Flight Paths of the Future?
Cranfield University AIRC

ISABE Conference
7th September 2017
Iain Gray, Cranfield University
What is the role of Universities

Teaching and Learning
High Level Apprenticeships
Continuing Professional Development
Executive education
Research ….

Improving productivity and competitiveness
Graduates with the right skills and mindset to compete in the high-tech global knowledge economy.

Today teaching and research as important as ever
Cranfield Airport and Runway – A unique asset

The only university in Europe with its own Airport and Runway

…. Ideal for demonstration of ground and flight concepts
Cranfield: a unique university

- Engineering, Science & Management
- Industry-focused, Industry-engaged, Transformational Research
- Exclusively Postgraduate
- Executive & Professional Development, Masters & PhD
  - > 4,500 Postgraduate students
  - > 800 Doctoral students
  - > 20,000 Exec & Professional Development
  - From > 100 countries
Cranfield has Distinctive Strengths

- Aerospace
- Defence and Security
- Energy and Power
- Environment and Agrifood
- School of Management
- Manufacturing
- Transport Systems
- Water
Extensive facilities: Aerospace, Transport & Manufacturing

- Autonomous Systems Laboratory
- National Wind Tunnel Facility
- Icing Wind Tunnel
- Gas Turbine Test Area
- Aerostructures Assembly & Systems Installation Laboratory
- Rolls-Royce University Technology Centre (UTC)
- Aerospace Integration Research Centre (AIRC)
- Cranfield Aerospace Solutions

also: Aerospace Technology Institute (ATI) based on Cranfield University Technology Park
Extensive facilities: Aerospace, Transport & Manufacturing

- Cranfield Airport
- National Flying Laboratory Centre
- Boeing 737
- Accident Investigation Centre
- Mechatronics Laboratory
- Offroad Laboratory
- Intelligent Mobility Engineering Centre
- Multi-User Environment for Autonomous Systems Integration
Extensive facilities: Aerospace, Transport & Manufacturing

- Centres for Innovative Manufacturing in:
  - Ultra Precision
  - Intelligent Automation
  - Through-life Engineering Services
- Surface Engineering Laboratory
- Engineering Photonics Laboratory
- Additive Layer Manufacturing and Welding Laboratory
- Virtual Reality Laboratory
- Composites
Cranfield Aerospace Education Example

Cranfield’s unique student experience, flying students in our own instrumented aircraft

Cranfield operates a fleet of three aircraft
Aerospace students at Cranfield fly in our instrumented aircraft to learn about, and feel, flight and ground dynamics, behaviour and technologies
Cranfield Group Design Project  Ae16
Boeing 737-400 Ground based demonstrator
Cranfield University
Home Europe’s foremost flying laboratory
FAAM 146 Research Aircraft
Gas Turbine Test facilities:

Analysis
Diagnostics
Energy and the Environment
Life Cycle Costs and Power
Propulsion and Power
Selection of Equipment
Simulation
“Unlike our major competitors, Rolls-Royce does not have a large corporate research centre. Instead, we have made ourselves totally dependent on our University Technology Centres for our future technology. Our global university partners more than rise to this challenge”

Ric Parker, former Rolls-Royce Director of Research and Technology

Source Rolls Royce
The Rolls-Royce UTC at Cranfield

- Industry-academia partnership since 1998
- From ‘Performance’ to ‘Systems Design, Integration & Performance’

“Core competence our ability to undertake detailed studies involving highly integrated, aero-thermal, multi-disciplinary models, to improve understanding of power plant and sub-system design, integration and performance in the context of the product’s life cycle and mission.”
The Rolls-Royce UTC at Cranfield

- Rolls-Royce customers:
  - System Design Global Function
    - Global Performance Function
    - Installations Aerodynamics
  - Engineering for Services
  - Systems Engineering
  - Future Programmes Engineering
  - Future Technologies Group
  - Marine
  - +++

- Conduit for Rolls-Royce to place research work with other groups and departments at Cranfield (50+ projects since 2010 worth >£1.8M)

- Collaboration through EU-funded research

- Additional gearing through ATI, IUK, EPSRC and other funding sources
What is the AIRC?

- A £35m investment by Cranfield, HEFCE, Rolls Royce and Airbus
  - Encouraging collaboration between academia and industry
  - A unique research facility for integration of complex aerospace solutions
  - Operational since January 2017

- Capacity
  - Over 2000 sq m lab space
  - Secure office space for 60 permanent hot desks
  - Further collaboration space for 100+ people
  - Airbus and Rolls Royce Offices for 6-8 people

- Simulators and Vision
  - Flight and ATM simulator
  - Virtual wind tunnel facility being developed
  - Advanced visualisation/presentation suite used for intensive workshops
Greater readiness of research

- Facilitating route to commercialisation of research
- Achieving higher “technology readiness”
  - Greater integration of technology within system
  - More representative environments
  - Whole end-to-end processes rather than individual activities
• Addressing:
  • New and novel aircraft concepts with advanced power and propulsion concepts
  • Wider system integration with air transport management and business model integration
Greater integration of product

- Benefits from optimising the whole rather than just the parts
- Considering technology, process and business models
- Grand challenges
  - More efficient and effective solutions
  - Improved timescales and costs
Aerospace Integration Research Centre  AIRC

- IDEAS Space
- Large Open Lab
- Flight Simulator
- Air Traffic Management Lab
- Aerospace Autonomy Lab
- Intelligent Assembly Lab
Aerospace Integration Research Centre
IDEAS SPACE
More than just a building – the wider capability

AIRC – the building

- LPA simulators and High Performance computing
- Manufacturing and auto assembly
- Large scale Gas Turbine test area
- Intelligent Mobility Engineering Centre and Multi User Environment for Autonomous vehicle innovation
- Icing and wind tunnels
- World renowned Management School
- Airport – runway 1.8km
- National Flight Laboratory: 2 Jetstream 31s, UAV surrogate, Bulldog, other
- Cranfield Aerospace: commercial arm with EASA and UK MoD approvals
- Air Transport Management department
Concept of operation

- An integration environment - integration of distributed research across UK and wider
  - Surrogate airframer for Rolls Royce, surrogate component supplier for Airbus
  - Provide a neutral ground for exploration and experimentation

- Themes:
  - Aircraft/ propulsion of the future
  - Smart and connected aerospace solutions
  - Aerostructures of the future
  - High value design
DARTeC Value Proposition

Integrated Digital Aviation Systems Research

- Aircraft
- Airspace
- Airport
- Airline
- Flight Ops
- Maintenance
- Integration
- Autonomy
- Passenger Service
- Multi-modal transport
- Passenger Experience
- Data Security
- Air Traffic Management
- Efficiency and Capacity
- Disruption Management
- Revenue
- Airline
- Ground Ops
- Integrated Digital Aviation Systems Research
AIRC is the first step on a journey…

- Air vehicles of the future
- Airspace Management of the future
- Airline of the future
- Airport of the future

AIRC – Aerospace Integration Research Centre
DARTeC - Digital Aviation Research and Technology Centre
Cranfield’s role .... Airport of the Future Masterplan

Cranfield Masterplan
May 2016
Establish a dedicated Digital Aviation Systems Research and Technology Centre (DARTeC) at Cranfield University to:

- Provide a technology demonstration and maturation environment (Physical + Virtual)
- Focus on the advancement of digital systems across the full aircraft + airport + airspace spectrum.
- Address door to door passenger journey with focus on aviation elements
- Leverage both the Centre’s assets plus those of the global Digital Aviation R&T sector to provide integrated technical and business systems solutions for accelerated market implementation
- Leverage UK and international research funding initiatives to scale up Digital Aviation Research and Technology Development activities
Cranfield Aviation Accelerator

**Idea Formation & Refinement**
- Cranfield University Bettany for Entrepreneurship
- Entrepreneurial Team Skill Development
- Support from Cranfield Centre for Competitive Creative for Design (C4D)
- Aviation Technical Expertise
- Customer Engagement Opportunities
- Pre-Seed Funding Opportunities
- Access to Business Incubation Centre
- Access to Aviation Workshops, Design & Analysis Tools
- Access to R&D Airspace & Cranfield Airport
- Business & Technical Mentoring
- Business Development Training
- Supply Chain and Customer Development
- Access to Seed Funding Opportunities

**Incubation**
- Cranfield University Business Incubation Centre
- 6 - 12 months

**Growth**
- Cranfield Technology Park
- 2 – 5 years
- Ongoing
- Follow On Funding Support
- Supportive Community of High Growth Start-Ups, Funding and Customer Networks

- Business support engagement with Local Enterprise Partnership (on Tech Park)
**Satavia**: The global leader in digital environmental intelligence.
What does the future look like?

• We are on the cusp of a 3rd Revolution in Aerospace

• No one organisation can do everything – new ways of working with partners across globe being established

• Cranfield can play a key role.

http://www.wired.co.uk/article/airbus-flying-car
Trigger points for ACARE change ..... 
Increase extent of inter-disciplinary within and outside classical aerospace

New system concepts, e.g. more electrical flying

RPAS / UAS development and market take-up quicker than initially anticipated

Change in light of new technologies

New materials and manufacturing processes vital for manufacturing industry

Dynamic developments in the field of IT, e.g. big data, automation, digitalisation and virtualisation
Systems Integrator at research level
FLAVIIR Subscale Demonstrator
The BWB concept

NASA-Boeing X-48C blended wing body technology demonstrator awaits its first flight from Rogers Dry Lake on a hot August morning at Edwards Air Force Base, Calif.
Jetstream - ASTRAEA
First surrogate ‘unmanned’ flight in civil airspace
Development of electric aircraft?

All Require Demonstration
Can this be a scaled technology vision?
Hybrid electric benefits – Opens up more design freedoms

Source Howard Smith Cranfield University
What does the future look like?

We are on the brink of a revolution in aerospace
Cranfield University AIRC is helping to shape it