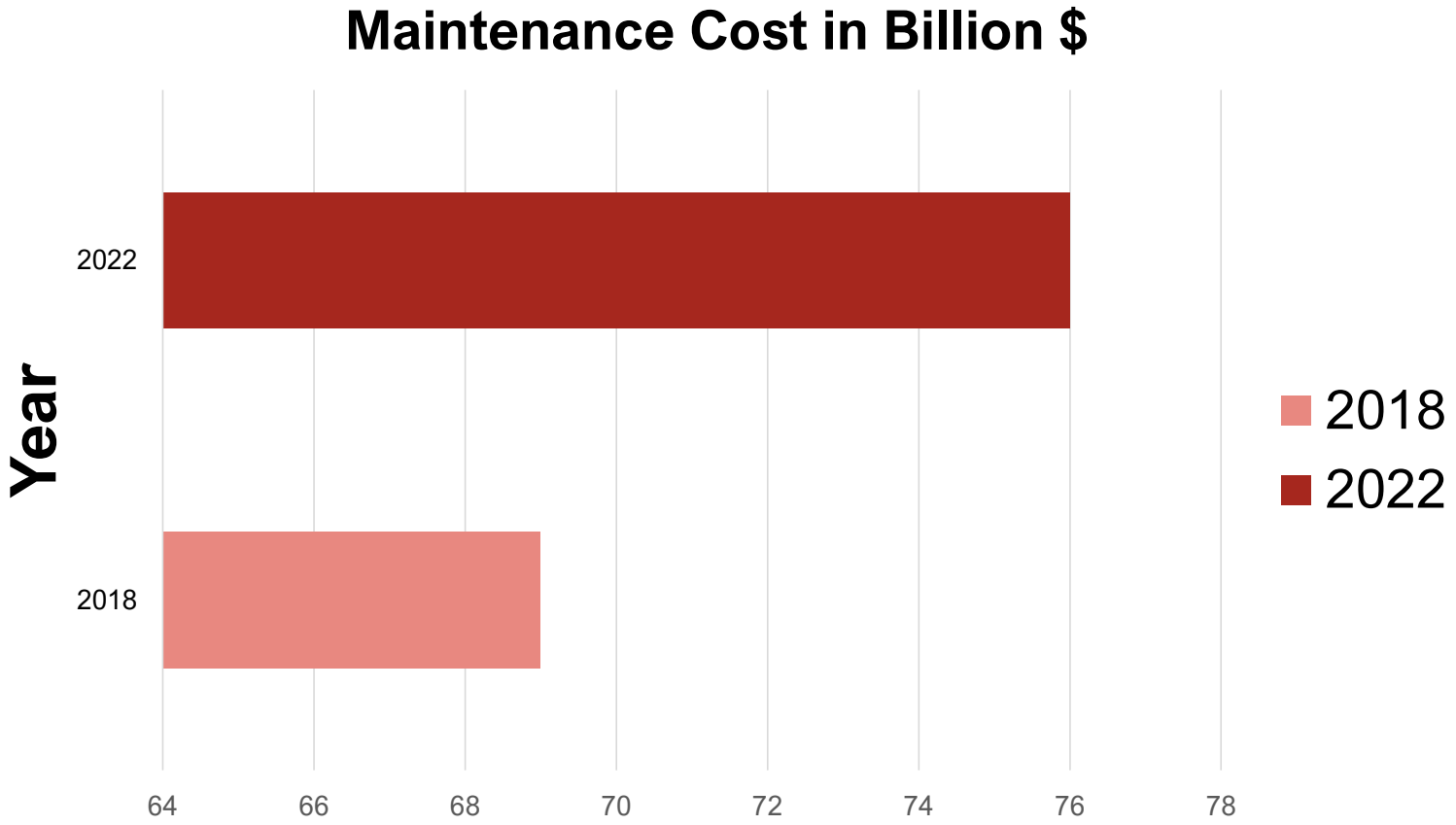
Feedback to the real objects
*Help in **decision-making***

Virtual Replica(s)

Change of Paradigm

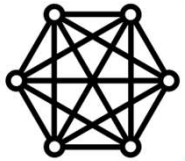


Maintenance Cost



Digital Twin Challenges

Complexity



Models and Data Availability

Data Imbalance

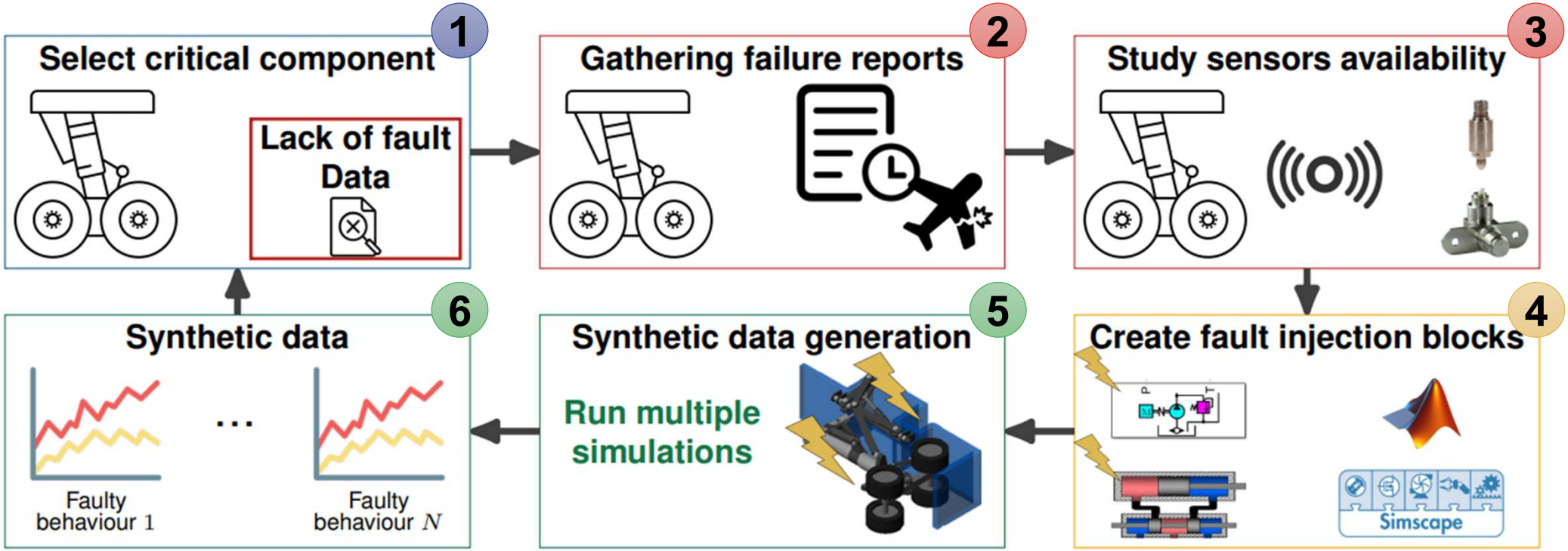
Explainability

Possible approach

- Model-Driven
  - **High interpretability**
  - **Exploration of virtually unlimited scenarios**
  - Rely on domain knowledge
  - Extremely time-consuming
  - Lack of flexibility
  - Computational intensive
- Data-Driven
  - **More general**
  - No simulation need
  - Time&Complexity
  - Size and variety of the dataset
  - Black-Box approach

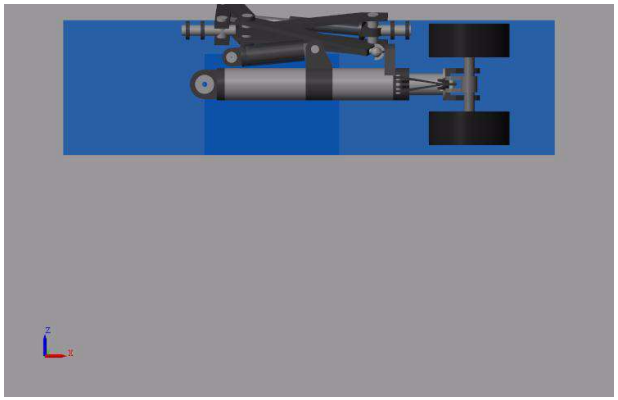
Hybrid Approach

Methodology

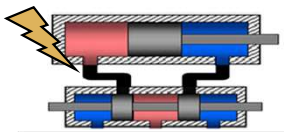


Multiple Fault Simulations

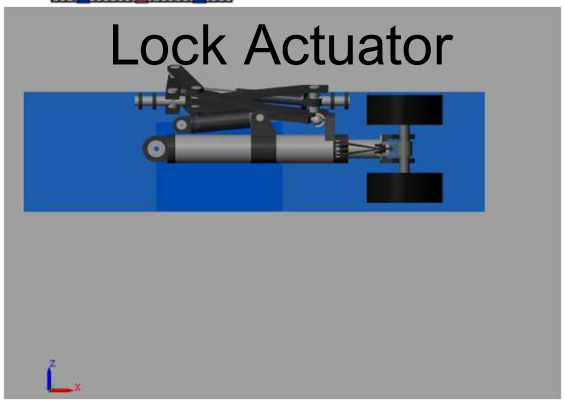
Healthy

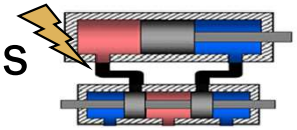


Faulty Simulations

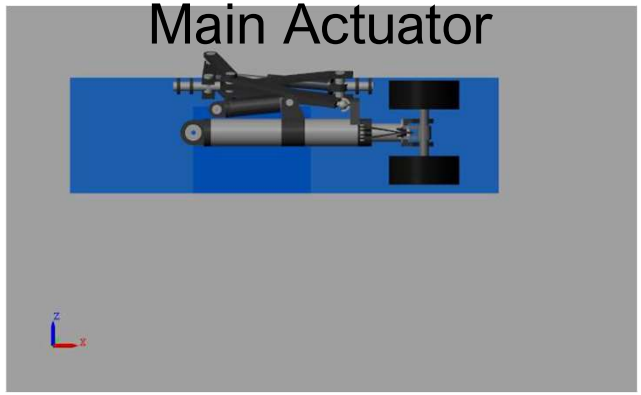


Lock Actuator

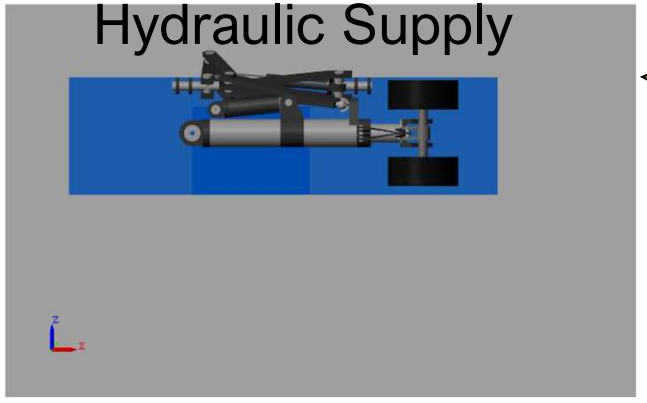


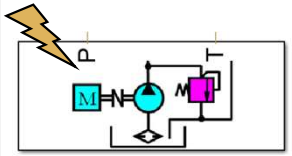


Main Actuator

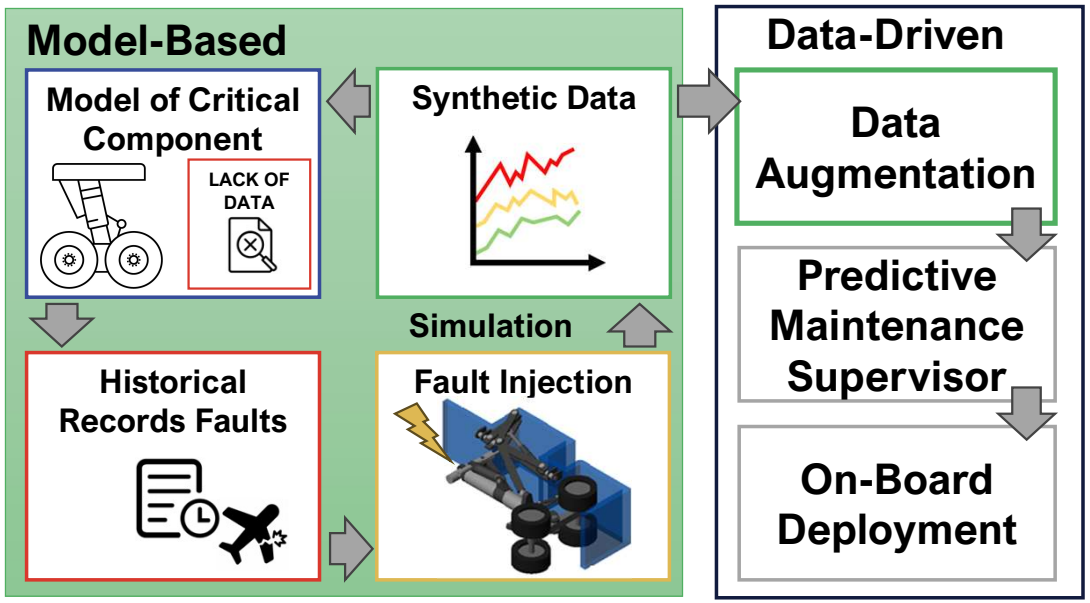


Hydraulic Supply





Actual and future works



- **Data augmentation with AI**
  - VAE
  - GAN
  - Diffusion Model

- PdM Supervisor to monitor the SOH of the system
  - Deploy on Edge