ReMAP

Real-time Condition-based Maintenance for Adaptive Aircraft Maintenance Planning

AI for Condition-based Maintenance in Aviation

H2020 ReMAP Project

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TU Delft, The Netherlands

AMLD conference – AI in aviation, Lausanne, 28th March, 2022

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 769288

EU Vision

ACARE

- By 2035 – the CBM philosophy will be accepted as a standard approach
  - For aircraft health monitoring & maintenance planning
- By 2050 - all new aircraft will be designed for CBM.

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Real-time Condition-based Maintenance
for Adaptive Aircraft Maintenance Planning

Project Number :	769288
Starting Date :	01/06/2018
Duration :	4 years
Action Type :	Research & Innovation (max TRL 5)
Budget :	6.8 million euros
Number of Partners :	13
Coordination :	Delft University of Technology (TU Delft)

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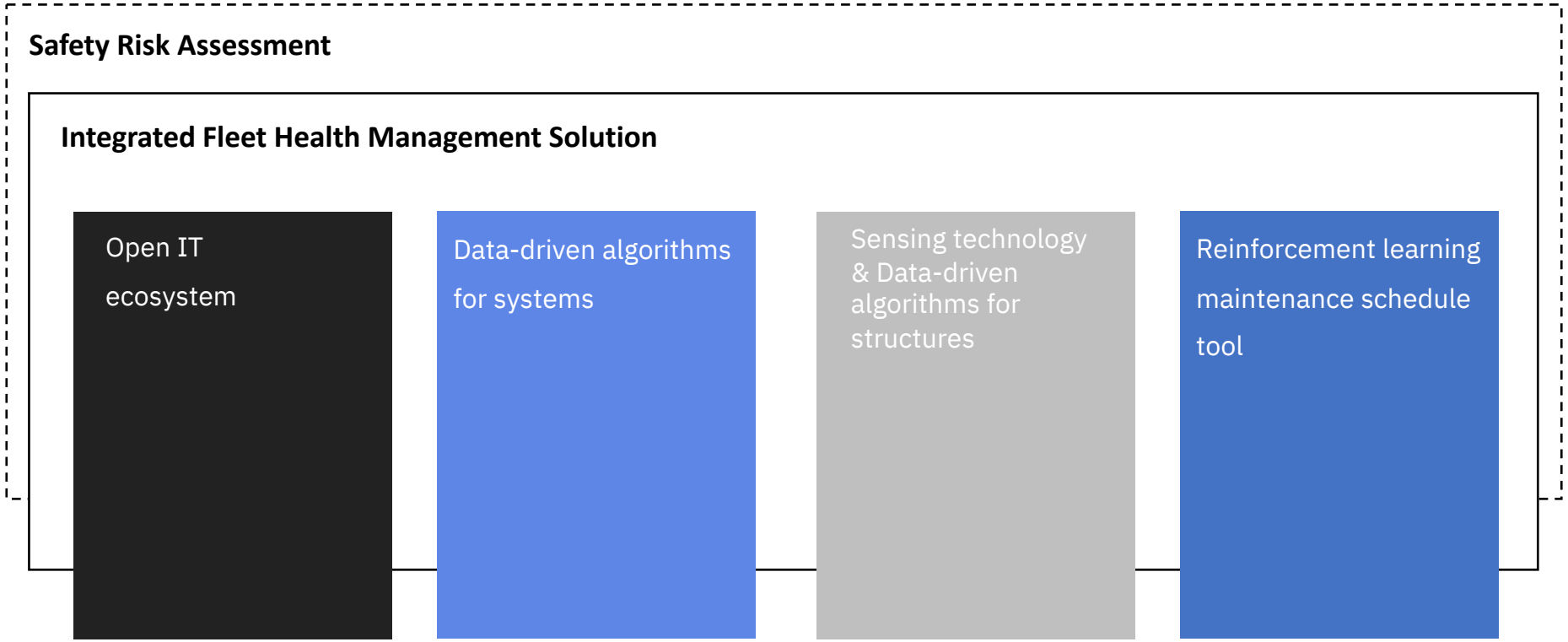
Our approach



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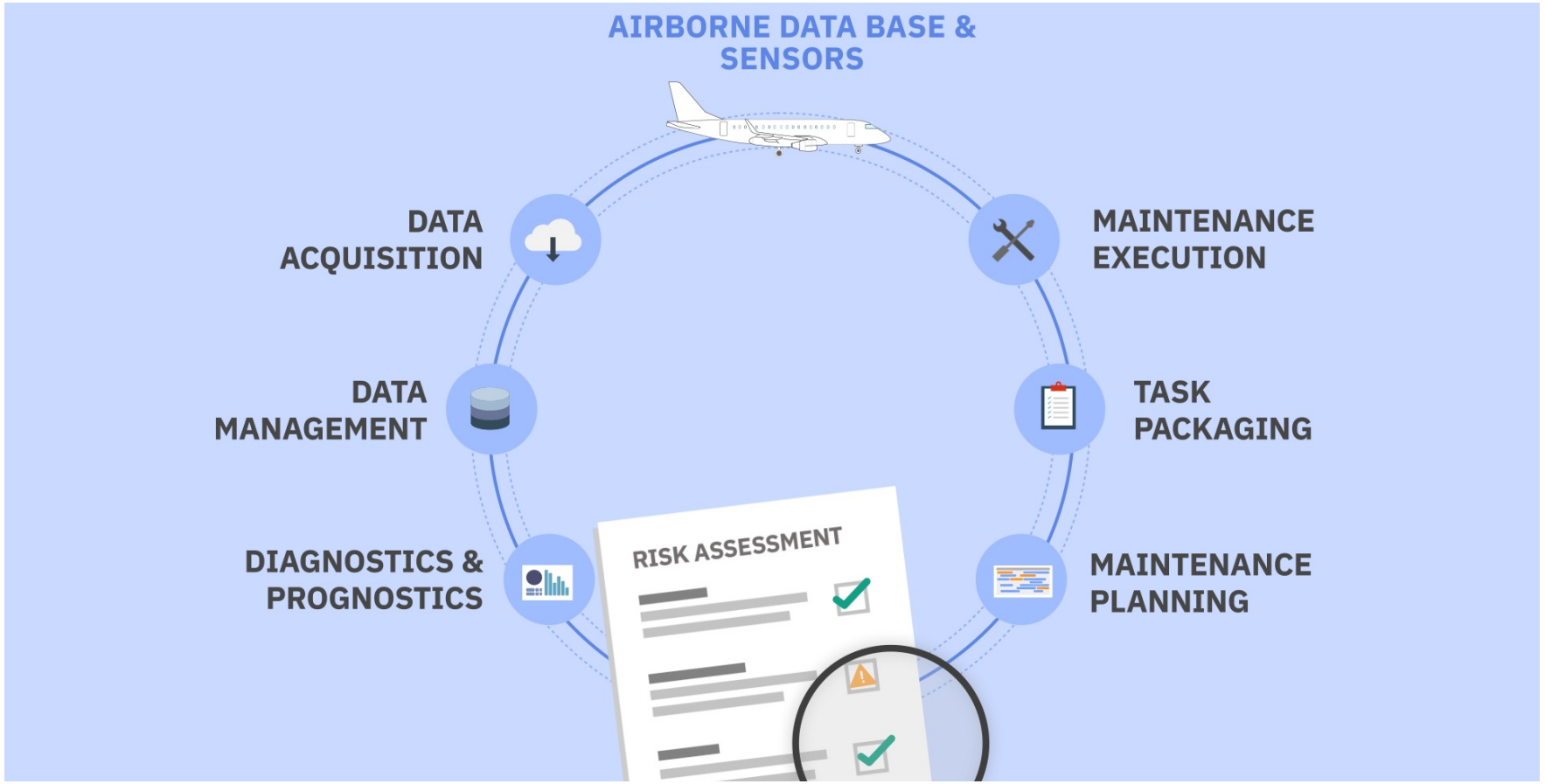

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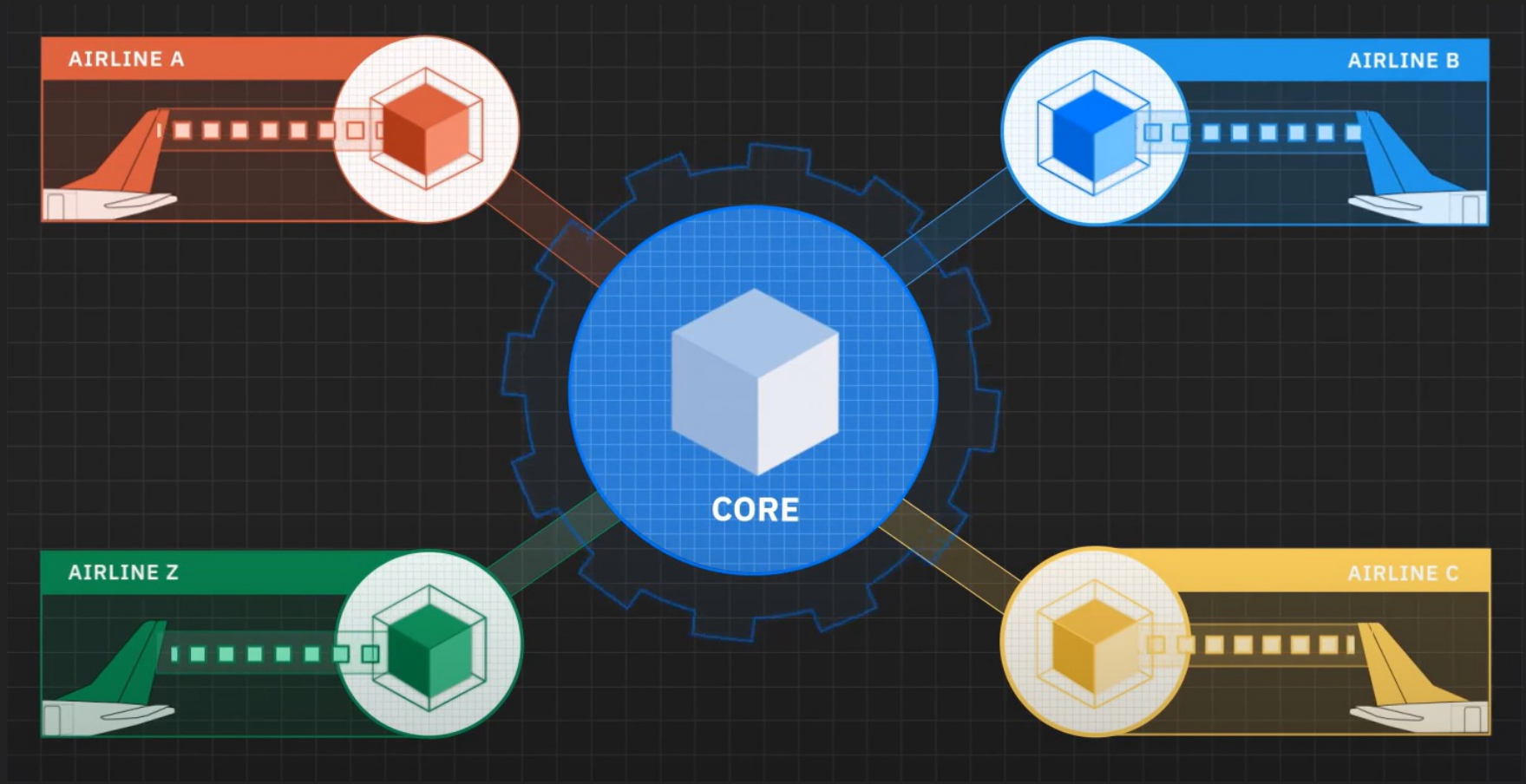
Open IT Ecosystem



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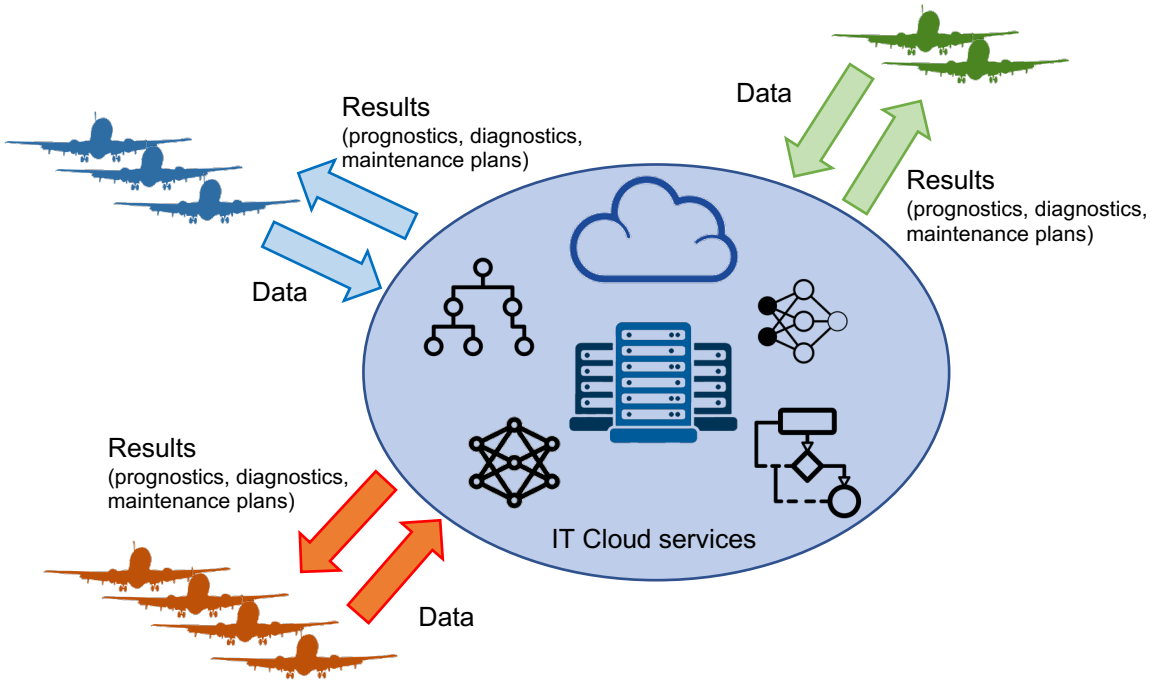
First approach

Hub & Spoke approach



We learned that

- Collaboration is key

  but…

- Airlines are reluctant to share their data
- Different airlines may require different levels of anonymization to be able to share data
- Data traceability challenges

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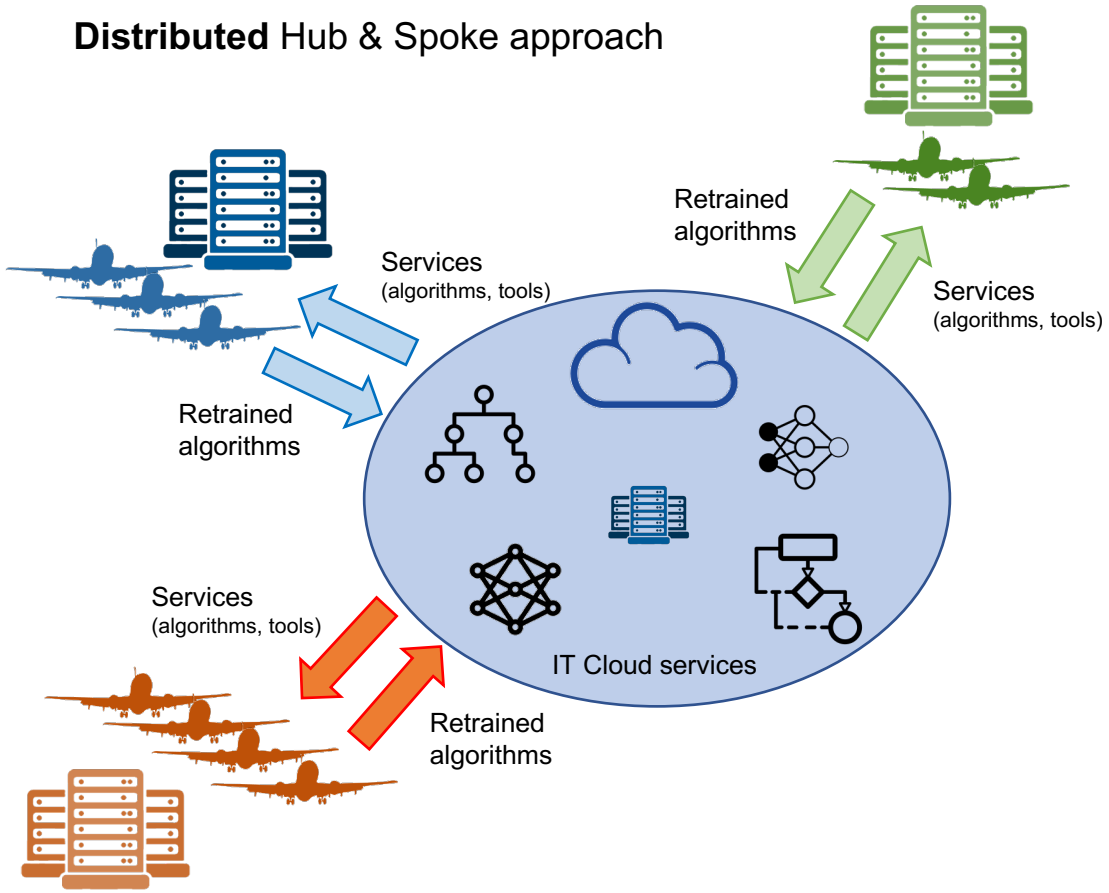
Implemented approach



Solution

- Data belongs to operators (and never leaves the airline's IT systems)
- Distributed Parallel Learning based design
- Models and Algorithms belong to developers
- Open API and Public SDK available for developers
- Focus on security and audit
- Easily adaptable to different Machine Learning techniques

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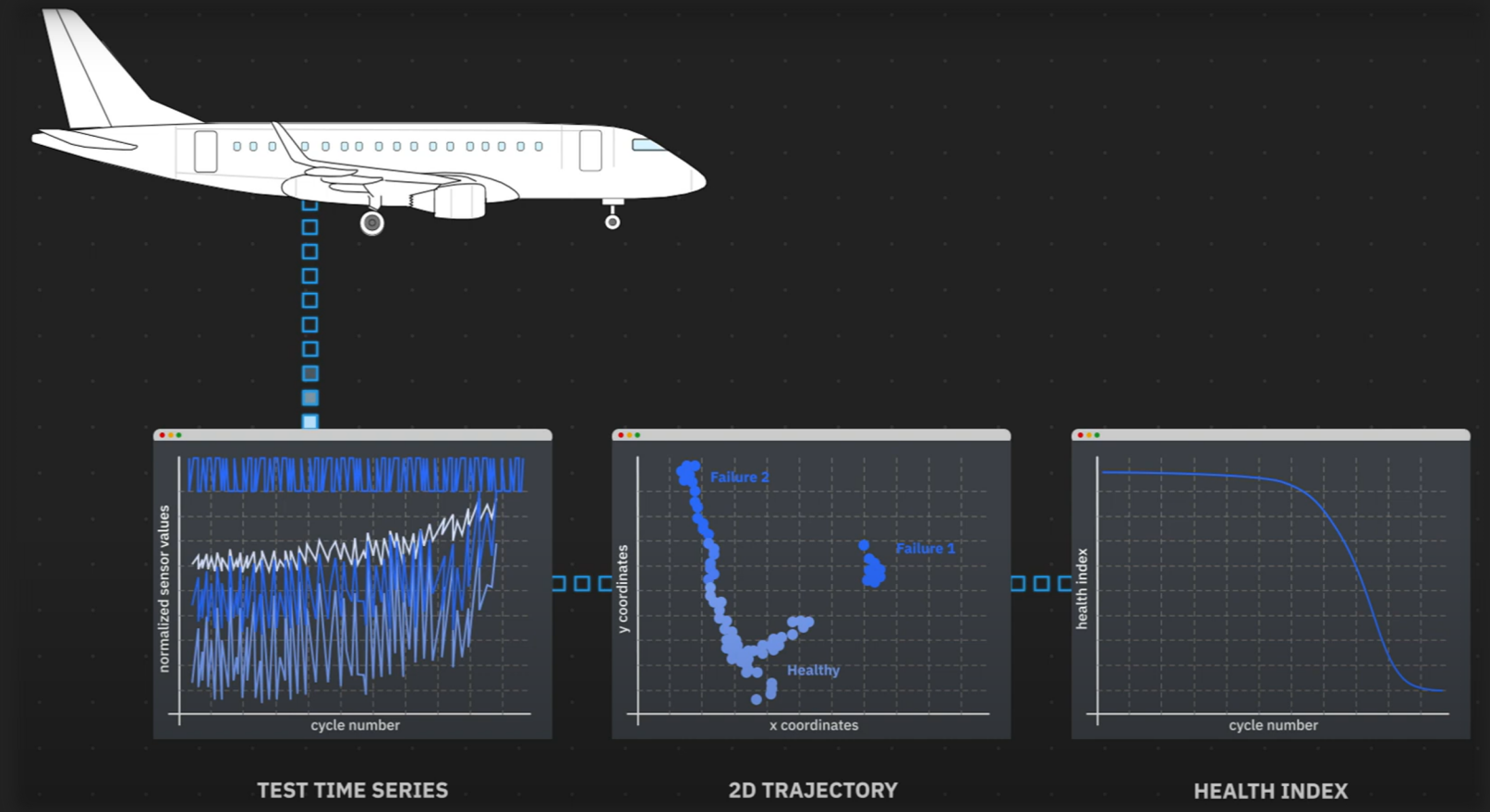
PHM Challenge



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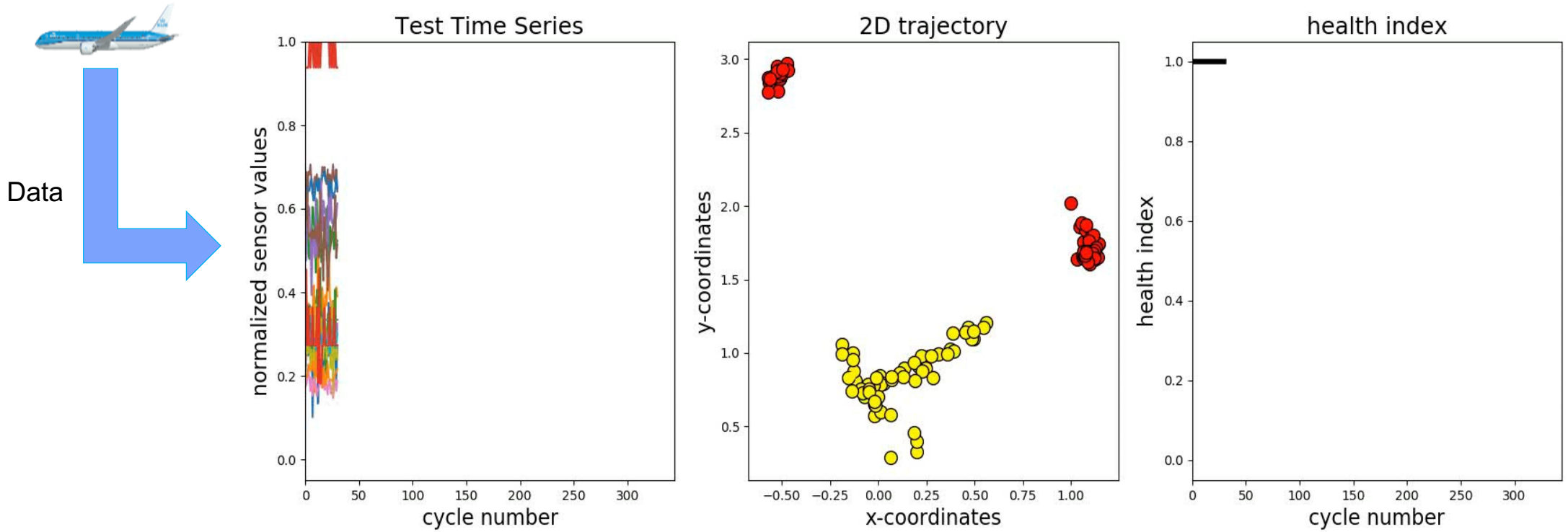
Approach 1 - TrajecNets



Shahid, N., and Ghosh, A. (2019) “TrajecNets: Online Failure Evolution Analysis in 2D Space", International Journal of Prognostics and Health Management: Vol 10 https://papers.phmsociety.org/index.php/ijphm/article/view/2614.

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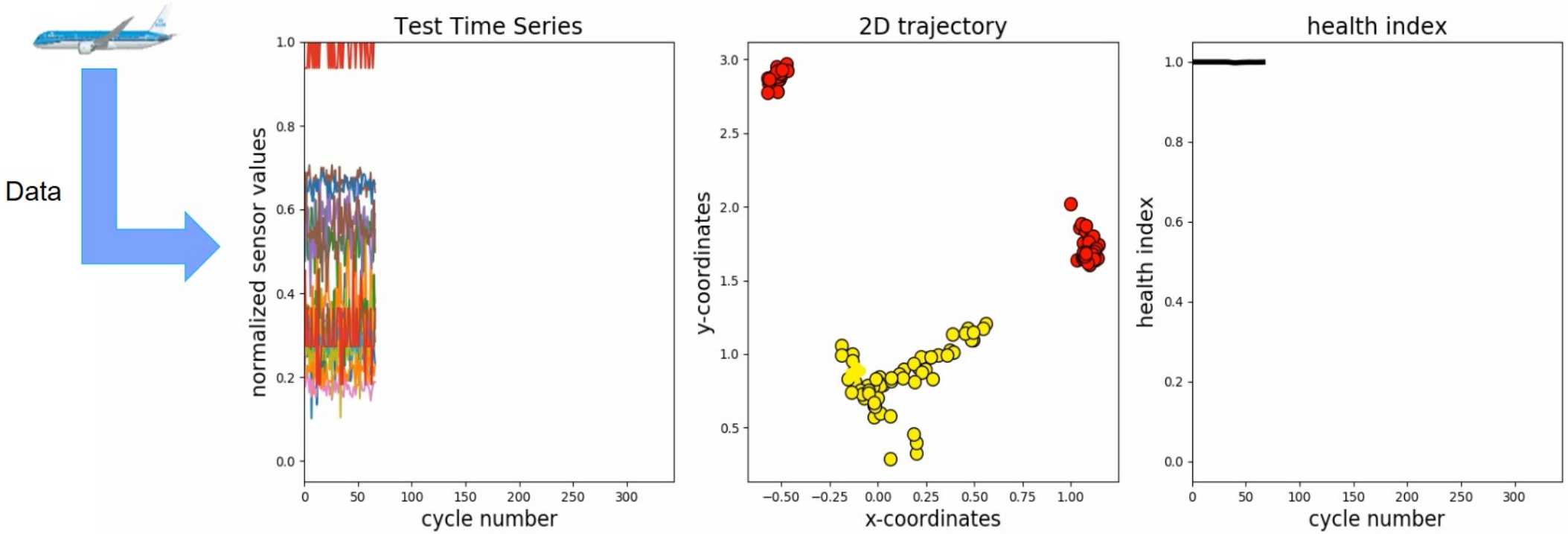

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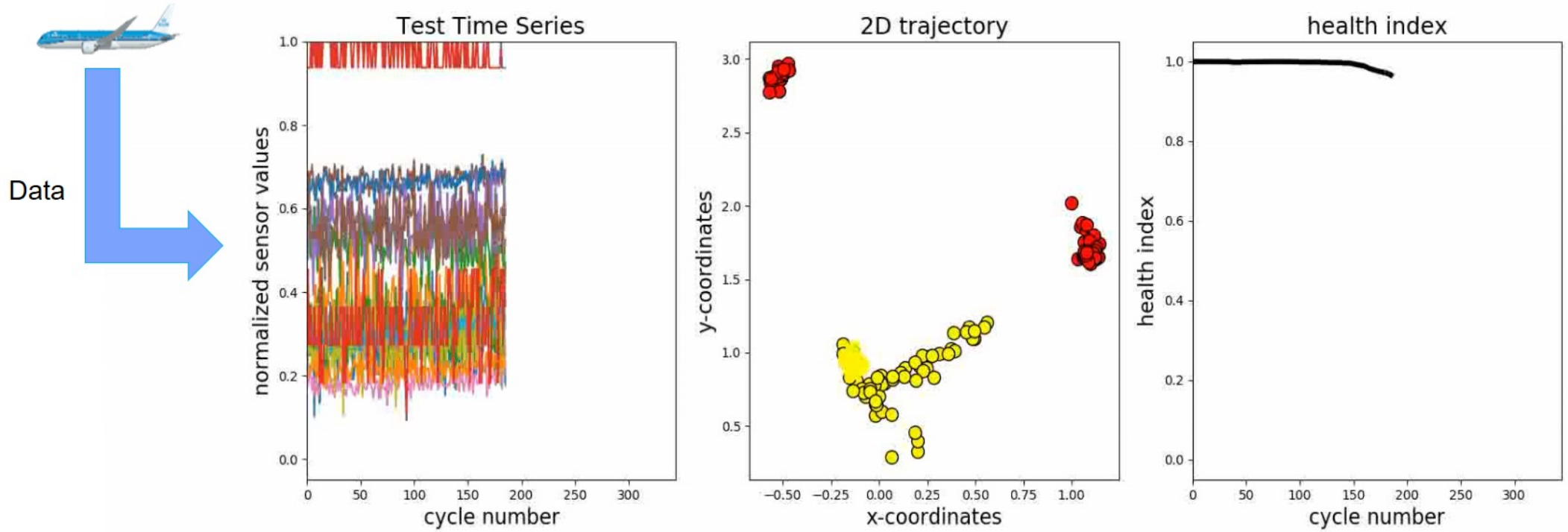

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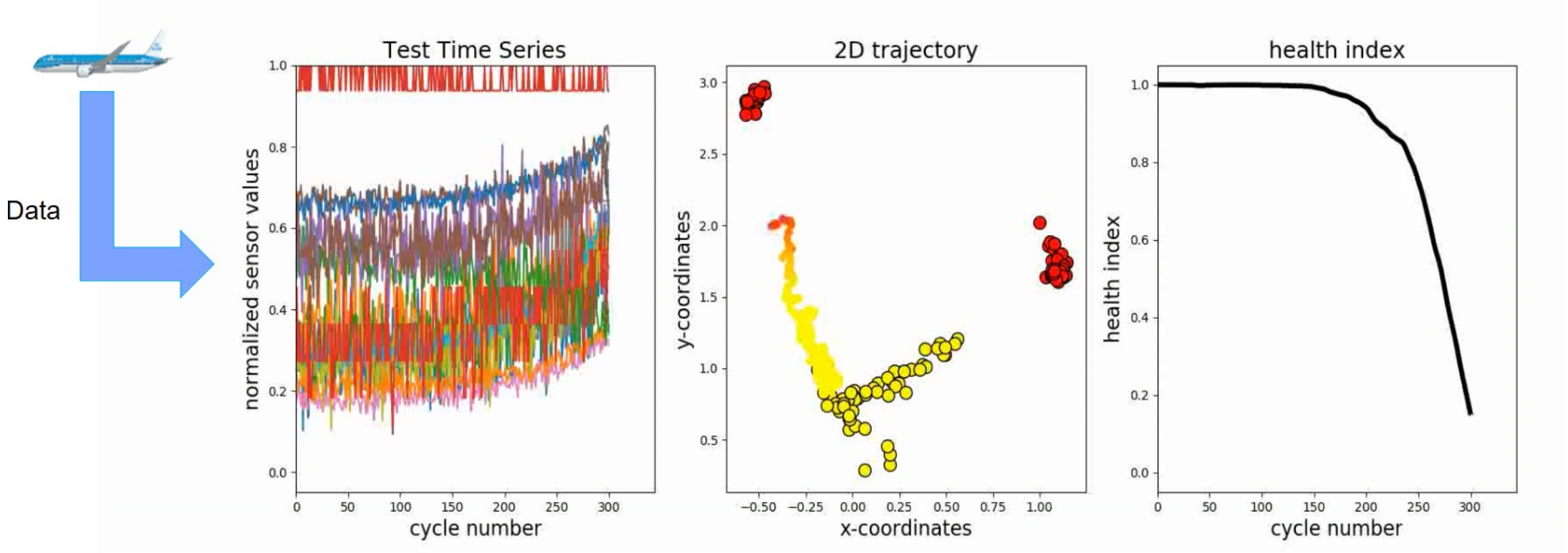

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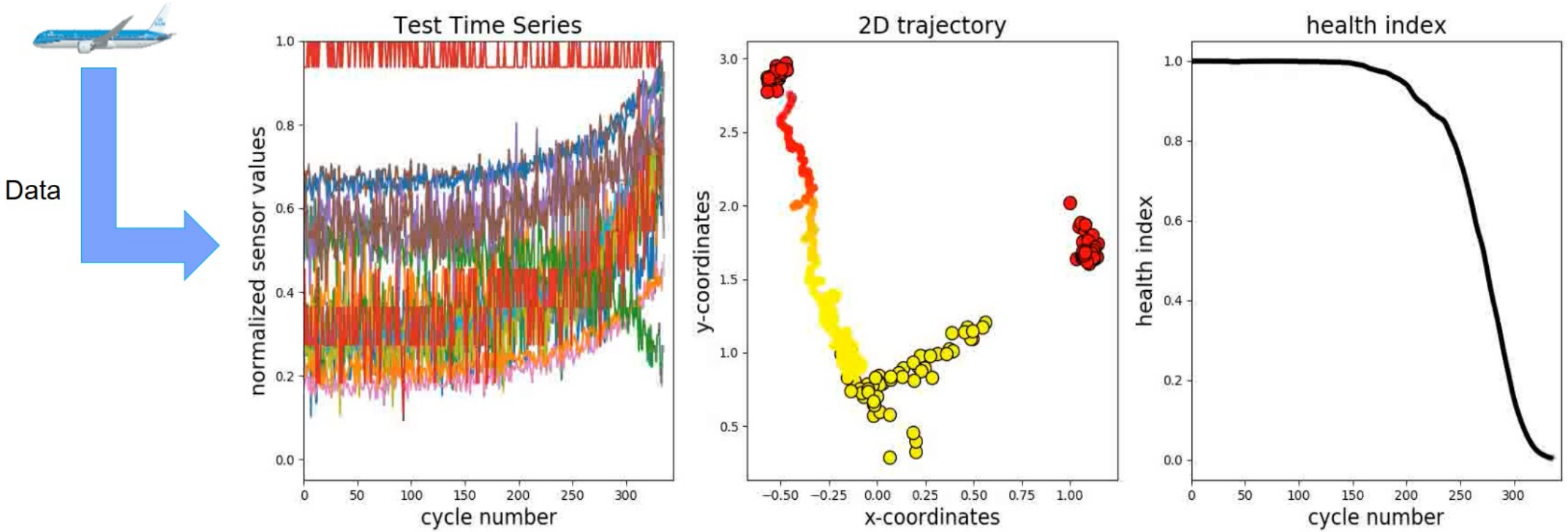

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Approach 1 - TrajecNets

Dataset	Samples	Failure predicted	Accuracy	Cycles in advance
FD001-train-test	36	36	100%	44 ± 14.2
FD003-train-test	36	36	100%	69 ± 9.1
FD001-test	100	31	31%	49.8 ± 17.1
FD003-test	100	24	24%	71 ± 9.4

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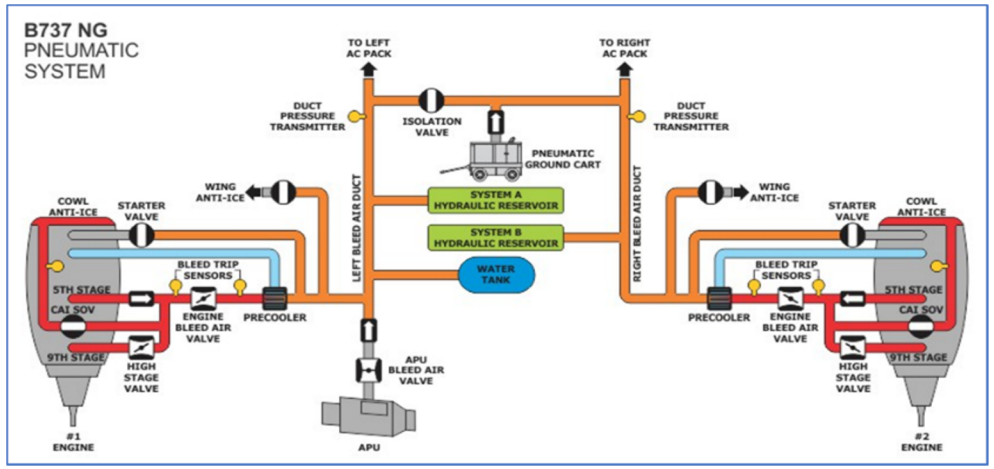
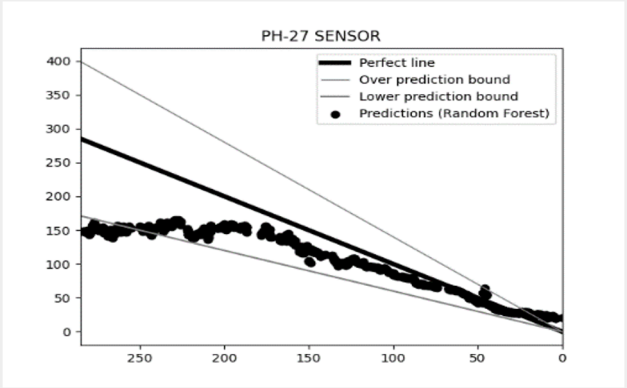
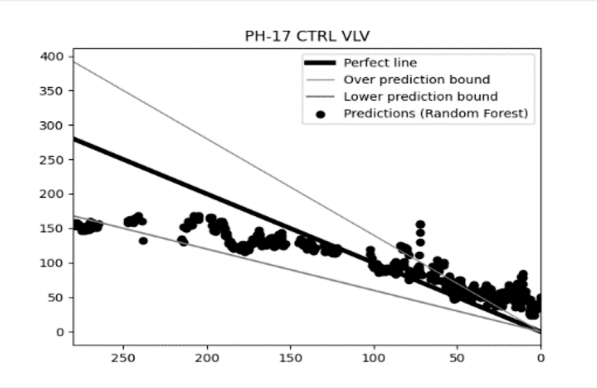
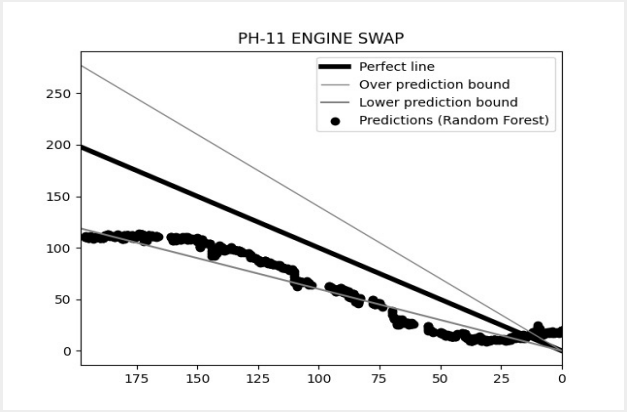
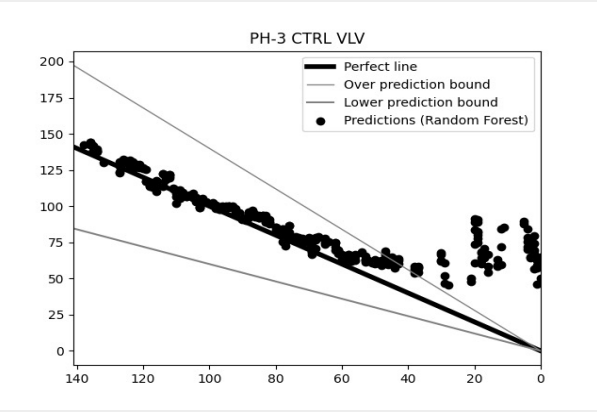
Approach 2 – Random Forest











Average:
Mean absolute error – 53.35 days

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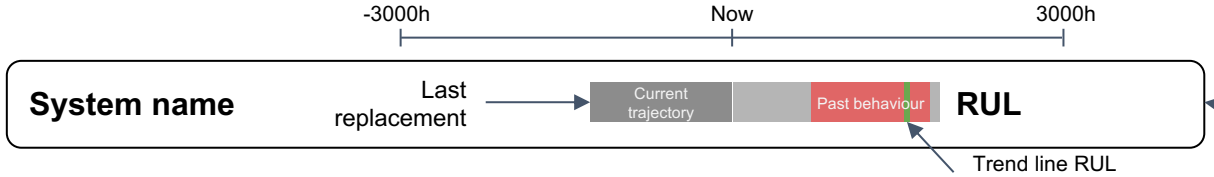
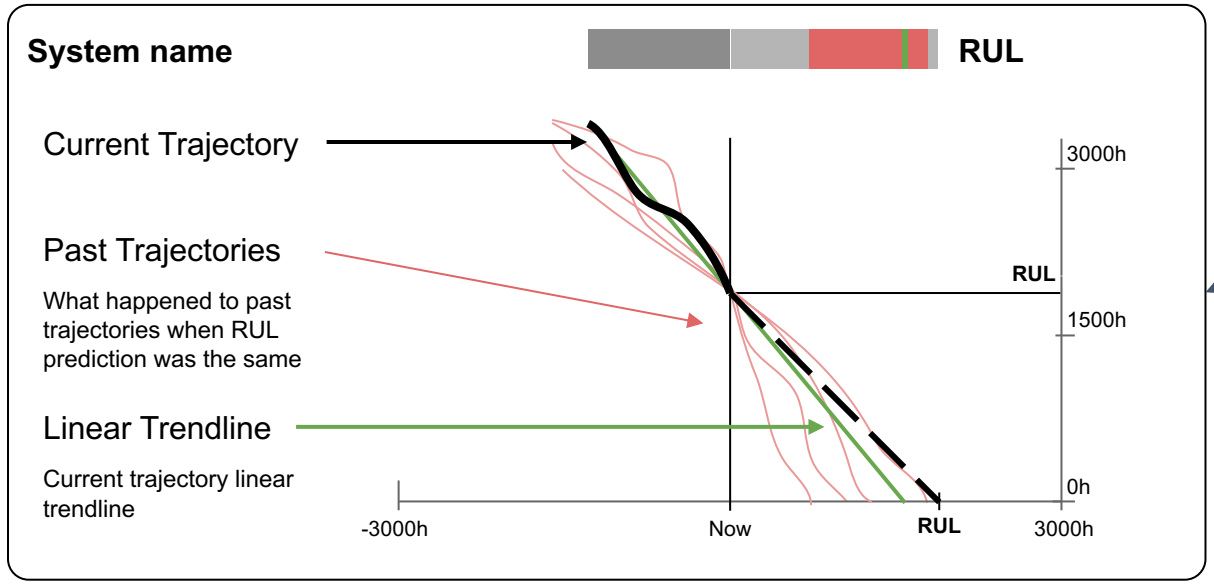
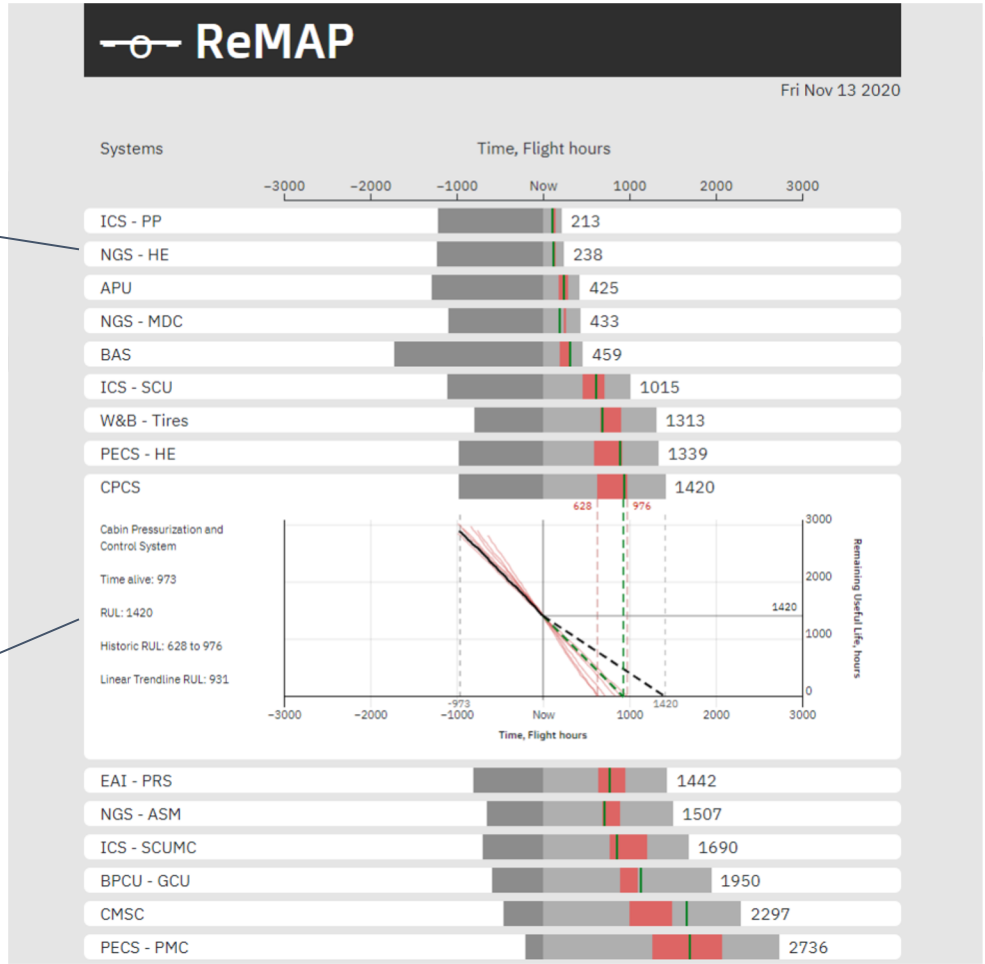
Visualisation

Display Remaining Useful Life (RUL) per sub-system



Display RUL behaviour over time for current and past trajectories





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Maintenance Planning

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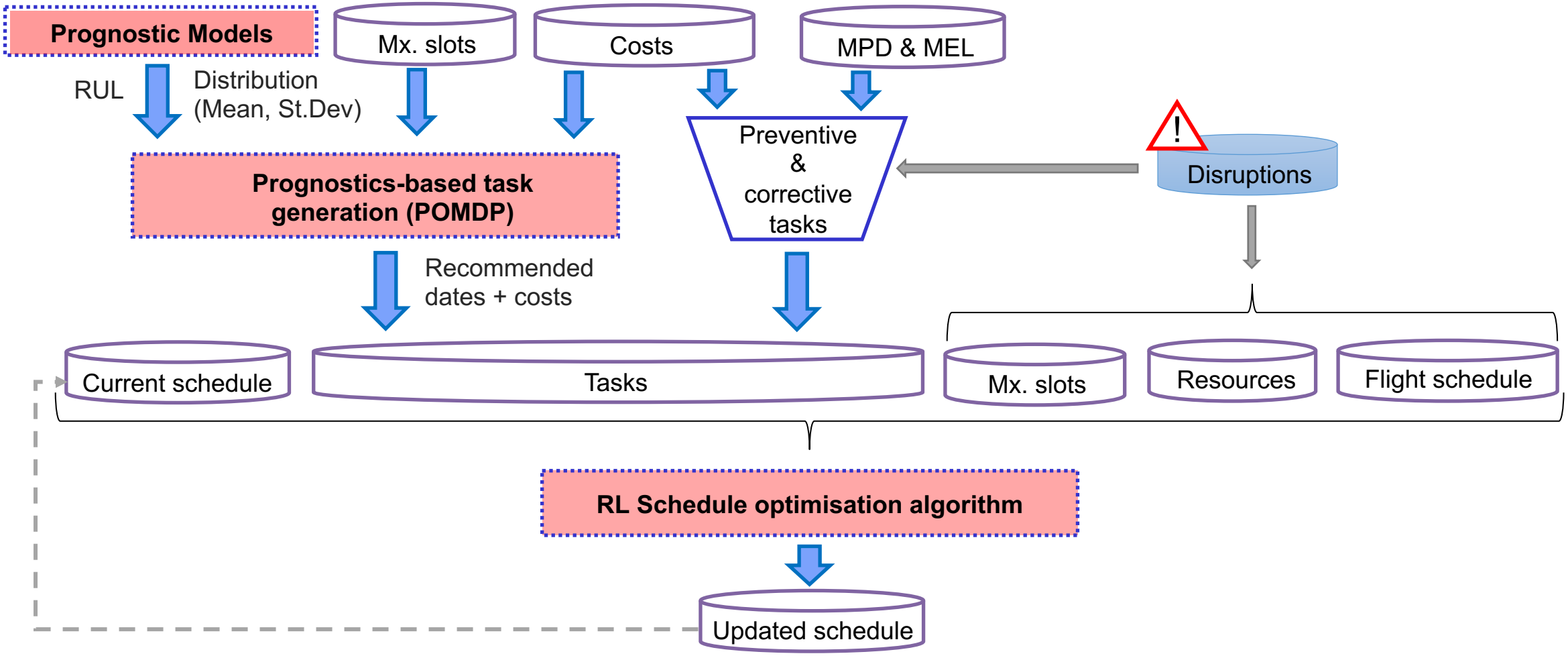
Decision support approach



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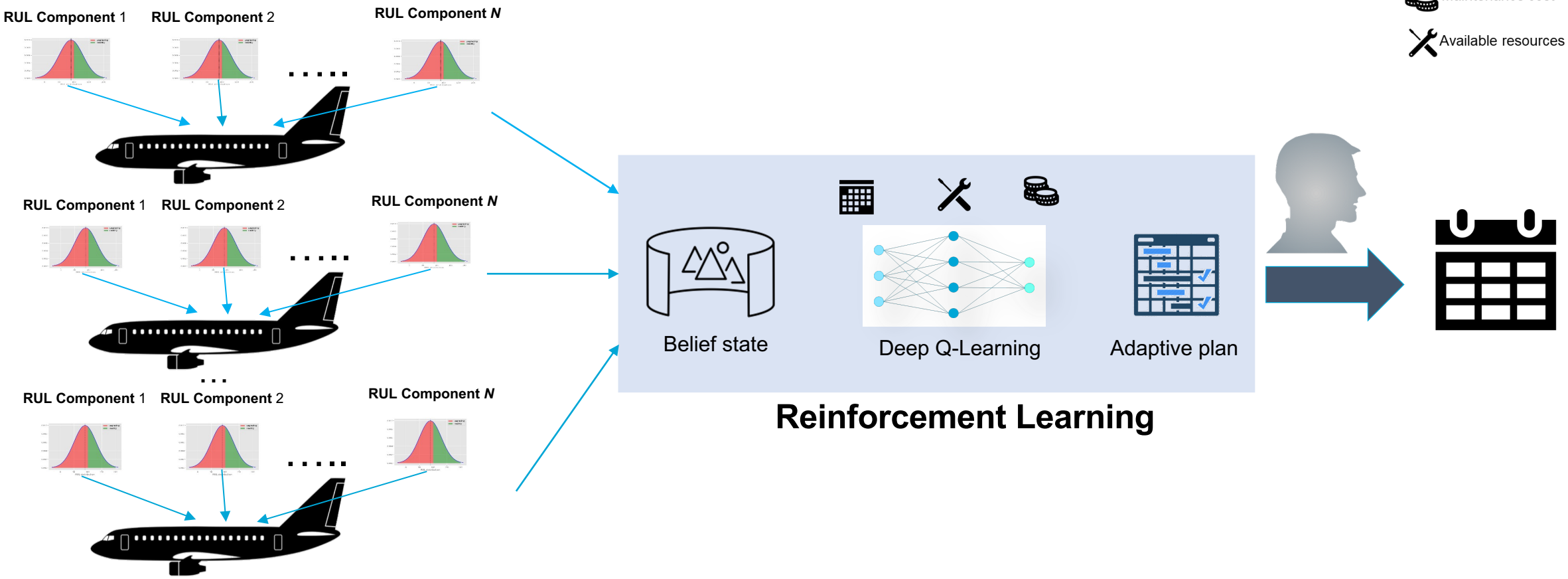

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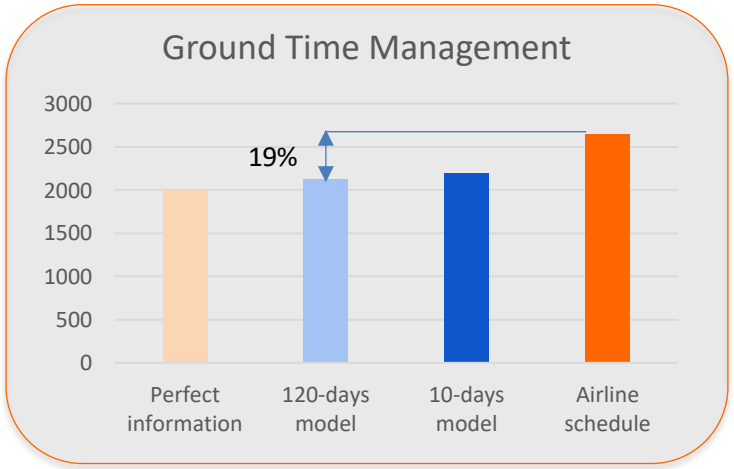
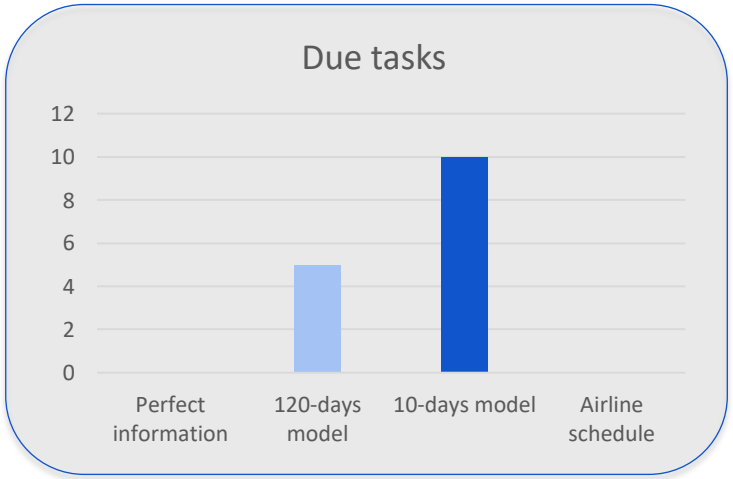
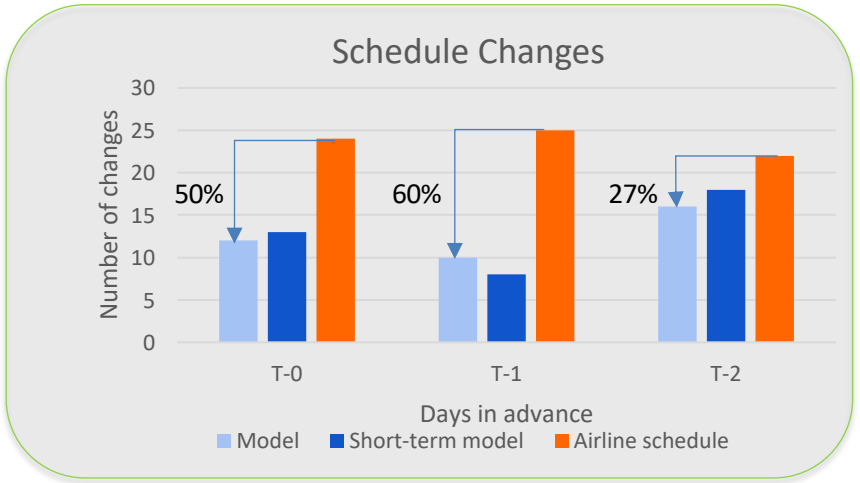
Results (without prognostics)

- Ground time decreased by 19% ≈ 1 day/year
- Less than 50% of schedule changes in T-0 and T-1







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The consortium

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1st International Conference for CBM in Aerospace

https://cbmacademy.eu/

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Paving the way for the future of CBM in aviation.

Project Coordinator:

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