SLF Thema dag

6 December 2018

Royal Dutch Airlines

KLM

Agenda

- Welcome to Component Services
- Aircraft Maintenance Program
- Big Data & component Maintenance
- The Case

Welcome

Component Services

Team CS

Schiphol Oost, 2018

Royal Dutch Airlines

KLM

AIRFRANCE KLM

Welcome at Component Services

- In what world do we operate?
- Who are we?
- What do we do?
- What products do we offer?

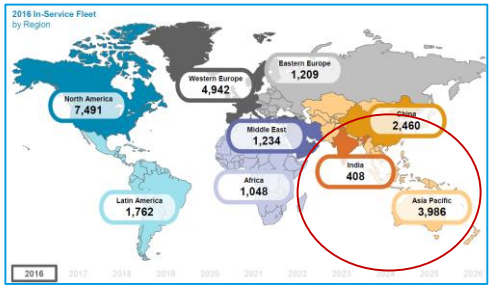
- In what world do we operate?

Royal Dutch Airlines

Trends urging to speed-up E&M strategy

Airline / MRO dynamics:

- Development fleet
- Growth MRO market

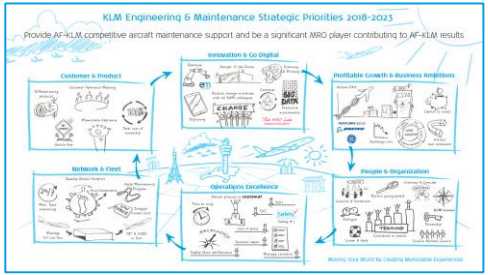


MRO market:

- Main MRO players & Dynamics
- Highlights of competition

AFKL Engineering & Maintenance:

- Ambitions & Products
- KLM E&M strategic priorities 2018-2023



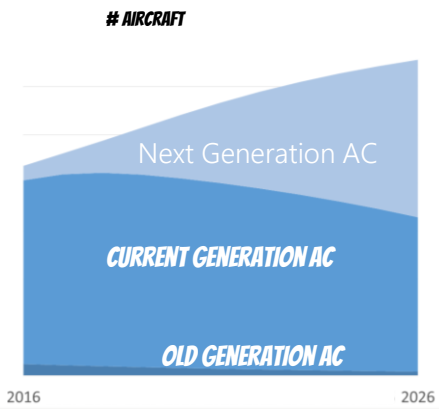
2016

Worldwide Fleet Dynamics *Fleet continue to grow and shifts towards Asia*

MASSIVE GROWTH >90%

2026

Production demands will put huge constrain on OEM-OAM supply chains



2026 50% of AC flying will be Next Generation

KLM Royal Dutch Airlines

- Who are we?

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AIR FRANCE KLM ENGINEERING & MAINTENANCE 2017

MULTI-PRODUCT MRO

AFKL E&M GLOBAL NO.2
IN ITS MARKET

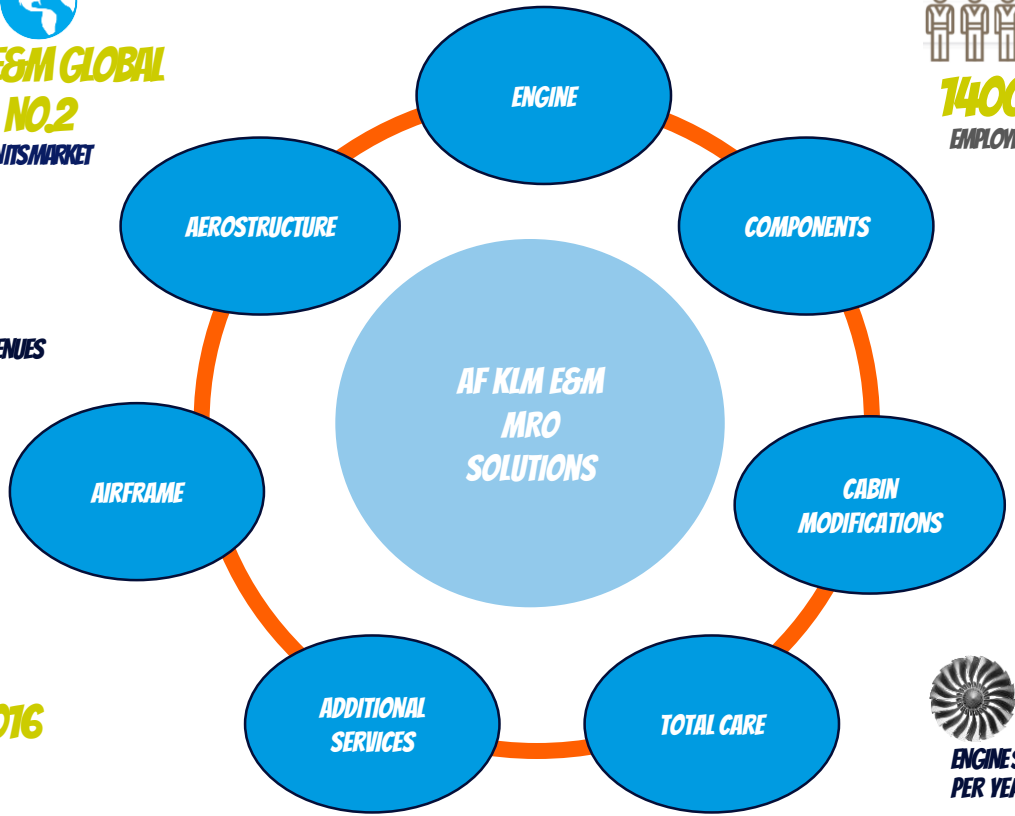
€ 4,2B
TOTAL REVENUES

>44%
CUSTOMER TURNOVER

14000
EMPLOYEES

1500+
AIRCRAFT IN COMPONENT SUPPORT

>450
ENGINE SHOPVISITS PER YEAR



MRO of the year 2014
MRO of the year 2015
MRO of the year 2016

2014, 2015 & 2016
MRO OF THE YEAR
AIRLINE ECONOMICS
BEST COMPONENT MRO
AIRCRAFT TECHNOLOGY E&M

KLM Royal Dutch Airlines

Our Network


Spairliners
EPCOR
CRMa
AIRFOILS
ADVANCED SOLUTIONS
KLM UK Engineering
iGO
SOLUTIONS
Aerotechnic
INDUSTRIES
BARFIELD
aaf spares
BonusTech Inc.
Engine Teardown
AIRFRANCE
INDUSTRIES
KLM
Engineering & Maintenance
Beijing
Line Maintenance International
AIRFRANCE
INDUSTRIES
KLM
Engineering & Maintenance
COMPONENTS CHINA
中国附件中心
ames
Max MRO Services Pvt. Ltd.
SINGAPORE
COMPONENT SOLUTIONS
The MRO Lab
Singapore
Repair Facilities
Services Centres
Sales Offices
AFKL Major Stations

Welcome at Component Services

	#Tails Supported		#Component requests / year
	Actual 2018	Ambition 2023	
787		→	
737 with Boeing CSP		→	

Pool

Closed Loop

Time & Material

3 Logistics Centers: AMS, MIA, KUL

2 Repair centers in AMS

#Packages / year in LC

"In 2020 we are a **wordleader** in Component Availability for the Boeing 787, 737 and we excel in Closed Loop and Time & Material MRO for selected technologies by being the **best performing, most innovative** and **customer-centric** provider"

Teaming

CS2.0

Digitizing

A worldwide footprint of 787 Customers

“

787 APU

*

A worldwide footprint of 737 Customers

* = Components and APU

- What do we do?

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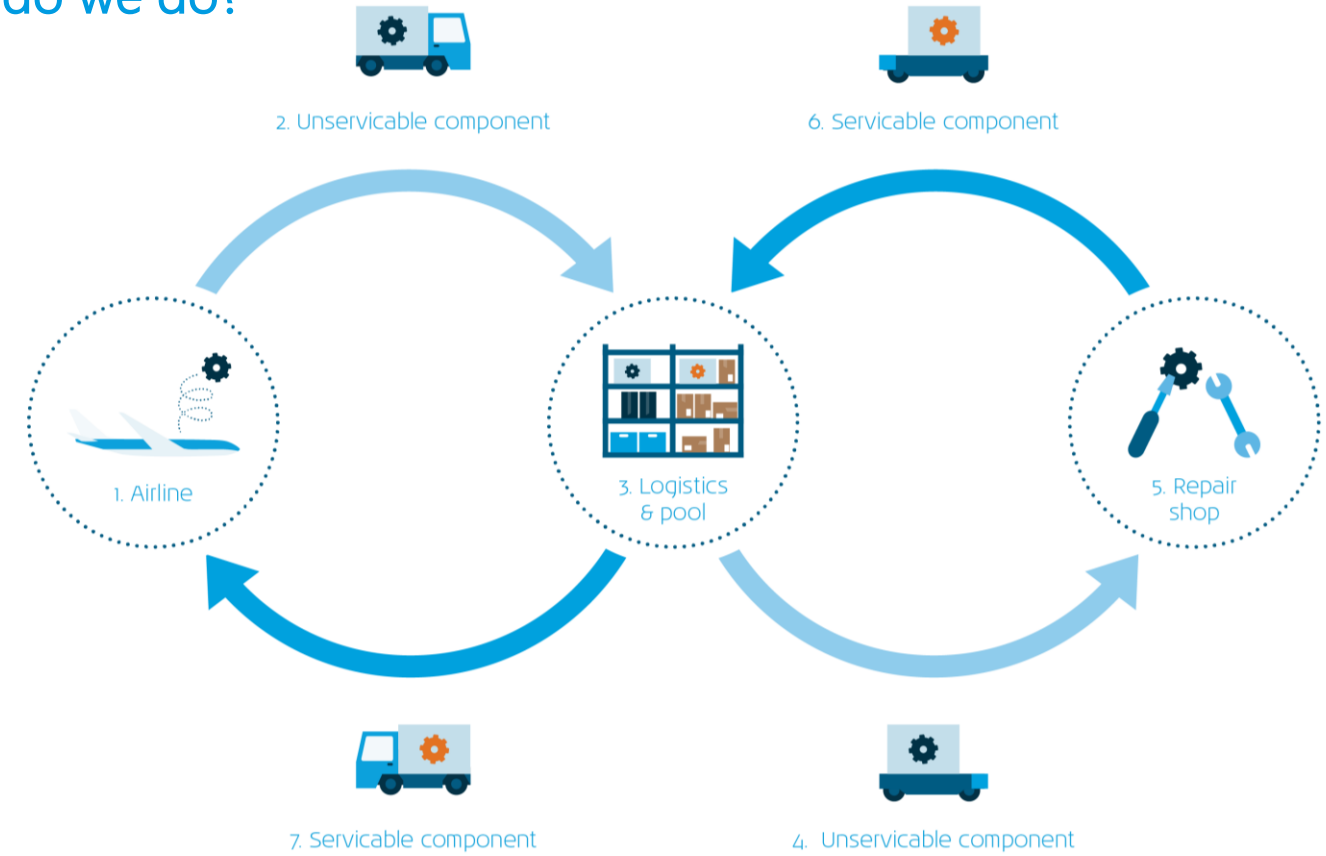
What do we do?


2. Unservicable component
6. Servicable component
1. Airline
3. Logistics & pool
5. Repair shop
7. Servicable component
4. Unservicable component

- What products do we offer?

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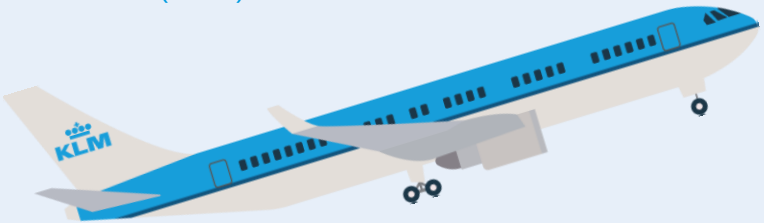
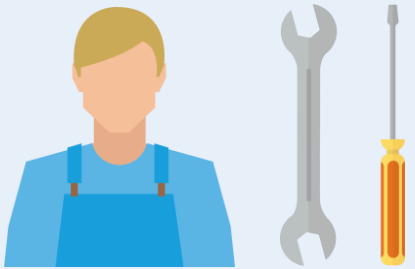
What products do we offer?

Pool (different part nr)	Close Loop (same part nr)	
Pool	Close Loop	T&M Sales
Power by the Hour (PBH) 		
External vendors possible		Only in-house

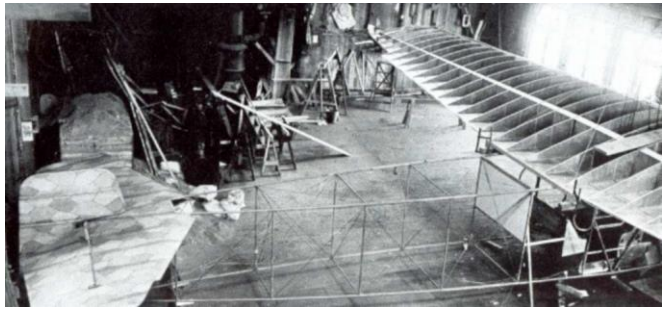
Aircraft Maintenance Program (AMP)

MSG-3 and beyond

Introduction

- Objective of maintenance:
  Safe and economical operation of A/C

Hard Time



On Condition Item
A primary maintenance process requiring repetitive inspection or test to determine the condition of units, systems or portions of structure to assure continued serviceability. Corrective action is taken when required by item condition as determined by analysis of inspection and/or test results.

Condition Monitoring (CM). .
This process is for systems, components, or appliances that have neither HT nor OC maintenance as their primary maintenance process. It is accomplished by appropriate means available to an operator for finding and solving problem areas.
The user must control the reliability of systems or equipment based on knowledge gained by the analysis of failures or other indications of deteriorations


First
BOEING 737

Aircraft Maintenance Program

- Aircraft Manufacturer provides MRB-/MPD-document (Maintenance Review Board/Maintenance Plannign Data)
- MSG guidelines used to analyze aircraft for maintenance.
- MSG-1/2 was used for 737PG and 747-100 thru 300
- MSG-3 is being used for the 737 NG, 737PG, 767, 777 and 747-400

MSG-1/-2 vs MSG-3

- MSG-1/2: "Bottom-up" result:
  - component-centered maintenance
  - "Shift in Maintenance Concept"

  >> what caused *component* to fail?

- MSG-3: "Top-down" result:
  - **aircraft/system-centered mainteneance**

  >> what caused the system *function* to fail?

  >> what are the consequences?
  - **(Safety/Operational/Economic)**
  - **Result: fewer specific Component Maintenance Tasks**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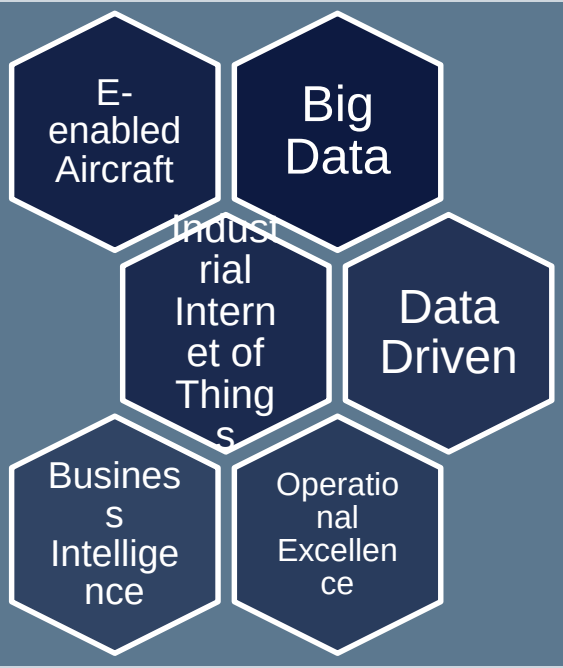
NEXT STEP

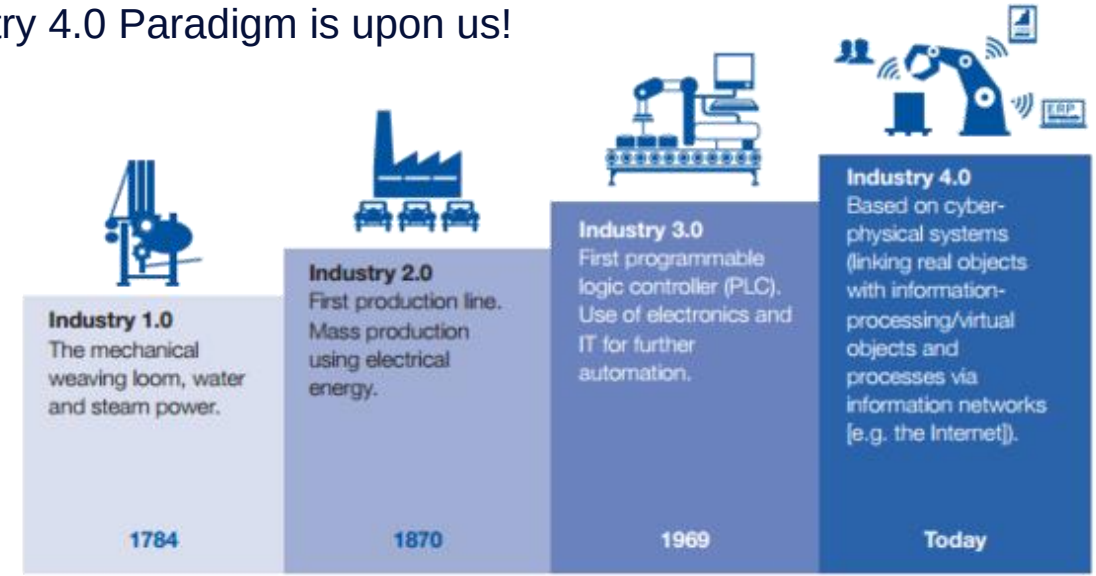
- BIG DATA



Big Data at KLM Engineering & Maintenance

The Revolution

- Industry 4.0 Paradigm is upon us!



- This might not sound new to you… but it is to “us”
  - Big Data, Internet of Things, Augmented Reality, 3D printing…
  - What to do with all that Data...?

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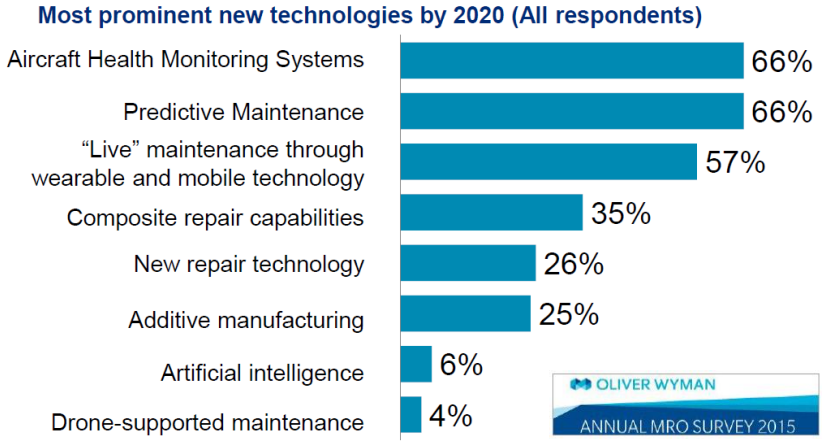
Predictive Maintenance

- #1 Development in Aircraft Maintenance
  - Predict and Anticipate Maintenance Events
  - Reducing airline operational disturbances
  - Optimizing maintenance operations
- Many challenges to overcome
  - Data collection and ownership discussion (Airline, MRO, OEM,…)
  - Model and algorithm development
  - Development of Decision support tools that integrate



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Good Old 747

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Predictive Maintenance Data science
Checking the “ECG” of technical systems

flight

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Big Data Tooling time

The MRO Lab
Adaptive Innovations

Issue detected: Broken membrane inside cooler valve

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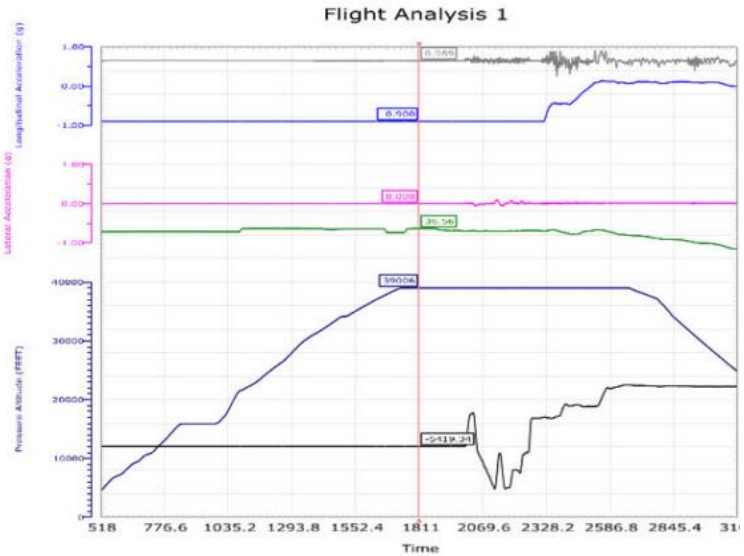
The explosion of aircraft data

Aircraft generate more and more data:

- 164986 parameters on a 787
- “A 787 flight can generate 500GB of data”



ACMS “Aircraft Condition Monitoring System” Data:

- Feed the aircraft control systems and cockpit
- Safety & Maintenance events are reported to OCC/MCC (ACARS)
- Full flight parameters are recorded and downloaded after each flight
- Depending the recorder; up to 2500 parameters for KLM 787
  - 100.000.000 data points per flight

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Prognos

Prognos® for AIRCRAFT

Prognos: Big Data tool

- Developed by AF KL IT departments
- Making use of Big Data Technology

Dashboard Maintenance Control Center:

AF KL Prognos:

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The Case based on 787

6 December 2018

Royal Dutch Airlines

Agenda

- Set Up
- Operational Information / Challenges
- The Case

Set Up

- KLM supports over 787 aircraft World Wide customers
- Customers have a small amount of components to support normal operation
- KLM Pool stock at 3 locations
  - SPL
  - Miami
  - Kuala Lumpur
- Repair is performed in house (Air France Industries and KLM) and at suppliers
- At various locations local representatives are available
  - Depends on airline requirements, phase of operation, etc

Set Up

- Majority of customers have small fleets
  - Information sharing is critical
  - Support of vendors and Boeing is available but subject to commercial interests
  - Help is appreciated in the team of customers
  - Special website and meetings in place

- For 787 more correlation between aircraft and components as compared to other aircraft
  - Often software related

- Technology leap from 777 to 787 is significant
  - Revolution if compared to competitors philosophy

- 787 assembly is Boeing. Design and build is vendors & Boeing.
  - First Boeing aircraft according this set up

Operational Information

- Main Battery / APU Battery

Operational Information

Operational Information

Operational Information

Challenge

- How to digest all the technical information by logistic people ?

Operational Information

Customer different maintenance

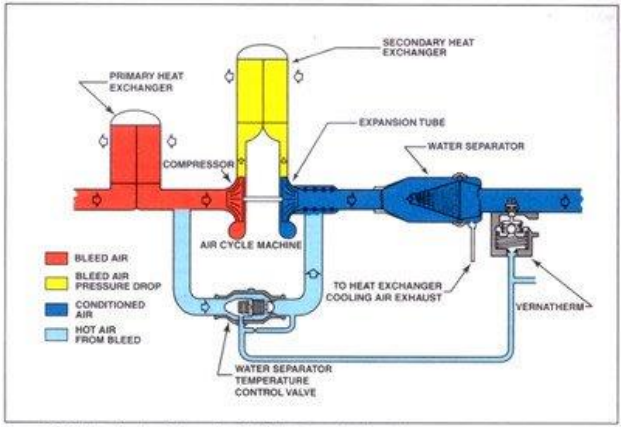
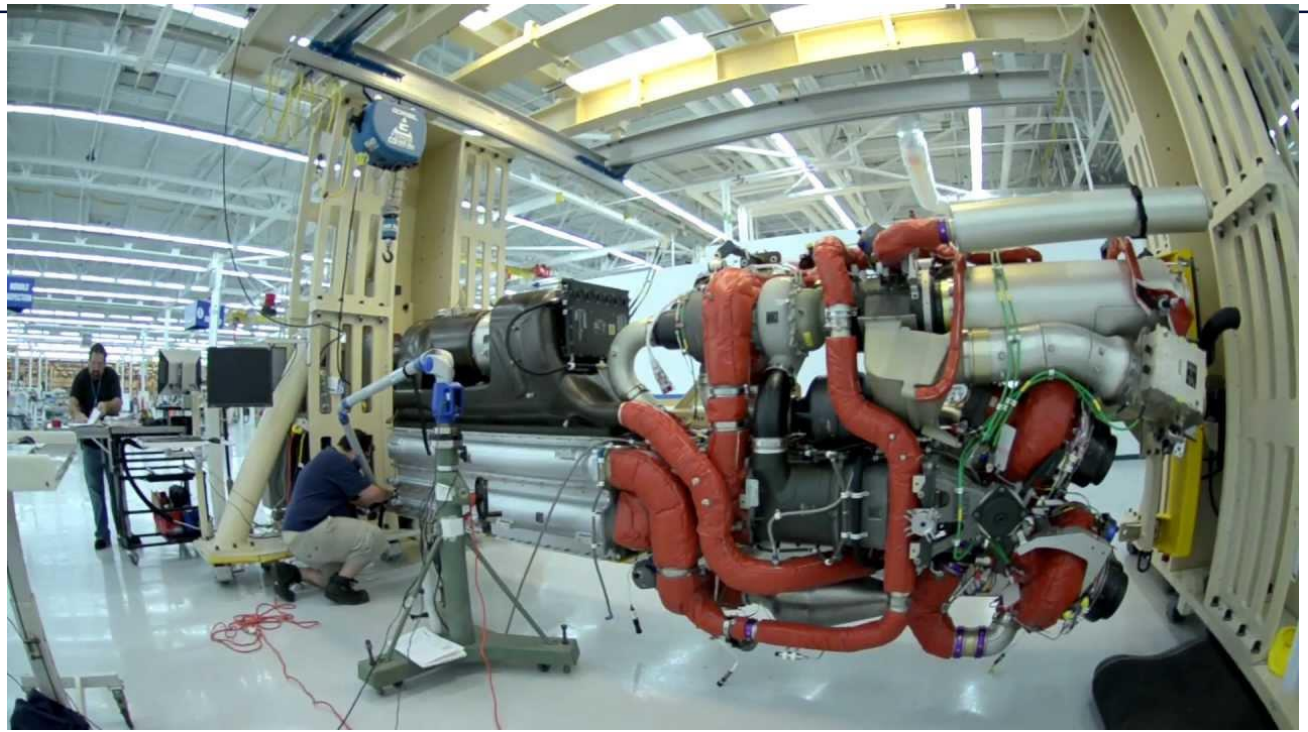


Figure 14-35. The air-cycle air conditioner utilizes bleed air to heat and cool the cabin.

Operational Information



Operational Information

Operational Information

Challenge

- AHM data could reduce customer cost and predict failures however CS cost could rise

The case

- In which way a logistical supply chain can provide added value to the customer while reducing the pool cost and the cost of the operator.

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