

GKN Aerospace Research and Technology

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GKN TECHNOLOGY
MAKING THINGS FLY

Agenda

- **GKN an Overview**
- **Our platforms**
 - Space
 - Military
 - Commercial
- **Research and Innovation Strategy**
 - The Challenge
- **Areas of Research and Technology development**
 - Some examples
- **Partnering to Deliver Customer Value**



GKN: A global engineering group

Every day at GKN...



We drive the wheels of hundreds of millions of cars...



We help thousands of aircraft to fly...

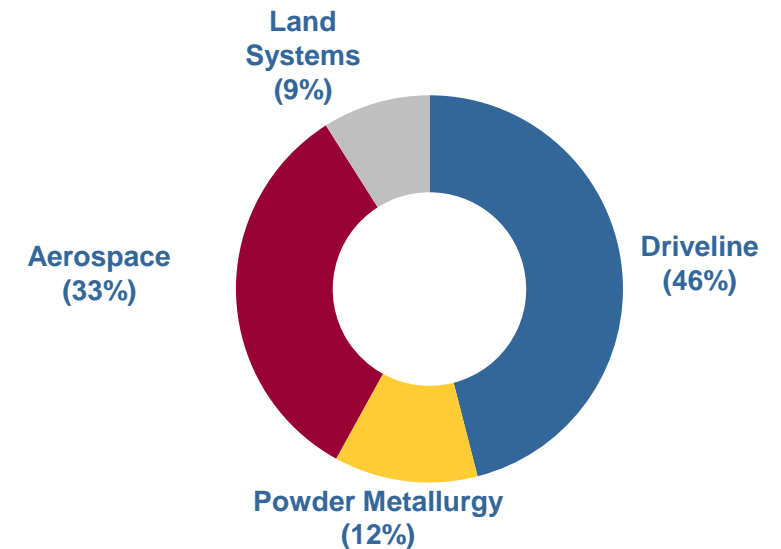


And we deliver the power to harvest crops and move earth.

In numbers

- > GKN founded in 1759
- > 56,000 employees
- > Locations in more than 30 countries
- > £8bn sales

Sales by division



GKN Aerospace - a leading global Tier 1 aircraft supplier



17,000
employees

62 locations

15 countries

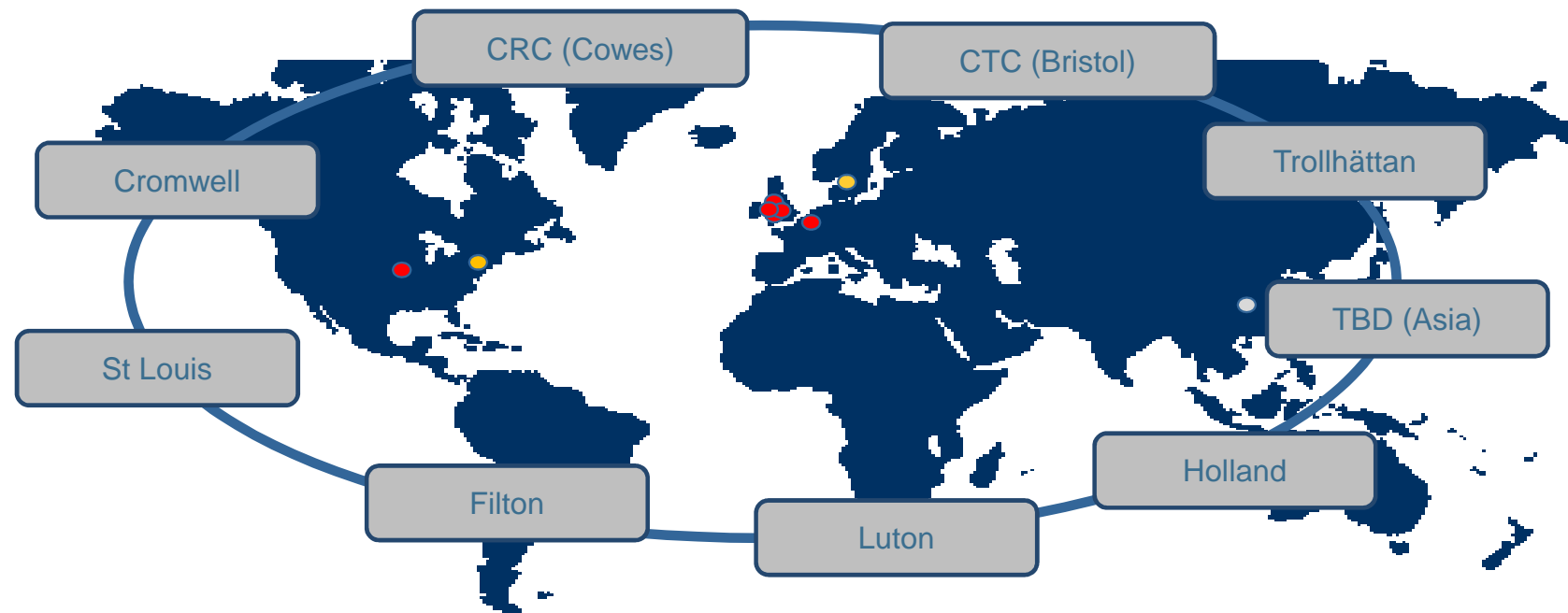
Sales: £3.0bn

* 2015 sales include Fokker



Technology Centres of Excellence

- Global - leverage the best of competences and technology
- Centralised - to excel in performance and create critical mass
- Local - to maximise support to operations
- Network - of industrial & academic partnerships leveraging best in the world



Space and Engine Services

European center of excellence in turbo pumps and exhaust nozzles

- > Design and build of Ariane 6
- > Manufacturing of US space components

Commercial engine overhaul experience since 1966

Our offer

- > Tailored maintenance solutions
- > On-site services
- > Around-the-clock technical support

Europe



Military market – on the right platforms

F35 JSF
Rate Readiness phase



A400M Atlas
In production



F15
FMS



C130J
US multi-year
and FMS



F18 Super Hornet
Rate Stable



V22
Multi-year



Gripen C/D
Product Support



Blackhawk
US multi-year
and FMS



Content on growth platforms



Commercial

- > A350XWB
- > A320neo
- > Bell 525
- > 737MAX
- > 787
- > CSeries

Military

- > A400M
- > F-35
- > CH53K



Business Jets

- > Global 7000
- > Falcon 5X
- > G500,600
- > Global 8000
- > HondaJet
- > HTF7000

Regional

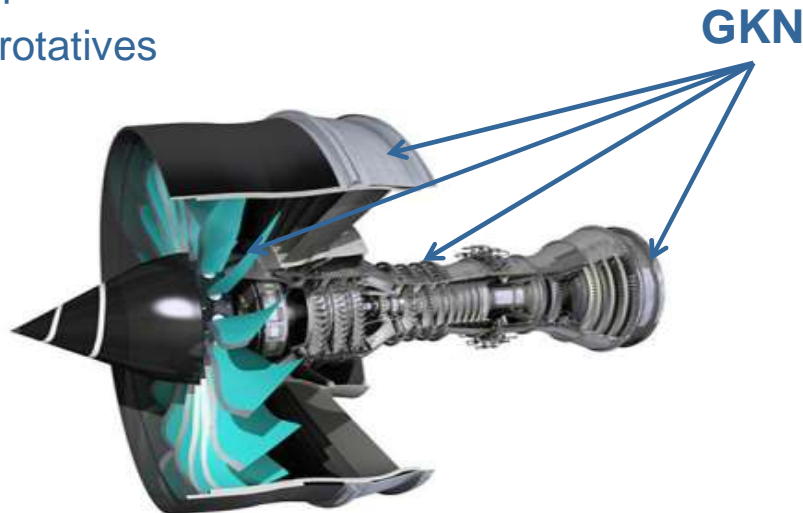
- > Ejet-E2
- > MRJ



























GKN Aerospace Engine Systems - Specialization

More than 90% of all new jet engines for large aircraft applications (>100 pax) contains parts from GKN Aerospace engine systems:

- > Fan structures
- > Turbine structures
- > Compressor and booster rotatives
- > Fan rotatives



| | | | |
|--|--|--|--|
|  Airbus A380 GP7000, Trent 900 |  Airbus A340 CFM56, Trent 500 |  Airbus A330 CF6-80, PW4000, Trent 700 |  Airbus A300 CF6-80, PW4000 |
|  Airbus A321 CFM56, V2500 |  Airbus A320 CFM56, V2500 |  Airbus A319 CFM56, V2500 |  Airbus A318 CFM56, PW6000 |
|  Airbus A350 Trent XWB |  Boeing 747 GE9x, CF6-80, PW4000 |  Boeing 777 GE90-115B, PW4000 |  Boeing 767 GE9x, Trent 1000 |
|  Boeing 767 CF6-80, PW4000 |  Boeing 757 PW2000 |  Boeing 737 CFM56, JT8D |  Boeing 717 BR715 |
|  Boeing MD90 V2500 |  Boeing MD-80 JT8D |  Fokker 50 PW100 |  Fokker 100 Tay |
|  Dassault Falcon 50 TFE731 |  Bombardier Learjet 45 TFE731 |  Bombardier C-series PW1000G |  Boeing C-17 PW2000 |
|  Saab Gripen RM12 |  Boeing F/A-18 E/F Super Hornet F414 |  Lockheed Martin F-35 JSF F135 | |

GKN's 7 Major Product Families

Current Product Portfolio



Flying
Surfaces



Fuselage
Sections



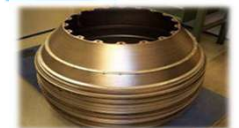
Nacelle &
Pylon



Engine Structures



Engine



Engine Rotatives



Transparencies &
Coatings

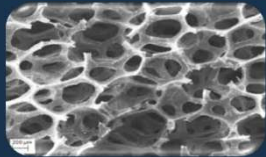


Protection Systems



The Widest Range of Technologies

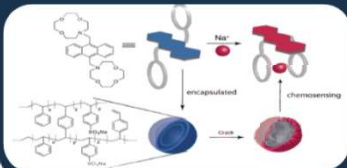
Chemistry & Materials



Erosion Coatings



Anti-Ice Coatings



Damage Detection Coatings



High temperature Materials

Processes



Near Net Joining



Additive Manufacturing



Forming & Welding



Composite Automation



Automated Polishing

Major Components



Co-Cured Wing Covers



Cutting edge canopies

Major assemblies



Composite Fuselages



Trailing Edge Assemblies



Composite Fan Cases



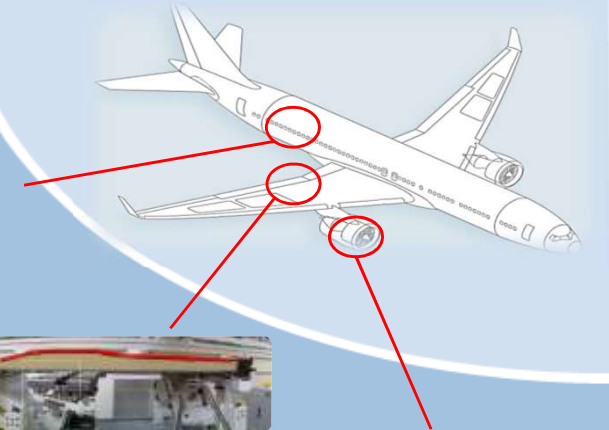
Laser Welded Structures



Engine certification



Space Propulsion Structures

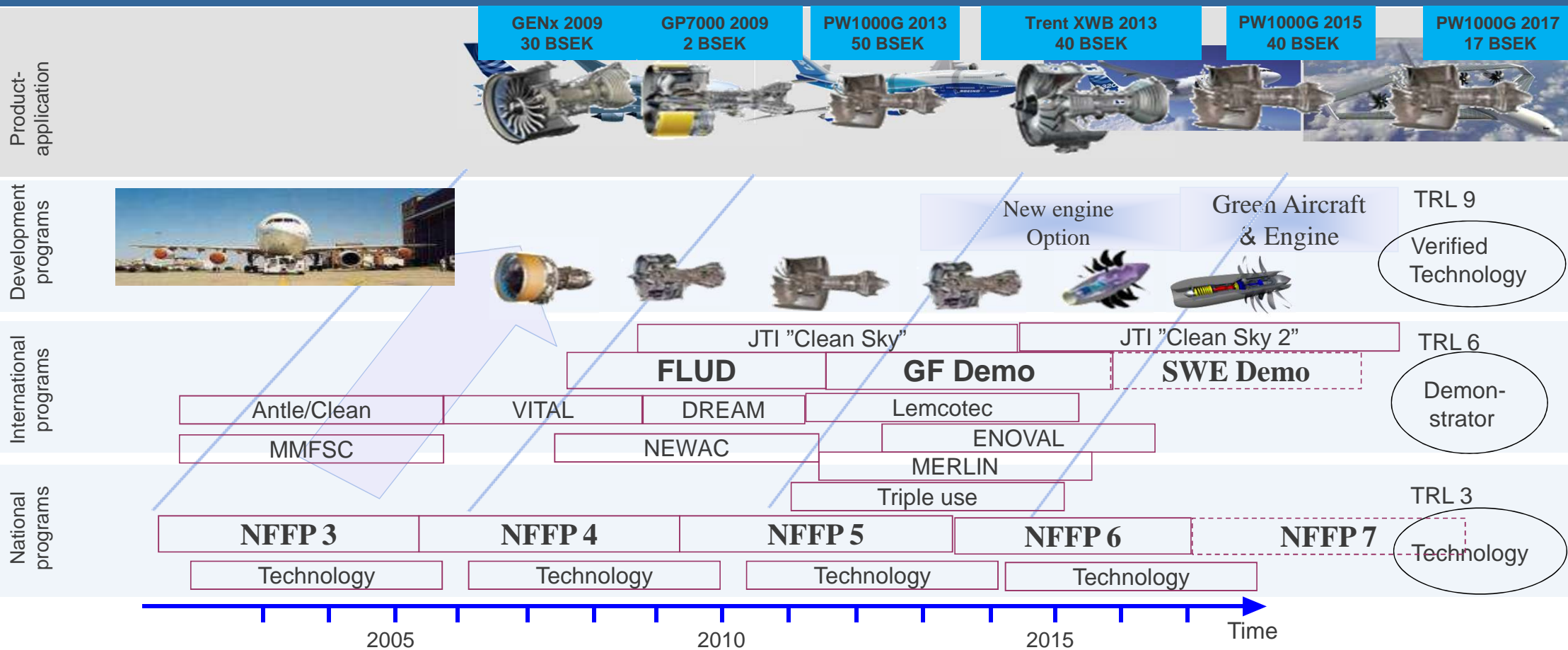


GKN Aerospace combining technologies to offer unique products



Research and Innovation strategy

"Snedes vågens princip"



Meeting the challenges

Contributing - Collaborating

- Environment
 - -75% CO₂
 - -90% Nox
 - -65% Noise
- Competitiveness
- Society
- Safety



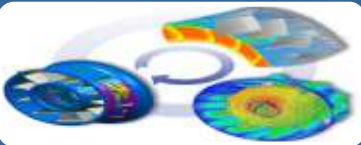
Areas of Research and Development



Product Integration

- Engine Performance Analysis
- Knowledge management

Next generation engine cycles
Next generation collaborative environment



Design and Analysis

- Functionality
- Aerodynamics and Solid mechanics

Thermal management
Multi Disciplinary Optimization



Manufacturing and Material

- Automated composite processes
- Rapid Machining & ECM

Advanced Fabrication & Joining
Additive Manufacture



Maintenance and Overhaul

- Repair technology
- Logistics optimization

REACH complains



Services

- Life tracking
- Logistics optimization

Big Data made useful



Illustrating multidisciplinary optimization

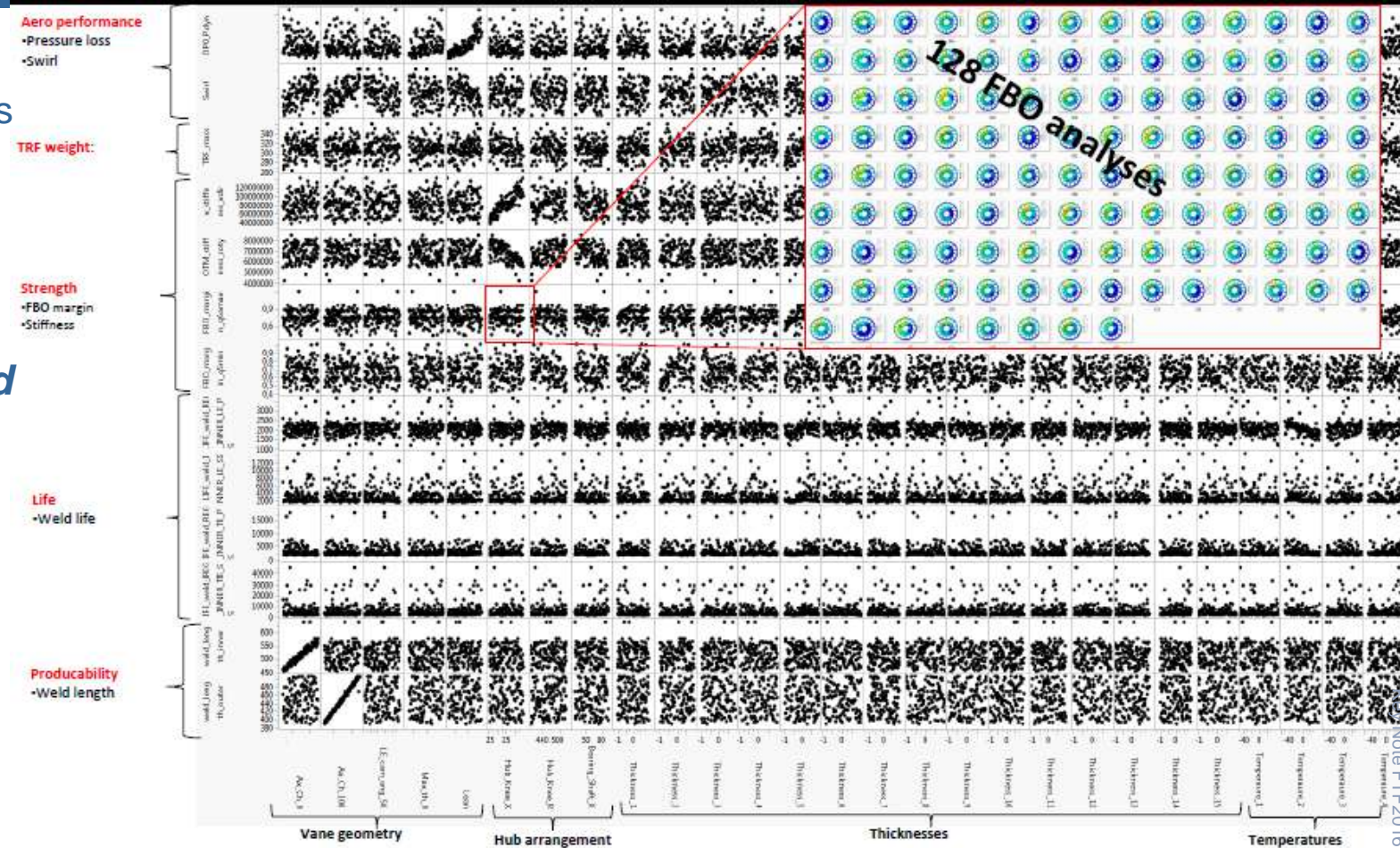
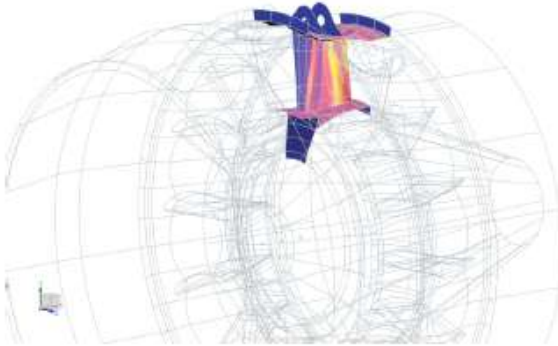
•Object Oriented Design

- enabling functional trade offs

•Design Space Exploration

- enabled through design automation and big data analytics

Advances in computer aided engineering support technology integration



Additive Manufacturing GKN Achievements So Far



Manufacturing and Material
• Automated composite processes
• Rapid Machining & ECM

Advanced Fabrication & Joining
Additive Manufacture



FIRST IN SERVICE AM PARTS - A350XWB ICC



FIRST EBM, LPB AND SLA PARTS FLYING



FIRST BLOWN POWDER CONTRACT - DELIVERED



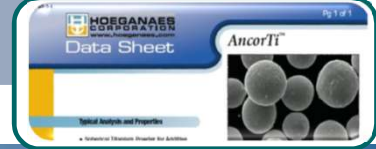
CENTRES OF EXCELLENCE IN UK, US AND SE



COMPLEX INNOVATIVE TOOLING IMPLEMENTED



GKN POWDER SPECIFIED & LAUNCHED

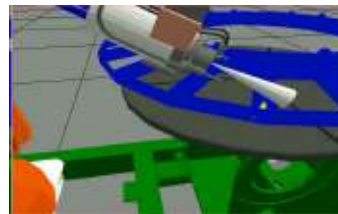


Simulation of manufacturing

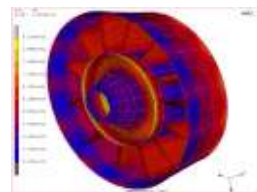
Factory simulations



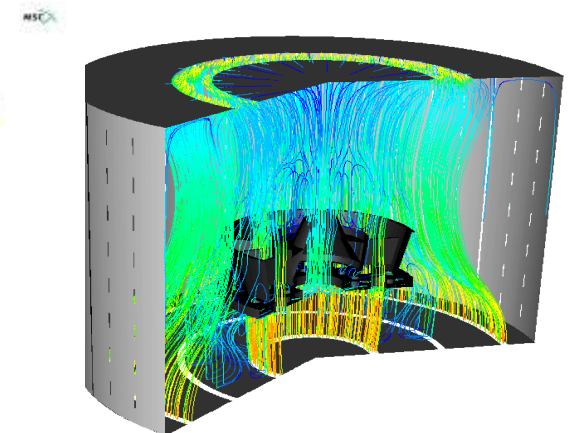
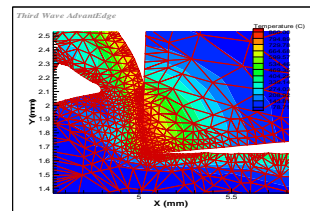
Machine simulations



Component simulations



Detailed process simulation

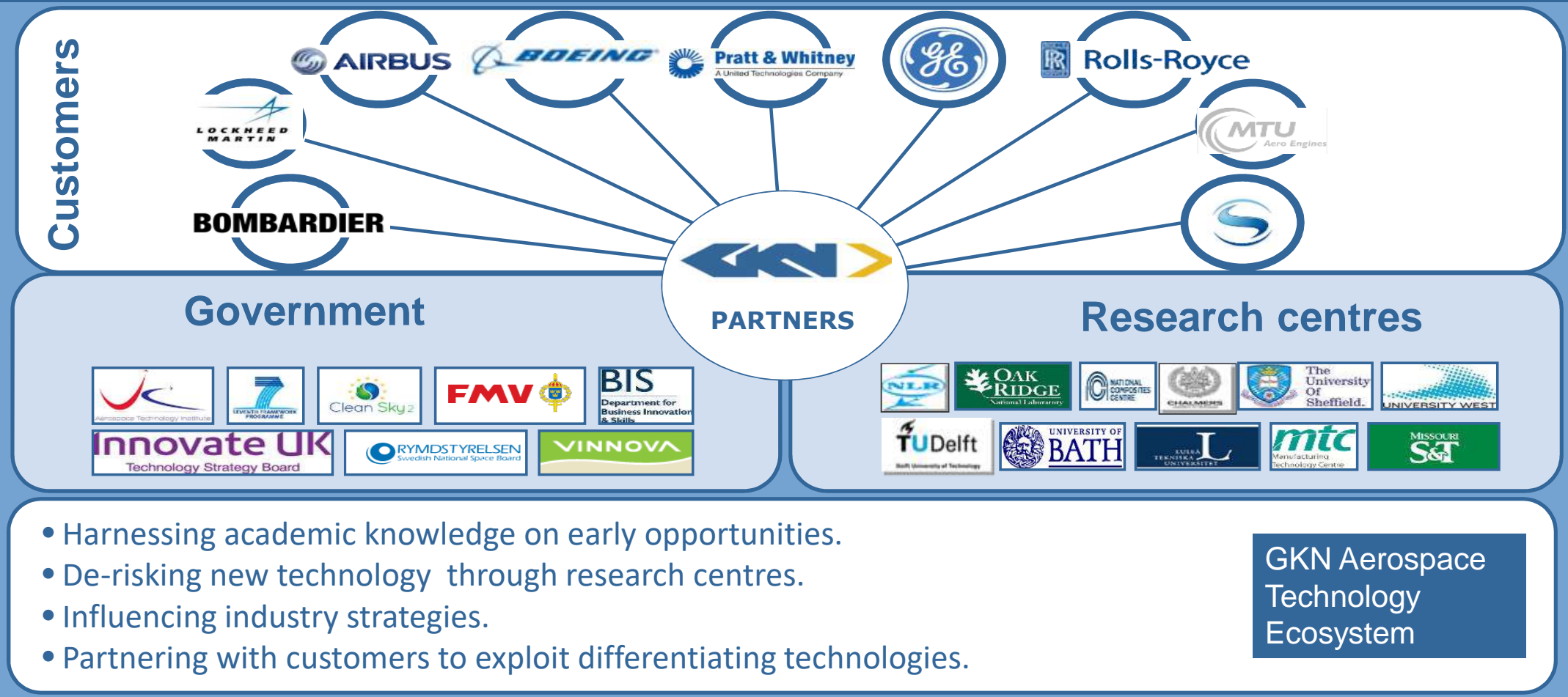


Operating in Commercial, Military and Space

- Synergies
- Edge technology
- Innovative people



Partnering to Deliver Customer Value



GKN at FTF 2016

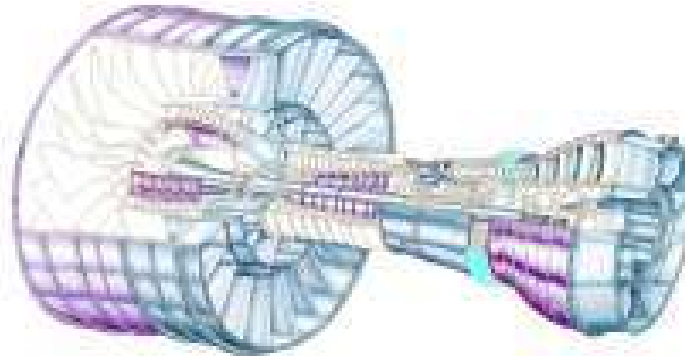
A10: GKN Aerospace involvement the Clean Sky engine demonstrators. **Robert Lundberg, GKN Aerospace**

K4: Microstructure variations in Ti-6Al-4V manufactured with different additive manufacturing processes. **Magnus Neikter, Luleå University of Technology/GKN-Aerospace**

A12: The Pratt & Whitney PW1000G engine family; Past, present and future for GKN Aerospace. **Marcus Borg, GKN Aerospace**

M5: Prognosis performance and management for efficient planning of aircraft engine maintenance. **Veronica Fornlöf, GKN Aerospace**

A13: Research in the INNOVAIR Turbomachinery cluster. **Hans Mårtensson, GKN Aerospace**



K8: Systematic redesign of manufacturing systems for aerospace. **Johan Vallhagen, GKN Aerospace**

E5: Methods to account for the effect of water and ice ingestion on compressor performance. **Lars Ellbrant, GKN Aerospace**

L13: Additive Manufacturing in Sweden and its Application in the Space Industry. **Christo Dordlofva, Luleå University /GKN Aerospace**

E7: An approach to support robust design and identify producibility parameters for jet engine components. **Johan Vallhagen, GKN Aerospace**

I7: Multidisciplinary Optimization for Integrated Design of Aero-engine Components. **Visakha Raja, GKN Aerospace**

F6: The Virtual TURbine Module Demonstrator (VITUM) research project. **Peter Johansson, GKN Aerospace**



Thank you for your attention



Source: Airbus

