Effective Industry-Academic Collaboration

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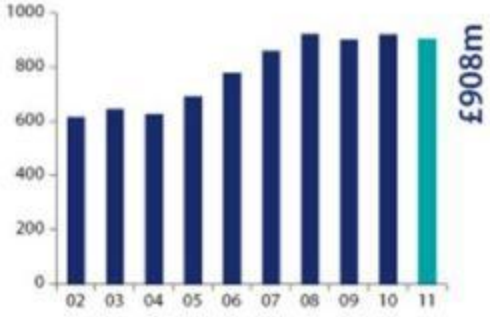
Research and development

We develop technologies and intellectual property that allow us to compete on a global basis in highly competitive markets.

- £908m invested in R&D in 2011
- £7.5bn invested in R&D over the past ten years
- 475 patent applications in 2011
- 28 University Technology Centres worldwide

Gross research and development expenditure (£m)



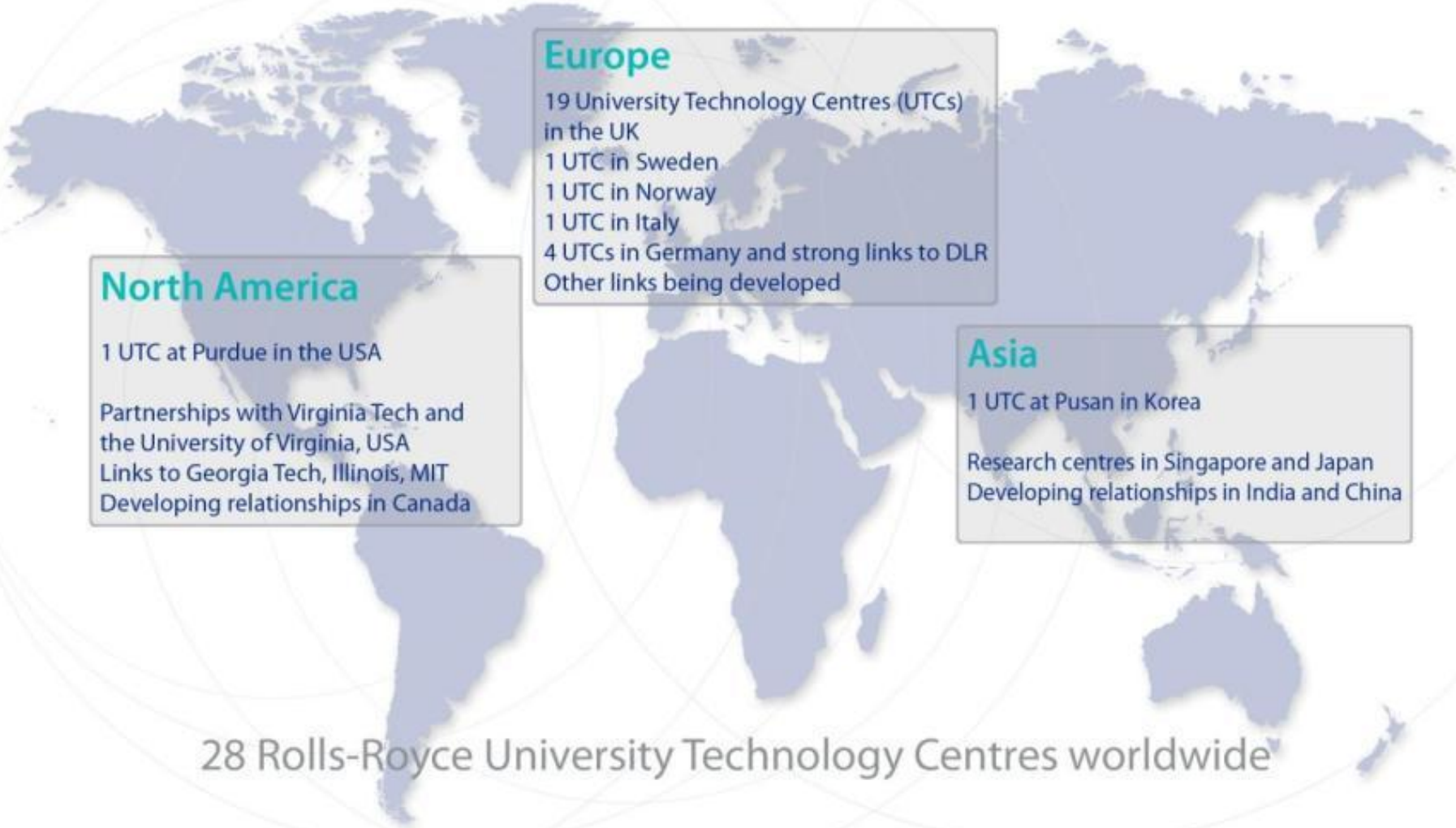
The Rolls-Royce Academic Network

- Rolls-Royce has established a strong network of successful academic collaborations
- Long term, strategic relationships
- Mutually beneficial, they take time to establish, but deliver significant and wide ranging benefits
  - Technology, Tools, Skills



http://www.rolls-royce.com/technology_innovation/index.jsp

Rolls-Royce University Technology Centres



University Technology Centres

- Long-term strategic view
- 5 year rolling contracts
- Owned by an internal Rolls-Royce business unit
- Distinct technical discipline

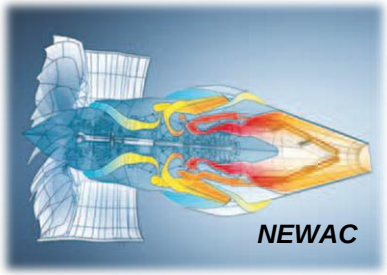
  e.g. noise, aerodynamics, combustion, performance
- Technology maturity monitored
- Technology transfer
- Funding support includes public sources

Partnerships that Work...

...over 700 people are working in the UTC network of world-class research teams...

- Multiplication of effort
- Recruitment pipeline for Rolls-Royce
- Secondment opportunities for Rolls-Royce employees
- Access to government funding
- Confidence to invest for the future
- UTC contribution to & benefit from IP
- Global network, wider collaboration
- Extensive research facilities/labs
- Effective allocation of risk

...over 400 doctorates are being supported by Rolls-Royce at any one time...



energy technologies institute

EPSRC
Engineering and Physical Sciences Research Council

Technology Strategy Board
Driving Innovation

Advanced Manufacturing network – Bridging the Technology Readiness gap

The Model

- Strong Industry pull
- Industrial 'Sand Pit'
- Technology transfer culture
- Collaborative environment
- Research with scale and pace

The Value

- High calibre teams
- Industry scale equipment
- Full scale components
- Sharing of knowledge and resources
- Exemplary public / private partnership
- Delivers real benefits
- Co-location of engineers

A Global Network of Manufacturing Research Centres

A Global Network of Advanced Manufacturing Research Centres

But it is a *Balance*

- You cannot easily “stop and start”
- It costs money, time and effort
- Publication & IP
- Avoid complacency

Need to keep the overall picture of the relationship; it is not just as a collection of projects

Making collaboration effective

- Avoid the EFFICIENCY trap
- Define what makes it successful to you
- Keep it simple, but take more than one view
- Rolls-Royce focuses its measures around
  - Strategy
  - Leadership
  - Resources
  - Output

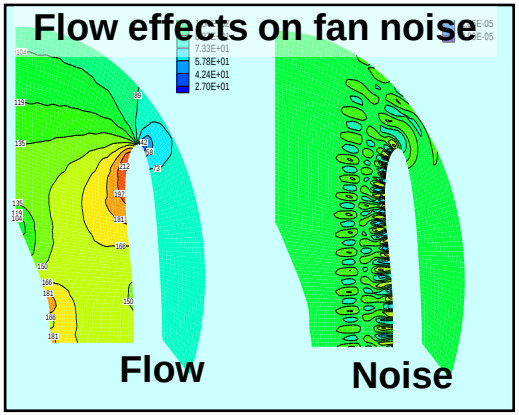
An International Perspective

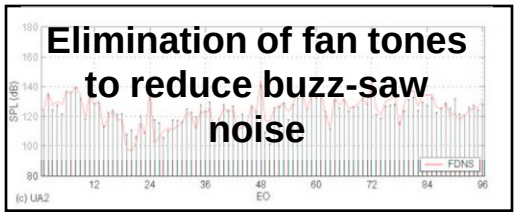
- UK
  - Excellent research & fundamental science
  - No national research centres.
- Germany
  - Excellent science, strong engineering skills,
  - National research centres (eg Fraunhofer, DLR).
- Asia
  - Generally still see PhD as training,
  - Very strong support for applied research
- US
  - Legislature influences IP ownership, but can be worked
  - Good economic development mechanisms

And yes, it works

Significant technology delivery - single component example (Trent 900 swept wide-chord fan blade)

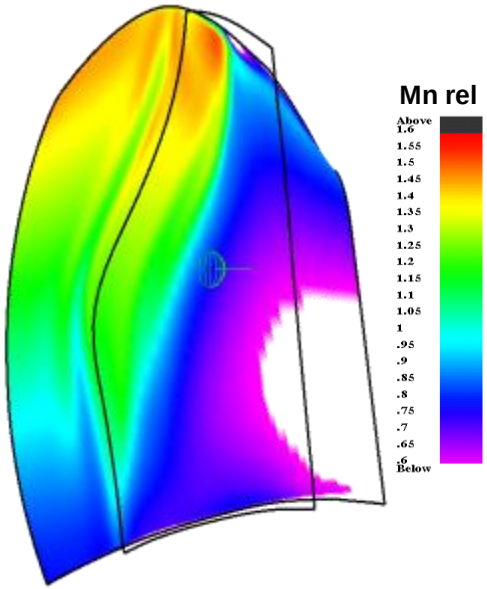
University of Southampton





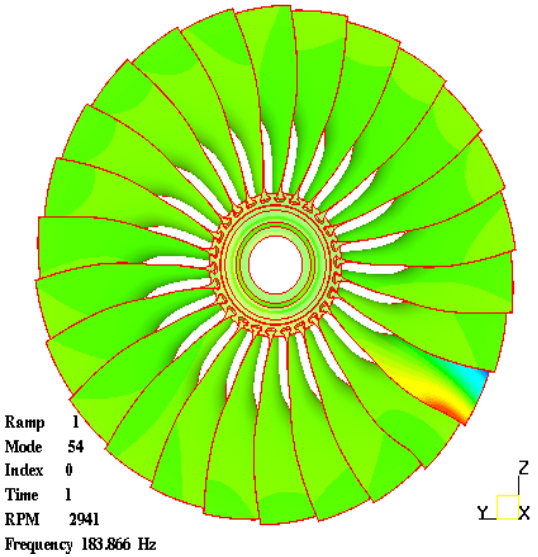
University of Cambridge

High efficiency swept fan



Imperial College London

'Aero-Mechanics of Bird Damaged Fan'



University of Birmingham

Titanium materials understanding

University of Nottingham

Manufacturing technology

University of Oxford

Understanding of bird-impact response

Rolls-Royce Group

Reliability, integrity, innovation