

# Digital Twins of Axial Piston Pumps (APPs) for Machine Learning based Condition Monitoring

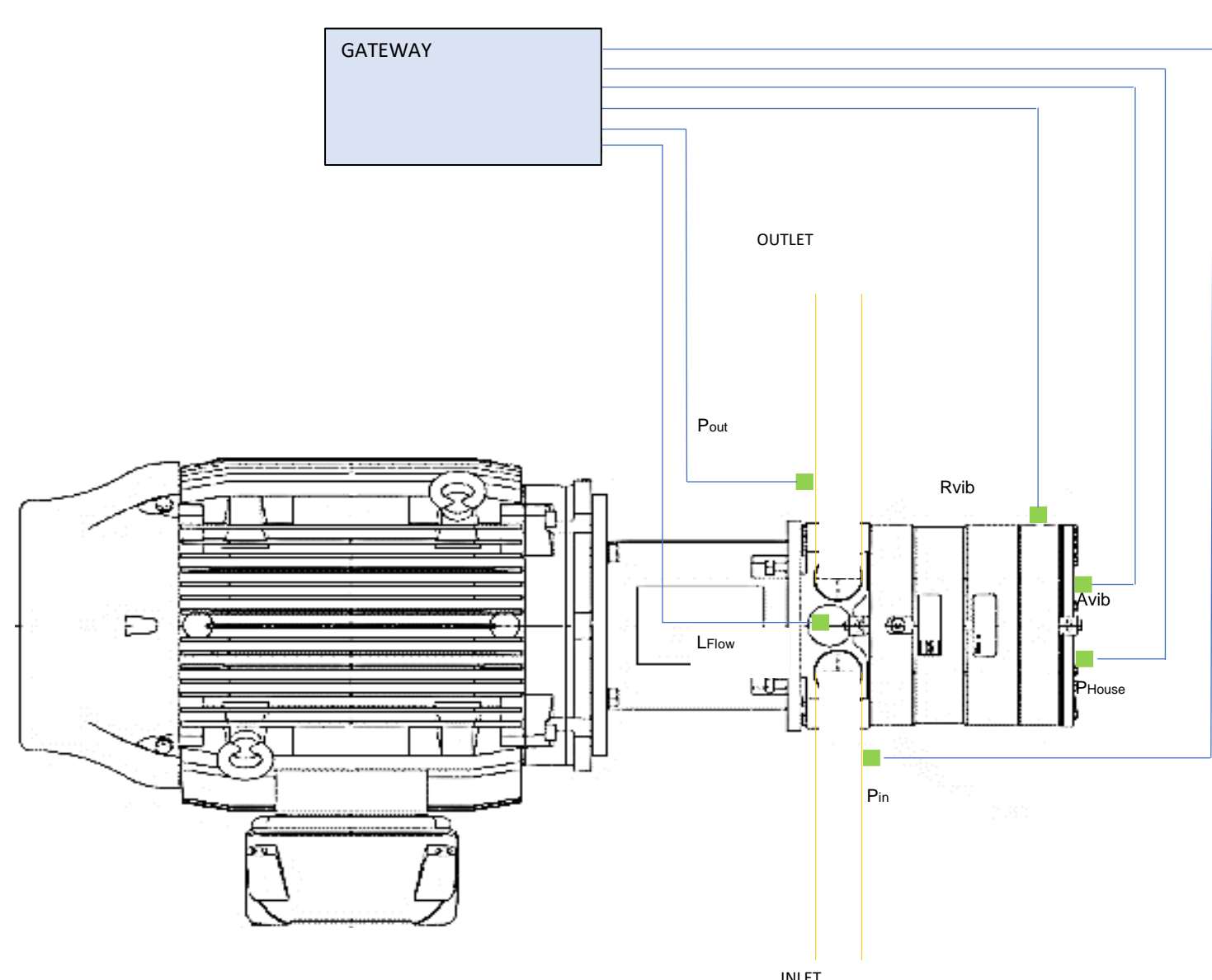
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## Danfoss APP's

- A Positive displacement pump, with a number pistons arranged into a multiple cylindrical bore around a common axis, running on top of a angular Swash Plate.
- APP's are highly efficient compared to centrifugal pumps, but they are not robust to the particles due to the tight tolerances.
- Relaxed tolerances increases the robustness of the pump at the cost of efficiency.
- Demands use of special materials due to corrosion and particle resistance in a typical seawater RO conversion plant, which is the main application area for APP's, thereby a higher price for spare parts and service.



Cut -section model of a typical APP



Layout of APP with Sensors for Data Acquisition

## Objectives

- To develop accurate FE Model (Digital Twin) of APP.
  - To validate FE model against experimental data.
  - Model updating to determine the uncertainties in FE model.
  - To carry out a stochastic analysis
  - To simulate damages in digital twin.
  - To develop ML algorithm for APP failure detection.
- **Project's success criteria**
- 1.Accurate FE modelling of the APPs using sub-structuring techniques.
  - 2.Numerical results validated against real-life experimental data.
  - 3.Deploy ML-driven CM algorithm for APPs.

## Work packages

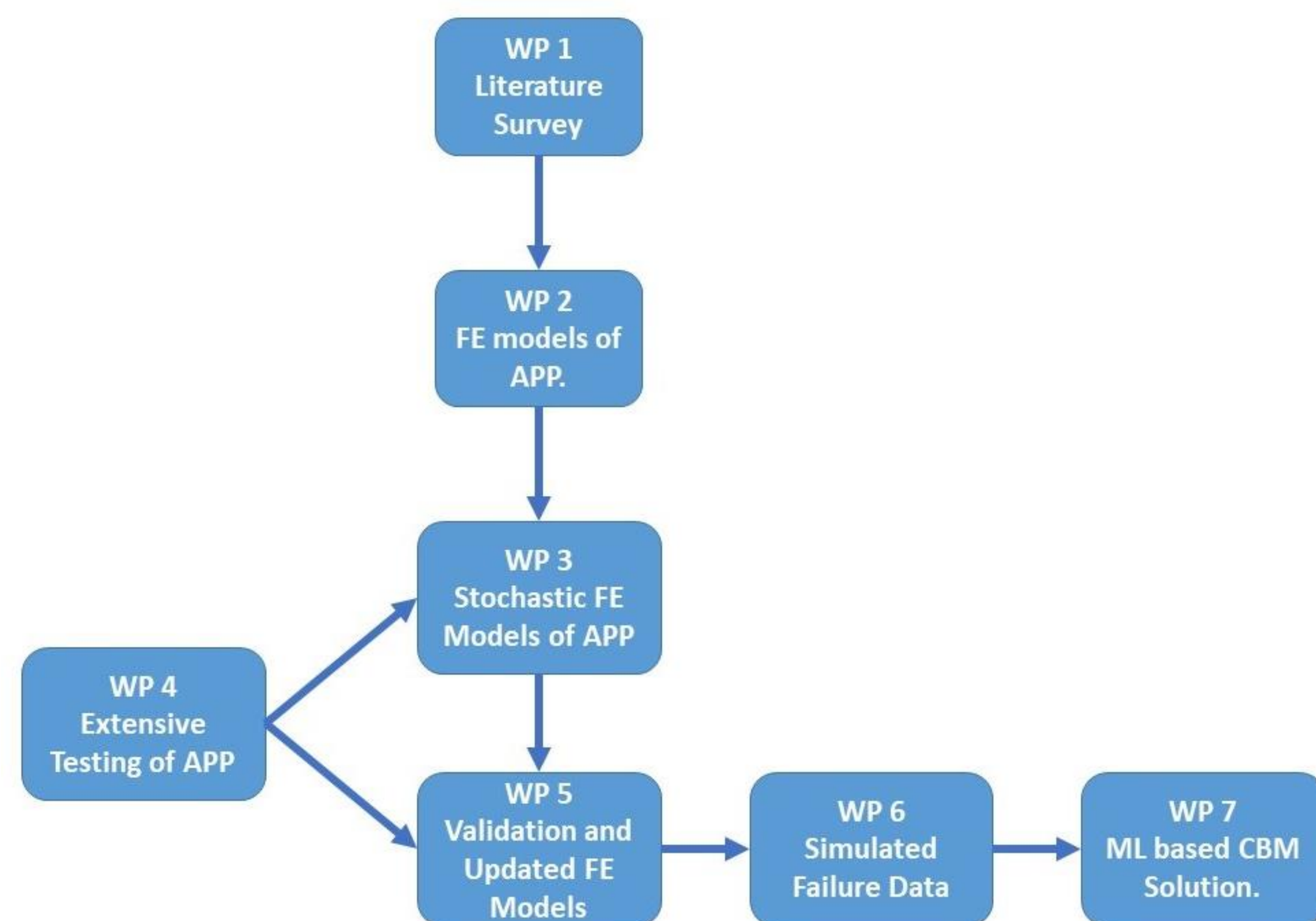


Illustration of the seven work packages in the project. The work packages lead logically towards the end goal of having an ML based CBM solution

## Collaborative partners

This PhD project is funded by the Innovation Fund Denmark and is a collaboration between SDU and Danfoss High Pressure Pumps.