Aerospace Technology in the UK

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UK Aerospace Technology Institute

ISABE 2017, Manchester UK, 5th September 2017

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ATI

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The ATI

- The Aerospace Technology Institute (ATI) is the objective convenor and voice of the UK's aerospace technology community
- We define the UK's national aerospace technology strategy
- We work closely with Government and industry to direct joint Government and industry funding of **£3.9Bn** into aerospace R&T projects that align with the strategy
- We lead international technology engagement in aerospace for the UK
- We are a non for profit company, owned by UK Government and UK Industry

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ATI Mission & Goals:

Through strategic investment in differentiating technologies, secure the full economic potential of the UK aerospace sector

Technology Investment

Provide Technology Leadership

Maximise funding impact

Institute Impact

Develop Sector Partnerships

Elevate the UK's International Profile

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Vision for UK Aerospace

To ensure the UK…

- Is a global leader in:
  - + civil aircraft **wings**
  - + large civil aircraft **engines**
  - + complex aircraft **systems**
- Is providing **differentiated technologies** and **competitive supply** for associated sub-systems and components
- Is **positioned to lead** new architectures and technologies in civil aviation

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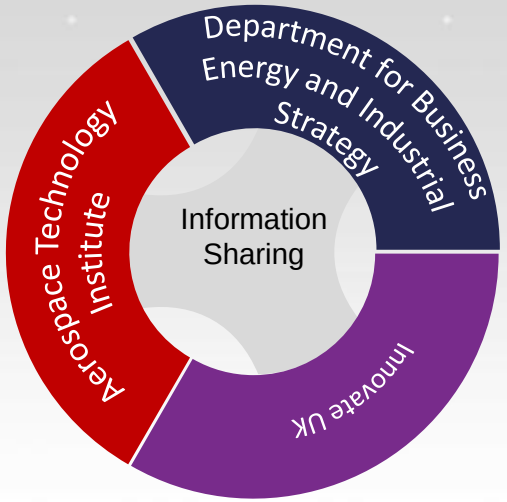
UK Aerospace Programme roles

- **BEIS holds the budget and has ultimate decision making responsibility for how it is used**
- **Innovate UK deliver the programme: manage contracts, pay grants and monitor results**
- **ATI shape the programme through independent strategic advice and industry engagement, to deliver maximum economic impact**



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ATI Technology Strategy

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UK Aerospace Industrial Strategy

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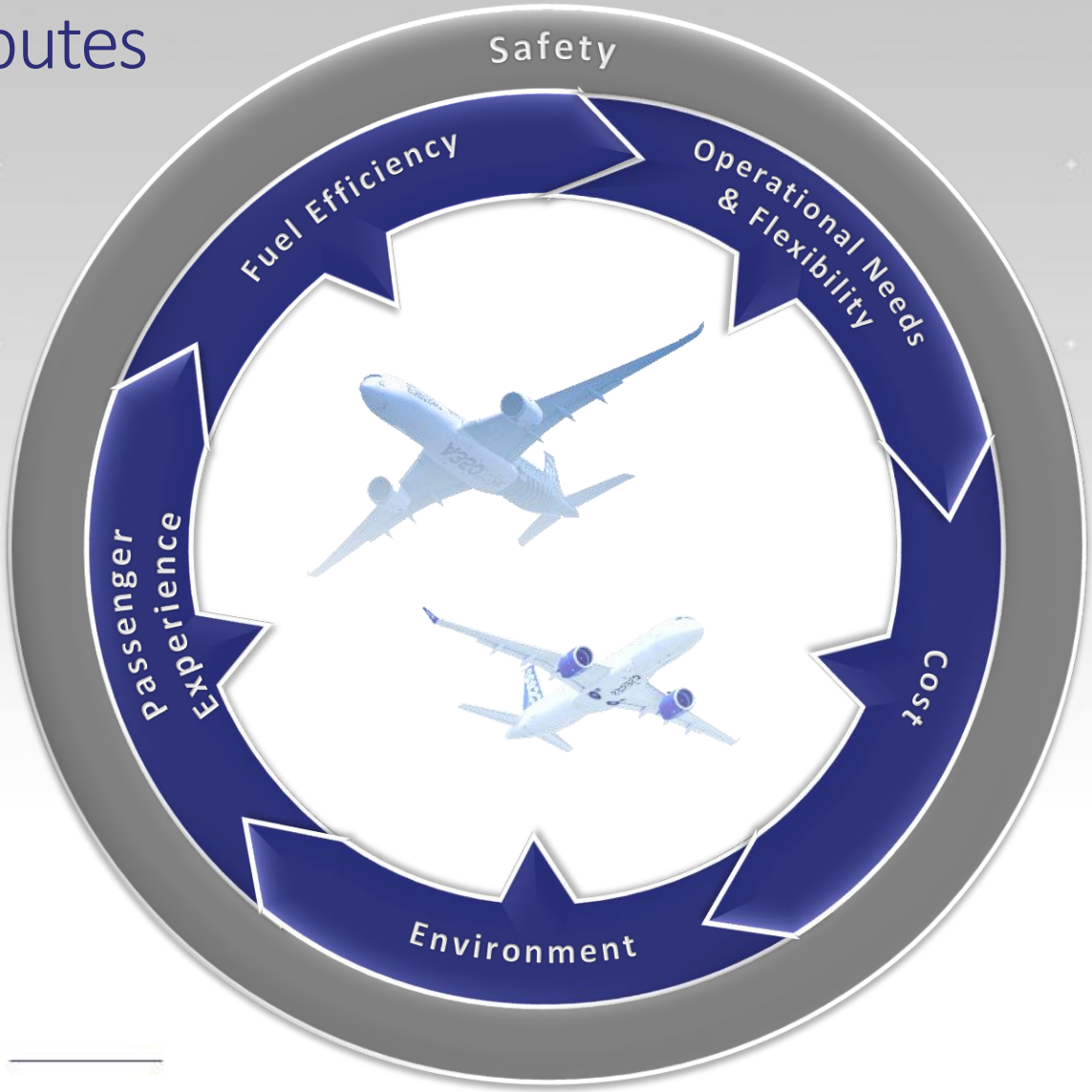
Attributes



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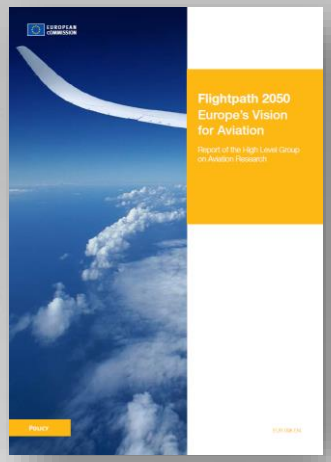
ACARE 2050 Targets

FlightPath 2050



Strategic Research & Innovation Agenda

- **Fuel Burn & CO_2 emissions[1]** **-75%**
- **NO_x emissions[1]** **-90%**
- **Perceived Noise emissions[1]** **-65%**
- **Accident Rate[2]** **-80%**
- **Certification Cost[2]** **-50%**

ACARE

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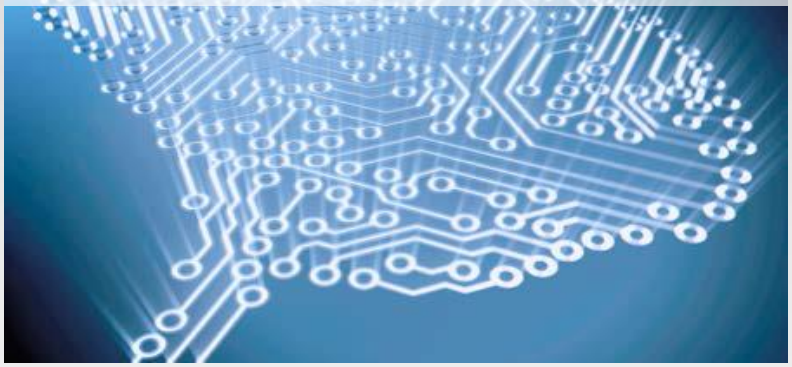
Four strategic technology themes

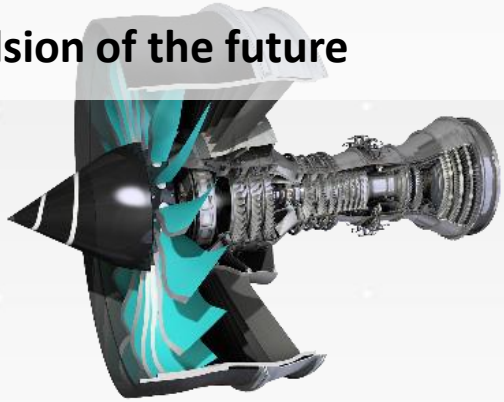
Aircraft of the future

Smart, connected and more electric aircraft



Aerostructures of the future

Propulsion of the future



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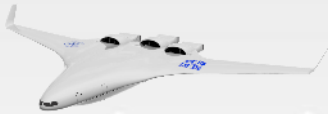
Aircraft of the Future

Secure a whole aircraft capability that enables the UK supply chain to understand future aircraft design directions and the value of their technologies

Explore the limits of conventional aircraft architectures and the benefits of introducing advanced systems

Characterise the benefits of radical aircraft architectures and the implications of future air traffic management systems

Accelerate the introduction of revolutionary aircraft and systems. Accelerate technologies for larger autonomous aircraft



Secure | Exploit | Position

2015 2020 2025 2030

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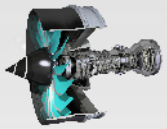
Propulsion of the Future – New Architectures

Lightweight fan system validation platform

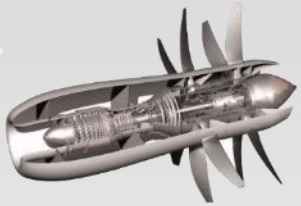
Advanced core demonstrator

UHBR geared turbofan

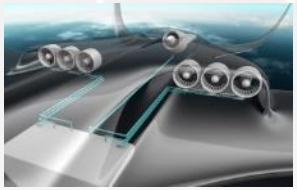


Lean burn combustion validation platform

Advanced propellers



Variable pitch for UHBR geared turbofan



Open rotor

Hybrid turbo-electric and distributed propulsion including flight test validation

Secure | Exploit | Position

2015 2020 2025 2030+

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Propulsion of the Future – Key Technologies

Environmental engine protection

High temperature turbines (CMCs, cooling)

Low loss engine air and oil systems

Automated assembly for propulsion

Integrated UHBR nacelle systems

Advanced cooling / heat exchanger

Active helicopter rotor blades, hub and transmission systems

Advanced powerplant transmissions, structures and drives

Joining dissimilar materials for propulsion

More electric propulsion systems

Advanced propulsion control strategies

Ultra-low emissions combustion systems

Secure	Exploit	Position

2015 2020 2025 2030+

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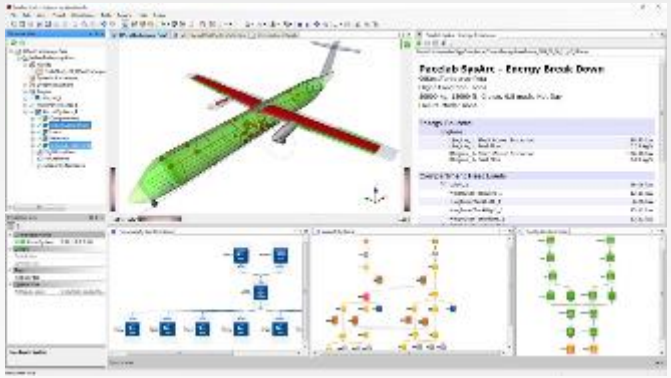
Raising Ambition - Four Major Integration Initiatives by 2020*

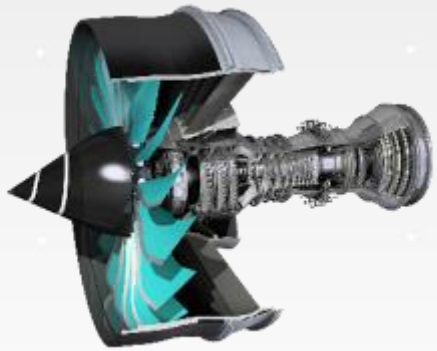
Future Integrated Aircraft and Propulsion System Concepts

Integrated Wing

Systems Technology Validation Platform



Ultra-High Bypass Ratio Turbo-Fan



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* Subject to stakeholder ambition and available funding

Cross cutting agendas

Strategic Technology Themes

High value design

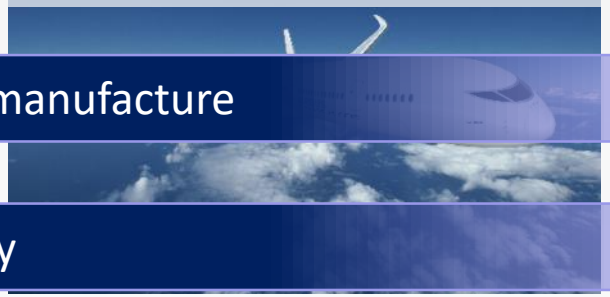
Additive manufacture

Autonomy

Digital Transformation

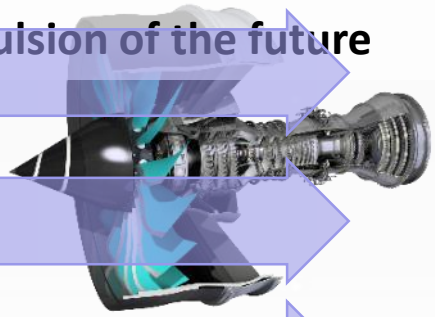
Through Life Engineering Services

Technology Infrastructure



Smart, connected and more electric aircraft

Propulsion of the future



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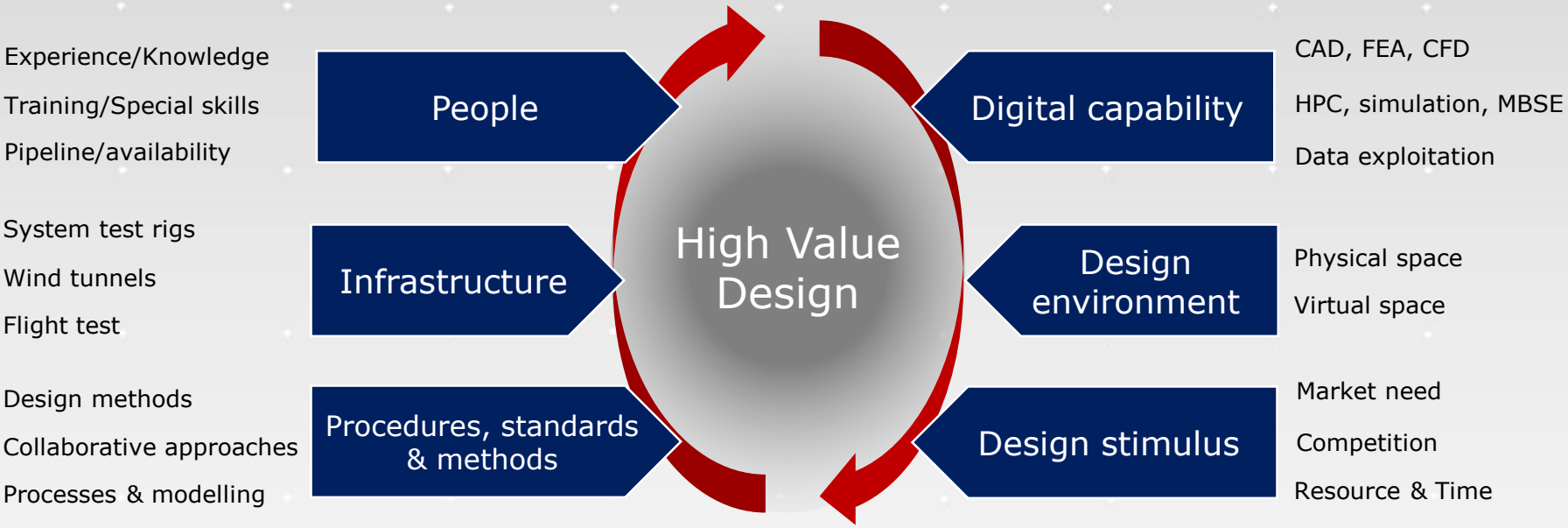
High Value Design



High Value Design is the ability to pull together skills, methods and assets to conceptualise, define and integrate complex products – it enables architectural decisions.

The capability is central to the creation of differentiated solutions and attracts and sustains High Value Manufacturing

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Digital Economy

INSIGHT

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Introduction

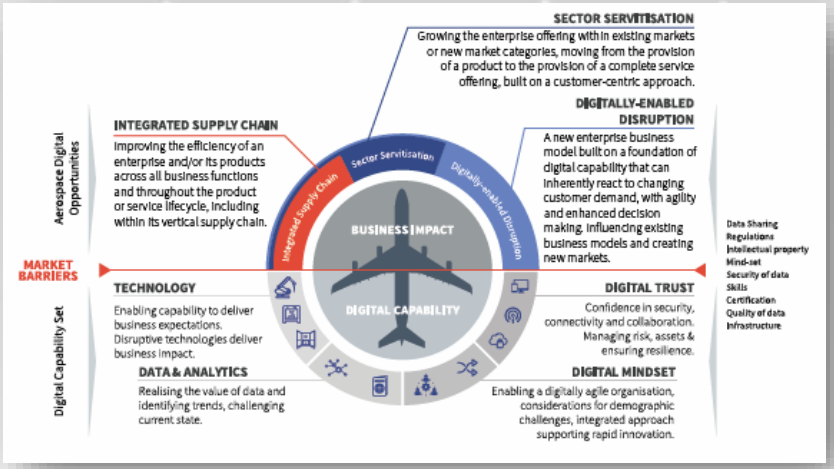
This paper explores the potential for digital transformation in aerospace, and examines the maturity of the UK aerospace sector's digital capability. It has been informed by surveys of and interviews with industry leaders, both internal and external to the sector, conducted by the ATI.

Most aerospace organisations surveyed are embedding digital technologies, but principally to deliver incremental efficiency and productivity improvements. Many are not considering the potential to change business models; in this regard, aerospace is following - but it could be leading.

01 DIGITAL TRANSFORMATION

1

..... ATI's Digital Framework for Aerospace



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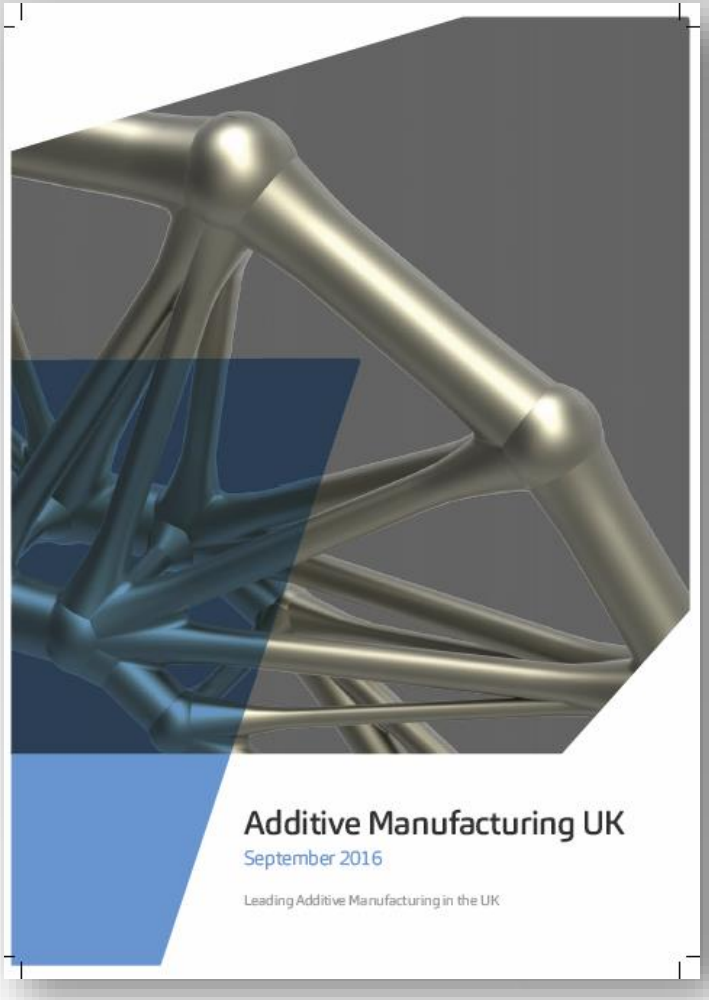
UK National Additive Manufacturing Strategy



- ATI led input from Aerospace
- Aerospace AM strategy being developed, consistent with national strategy

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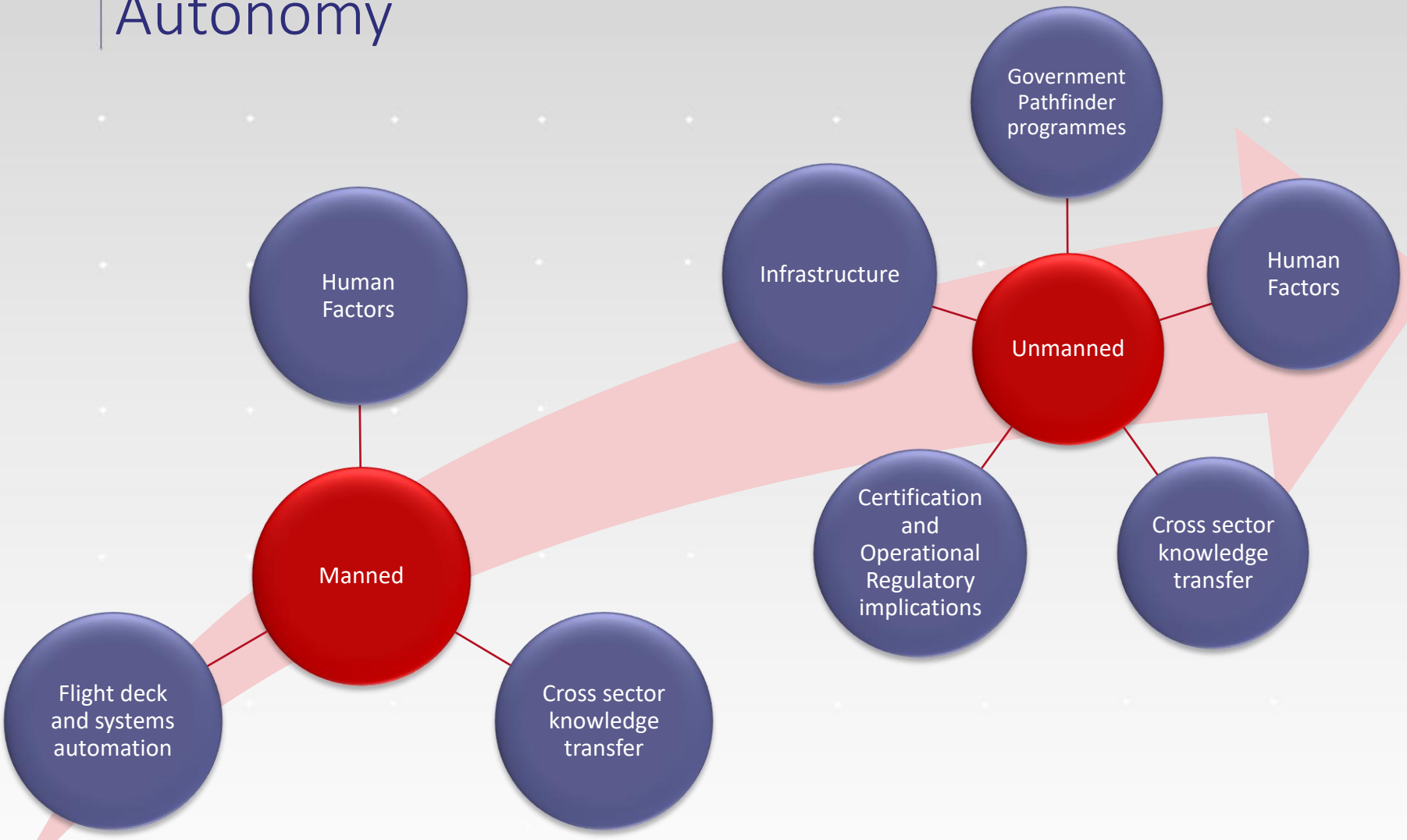
Autonomy



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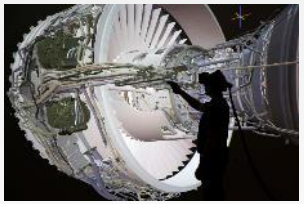
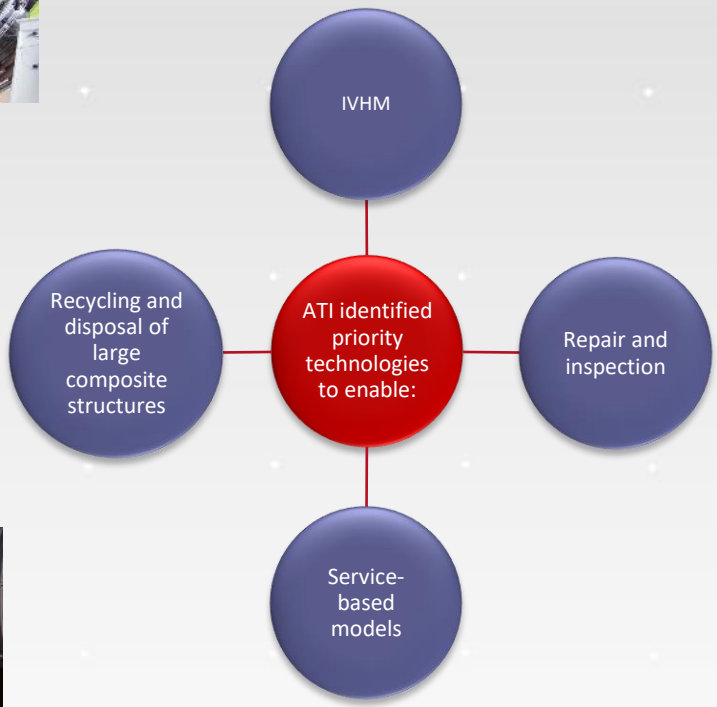
Through Life Engineering Services





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ATI investing in UK Aerospace Technology Infrastructure

Seven UK Universities with outstanding aerodynamics capability
National Wind Tunnel Facility £13.3M

Queen's University Belfast
Supply Chain Manufacturing Centre £5.0M

Airbus
Wing Integration £37M

GKN Aerospace
Electron Beam Melting £3.6M

AMRC
Casting £15.4M, Flexible Robotic Machining £1.1M

University of Nottingham
Transmissions £2.7M

University of Loughborough
Combustion £9.8M

The MTC
Near net shape AM £4.1M,
Aerospace Centre £15.1M

ARA
Wind tunnel £9.4M

£116M of Capital Funding Committed
*Values shown are Total Project Cost

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Hybrid Propulsion

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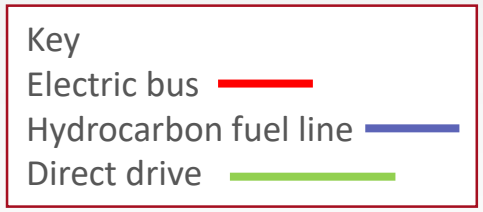
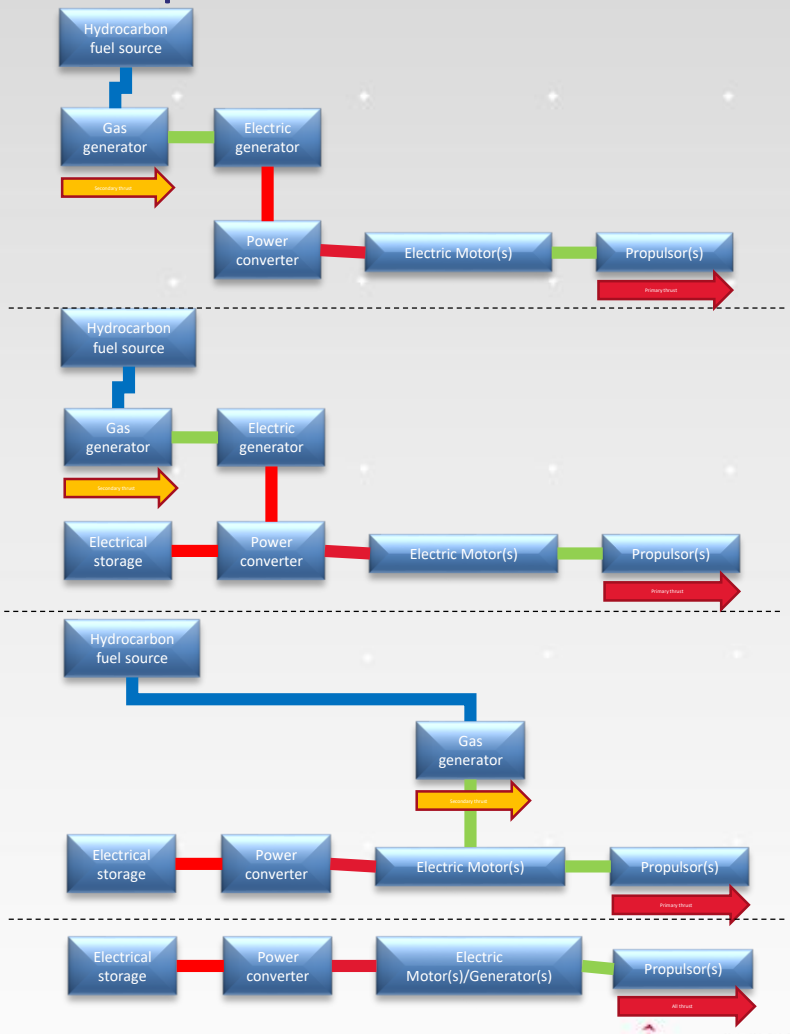
Hybrid Electric Aircraft Propulsion

Multiple arrangements of hybrid (including all electric) are being considered. Examples of these are:

- Turbo-electric hybrid
- Series hybrid
- Parallel hybrid
- Series-parallel hybrid
- All electric

Some of these are shown here.





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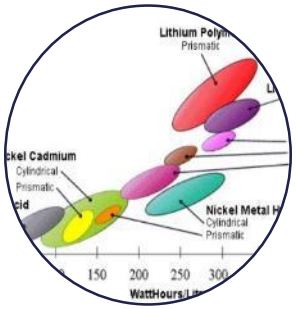
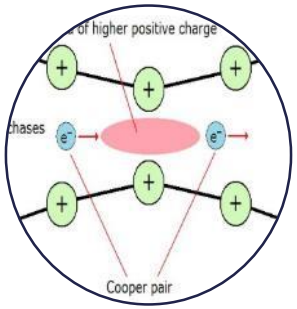
Key technology building blocks for hybrid Propulsion

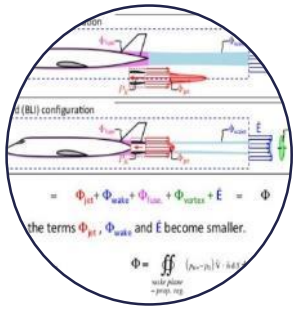
High power density electrical machines & drives



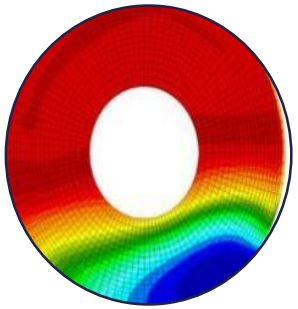
High energy & power density electrical storage



Superconducting electrical systems



Aerodynamics of boundary layer ingestion



Distortion tolerant boundary layer ingestion fans

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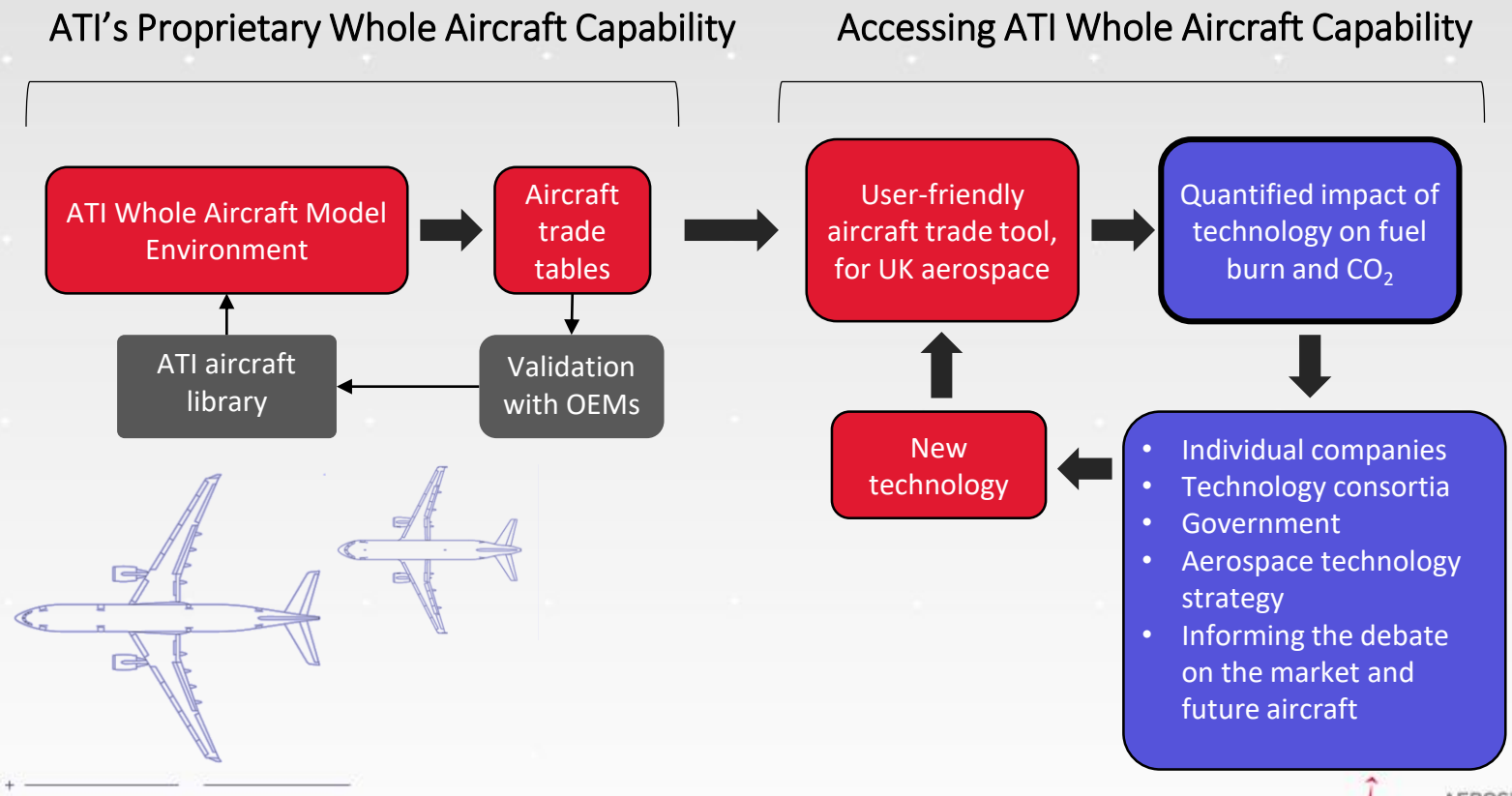
Hybrid Propulsion Systems Integration

The Aerospace Technology Institute is building on its existing Whole Aircraft Capability



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Delivering the Strategy

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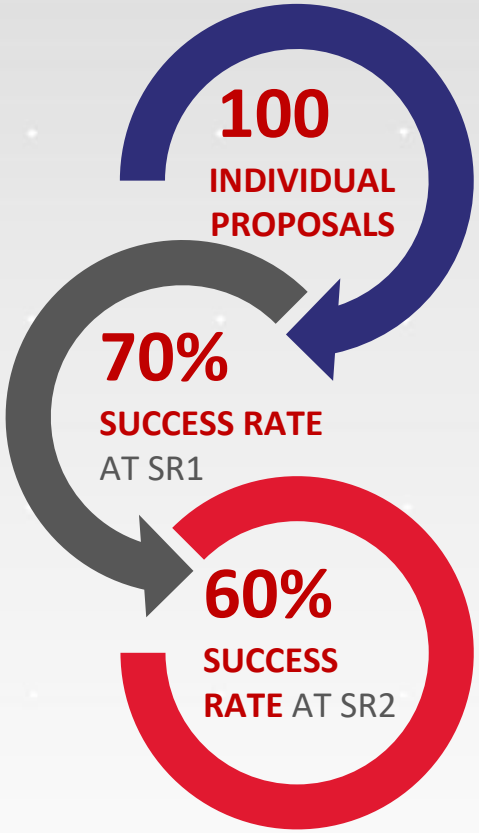
Headline ATI Portfolio Statistics

Projects developed in the last 18 months…



WILL HELP TO SECURE OR GROW

40,000

UK HIGH VALUE JOBS

…are adding to an extensive technology portfolio

ATI PROJECTS ON CONTRACT: **183**

TOTAL VALUE: **£1.5BN**; GRANTS OF **£825M**

207 UNIQUE ORGANISATIONS

106 SME's DIRECTLY CONTRACTED

WITH MANY MORE SMEs SUBCONTRACTED

Source: ATI Analysis of Innovate UK Public Data (1st July 2017)

Note: SMEs are defined as having 250 or fewer employees in the UK

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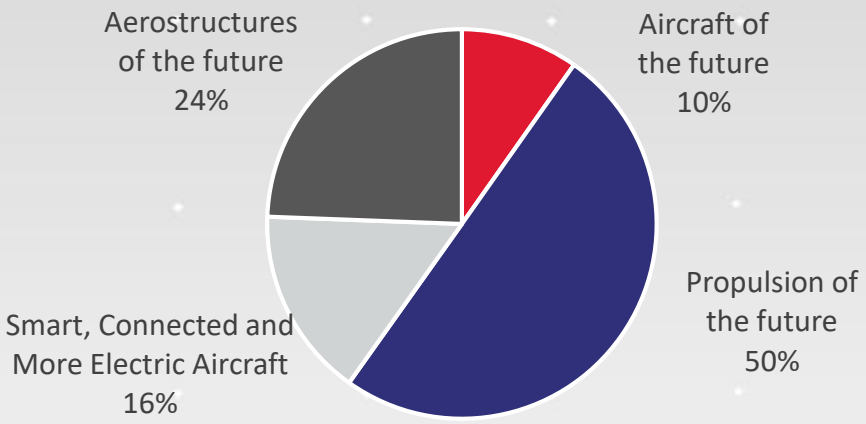
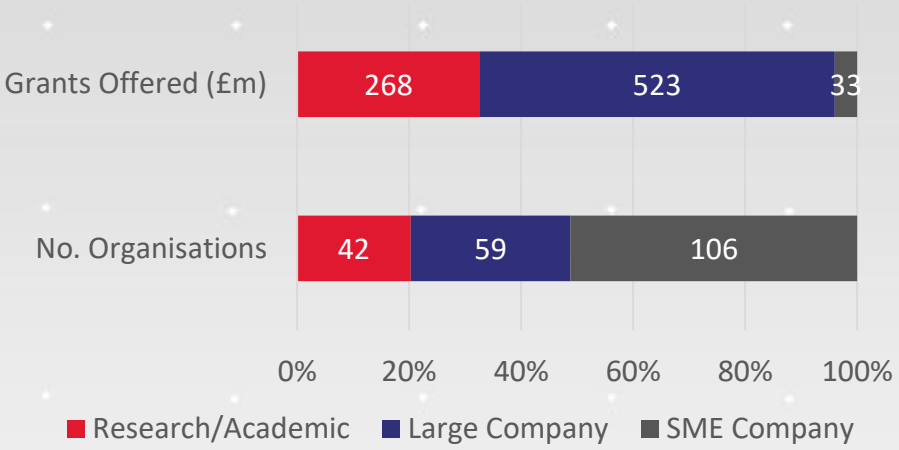
Key ATI Portfolio Statistics

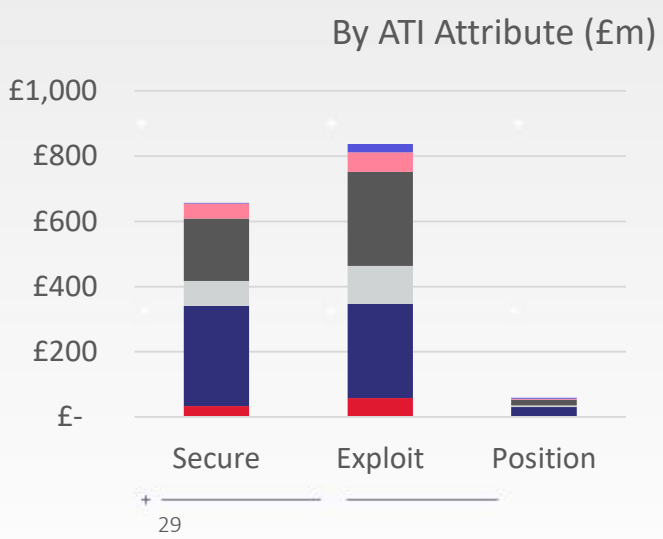
ATI Portfolio by Value Stream



ATI Grants by Company Size



By ATI Attribute (£m)



- ATI funding by value stream in line with UK aerospace sector turnover.
- Largest focus in portfolio on cost reduction and fuel efficiency projects
- Funding for exploit projects (5-10 years) has increased over the past months.
- >50% of the partners participating are SMEs, receiving >£30m of grant funding

Source: ATI Analysis of Innovate UK Public Data (1st July 2017)
Note: SMEs are defined as having 250 or fewer employees in the UK

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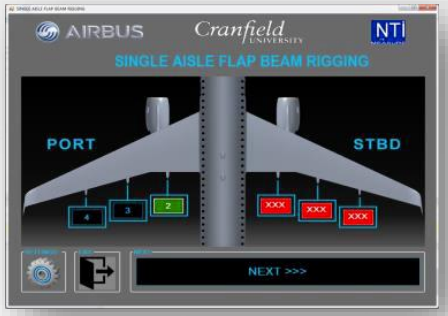
Impact of New Technologies – Case Studies 1

Fast Make
- -75% lead time for Demo/ Dev Parts

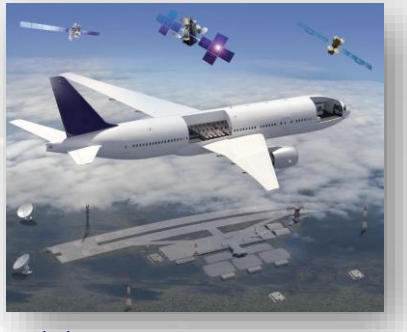
Harsh Environment Electronics
- 250°C Capable Electronics

Composite Fan Manufacturing
- -750lb per engine

Future Flight Deck
- Waveguide: -60% Lead; -50% NRC
- Enhanced pilot productivity and safety



Advanced Wing Assembly
- Right first time assembly
- Cost & Lead time reduction



Modular Communications
- Reduced weight & volume
- Improved safety & reliability

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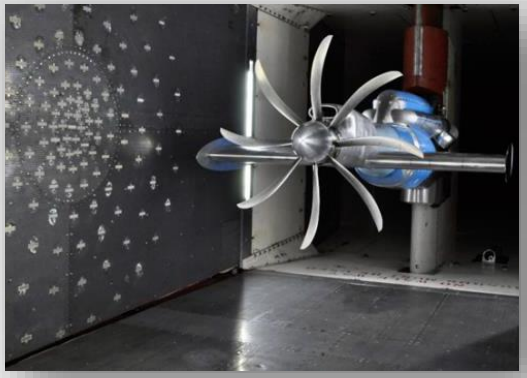
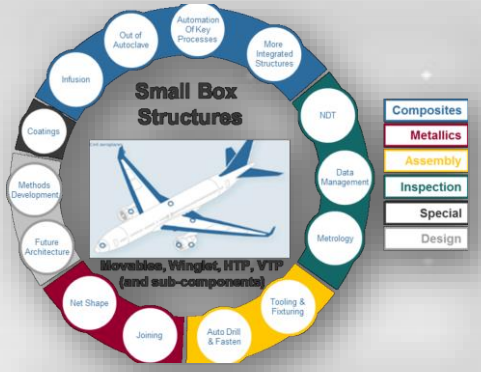
Impact of New Technologies – Case Studies - 2

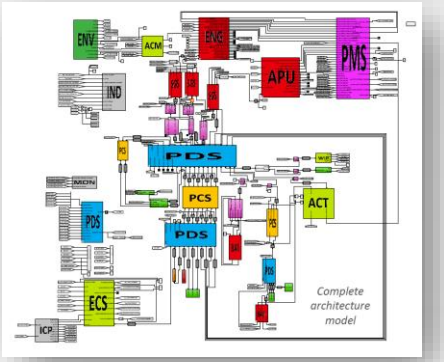
AMRC Titanium Casting
- World's Largest Ti Casting Facility



Low Noise Propellors
- Efficiency -3%; Noise -6dB

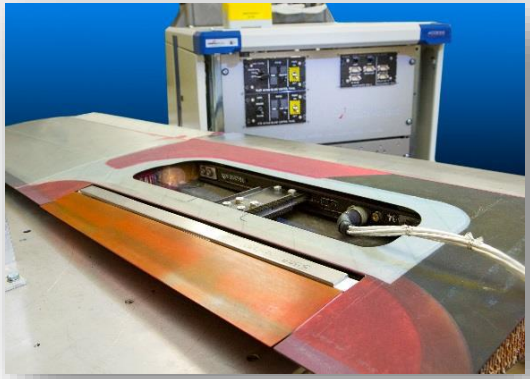


Wing component manufacture (VIEWS)
- Tier 1 wing supply chain
- Cost -20%; Rate +80%



Future Power Architectures
- Identify future technologies
- Up to 6% potential fuel saving

Modular Manufacturing
- Smart reconfigurable work bench
- Productivity Improvement



Advanced Landing Gear Manufacture
- Vibration -90%
- Critical Speed +10%

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And now the commercial break……

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