
oases
CUSTOMER EVENT
PRAGUE 2022
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Cranfield University, UK

Digital Aviation Research & Technology Centre (DARTeC)

Addressing Digital Systems Integration

THALES

inmarsat

BOEING

Cranfield IVHM Centre

BOEING

Heathrow

الإتحاد ETIHAD AIRWAYS

CATAPULT Connected Places

CATAPULT Satellite Applications

Cranfield University

SAAB TECHNOLOGIES

SAAB

AVEILLANT A Thales company

BOXARR

Ospirent Promise. Assured.

BLUEBEAR

IATA

Research England

Cranfield's global research airport

A national asset for the UK

Multi-User Environment for Autonomous Vehicle Innovation (MUEAVI)

This instrumented transport corridor runs through the middle of the campus and is used for the development of intelligent and autonomous vehicles. Sensors include lidar (laser scanners that can measure distance), radar that can detect pedestrians and cyclists at up to 200 metres, and thermal imaging cameras.

Opened 2017

Gas turbine and propulsion laboratories

Living laboratory

Sensors around the airport monitor air quality, soil moisture, temperature and noise levels, including sound from wildlife. Other sensors monitor water quality and levels, and runway and ground movements.

Digital air traffic control centre

Housing the UK's first operational remote air traffic control tower, the centre provides air traffic services for the airport.

Operational December 2018

Boeing 737

Donated by British Airways, the aircraft is used for research and teaching and will be an important part of DARTeC.

Aviation Innovation and Technology Entrepreneurship cluster (AVIATE+)

Operational Q1 2021

Cranfield Eagle Lab

A partnership between Barclays and Cranfield University. **Opened 2019**

Holographic radar

State-of-the-art Aveillant drone detection radar for research as part of DARTeC

Research ready 2021

HyPER Hydrogen Production

Operational Q2 2020

Digital Aviation Research and Technology Centre (DARTeC)

A unique centre addressing the global challenges of digital systems integration across aviation.

Operational Q4 2020

'Smart' car park connected to MUEAVI

Aerospace Integration Research Centre (AIRC)

Major research facility with Airbus and Rolls-Royce dedicated to future aerospace integration challenges.

Opened 2017

National Beyond visual line of sight Experimentation Corridor (NBEC)

Designed to enable drones and unmanned aircraft to fly in the same airspace as manned aircraft, NBEC will open in phases as surveillance systems are approved. The first NBEC test flights were undertaken in February 2019 in collaboration with the CAA innovation team and Blue Bear Systems.

Operational late 2020

Data from MUEAVI is relayed into the **Intelligent Mobility Engineering Centre (IMEC)** control room. Within IMEC there are vehicle workshops, vehicle electrification and autonomous vehicle research capabilities.

SAAB 340B Flying Test Bed

Operational Q1 2021

National Flying Laboratory Centre (NFLC)

The NFLC's 'flying laboratory' provides a viable alternative to flight test and research work using simulators, wind tunnels, or more expensive turbine aircraft, often testing new parts and equipment for industry partners. The NFLC also has other light aircraft used for research.

Air Park

Future

FAAM Airborne Laboratory

Dedicated to the advancement of atmospheric science, the specially-modified BAe-146 research aircraft is owned and run by the Natural Environment Research Council (NERC). This is used by many UK and overseas universities and by the Met Office.

Cranfield Aerospace Solutions Ltd

Wholly-owned subsidiary company specialising in aircraft prototyping, modifications and approvals.

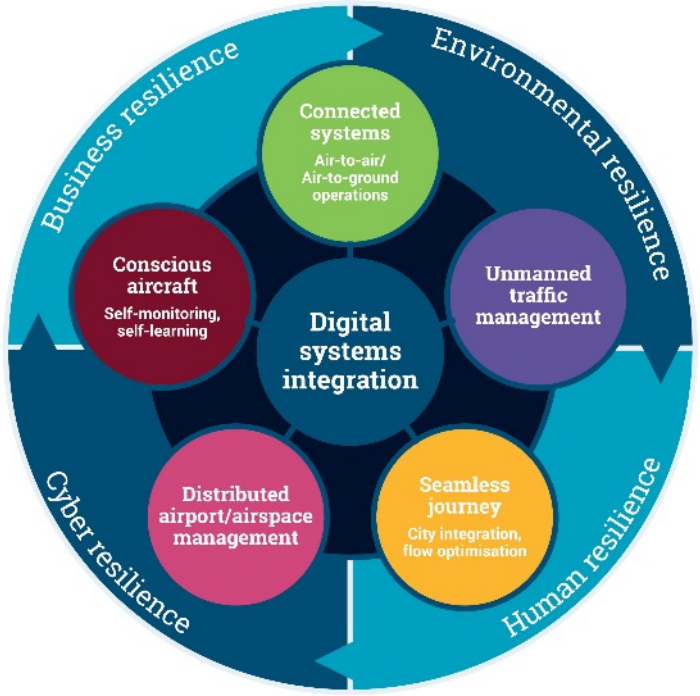
Solar power farm

Clean, renewable energy for the airport flows from a solar power farm located on the other side of the airfield.

Digital Aviation Research Technology Centre (DARTeC)

Digital Aviation Research Focus

Enabling Digital Systems Integration



Systems Resilience is at the core

Seamless Journey Experience

- Door to Door Journey Experience
- Airport Experience (Wayfinding, Retail, Less Able Passengers)
- City-Urban-Airport Relationship

Connected Systems

- Air to ground data upload/download capacity challenges
- Connectivity resilience (Dual systems, Cyber)
- Data utilisation

Conscious Aircraft

- Next Generation MRO (Zero maintenance platforms)
- Hangar of the Future (Integrated Vehicle Health Management)

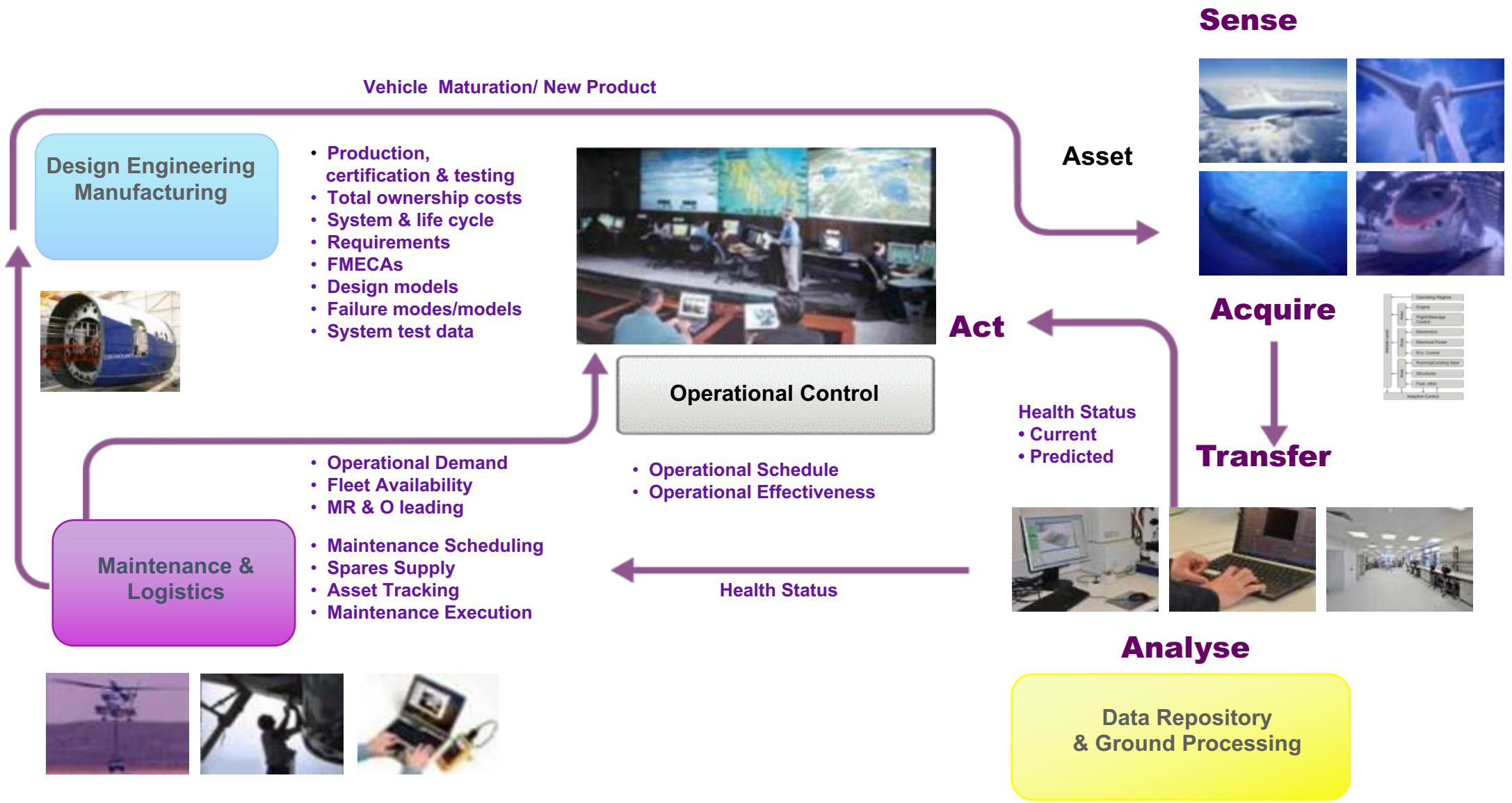
Unmanned Traffic Management

- Low altitude Drone operation in unsegregated airspace
- Drone management in segregated & restricted airspace

Distributed Airport/Airspace Management

- Distributed rural airport management
- Multi airport ATC operational challenges

Integrated Vehicle Health Management



The Aircraft That Looks After Itself

I carry the optimised fuel based on flight path, load and engine condition

My next heavy check is 24 months away

I need to compensate for the nearly worn right hand fuel pump

My flight path is GPS optimised

Actuator on left elevator uses 15% more power than right…

The last pilot landed a bit heavy

Engine 1 can go for another 324 flight hours

Engine 2 can go for another 1357 flight hours

My sensors say I am correctly loaded

E-enabled Aircraft

A350 XWB

B787

Big Data Analysis

Health Monitoring

Maintenance support control

ENB

Flight deck Integration

In-Flight data transmission

Post flight data transmission

A320 Neo

B737 MAX

Civil Aviation - Stakeholders

Regulators

- FAA
- CAA
- EASA
- CAAC

Airlines

- British Airways
- American Airlines
- EasyJet
- Etihad

MROs

- SR Technics
- Lufthansa Technik
- Delta TechOps
- STS Aviation

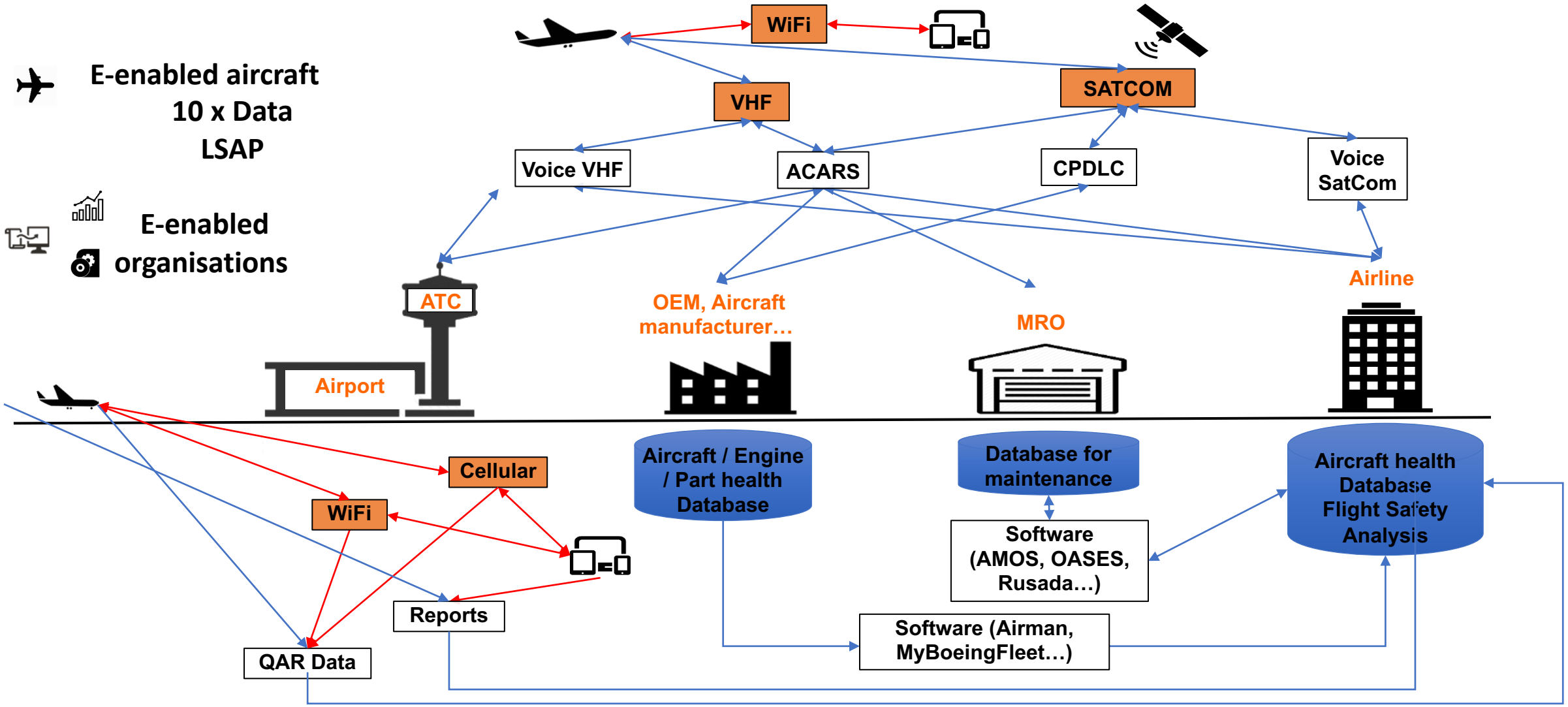
OEMs

- Boeing
- Airbus
- Embraer
- Rolls-Royce
- GE

Airports

- Heathrow
- Luton
- Cranfield

Data and Communication



Construction Vehicle Tracking

https://youtu.be/3Ij4tVkXQV8

IVHM and asset support trade-off

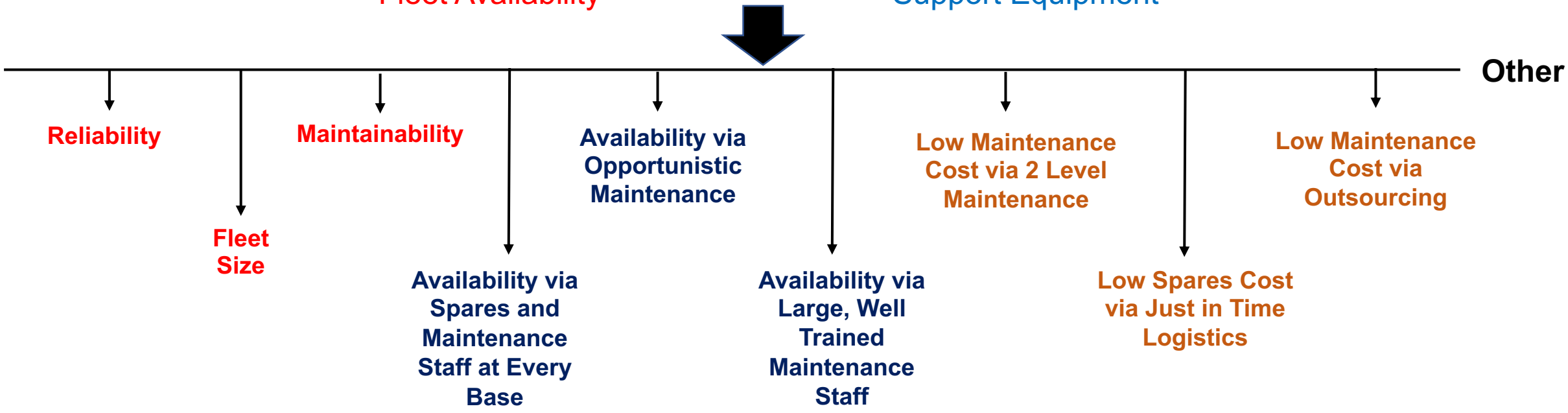
Operations and Support Strategy

Fleet Support Requirements

- Gate Departure
- Mission Reliability
- Fleet Availability

Support Costs

- Spares
- Maintenance Staff
- Support Equipment



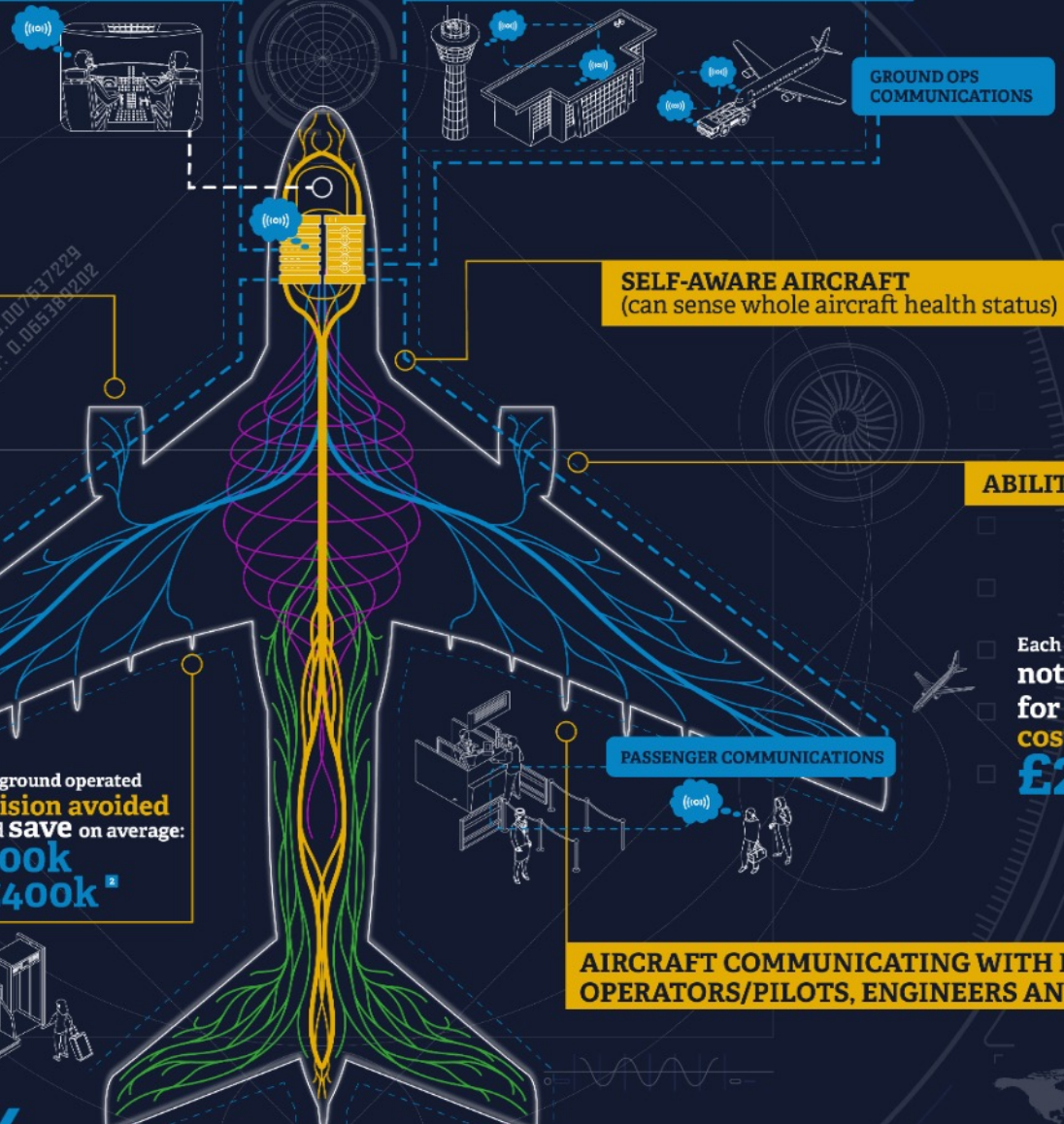
CONSCIOUS AIRCRAFT ©

Cranfield University

PILOT COMMUNICATIONS

AIRLINE AND AIR TRAFFIC CONTROL COMMUNICATIONS

GROUND OPS COMMUNICATIONS



OPERATIONAL COST SAVINGS

Looking for savings in a maintenance, repair, and operations (MRO) market worth over **£14 billion** [1]

SELF-AWARE AIRCRAFT
(can sense whole aircraft health status)

Save over **£1,000** per flight hour [5]
(based on zero maintenance for widebody aircraft)

ABILITY TO SELF-REPAIR

Each day an aircraft not available for operation costs over **£200,000** [4]

AIRCRAFT MAINTENANCE COMMUNICATIONS

Each ground operated collision avoided could save on average: **£300k** to **£400k** [2]

SAFETY AND SECURITY

PASSENGER COMMUNICATIONS

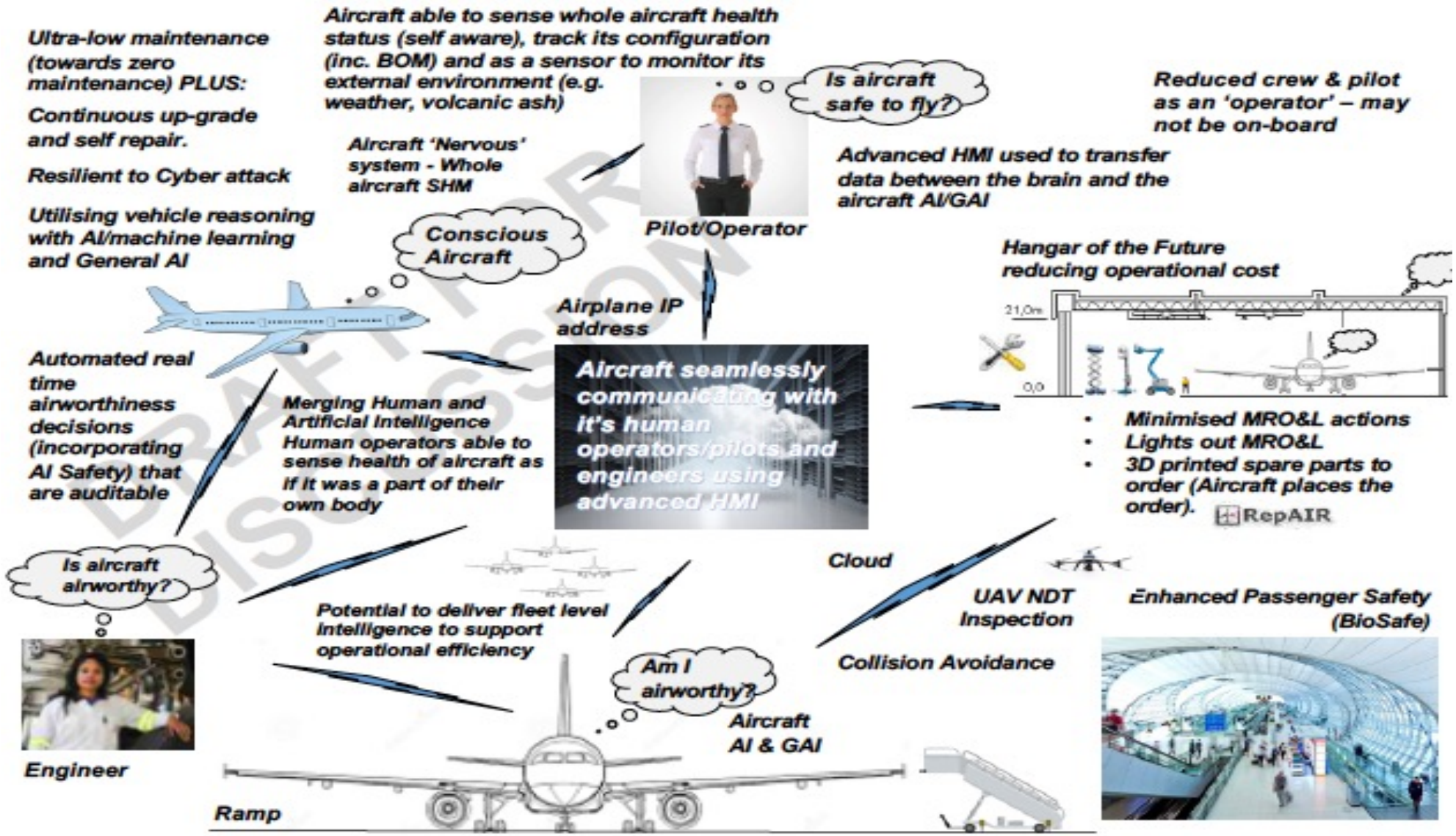
AIRCRAFT COMMUNICATING WITH HUMAN OPERATORS/PILOTS, ENGINEERS AND PASSENGERS

Up to **30%** reduction in maintenance costs [3]

Cranfield IVHM Centre

BOEING

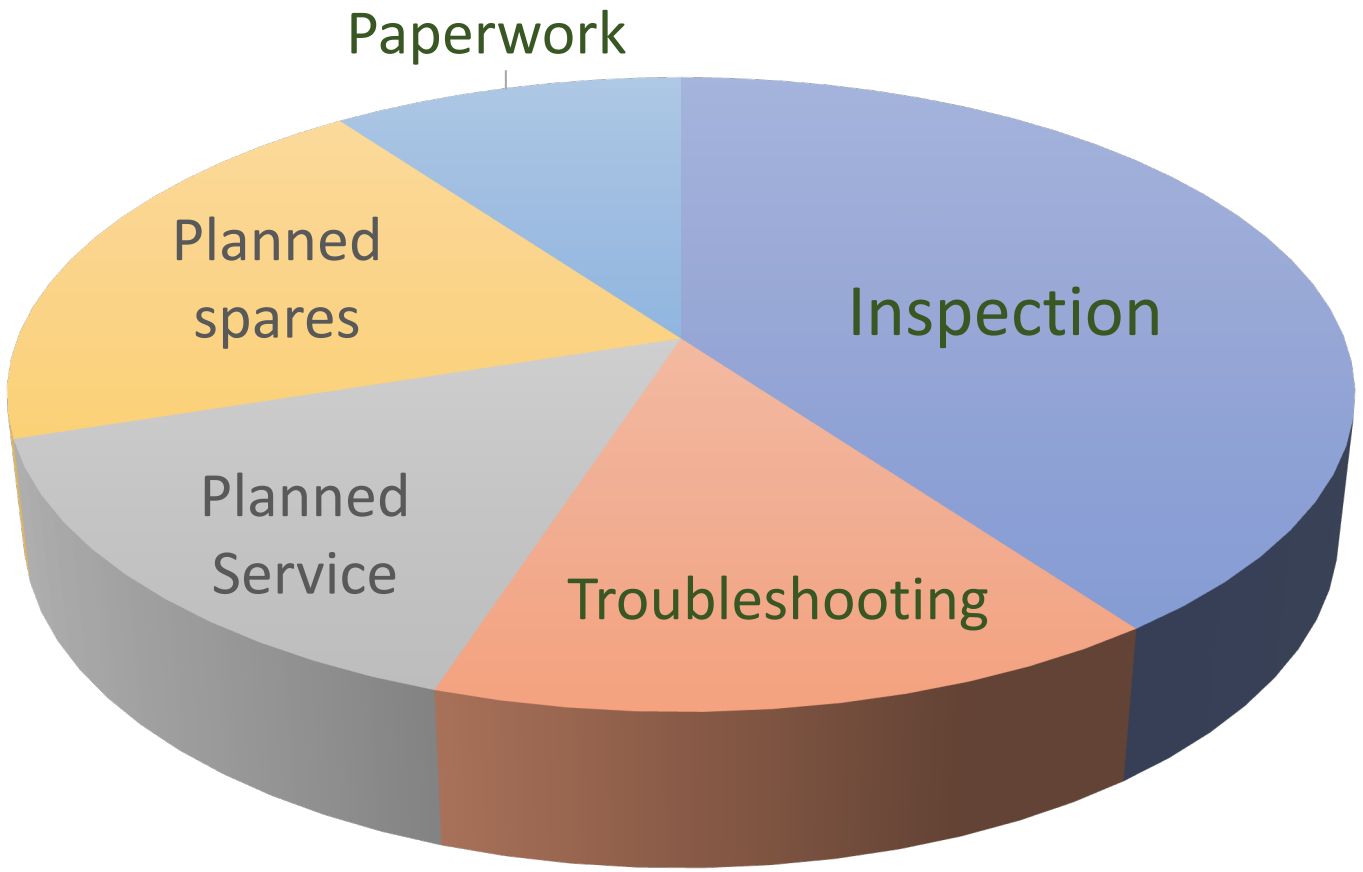
Future of MRO



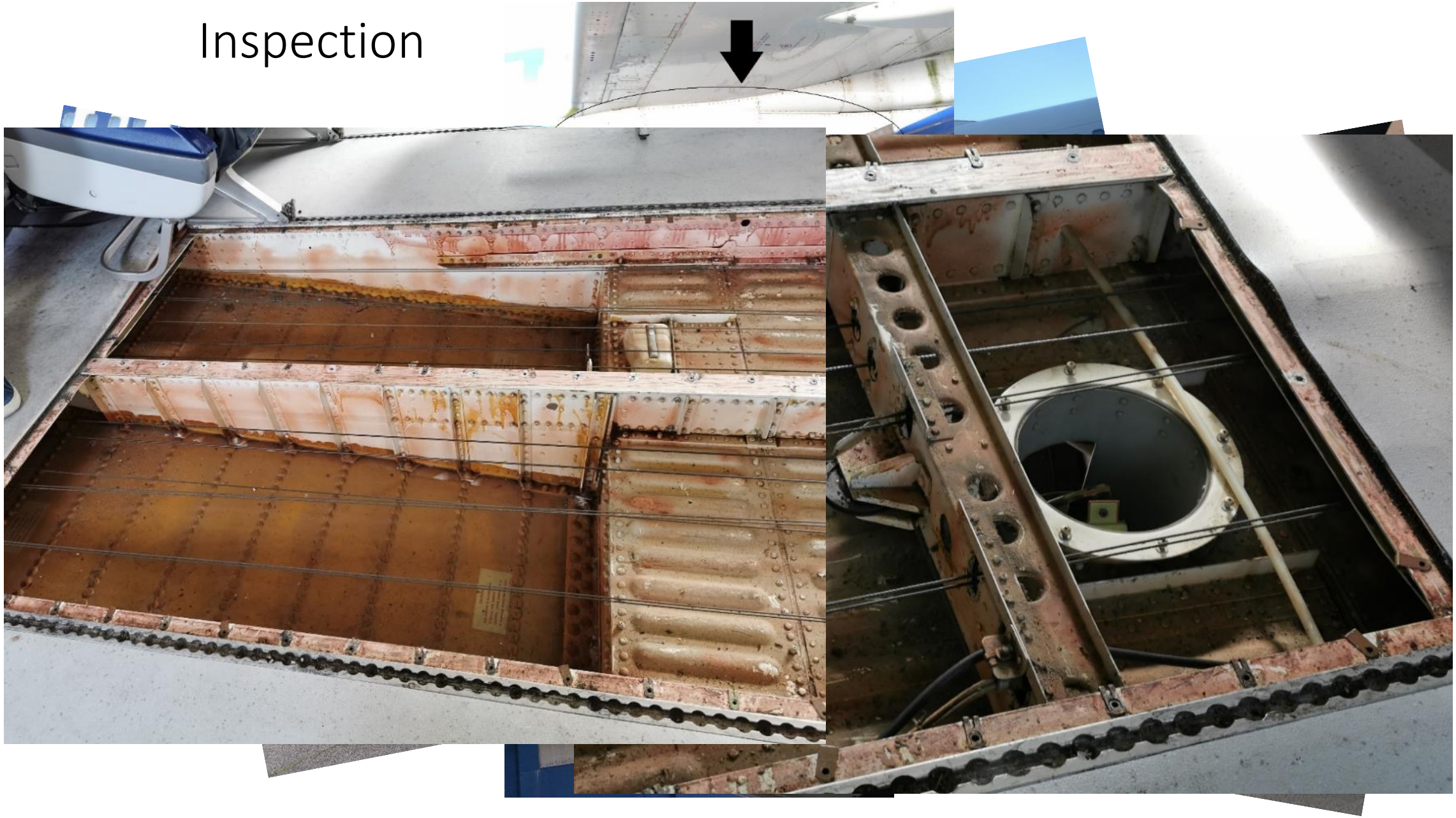
'Airworthy Operations'

Up to 30% reduction in maintenance costs

Unscientific MRO Tasks Breakdown



Inspection



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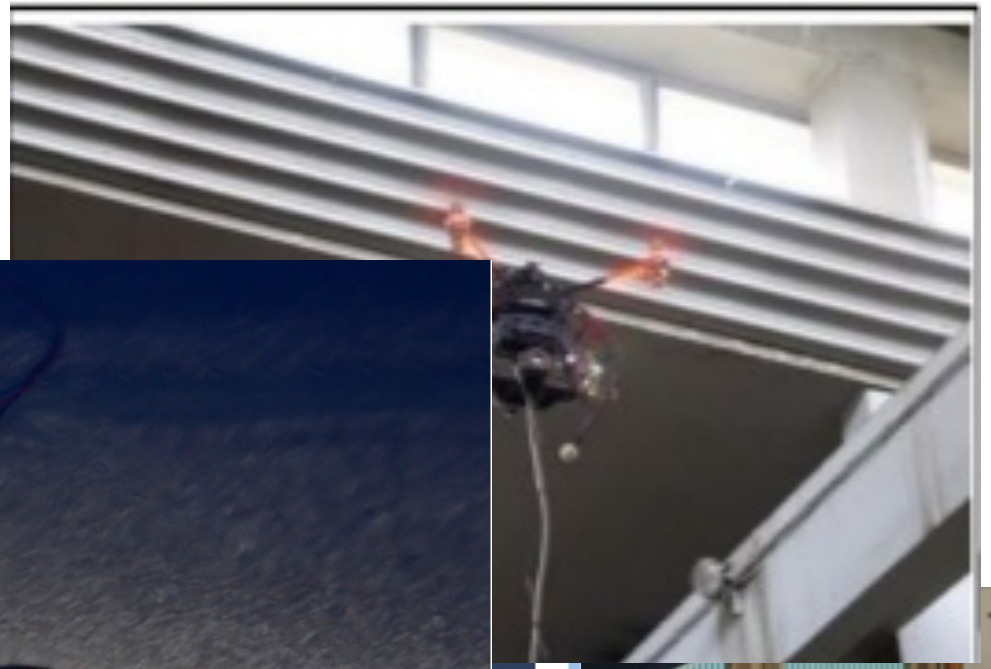
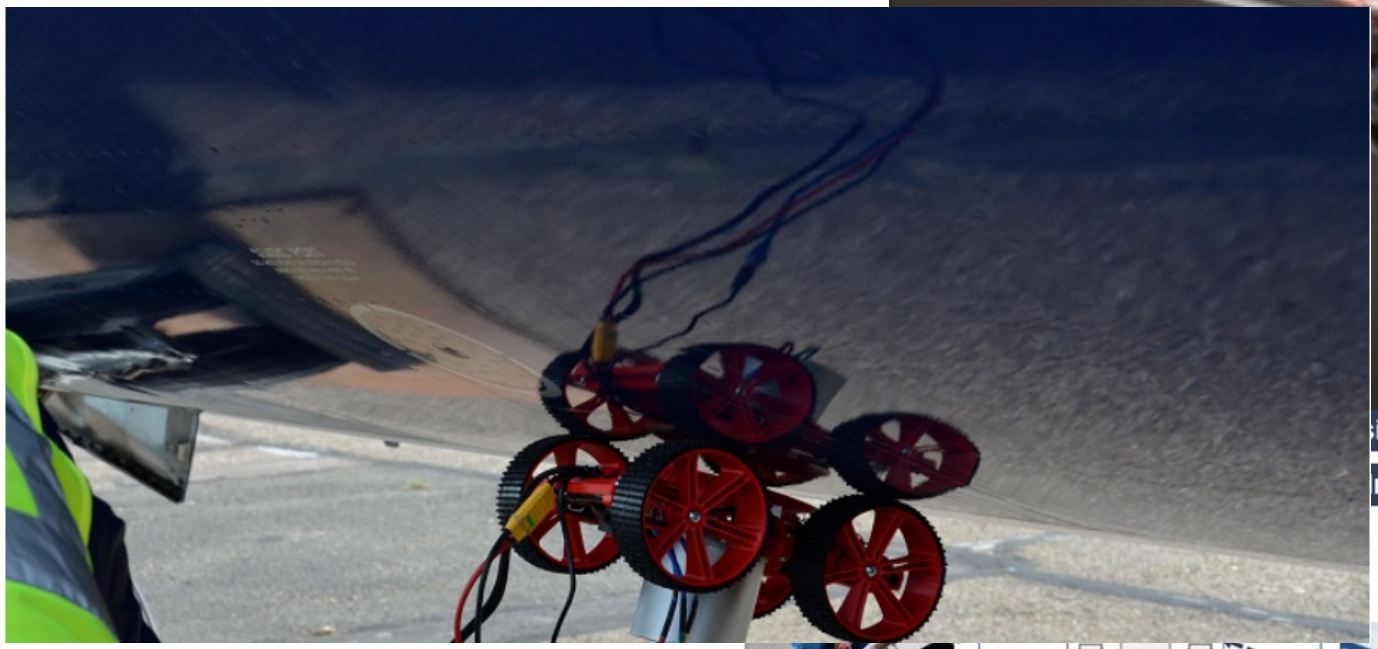
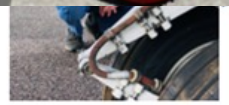
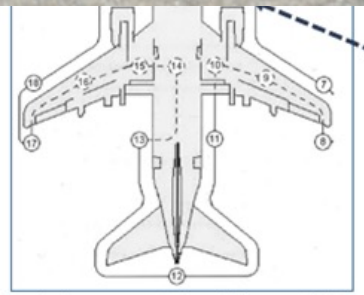


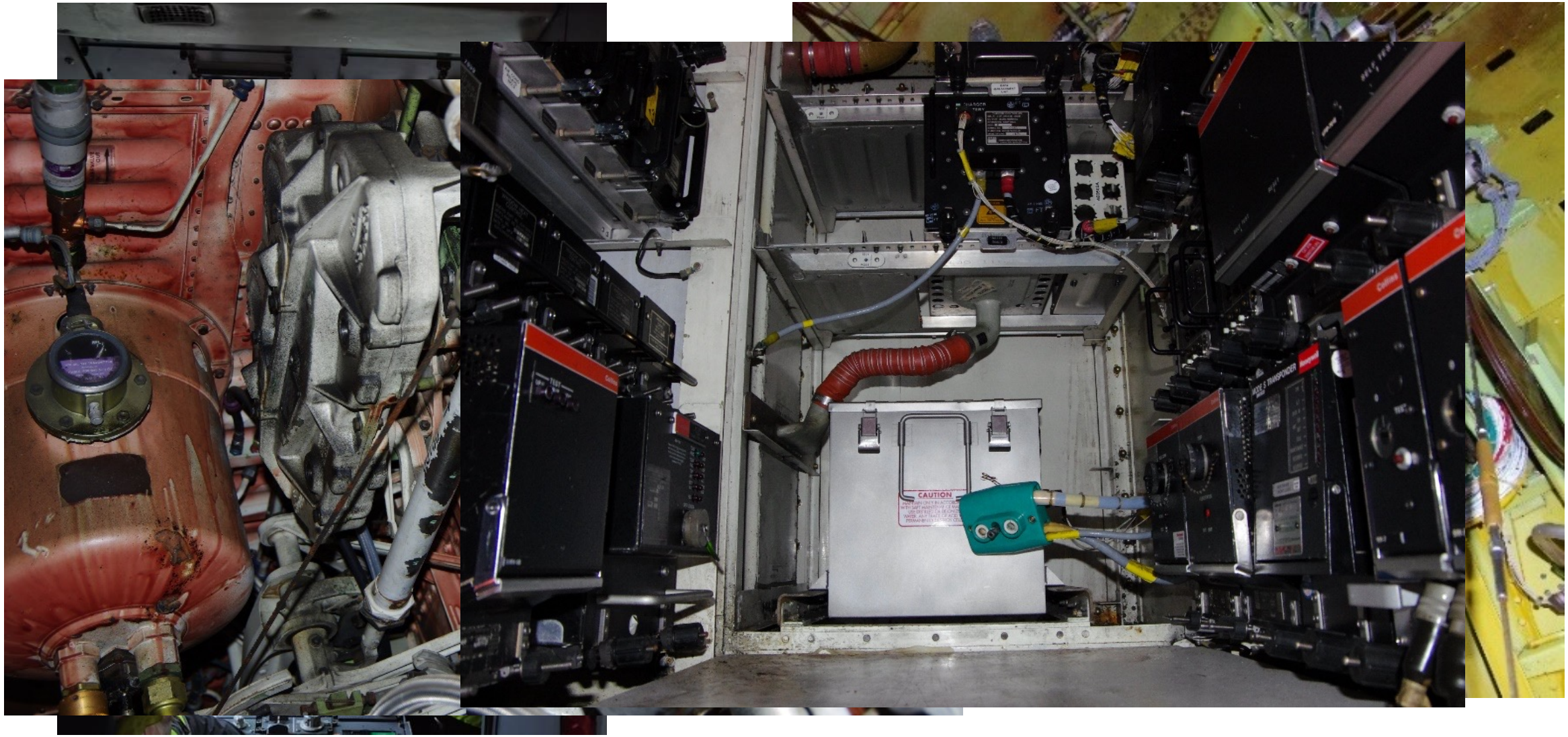






Scenario is representative of the pre-flight check before aircraft despatch

Troubleshooting



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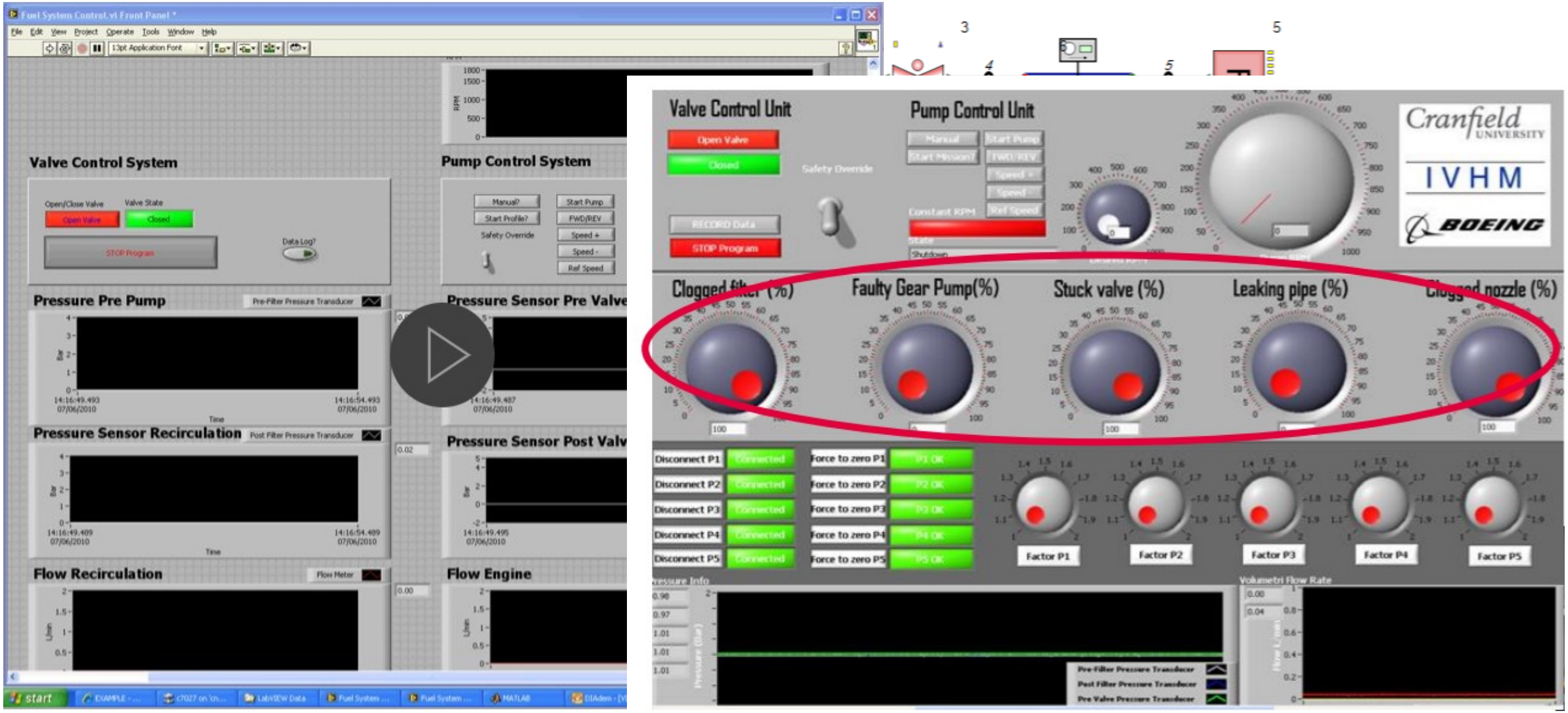


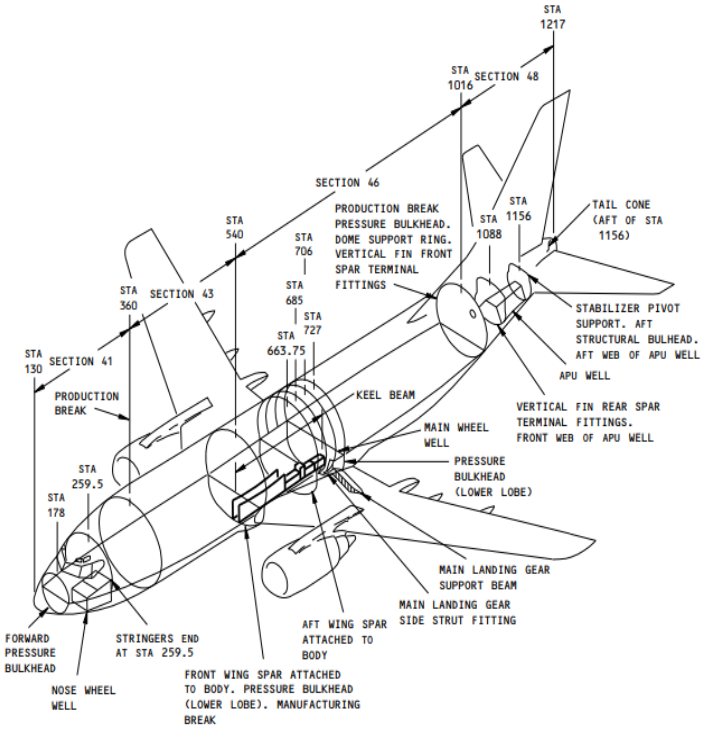
Planned Maintenance Tasks

Planned Maintenance Tasks

Digital

BOEING

737-300/400/500
AIRCRAFT MAINTENANCE MANUAL



BOEING

737-300/400/500
AIRCRAFT MAINTENANCE MANUAL

53-05-03-210-819

nal - General Visual Inspection of the Side Strut Support Frame, Sta 685

: This is a MSG-3 scheduled maintenance task.

General

1) The purpose of this inspection is to detect corrosion, stress corrosion, minor accidental damage, and fatigue damage to the side strut support frame, Sta 685.

2) The structure inspection satisfies the CPC basic task.

References

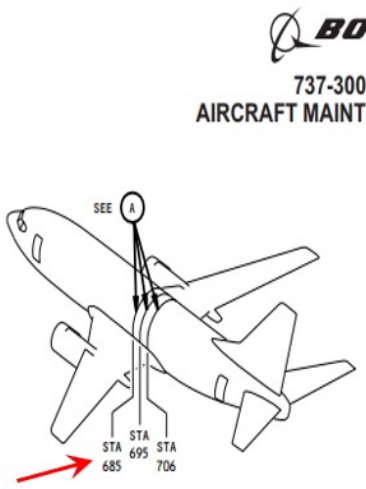
Reference	Title
51-00-53	CORROSION PREVENTION - CORROSION REMOVAL

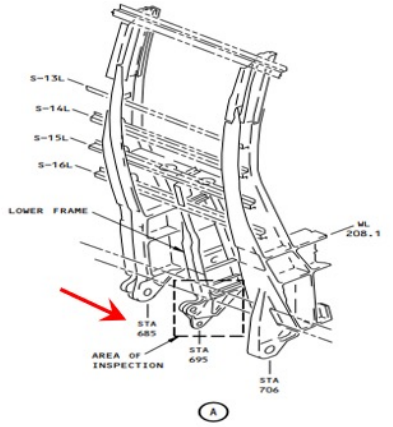
Consumable Materials

Reference	Description	Specification
C00174	Compound - Corrosion Preventive, Solvent Cutback, Cold Application	MIL-PRF-16173 (Supersedes MIL-C-16173)

BOEING

737-300/400/500
AIRCRAFT MAINTENANCE MANUAL





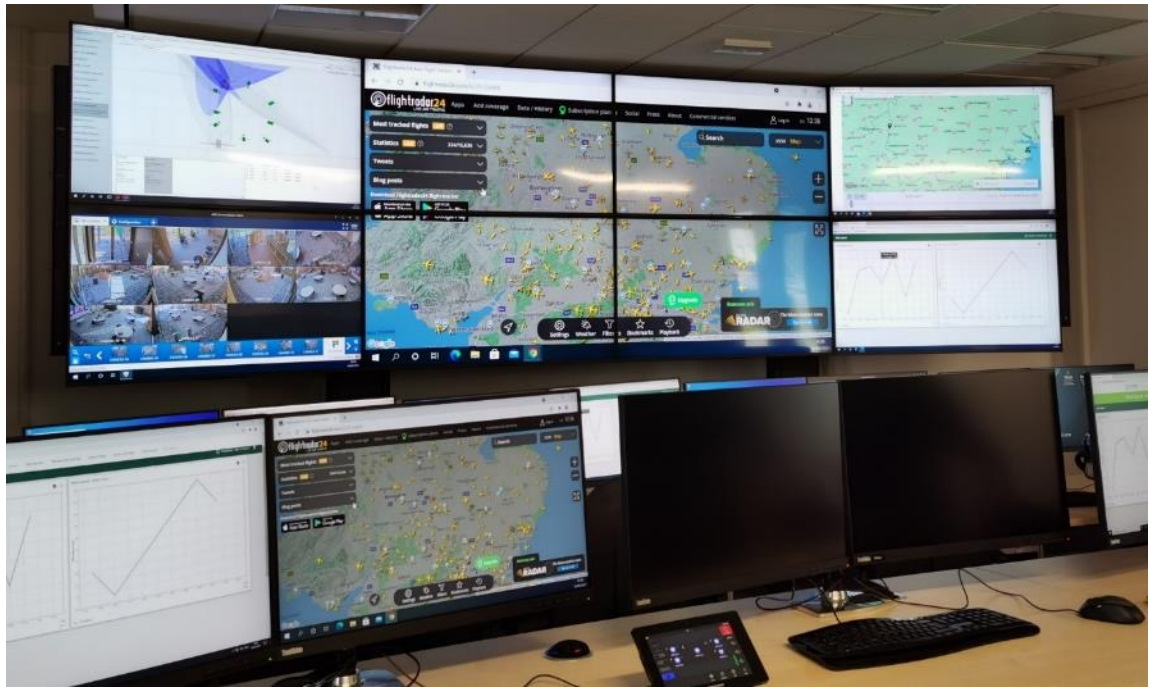
Main Landing Gear Support Structure
Figure 245/53-05-03-990-846

MRO KPI improvement targets

KPI	Current (notional)	In 3 years	In 5 years
Available Hours / Chargeable Hours	2.5	?	1.2
Material Availability	85%	?	100%
Job Card rework	1/1000	?	1/10000
On Time Delivery	90%	?	100%
Material Accuracy	95%	?	100%
Accidents/ Near Misses	3 / year	?	0

DMRO Research Complex

Super Big Brother House for Real World Air Systems Research



A unique facility to integrate digital, human and physical aspects of aviation for research and technology development

Hangar


AIRLIFT
AL100
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07961 280552


G-DOCB


Cranfield
University
G-DOCB

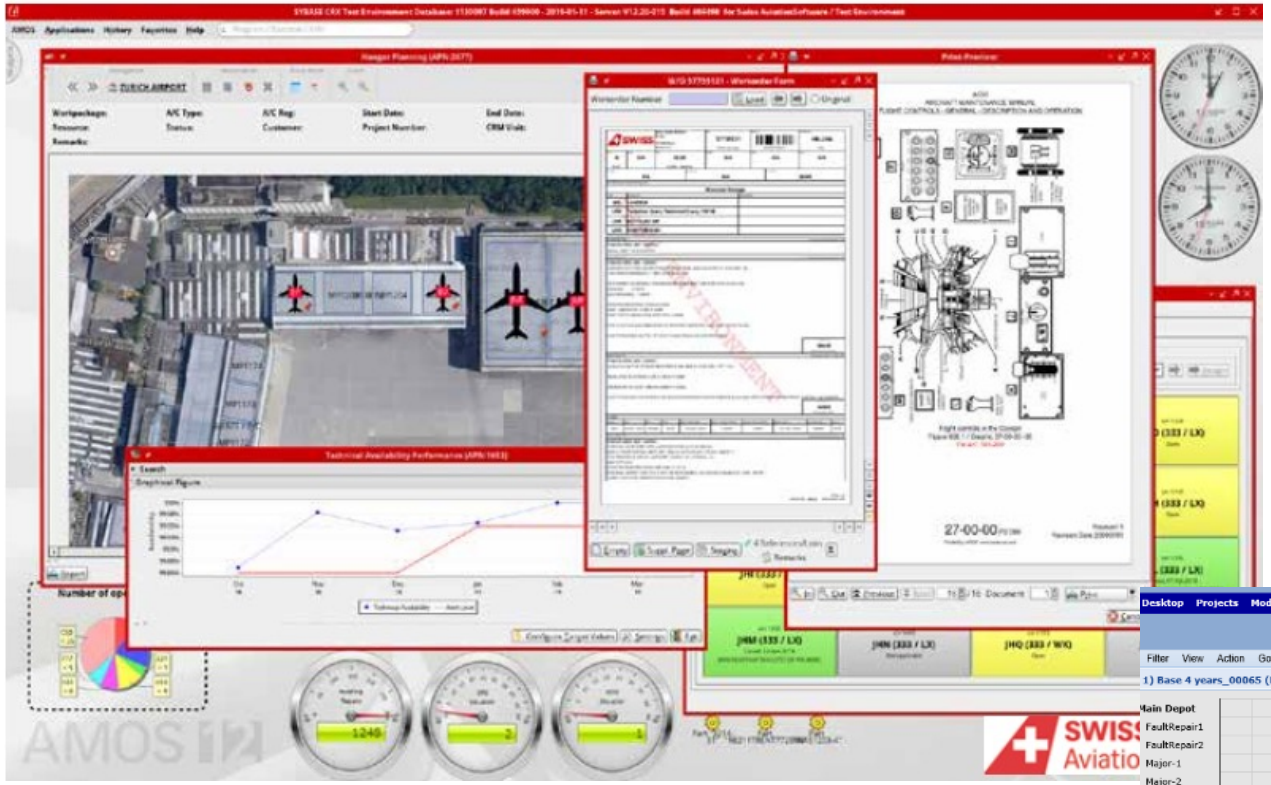
A Fleet Maintenance Operations Centre

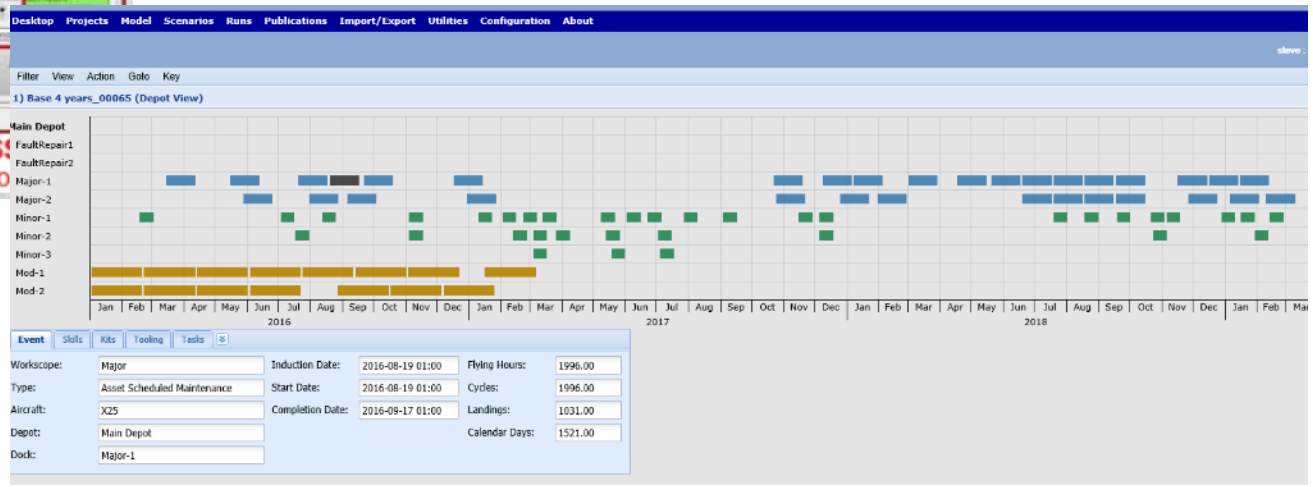
for digital, human and physical research into the sector's next generation aircraft maintenance systems

United Kingdom Time UTC 00

A/C No	A/C Reg.	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	0100
A/C 1	G-MABC		LGW-FRA		FRA-LGW		LGW-BCN			BCN-LGW			LGW-BCN			BCN-LGW					
A/C 2	G-MDUO	LGW-NCE		NCE-LGW		LGW-NCE			NCE-LGW			LGW-PMI			PMI-LGW						
A/C 3	G-MEEM		LGW-ZRH		ZRH-LGW			LGW-FCO			FCO-LGW			LGW-GVA		GVA-LGW					
A/C 4	G-MEMB	LGW-PMI			PMI-LGW			LGW-FRA		FRA-LGW			LGW-NCE			NCE-LGW					
A/C 5	G-MICH		LGW-MXP		MXP-LGW		LGW-EDI		EDI-LGW			LGW-FCO				FCO-LGW					
A/C 6	G-MIGO	LGW-BCN			BCN-LGW			LGW-BCN			BCN-LGW				LGW-NCE			NCE-LGW			
A/C 7	G-MIYO		LGW-CDG		CDG-LGW			LGW-MXP			MXP-LGW			LGW-CDG		CDG-LGW					
A/C 8	G-MIEF		LGW-GVA		GVA-LGW		LGW-CDG		CDG-LGW			LGW-CDG		CDG-LGW		LGW-EDI		EDI-LGW			
A/C 9	G-MYMY			LGW-FCO			FCO-LGW				LGW-MAD			MAD-LGW							
A/C 10	G-MINE	ZRH-LGW			LGW-MAD			MAD-LGW			LGW-GVA		GVA-LGW		LGW-ZRH						
A/C 11	G-MHIO	FRA-LGW			LGW-PMI			PMI-LGW			LGW-NCE			NCE-LGW			LGW-FRA				
A/C 12	G-MMOI		LGW-EDI		EDI-LGW				LGW-ZRH		ZRH-LGW			LGW-MXP		MXP-LGW					

Maintenance and Ops Control





Virtual Airline Operations Control

From	To	Block Times Destinations																
ICAO	code	00	15	30	45	01	15	30	45	02	15	30	45	03	15	Hours	Routes Km
GTW	FRA	1h30														1.5	655
GTW	BCN	2h30														2.5	1148
GTW	EDI	1h15														1.25	533
GTW	MAD	2h45														2.75	1244
GTW	MXP	2h00														2	938
GTW	GVA	1h30														1.5	756
GTW	NCE	2h15														2.25	1042
GTW	PMI	2h30														2.5	1348
GTW	FCO	3h15														3.25	1446
																	790
																	348

United Kingdom Time UTC 00

A/C No	A/C Reg.	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	0100
A/C 1	G-MABC		LGW-FRA		FRA-LGW		LGW-BCN			BCN-LGW			LGW-BCN			BCN-LGW					
A/C 2	G-MDUO	LGW-NCE			NCE-LGW			LGW-NCE			NCE-LGW			LGW-PMI			PMI-LGW				
A/C 3	G-MEEM		LGW-ZRH		ZRH-LGW			LGW-FCO				FCO-LGW				LGW-GVA		GVA-LGW			
A/C 4	G-MEMB	LGW-PMI				PMI-LGW			LGW-FRA		FRA-LGW			LGW-NCE			NCE-LGW				
A/C 5	G-MICH		LGW-MXP			MXP-LGW			LGW-EDI	EDI-LGW			LGW-FCO				FCO-LGW				
A/C 6	G-MIGO		LGW-BCN			BCN-LGW			LGW-BCN			BCN-LGW				LGW-NCE			NCE-LGW		
A/C 7	G-MIYO		LGW-CDG			CDG-LGW			LGW-MXP			MXP-LGW			LGW-CDG		CDG-LGW				
A/C 8	G-MIEF		LGW-GVA		GVA-LGW			LGW-CDG		CDG-LGW			LGW-CDG		CDG-LGW		LGW-EDI		EDI-LGW		
A/C 9	G-MYMY			LGW-FCO				FCO-LGW				LGW-MAD				MAD-LGW					
A/C 10	G-MINE	ZRH-LGW			LGW-MAD				MAD-LGW				LGW-GVA		GVA-LGW			LGW-ZRH			
A/C 11	G-MHIO	FRA-LGW				LGW-PMI				PMI-LGW				LGW-NCE			NCE-LGW			LGW-FRA	
A/C 12	G-MMOI		LGW-EDI		EDI-LGW						LGW-ZRH		ZRH-LGW			LGW-MXP			MXP-LGW		

Data Quality and Interoperabiltiy Cranfield Maintenance Program and CAMO

Cranfield CAMO

Accountable Manger – TBC

It is the responsibility of the accountable manager to ensure all work carried out on the aircraft is done so according to approved procedures as laid out in the Boeing Aircraft Maintenance Manual, and other manufacturer-approved documentation

It is the responsibility of the Accountable manager to ensure all staff observe and adhere to safety and warning/caution notices given in the Approved maintenance manual, when working on or near the aircraft

It is the responsibility of the accountable manager to ensure all access equipment and tooling utilised for the purpose of maintenance on the 737-400 are in a serviceable condition

Facilities

All maintenance will be carried out on campus at Cranfield University

Maintenance

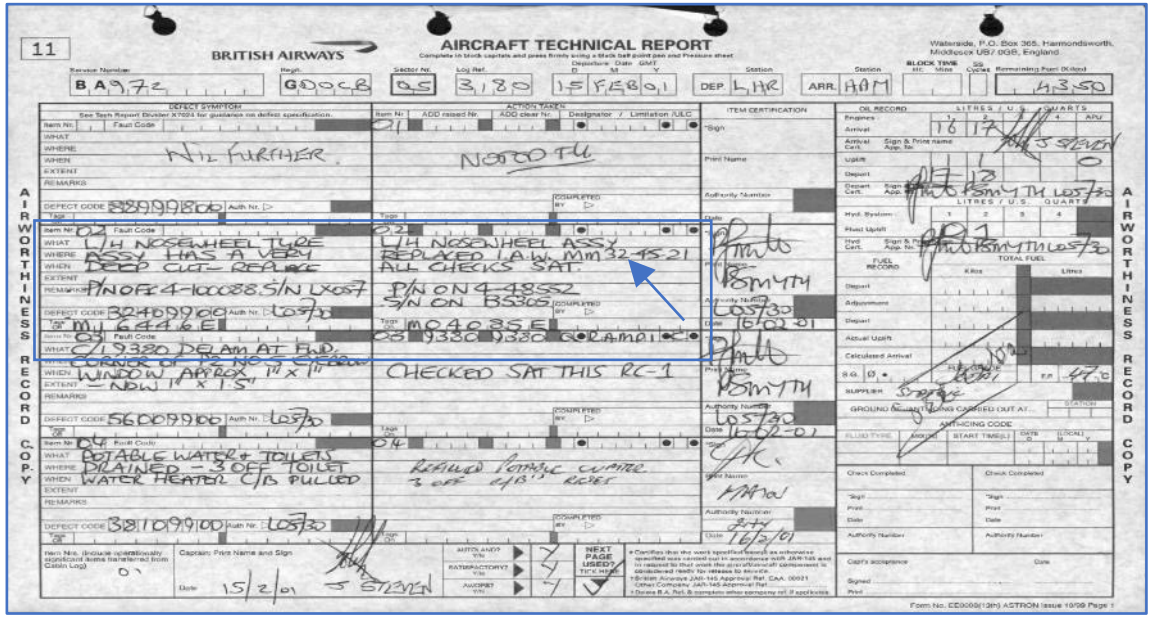
All maintenance is to be carried out in accordance with manufacturer Approved documentation
All maintenance undertaken on the aircraft is to be recorded in the Aircraft Maintenance Manual, as well as by completion of the relevant work pack worksheets of the Parking Maintenance Programme
Any damage to the aircraft is to be recorded, and reported to the Accountable Manager

Aircraft Maintenance Programme Compliance

The aircraft is to be maintained in accordance with the Cranfield 737-400 Parking Maintenance Programme
This maintenance is to be planned in advance, using the Parking Maintenance Record worksheet, and resource made available in order to comply with the Maintenance Programme

Aircraft Records

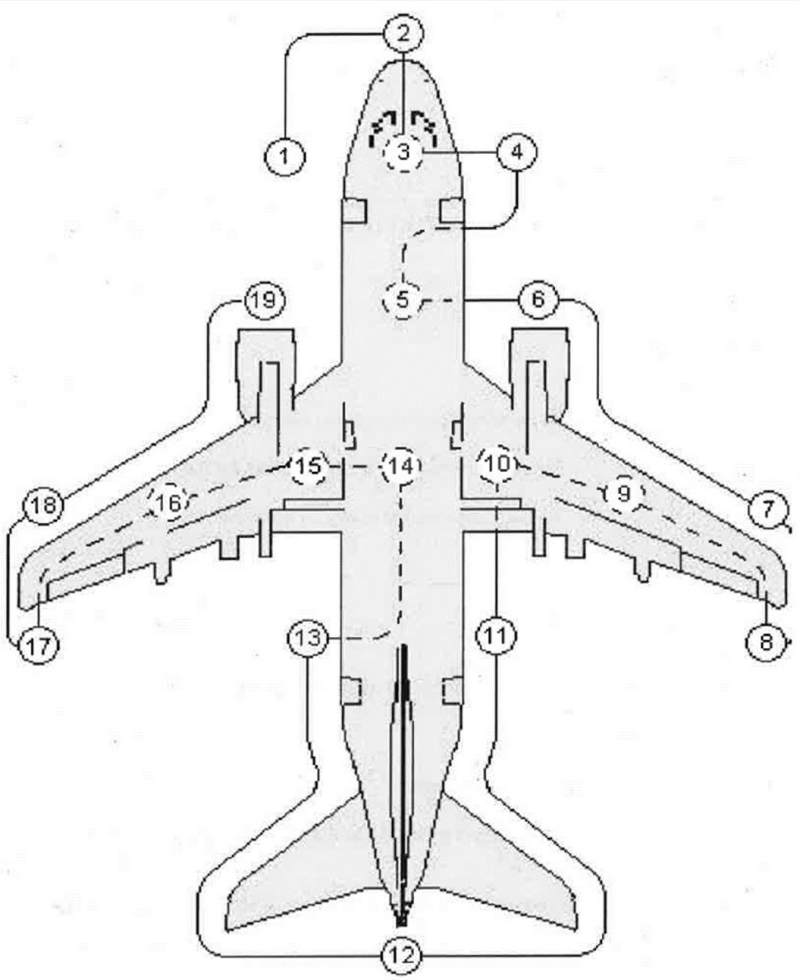
All maintenance is to be recorded in the Aircraft Maintenance Manual
Completion of a Parking Maintenance Programme work pack should additionally be recorded by completion of the worksheet, as well as annotation of the Parking Maintenance Record worksheet

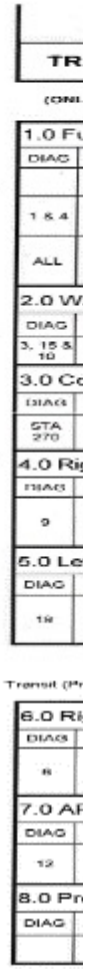


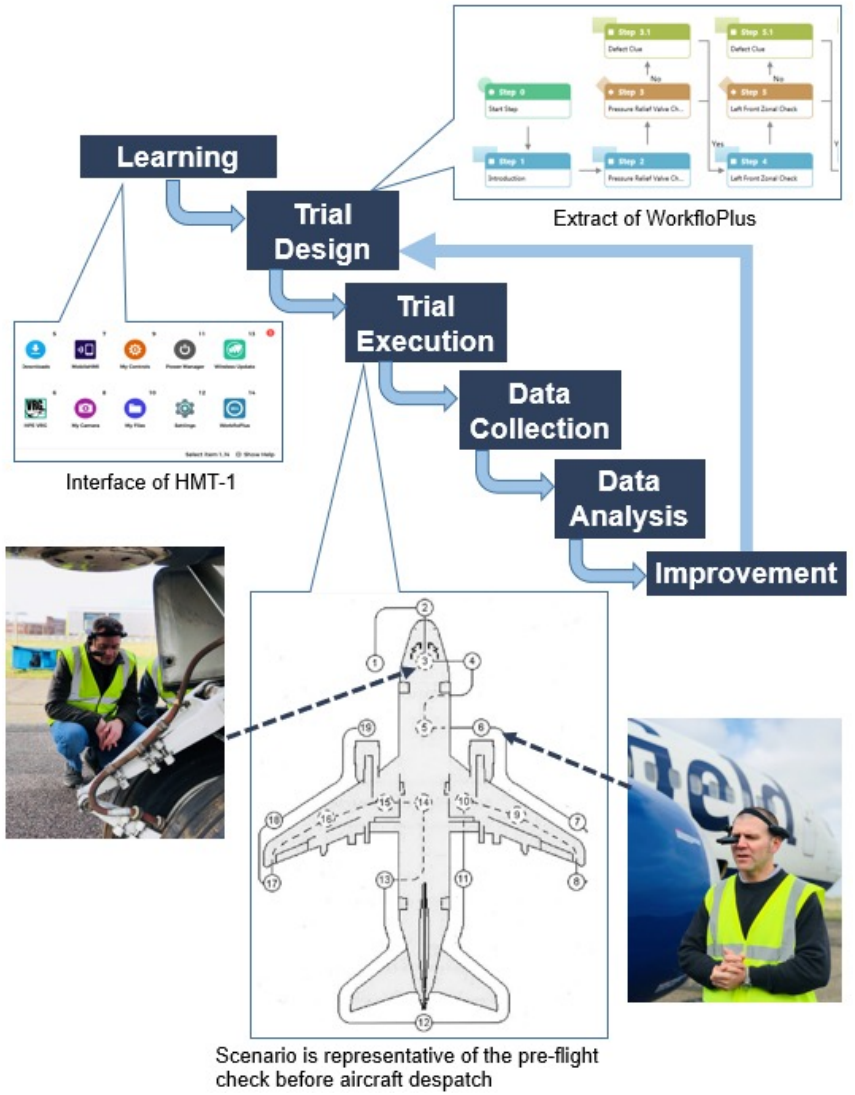
Aircraft Technical Report

Maintenance Task Card

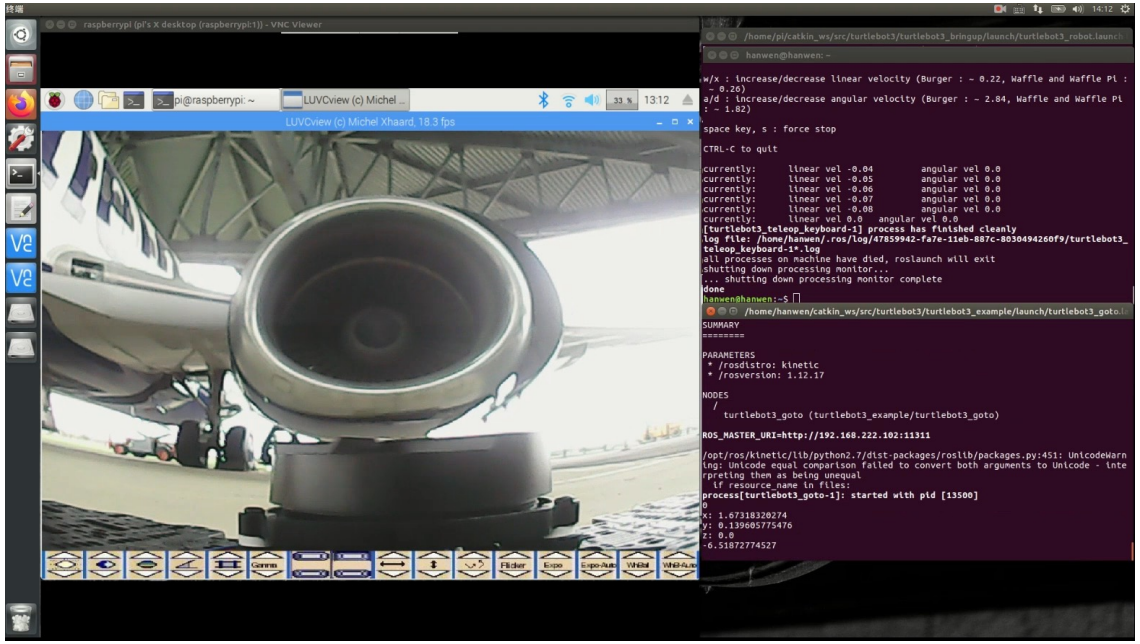
Digital Engineer



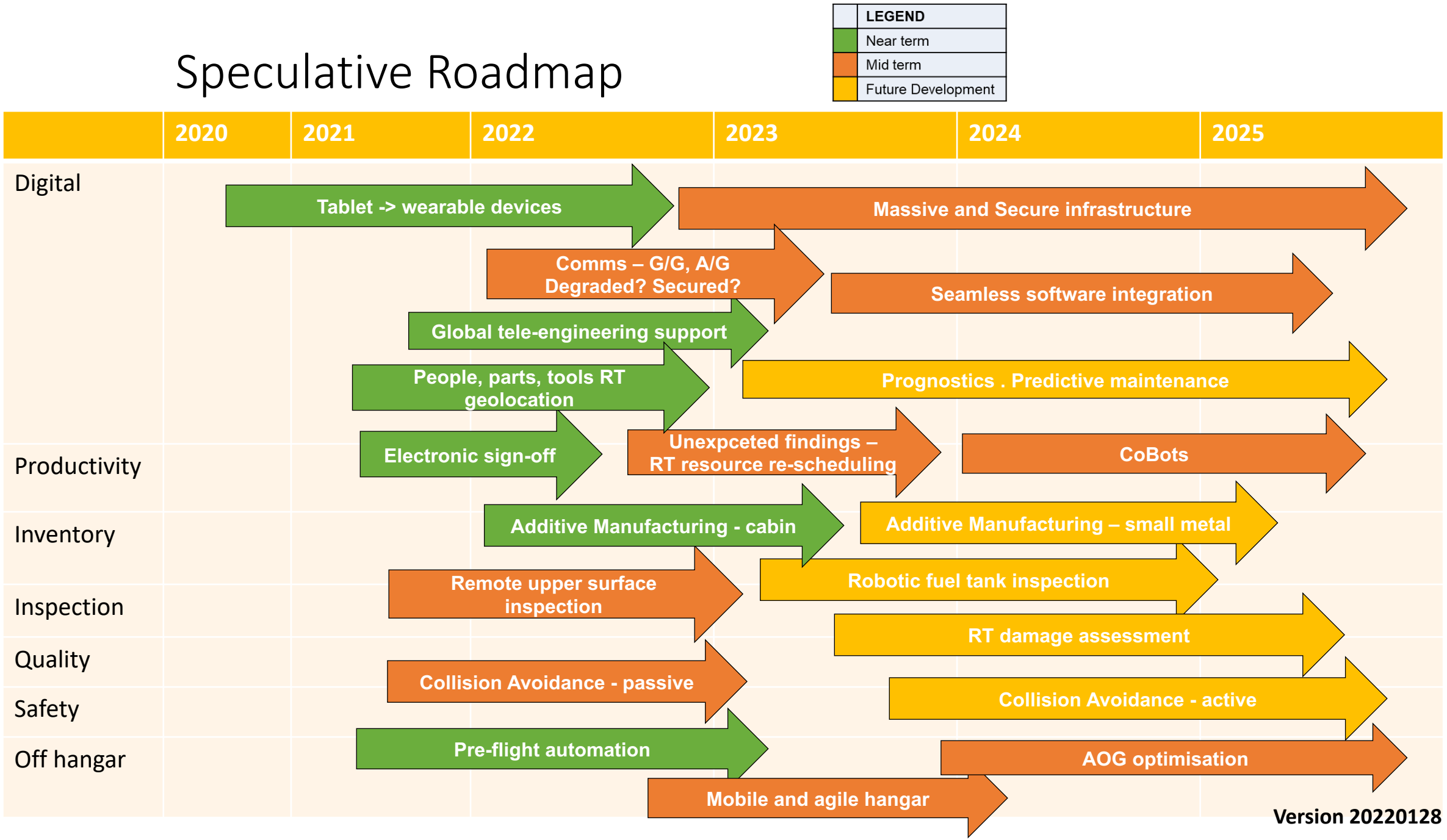




Autonomous Inspection



Speculative Roadmap



Version 20220128

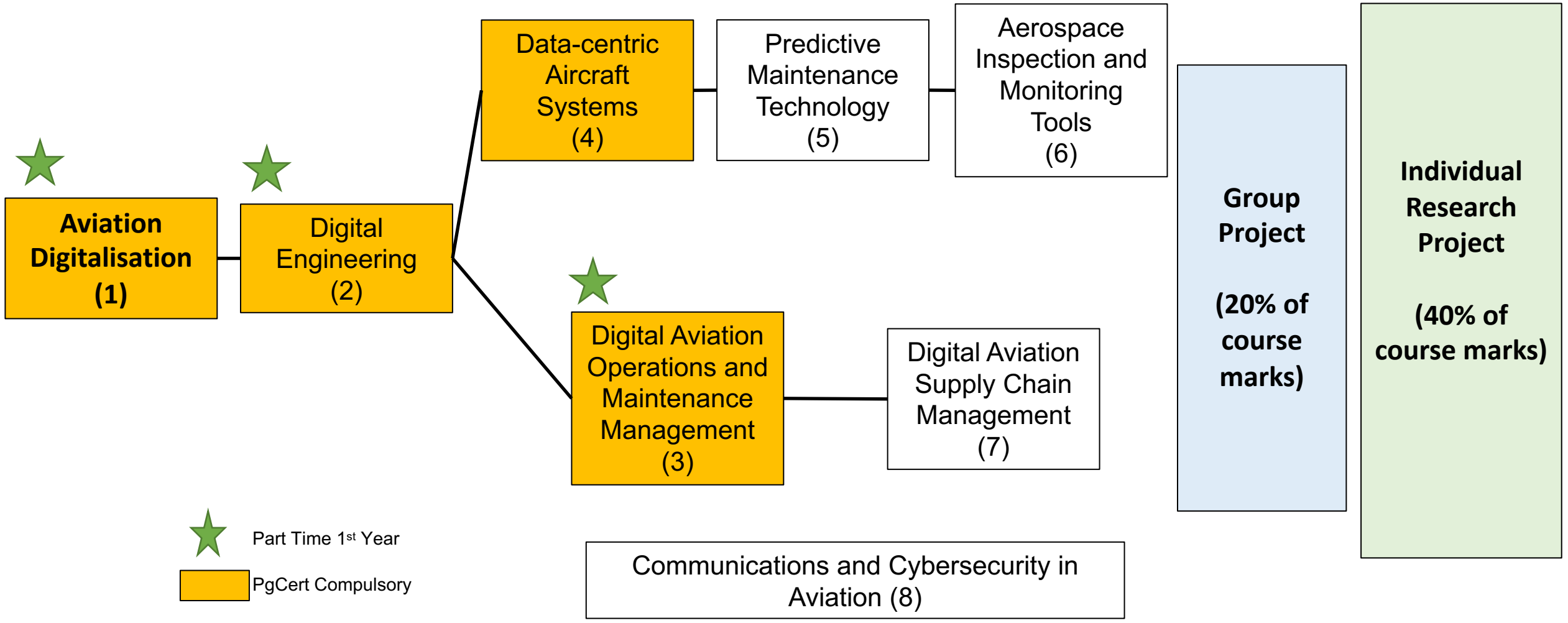
MSc Digital Aviation Technology Management

(First Cohort October 2022)

Who is this for

- Fresh/recent aeronautical graduates aspiring to add Digital in postgraduate degree
- Fresh/recent engineering, computing, maths and physics graduates aspiring to enter aviation sector employment
- Engineers/managers already in aviation sector seeking postgraduate degree for career progression

Module flow


Aviation Digitalisation (1)
Digital Engineering (2)
Data-centric Aircraft Systems (4)
Predictive Maintenance Technology (5)
Aerospace Inspection and Monitoring Tools (6)
Digital Aviation Operations and Maintenance Management (3)
Digital Aviation Supply Chain Management (7)
Group Project (20% of course marks)
Individual Research Project (40% of course marks)
Part Time 1st Year
PgCert Compulsory
Communications and Cybersecurity in Aviation (8)

Entry Requirements

- A first or second class UK honours degree in engineering, or an equivalent degree in engineering, engineering science, physics, applied mathematics, or other appropriate applied science.
- Other recognised professional qualifications or several years relevant industrial experience may be accepted as equivalent; subject to approval by the Course Director.
- English requirements:
  - If you have previously obtained a higher education level qualification from a UK university and have been taught and assessed in English.
  - If you are a national of or have a obtained a higher education level qualification from a country on the UK Visas and Immigration (UKVI) list of majority English speaking countries.
  - If you have been continuously employed in the UK for a minimum of five years immediately prior to the start of the course, providing you are able to supply a reference from your current employer which explicitly confirms you are able to communicate effectively in English.
  - By providing a satisfactory English test certificate that meets the requirement of the course you have applied for.

Part Time Journey

- Part-time students register for the course in September and are expected to complete the course within 3 years.
- The Course Director discusses with each student to recommend the learning choices most appropriate to the student's background and career interest.
- The preferred path for part-time students is to complete modules 0,1,2,4 and one additional taught module, and the group project during the first year.
- In the second year, the student completes the rest of the taught modules and the Individual Research Project.
- For part-time students it is common that their individual project is undertaken in collaboration with their place of work.
- Students who need to pace the study over three years agree with the Course Director an appropriate learning path.

Cranfield IVHM Centre

BOEING

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