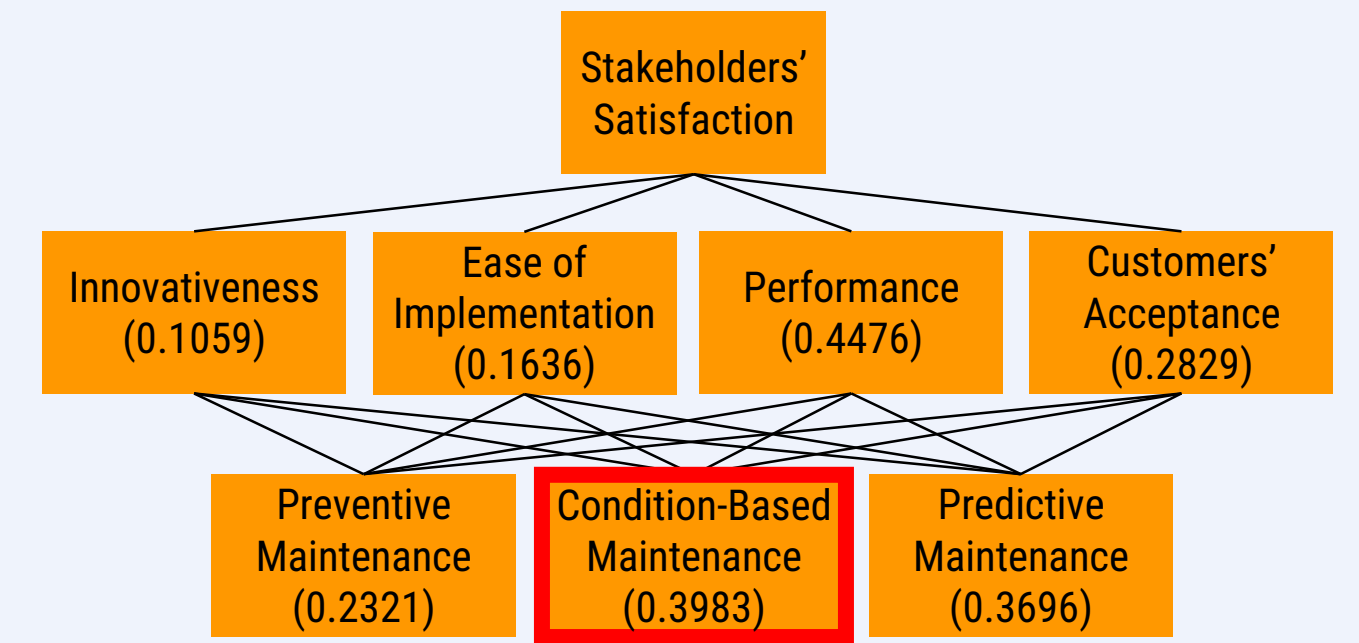


Company Background

SIA Engineering Company (SIAEC) provides maintenance, repair and overhaul (MRO) services for the aviation industry. In view of the greater competition in the region, SIAEC seeks to innovate efficient and effective ways to conduct maintenance.

Corrective and Preventive Maintenance (CM/PM)	Condition Based Maintenance (CBM)	Predictive Maintenance (PdM)
<ul style="list-style-type: none"> CM is conducted when a failure is deducted PM schedules time-based maintenance, based on expected time to failure 	<ul style="list-style-type: none"> Monitoring actual operating conditions of the assets to assess the need for maintenance 	<ul style="list-style-type: none"> Use the data available from condition monitoring to model the lifespan of the asset

Selection of Strategy using Analytical Hierarchy Process (Goal - Criteria - Alternatives)



Project Overview

Key Skillsets

- Decision Making: analysis of alternatives using analytical hierarchy process
- Statistical and Data Analysis: data preprocessing (reduction, transformation, integration), clustering analysis and silhouette analysis
- System Thinking: holistic strategic implementation including inventory and database management

Key Objectives

- To explore the use of different types data to improve MRO operations
- To investigate the feasibility of clustering analysis for failure signal detection
- To determine strategies to implement CBM

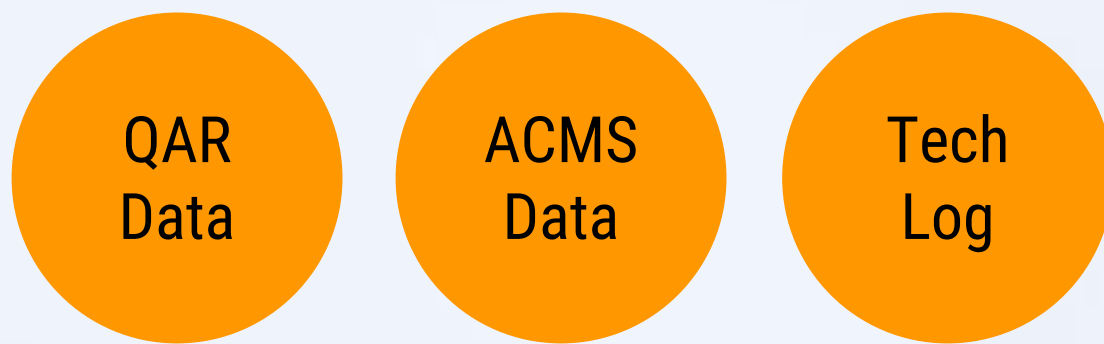
Project Outline

- Failure Signal Detection
- Strategic Implementation
- Conclusions

Failure Signal Detection

Data Exploration

- Look into 3 different types of data:

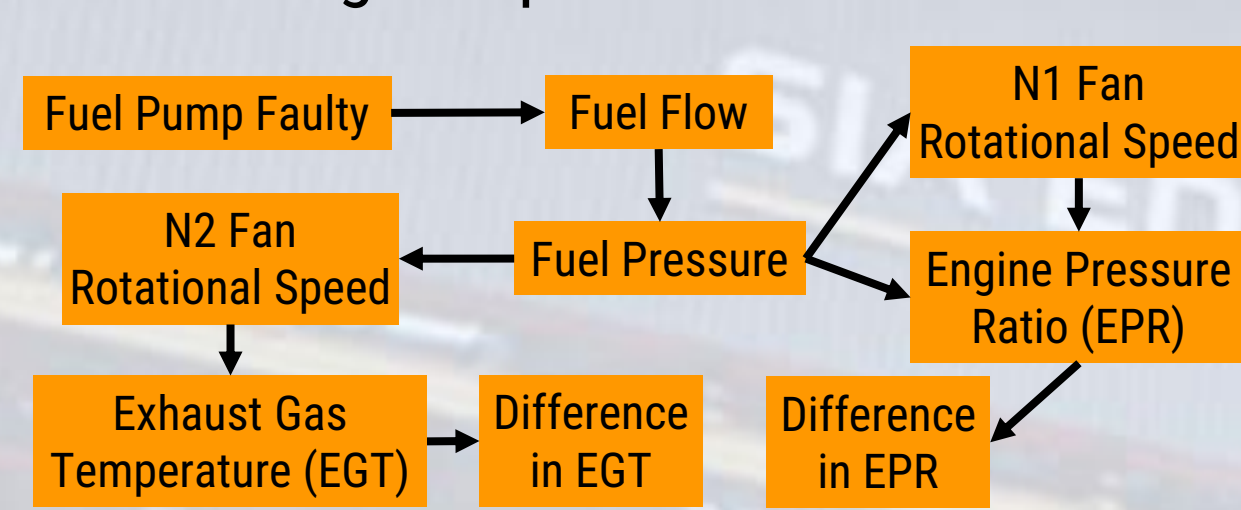


Quick Access Recorder (QAR) Data

- Approximately 900 parameters
- Recorded at 1Hz
- Monitors condition of each part of the aircraft.

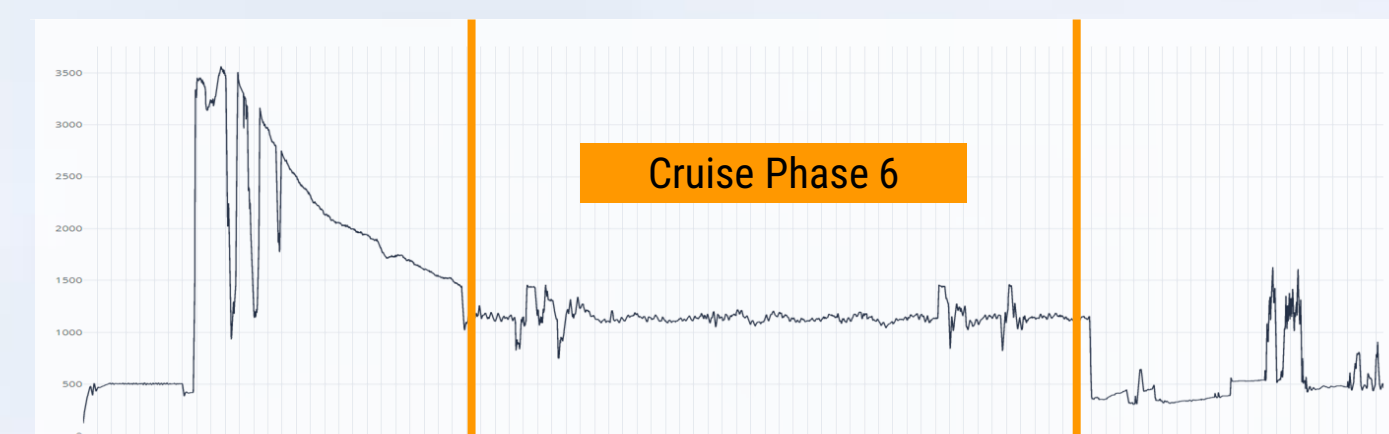
Data Cleaning

- Feature selection with domain knowledge to reduce number of parameters from 900 to 10 using a knowledge map.

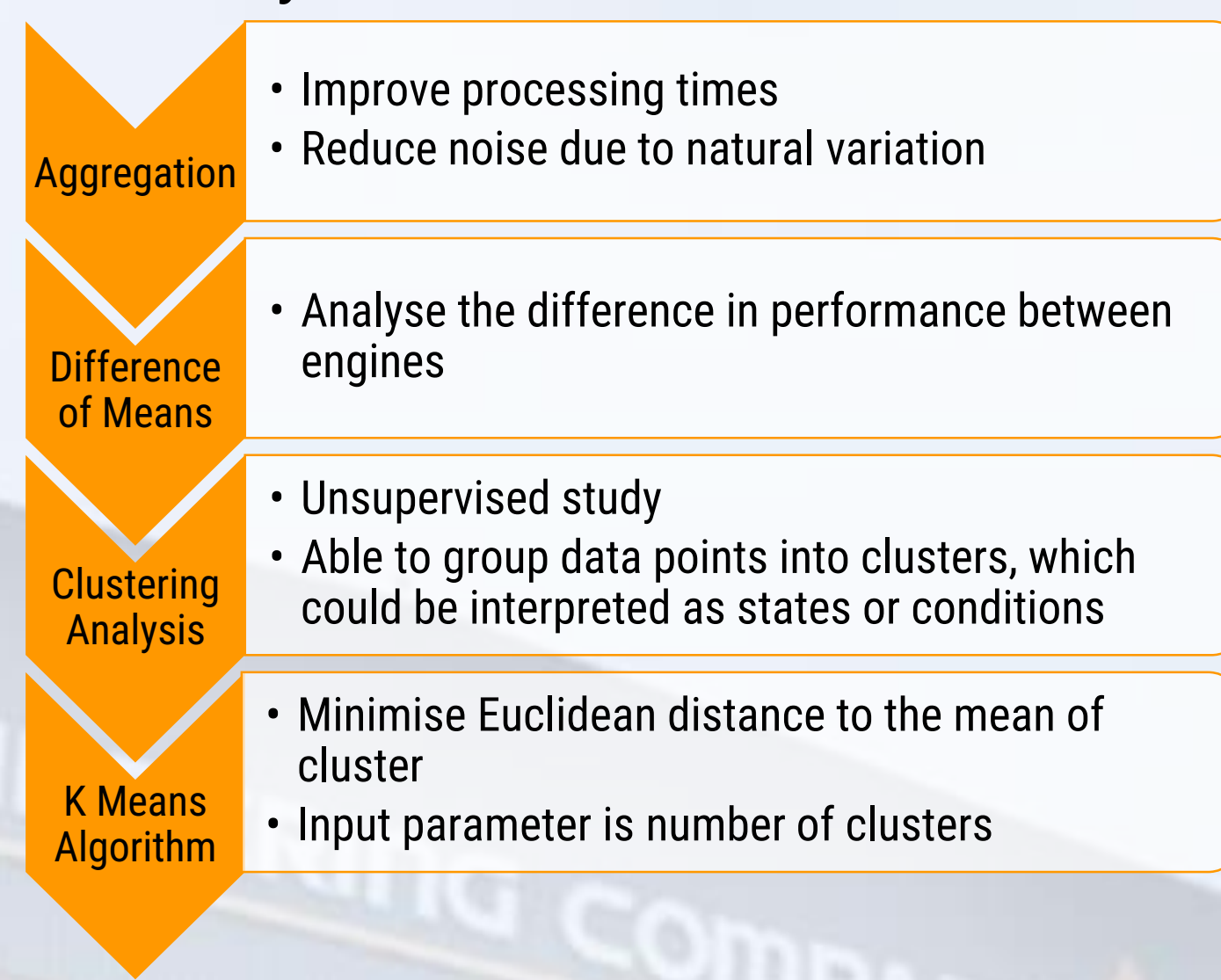


Data Cleaning

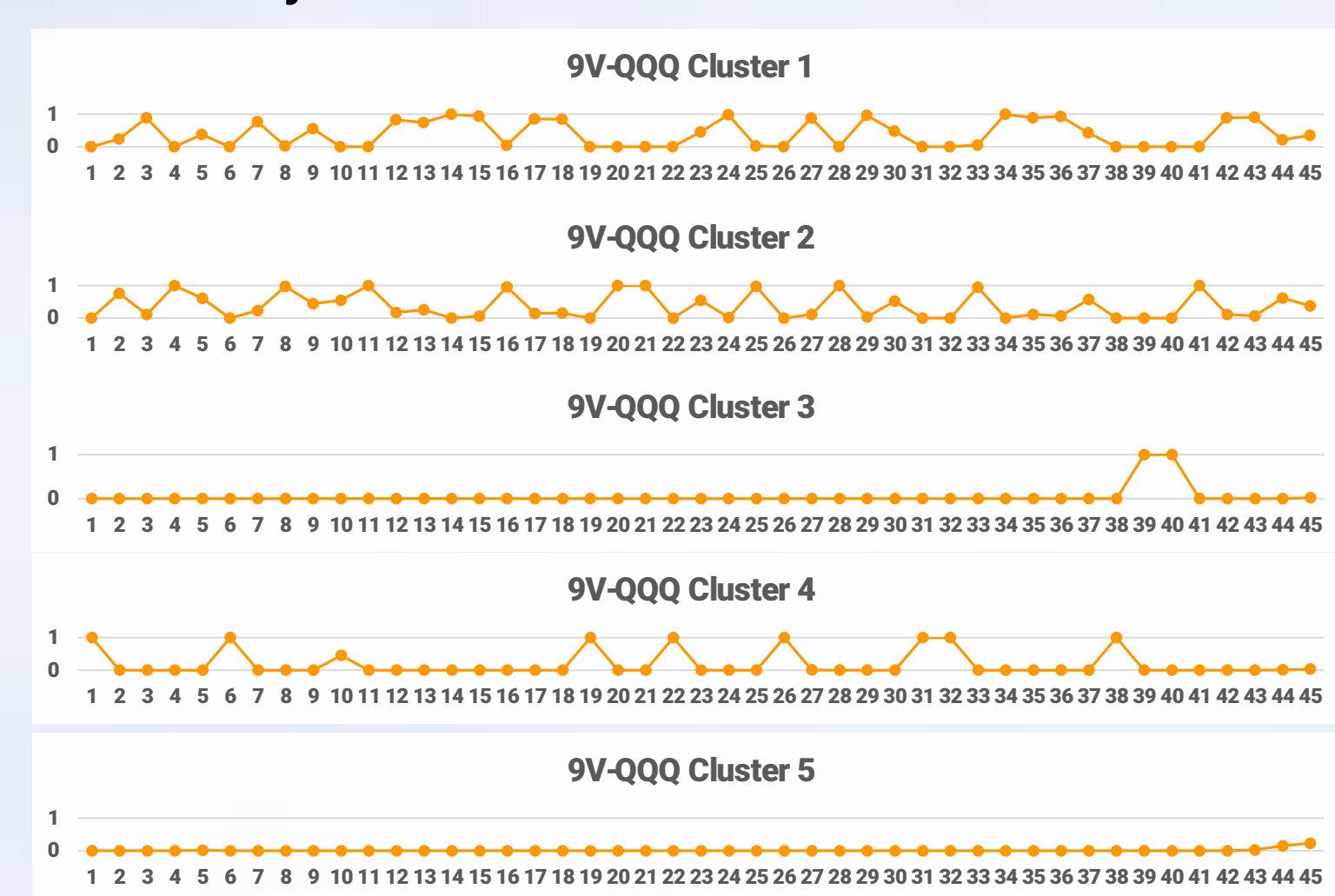
- Flights are divided into phases.
- Cruise phase 6 is chosen for the study.



Data Analysis



Data Analysis Results



- Each point represents a single flight
- X-axis: Each flight in time series
- Y-axis: Proportion of each cluster per flight.
- Clusters 1 and 2 exhibit high variance and they are interpreted as background noise.
- Failure signal is exhibited by cluster 4 (pre-maintenance) with some false positive signals.
- Post maintenance signals are in cluster 3 and 5.

Strategic Implementation

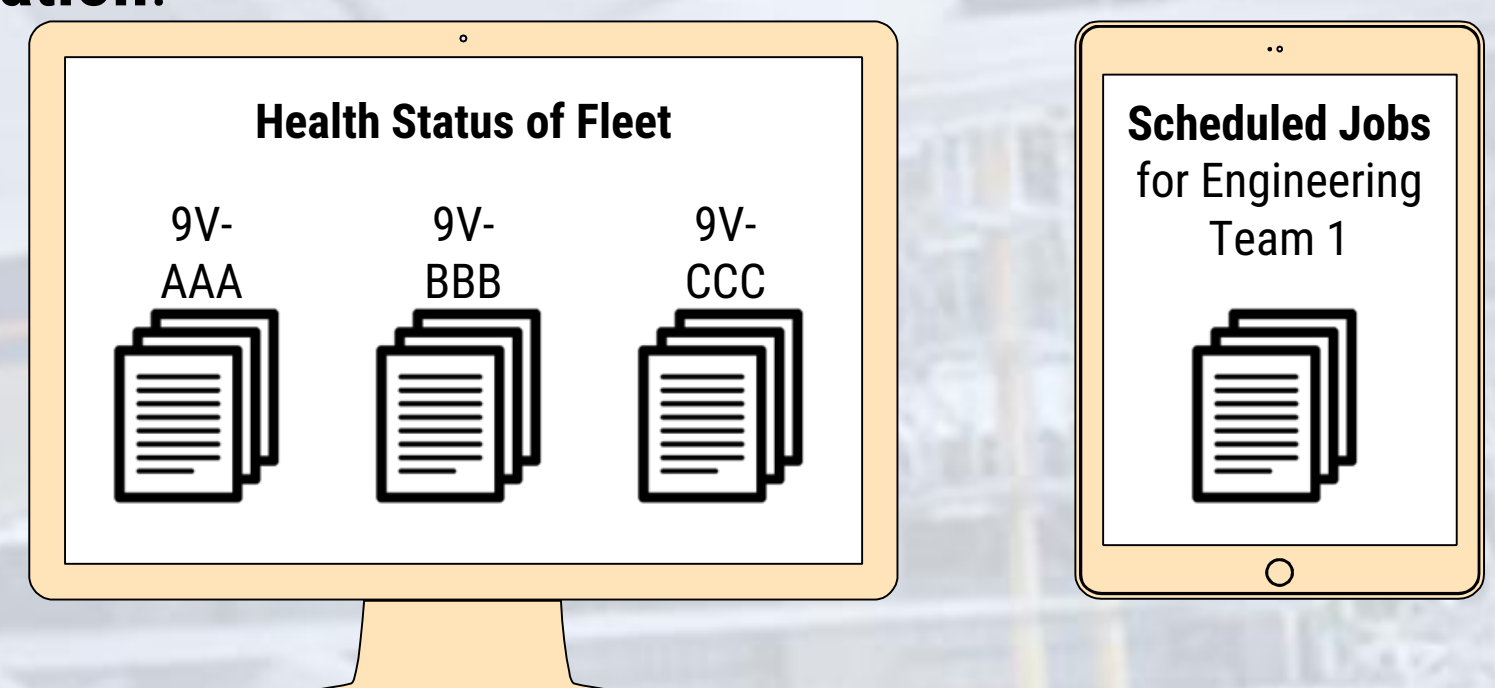
Multi-Echelon Inventory Optimisation (MEIO)

- Changes to the inventory model could enhance the benefits of CBM.
- A shift to **alternative inventory models** could yield lower inventory levels while meeting demand.



Health Status Database for Fleet Management

- Continuous monitoring of the status of each aircraft.
- Includes inflight data, technical logs and archives of the aircraft.
- This database can enhance **maintenance scheduling** and **manpower optimisation**.



Conclusion & Future Direction

- Condition Based Maintenance should be adopted as a strategy for SIAEC as they embark on data driven maintenance to improve their dispatch reliability KPI.
- Implementation strategies to be in place to get the full benefit CBM, including optimising inventory by multi-echelon inventory optimisation and a health status database.
- Further studies could look into
 - Using this failure signal detection methodology on other subsystems and components, and
 - Study the characteristics of each clusters as a Markovian state and explore feasibility of Markov State Model as a failure prediction model.