Shaping the Future

WMG
THE UNIVERSITY OF WARWICK

Research Excellence Framework: What is Impact and How to Achieve

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About WMG

- **University of Warwick Manufacturing**
  - Research, Education, Implementation
- **World class research**
  - 90% world-leading/internationally excellent (HEFCE: REF 2014)
- **High Impact**
  - UK Lambert, Wilson, Witty Reviews of University - Business Collaboration
- **Improving skills base**
  - From school to postgraduate

OUTPUTS, OUTCOMES AND IMPACT

Research Outputs and Outcomes

- Need to be quantified and evidenced

- Outputs include
  - *Financial:* e.g. Industrial Income.
  - *Operational:* e.g. New academic posts
  - *Industry:* e.g. Businesses Assisted, New Collaborations with the Knowledge Base
  - *Academic Engagement:* e.g. Journals, Conferences, Trade Publications
  - *Public Engagement:* e.g. Events, TV coverage

Outcomes - Impact

- Outputs lead to outcomes and impact
- Impact required from all research – time to market varies by technology readiness level (TRL)
- Longer Term – TRL 1-3 – Research Councils
- Medium Term – TRL 4-6 –Horizon 2020, Innovate UK
- Short Term – TRL 7-9 – Industry Funded
- The researcher is best placed to develop and deliver ‘pathway to impact’

The Baseline - Academic Impact

- Publication - Citations
- Incorporation of Outcomes into Research by Other Institutions
- Incorporation of Outcomes into Undergraduate and Graduate Education

But also economic, social, environmental, international etc. impact

Economic Impact

- Employment Safeguarded and / or Created
- Increased Gross Value Added
- Inward Investment Enabled
- New Products, Processes and Services Created
- New Skills Gained by Individuals in Industry
- Increased R&D Investment in Industry

Environmental Impact

- Reduced Emissions of Greenhouse Gases
- Reduced Energy and Materials Consumption
- Reduced Waste Generation
- Reduced Travelling

Social Impact

- Increased Number of Young People – Apprentices etc. into Employment
- Increased Applications to Undergraduate Courses with Wider Participation
- Enhanced Attractiveness of Jobs in Industry
- Impact on Disadvantaged Groups
- Enhanced Public Perception of Sector

International Impact

- Enhanced International Competitiveness of Industry
- Improved Profile of Companies
- Increased Exports linked to Research Innovations

Approach to Impact

- Engineering, technology and business are applied subjects – collaboration and impact at their heart
- Role to put knowledge in form that can be used
- Create tailored mechanisms '*pathways to impact*' to enable exploitation
- Focus on how a 'customer' can most easily absorb
- Partnerships, research, unique facilities, education, demonstrators and knowledge transfer in context of REF

REF 2014

How REF 2014 Operated

REF assessed the quality of research in all UK universities, in all disciplines. It was carried out by 36 expert panels, grouped into 4 main panels.

Main Panel A: **Medical and life sciences**

Main Panel B: **Physical sciences and engineering**

Main panel C: **Social sciences**

Main Panel D: **Arts and humanities**

2011-12

Preparation

Panels were appointed. Guidance and criteria were published.

2012-13

Submissions

Universities made submissions in whichever subjects they chose to.

2014

Assessment

36 expert panels reviewed the submissions, guided by the 4 main panels.

What was Assessed

Panels judged the **overall quality** of each submission

65%	20%	15%
Quality of research **outputs**	**Impact** of research on society	The research **environment**
191,150 research outputs by **52,061** staff were reviewed	**6,975** impact case studies were reviewed	The review was based on data and information about the environment

REF2014
Research Excellence Framework

The research of 154 UK universities was assessed

They made **1,911** submissions including:

- **52,061** academic staff
- **191,150** research outputs
- **6,975** impact case studies

The **overall quality** of submissions was judged, on average to be:

★★★★ **30%** world-leading (4*)

★★★ **46%** internationally excellent (3*)

★★ **20%** recognised internationally (2*)

★ **3%** recognised nationally (1*)

Results were in the form of ‘profiles’

EXAMPLE - 2014 Research Excellence Framework Results									
Quality profiles for all submissions (sample)									
Institution name	Main panel	Unit of assessment name	Profile	FTE Category A staff submitted	4*	3*	2*	1*	unclassified
University X	A	Biological Sciences	Outputs	50.45	12.8	32.8	43.0	11.4	0.0
University X	A	Biological Sciences	Impact	50.45	20.0	45.0	35.0	0.0	0.0
University X	A	Biological Sciences	Environment	50.45	0.0	40.0	40.0	20.0	0.0
University X	A	Biological Sciences	Overall	50.45	12	37	41	0	0
University X	B	General Engineering	Outputs	65.20	25.9	43.1	27.0	4.0	0.0
University X	B	General Engineering	Impact	65.20	17.9	60.1	21.0	1.0	0.0
University X	B	General Engineering	Environment	65.20	10.0	70.0	20.0	0.0	0.0
University X	B	General Engineering	Overall	65.20	22	51	24	3	0
University X	A	Architecture	Outputs	40.00	17.0	60.0	20.0	2.0	1.0

The overall quality profile is weighted 65% for Outputs, 20% for Impacts, 15% Environment

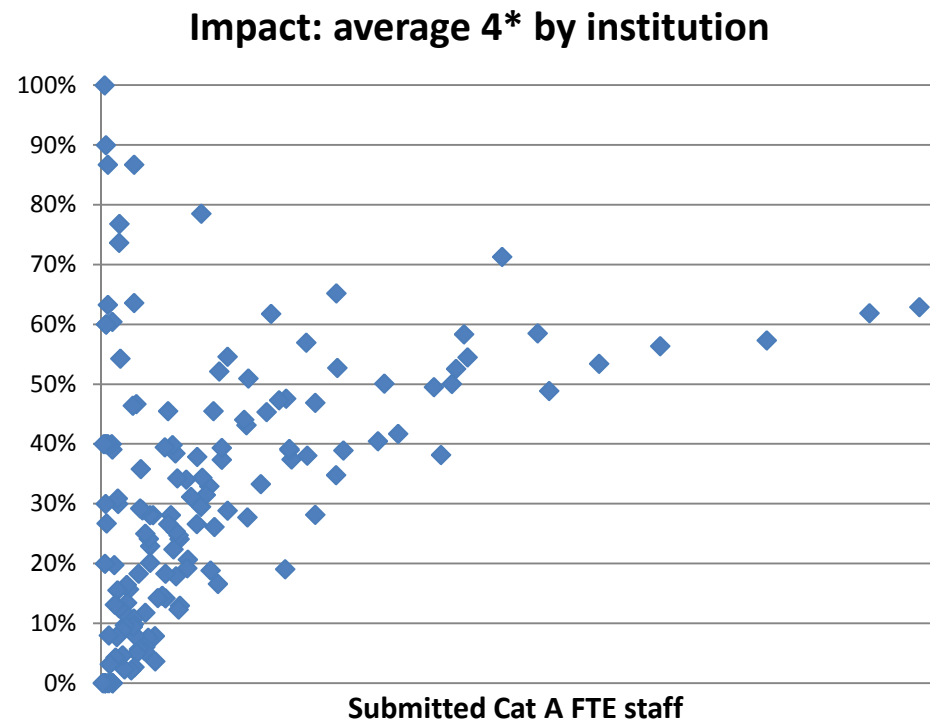
Definition of Impact for the REF

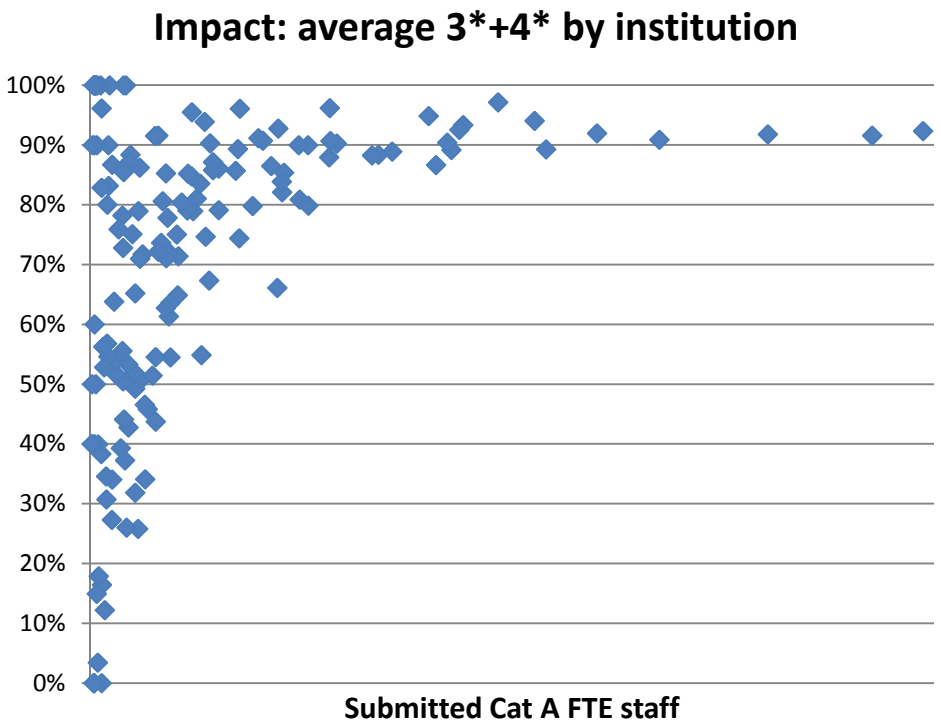
- *"An effect on, change or benefit to the economy, society, culture, public policy or services, health, the environment or quality of life, beyond academia"*
- Impact **includes**, but is not limited to, an effect on, change or benefit to:
  - the activity, attitude, awareness, behaviour, capacity, opportunity, performance, policy, practice, process or understanding
  - of an audience, beneficiary, community, constituency, organisation or individuals
  - in any geographic location whether locally, regionally, nationally or internationally.
- Impact **includes** the reduction or prevention of harm, risk, cost or other negative effects.
- Impacts on research or the advancement of academic knowledge within the higher education sector (whether in the UK or internationally) are **excluded**. (The submitted unit's contribution to academic research and knowledge is assessed within the 'outputs' and 'environment' elements of REF.)
- Impacts on students, teaching, other activities within submitting HEI **excluded**.
- Other impacts within the higher education sector, including on teaching or students, are **included** where they extend significantly beyond submitting HEI.

REF demonstrated impact in all subjects

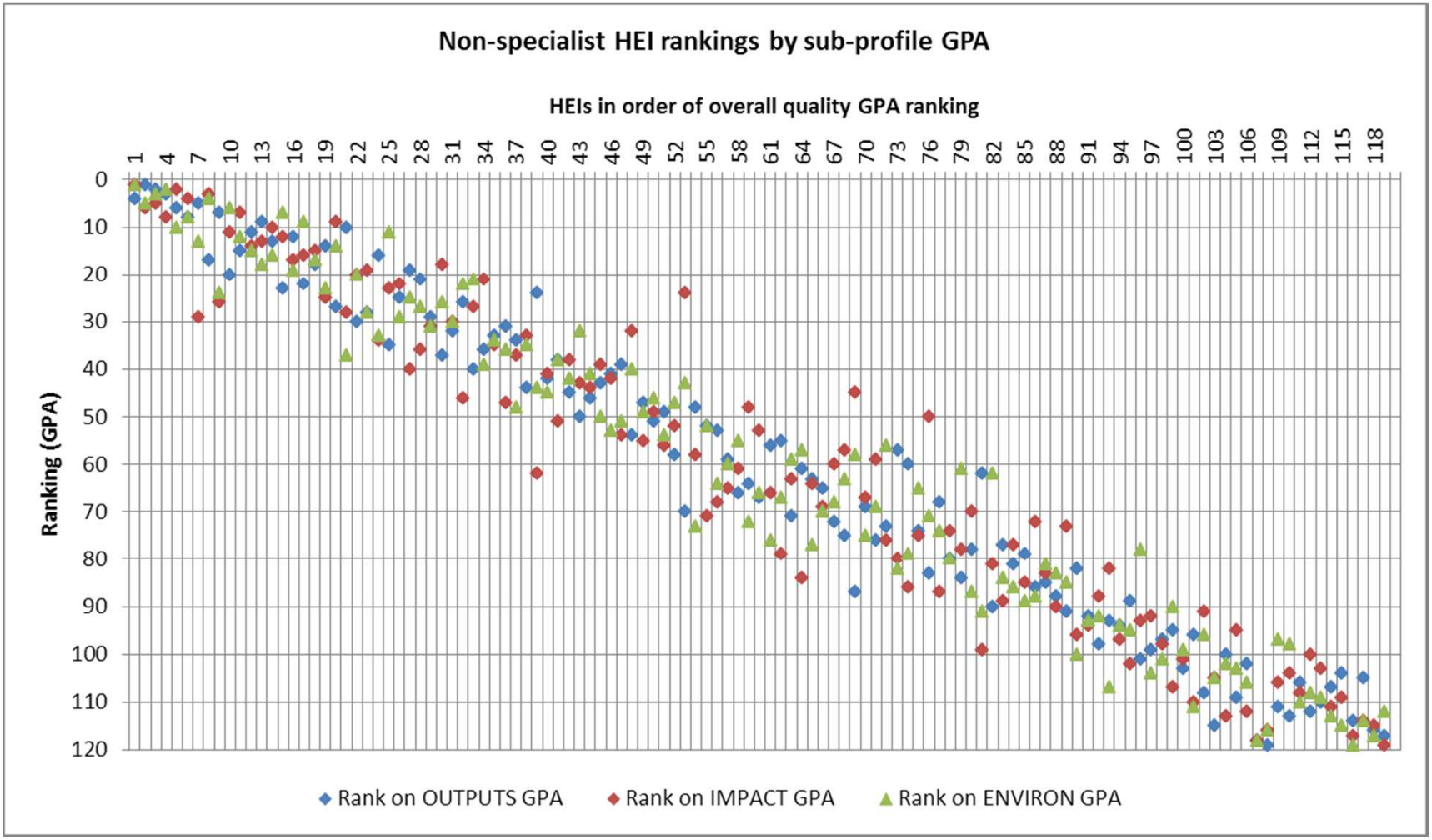
- Over 250 research users judged the impacts, jointly with academic panel members.
- **44%** of impacts were judged outstanding (4*). A further **40%** were judged very considerable (3*).
- Impressive impacts were found from research in all subjects.
- REF shows many ways in which research has fuelled economic prosperity, influenced public policy and services, enhanced communities and civic society, enriched cultural life, improved health and wellbeing, and tackled environmental challenges.

Impact was found across institutions with submissions of all sizes





Impact and other scores related, but not perfectly



REF 2014 – Assessment of Impact

- Impacts will be assessed in terms of their 'reach and significance' regardless of the geographic location in which they occurred, whether locally, regionally, nationally or internationally.

- Many impacts will contribute to the economy, society and culture within the UK, but equally value the international contribution of UK research.

- Note – some panels under 'Additional Information' to each research output (Quality assessment – REF2) sought 100 words on significance of the output where not evident within the output (e.g. if the output had gained external recognition, led to further developments or been applied).

REF 2014 – Submission Requirements

- Assess impact of excellent research undertaken within each submitted unit.
- Evidenced by specific examples of impacts underpinned by research undertaken within the unit over a period of time, and the submitted unit's general approach to enabling impact.
- The focus of the assessment is the impact of the submitted unit's research, not the impact of individuals or individual research outputs.
- **A completed impact template (REF3a)**: describing the submitted unit's approach, during the assessment period (1 January 2008 to 31 July 2013), to enabling impact from its research.
- **Impact case studies (REF3b)**: describing specific impacts during the assessment period (1 January 2008 to 31 July 2013) that were underpinned by excellent research undertaken in the submitted unit during the period 1 January 1993 to 31 December 2013.

REF 2014 – Panel Assessment

- Panels assess evidence in the completed impact template (REF3a) and the submitted case studies (REF3b).

- Form impact sub-profile for each submission by attributing a weighting of 20 per cent to the impact template (REF3a) and 80 per cent to the case studies (REF3b).

- Panels applied their expert judgment based on all the information provided in the impact template and case studies, before confirming the impact sub-profiles.

REF 2014 – Impact Template (REF3a)

- Describes the submitted unit's approach during assessment period (1 January 2008 to 31 July 2013) to supporting and enabling impact.
- Context for the individual case studies and additional information about a wider range of activity within the submitted unit and its capacity for impact.
- Mechanism for the assessment to take account of particular circumstances that may have constrained selection of case studies (e.g. new department, or where the focus of its research may have limited opportunities for application).
- Information on: context, the unit's approach to impact during the period 2008-2013, strategy and plans for supporting impact, the relationship between the unit's approach to impact and the submitted case studies.

REF 2014 – Impact Template (REF3a)

- Focus primarily on the approach taken by the submitted unit to achieving research impact – not the approach of the HEI as a whole (can include statement of how made use of institutional resources and infrastructure, and aligned with wider HEI strategy).
- Not repeat evidence included in case studies, though could refer to submitted case studies. Include evidence and specific details or examples of the submitted unit's approach, rather than broad general statements.
- Panels will assess the impact template in terms of the extent to which the unit's approach is conducive to achieving impacts of reach and significance.

WARWICK / WMG - IMPACT

WMG Impact Template Sections

- 5 page submission
- A – Context (0.25 side)
- B – Approach to Impact (3.50 sides)
- C – Strategy and Plans (1 side)
- D – Relationship to Case Studies (0.25 side)

Impact Policy (Section A – Context)

- Structure research to ensure excellence with impact
- Internationally leading research in conjunction with non-academic users
- Take responsibility for transferring knowledge in a form and environment to enable exploitation
- Academic staff recruited based on excellence and wish to engage with non academic users
- Full training provided and dedicated support to achieve transfer and impact

Global Research Priorities

CONNECTING CULTURES

ENERGY

FOOD SECURITY

GLOBAL GOVERNANCE

BEHAVIOURAL SCIENCE

INNOVATIVE MANUFACTURING

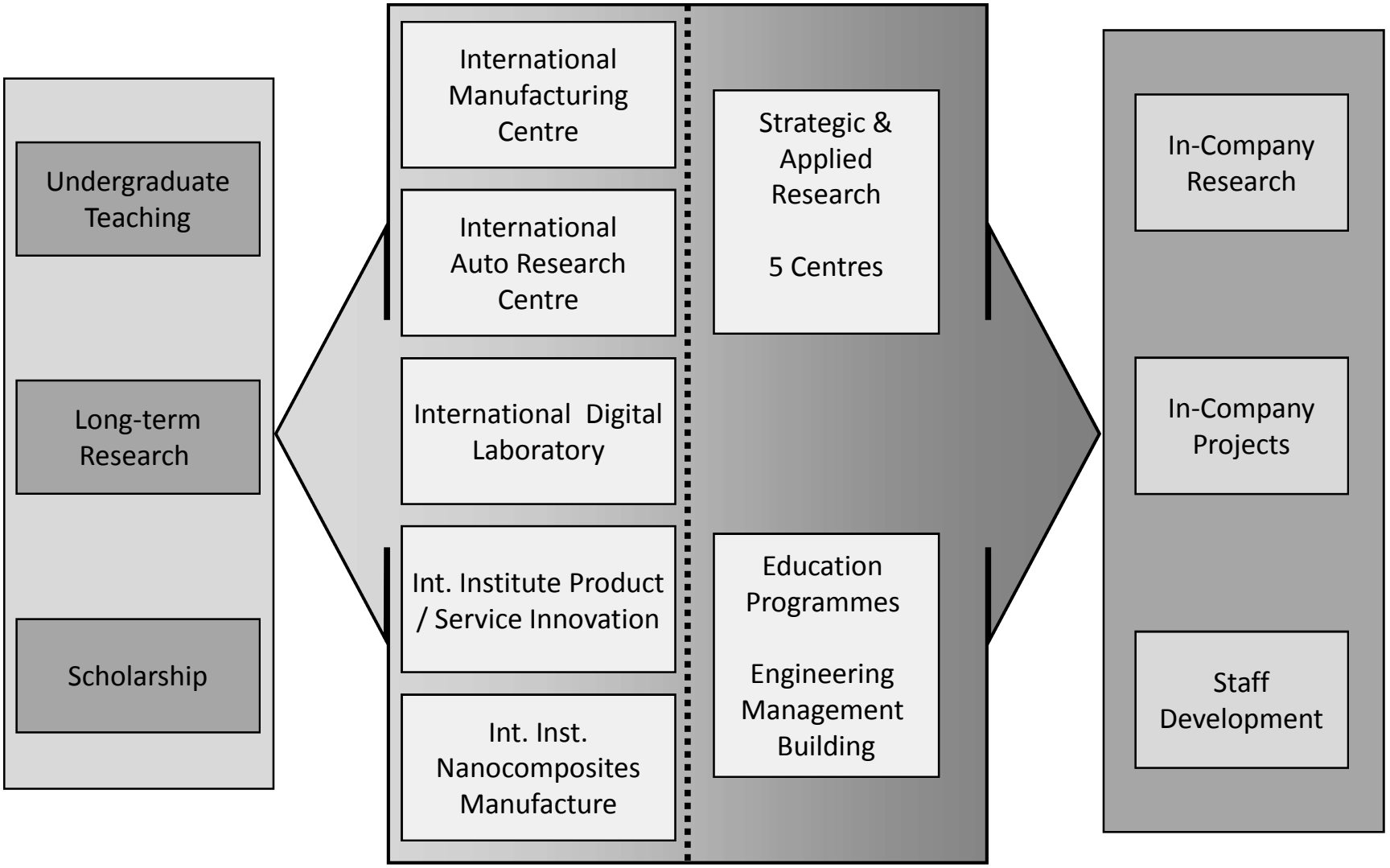
INTERNATIONAL DEVELOPMENT

MATERIALS

SCIENCE & TECHNOLOGY FOR HEALTH

SUSTAINABLE CITIES

Intermediate Institute

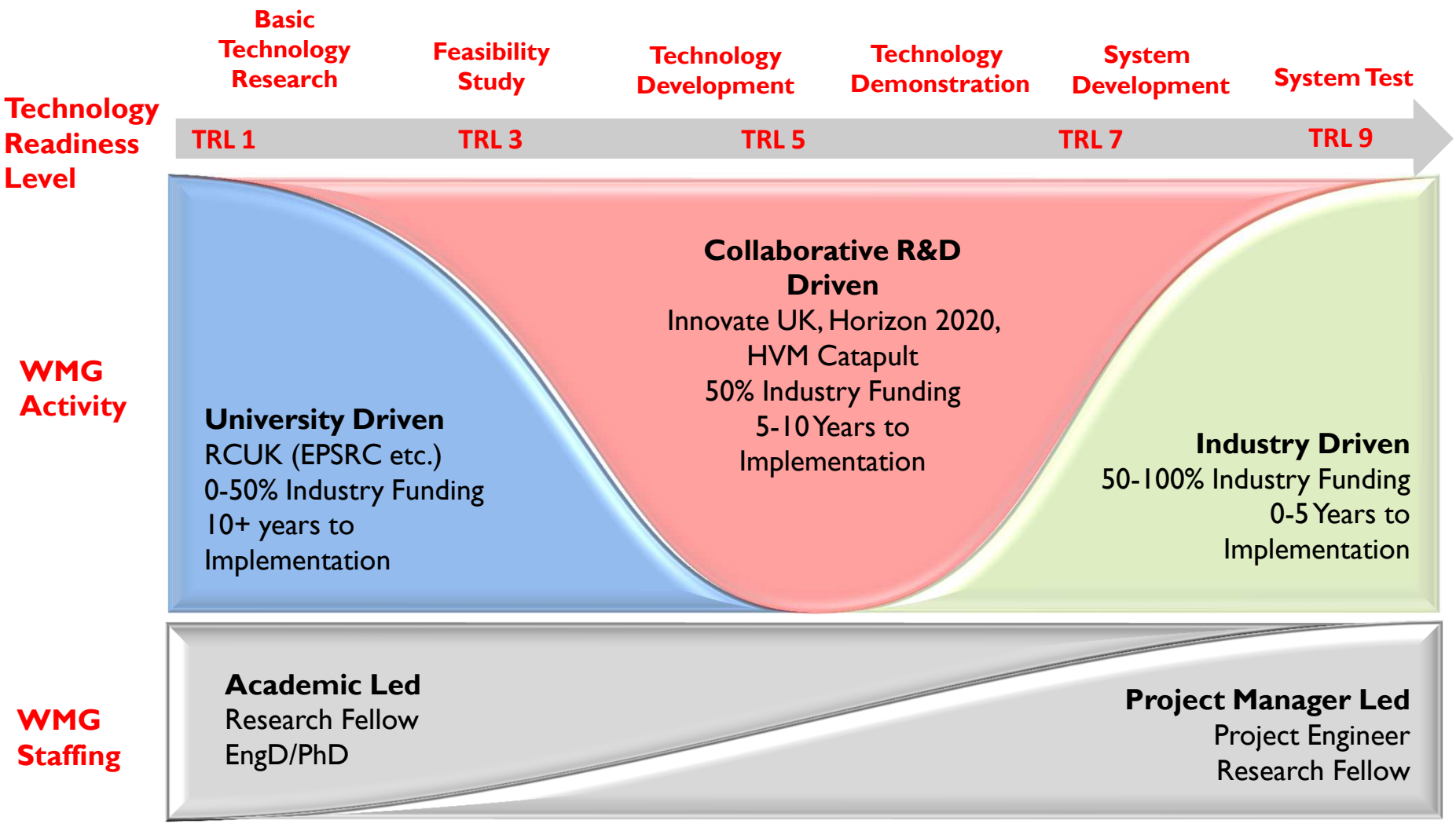


Research Priorities

Research Group	Lead Academic	Theme
Experiential Engineering	Cain	DESIGN
Visualisation	Chalmers	
Engineering Materials & Manufacturing	Dashwood	MATERIALS
Steels Processing	Seetharaman	Ceramics
Nanocomposites	McNally	Composites
Sustainable Materials & Manufacturing	Kirwan	Metals
Electrochemical Engineering	Dashwood	Polymers
Net-Shape Manufacturing	Barnes	
Metrology	Williams	
Automation Systems	Harrison	MANUFACTURING
Digital Lifecycle Management	Ceglarek	
Energy & Electrical Systems	Jennings	
Propulsion Systems	Greenwood	
Biomedical Informatics, Imaging & Healthcare Technology	Arvanitis	SYSTEMS
Cybersecurity	Watson	
Service Systems	Ng	BUSINESS
Supply Chain	Godsell	

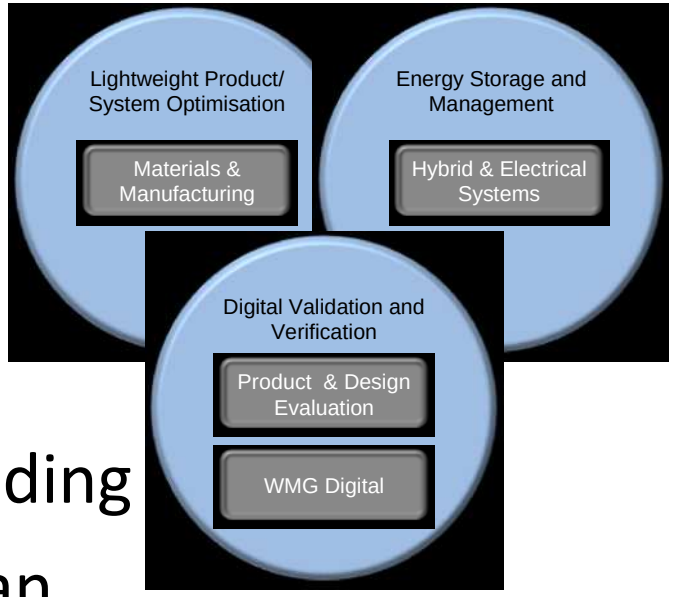
User Engagement
WMG centre High Value Manufacturing Catapult
Institute for Digital Healthcare
Education Programmes
SME Programmes

Research Landscape



WMG centre HVM Catapult

- WMG is part of the UK government's first Catapult as one of seven partners.
- Launched October 2011
  - RMB 220M pa core funding
  - RMB 220M pa industry match funding
  - RMB 220M pa other UK / European funding
- WMG focus on Low Carbon Mobility (Automotive with Rail, Marine, Yellow Goods and Aerospace)



CATAPULT
High Value Manufacturing

Institute of Digital Healthcare

Institute of Digital Healthcare
design : develop : deploy : evaluate

The Institute of Digital Healthcare (IDH) is a co-funded collaboration programme between NHS West Midlands, WMG and Warwick Medical School.

Improve people's health and wellbeing through the use of innovative digital technologies and methodologies.

- Healthcare Technology
- eHealth Innovation
- Activity Monitoring
- Healthcare Systems Engineering
- Informatics & Virtual Reality
- Neuroimaging

NHS West Midlands

Warwick Medical School

National Automotive Innovation Centre

- RMB 1.3bn investment – one of the biggest private sector investments in any university
- A 33,000m^2 collaborative research environment
- Unique infrastructure and national focus for R&D addressing UK Automotive Council agenda
- Creating 1,000 and attracting 3,000 further R&D jobs
- Bringing global R&D of major Tier 1 suppliers to co-locate

Unique Facilities – e.g. Energy Innovation

- UK Energy Storage R&D Centre: to enable battery scale-up and develop processes to take new chemistries from lab to power pack
- Research Council SUPERGEN Energy Storage
- UK's RMB 90m Spearheading Future Electric Vehicle Battery Production
- Enabling Electric Vehicle Land Speed Record holding Drayson vehicle

What is the Impact from Your Research?

- Can’t leave to chance or to others to ‘pull knowledge’ through
- Think about the breadth of potential impact that your research has
- Put in place pathways to achieve impact – take responsibility

PATHWAYS TO IMPACT

Approach to Impact (Section B)

- Research (TRL 1-3) – research council projects, co-funded programmes, research networks, Science City Research Alliance.
- Research (TRL 4-6) – Innovate UK projects, demonstrator projects, Catapult centre, direct industry contracts.
- Start-Up Companies, Strategic Partnerships, Facilities Usage, Knowledge Transfer Programmes, Education Programmes for Industry, Industrial Doctorates, Influencing Policy, Public Understanding.
- Examples discussed …

Direct Exploitation by Partners

- Premium Automotive R&D Programme (PARD)
- Four year strategic programme including 170 supplier companies
- 17 research projects with wide dissemination through 2 skills projects
- Numerous implementations in existing and new vehicles
  - 295 New Products and Processes
  - 5,439 Learning Opportunities
  - RMB 900M Additional R&D investment
  - RMB 1.3bn. Gross Value Added
  - RMB 300M Private Sector Leverage

Automotive Simulation Project: Partners

Morganite Electrical Carbon

Coupland Bell

Demonstrator Programmes

Start-Up Companies

- Number of start-ups
- How enabled start-ups

- Evidence of impact:
- Protected intellectual property
- Full time staff employed
- Venture Capital invested and R&D grants awarded
- Credit scores
- Innovation Awards
- Web ‘hits’ and sales leads
- Product launches and product sales
- Quotations from satisfied users
- Environmental impact of technology

Knowledge Transfer Programmes

- **20% - Late adopters**
  Awareness briefing, case studies, demonstrators

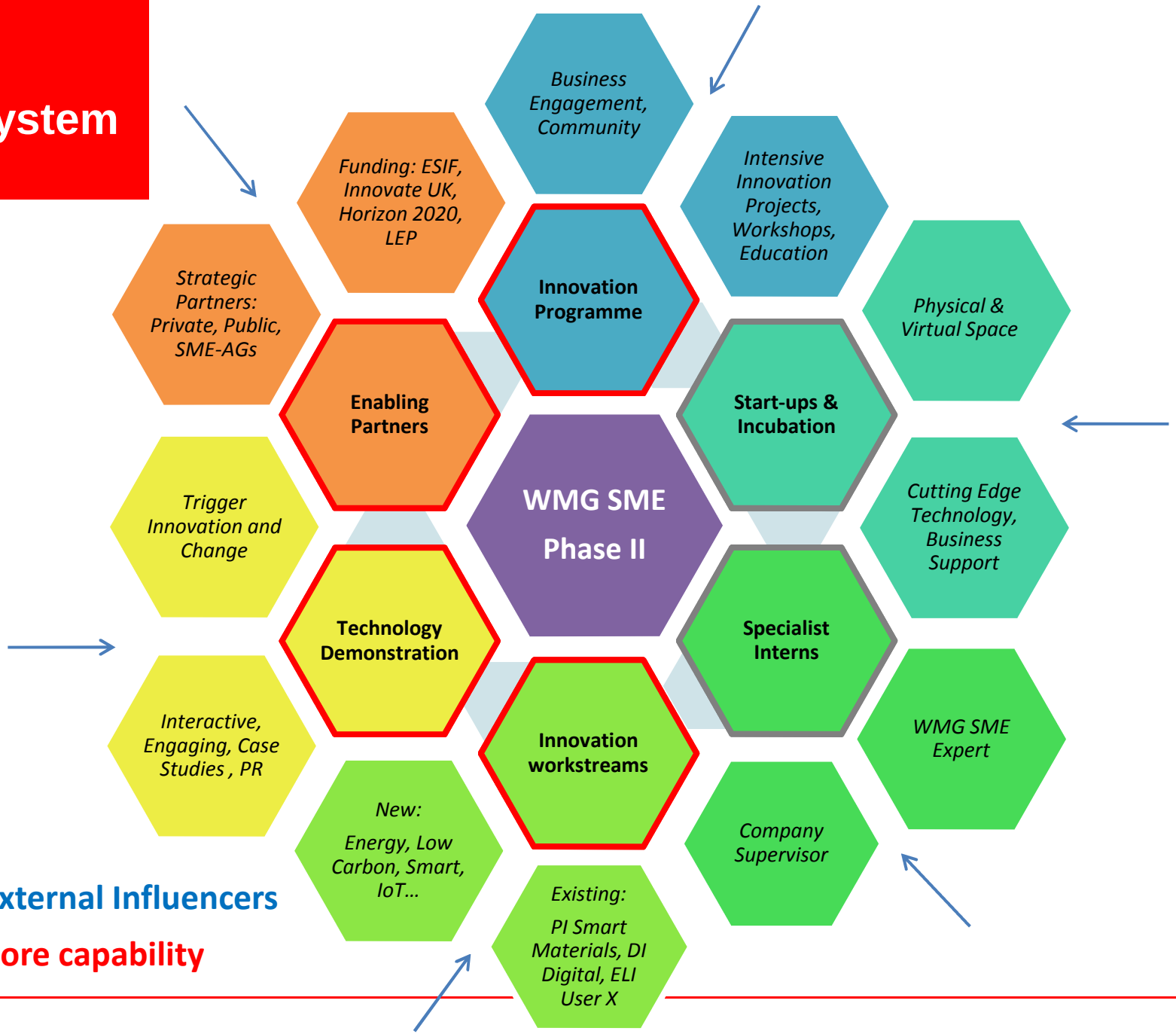
- **45% - Mainstream SMEs**
  Intensive company projects – prototyping, identifying markets, internships, product/service evaluation

- **25% - Leading edge SMEs**
  In-depth workshops, advanced demonstrations, horizon scanning, hands-on

- **10% - Feasibility to full R&D**
  Feasibility studies, collaborative projects assistance with funding / grant applications

Small & Medium Sized Enterprises

SME Ecosystem



Education Innovations

- WMG Academy for Young Engineers - business-focused, business-led innovative school
- Innovative industry skills programmes– 30,000 awards
- Major programmes include
  - *AstraZeneca, BAE Systems, Network Rail, Rolls-Royce, UTC Aerospace*
- Technical Accreditation Scheme - 3,000 technology Masters modules taken by staff to date – 8 Universities
- Applied Engineering Programme - Online undergraduate programme for company staff
- Training banks on investment decisions in manufacturing e.g. Barclays, Lloyds, RBS and Santander
- Research Council Doctoral Training Centre / Engineering Doctorate

Modules (2 ½ and 5 day)

Business Modules

- Business Awareness
- Commercial & Industrial Law
- International Joint Ventures
- Managerial Accounting & Control Systems
- Strategic Marketing
- Business Policy & Strategic Management
- E-Commerce
- Financial Analysis & Control Systems
- Financial Decision Making
- Global Business Environment
- Global e-Business
- Legal Aspects of Global Business
- Management of Change
- People in Organisations

Operations Modules

- Design Management
- Improving Business Performance
- Improving Manager Performance
- Industrial Engineering
- Logistics Planning
- Process Analysis
- Process Improvement
- Project Planning, Management and Control
- Quality Management
- Manufacturing Planning & Control
- Manufacturing Process Capability
- Supply Chain Management
- Total Productive Maintenance
- Working in Teams
- Applied Statistical Methods
- Business and Operations Design
- Collaborative Product Development
- Creating Business Excellence
- Design for the Environment
- Improving Personal Performance
- Innovation Strategy
- Knowledge-based Asset Management
- Leadership
- Leadership & Excellence
- Lean Principles & Application
- Logistics & Operations Management
- Managing the Multi-Project/Programme Environment
- Operations Strategy for Industry
- Process Improvement Using Six Sigma
- Product Design & Development Management
- Product Excellence Using Six Sigma
- Quality Management and Techniques
- Robust Design & Development
- Simulation of Production Operations
- Storage & Warehousing Techniques
- Technology Management

Technology Modules

- Dimensional Management
- Information Technology
- Process Modelling
- Advanced Materials & Processes
- Automation and Robotics
- Enterprise Information Systems
- Information & Communication Technologies
- Machining Technologies
- Manufacturing Process Technologies
- Manufacturing Technology
- Materials Engineering
- Packaging

Education Pathway

Hands On Education

Influencing Policy

- Professional advice or expert testimony
- New approaches and behaviours based on research
- Creation of national and international standards
- New national and international Government policies

Public Understanding Activities

- Events for schools and other organisations
- Work with partners e.g. Professional Bodies
- High profile events
- Provides Personal and University Profile

ENABLING COLLABORATION

Many options for partners

- Collaborative R&D in research consortia
- Company specific R&D for future products
- Strategic partnerships with third parties
- Exploration of new application sectors for products

- Specially tailored postgraduate education programmes
- Targeted staff recruitment / internships
- Engineering Doctorate – existing and new staff

- High profile physical presence
- Access to high quality demonstration / presentation facilities
- Co-ordinated relationship and shared publicity

Benefits to Collaboration include

- Funding for research infrastructure
- Funding for research programmes

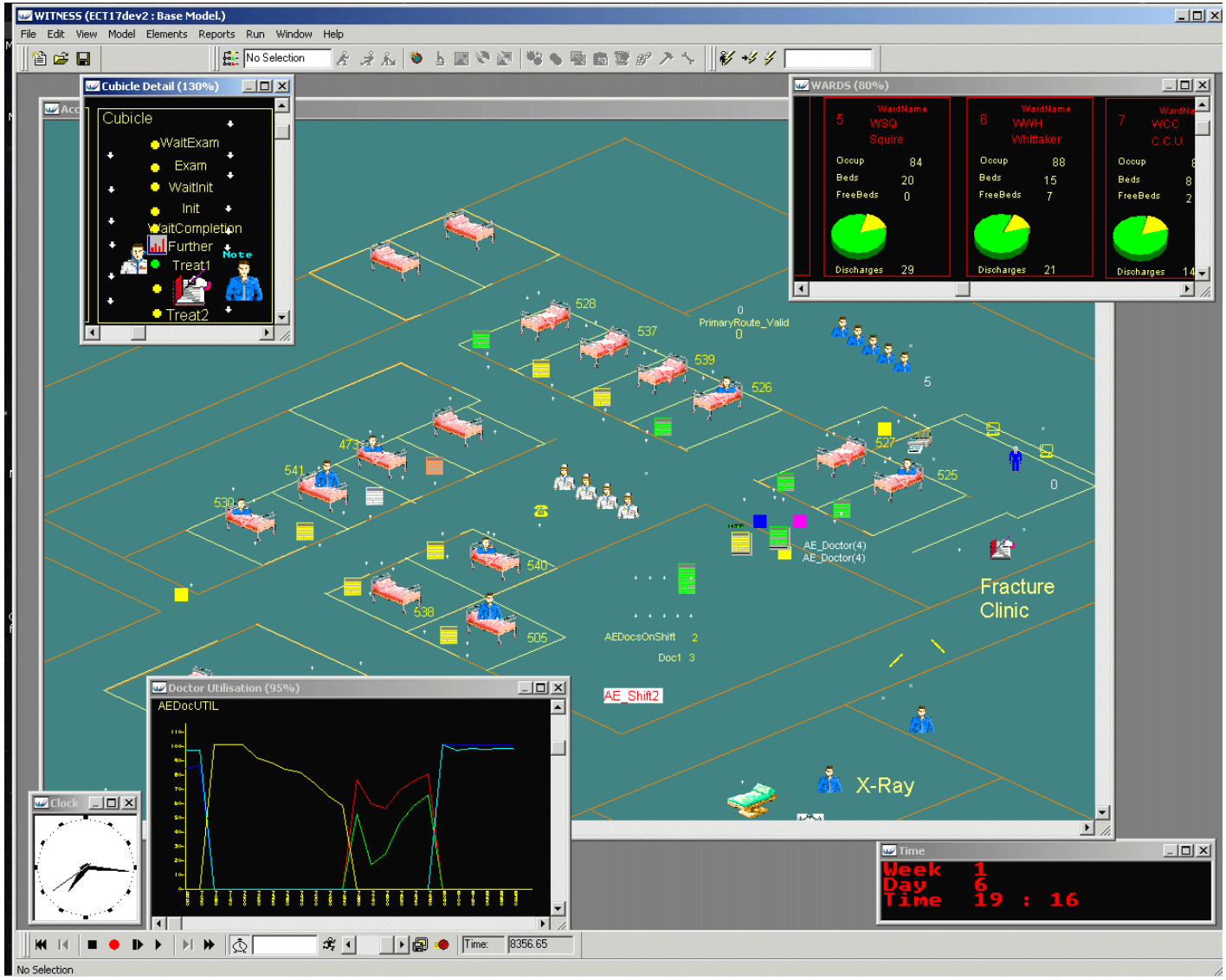
- Generation of new ideas
- Sharing opportunities across education and research
- Case studies for education programmes
- Career destinations for students

- Collaboration and impact grows individual network and profile
- Collaboration and impact grow University profile and relevance

Think About Use of Unique Equipment

- Crash and Body in White Guilds

Think About Impact Outside Your Sector



ENABLING & EVIDENCING

REF 2014 – REF3a and REF3b Documents

Number of Category A staff in the submission (FTE)	Page limit for impact template (REF3a)	Page limit for environment template (REF5)
1 – 14.99	3	7
15 – 24.99	3	8
25 – 34.99	3	9
35 – 44.99	4	10
45 – 54.99	4	11
55 – 74.99	4	12
75 or more	5, plus 1 further page per additional 60 FTE	13, plus 1 further page per additional 20 FTE

Number of Category A staff submitted (FTE)	Required number of case studies
Up to 14.99	2
15 – 24.99	3
25 – 34.99	4
35 – 44.99	5
45 or more	6, plus 1 further case study per additional 10 FTE

Approach to Impact (Section B)

- Support to Staff – development team, SME team, University corporate relations, web presence, visitors (intermediaries), communications and marketing team.
- Incentives to staff – annual reviews, merit awards, promotion selection, match funding of PhD studentships.
- Institutional support – Warwick Ventures, Seed and Venture Capital funding, space for start-ups, leading edge research equipment, Business Development Managers.

Strategy and Plans (Section C)

- Impact through Research.
- Research Committee / Industrial Advisory Panels
- Major Project Academic/Industry Steering Groups
- Research Themes supporting Global Research Priorities (pump priming)
- Strategic Initiatives e.g. National Automotive Innovation Centre, Energy Innovation, Applied Education

Case Studies (REF 3b)

- One per 10 staff submitted - 4 sides each
- Summary of Impact (indicative maximum of 100 words)
- Underpinning Research (indicative maximum of 500 words)
- References to the Research (indicative maximum of six references (at least internationally recognised 2*) plus research funding, doctorates and staff destination details)
- Details of the Impact (indicative maximum of 750 words)
- Sources to Corroborate the Impact (indicative maximum of 10 references e.g. quotations from users, media and public statements, evaluations, awards, web references)

WMG / Engineering Case Studies

- Collaborative research at low technology readiness levels with impact in healthcare, construction and automotive (Case Studies 15.1, 15.2 and 15.3).
- The role of strategic research, demonstrators and industry education programmes to enable impact in the automotive sector (Case Studies 15.4 and 15.5).
- Start-up companies, initially in electronics but with broad impact (Case Studies 15.6 and 15.7).
- Strategic partnerships (Case Study 15.8), together with a start-up company and influencing policy.
- Influencing of construction practice (Case Study 15.9).
- Case study (15.10) sustainable motorsport, where demonstrators informed public understanding.

Analysis of REF Impact case studies

- Work commissioned from Digital Science and King's College London
- Two objectives:
  - Publish case studies as a searchable, text-minable database
  - High level synthetic analysis of case studies – what do they tell us about the impact of research?
- Published at end of March 2015 – categorises by political, legal, health, cultural, technological, societal, economic and environmental
- http://impact.ref.ac.uk/CaseStudies/

Think Impact!

- The Impact agenda is here to stay
- The leading academics will combine excellence with relevance – academic output plus impact
- Impact grows your network and your profile

In short – impact aids your career…

Discussion

Thank You

Discussion Welcomed

www.wmg.warwick.ac.uk