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For more information, please contact the WRAP Team at: wrap@warwick.ac.uk
Shaping the Future

Research Excellence Framework: What is Impact and How to Achieve

Professor David Mullins

Director External & International Relations, WMG, University of Warwick, UK
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 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%**
  - Quality of research **outputs**
  - *191,150* research outputs by *52,061* staff were reviewed

- **20%**
  - **Impact** of research on society
  - *6,975* impact case studies were reviewed

- **15%**
  - The research **environment**
  - The review was based on data and information about the environment

[www.wmg.warwick.ac.uk](http://www.wmg.warwick.ac.uk)
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’

<table>
<thead>
<tr>
<th>Institution name</th>
<th>Main panel</th>
<th>Unit of assessment name</th>
<th>Profile</th>
<th>FTE Category A staff submitted</th>
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<td>Outputs</td>
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<td>60.0</td>
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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.
• 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.
• 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.
• 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.
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

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## Research Priorities

<table>
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<tr>
<th>Research Group</th>
<th>Lead Academic</th>
<th>Theme</th>
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<tbody>
<tr>
<td>Experiential Engineering</td>
<td>Cain</td>
<td>DESIGN</td>
</tr>
<tr>
<td>Visualisation</td>
<td>Chalmers</td>
<td>MATERIALS</td>
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<tr>
<td>Engineering Materials &amp; Manufacturing</td>
<td>Dashwood</td>
<td>MANUFACTURING</td>
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<tr>
<td>Steels Processing</td>
<td>Seetharaman</td>
<td>SYSTEMS</td>
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<tr>
<td>Nanocomposites</td>
<td>McNally</td>
<td>BUSINESS</td>
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<tr>
<td>Sustainable Materials &amp; Manufacturing</td>
<td>Kirwan</td>
<td></td>
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<tr>
<td>Electrochemical Engineering</td>
<td>Dashwood</td>
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<td>Net-Shape Manufacturing</td>
<td>Barnes</td>
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<tr>
<td>Metrology</td>
<td>Williams</td>
<td></td>
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<td>Automation Systems</td>
<td>Harrison</td>
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<tr>
<td>Digital Lifecycle Management</td>
<td>Ceglarek</td>
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<tr>
<td>Energy &amp; Electrical Systems</td>
<td>Jennings</td>
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<tr>
<td>Propulsion Systems</td>
<td>Greenwood</td>
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<tr>
<td>Biomedical Informatics, Imaging &amp; Healthcare Technology</td>
<td>Arvanitis</td>
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<td>Service Systems</td>
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<tr>
<td>Supply Chain</td>
<td>Godsell</td>
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User Engagement
WMG centre High Value Manufacturing Catapult
Institute for Digital Healthcare
Education Programmes
SME Programmes
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)
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.*
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
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
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

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SME Ecosystem

Innovation Programme

WMG SME Phase II

Start-ups & Incubation

Cutting Edge Technology, Business Support

Physical & Virtual Space

Enabling Partners

Trigger Innovation and Change

Interactive, Engaging, Case Studies, PR

Technology Demonstration

Funding: ESIF, Innovate UK, Horizon 2020, LEP

Specialist Interns

WMG SME Expert

New: Energy, Low Carbon, Smart, IoT...

Existing: PI Smart Materials, DI Digital, ELI User X

Company Supervisor

Intensive Innovation Projects, Workshops, Education

Business Engagement, Community

External Influencers

Core capability

WMG SME

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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

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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

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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
### Number of Category A staff in the submission (FTE)

<table>
<thead>
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<th>Number of Category A staff</th>
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<th>Page limit for environment template (REF5)</th>
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### Number of Category A staff submitted (FTE)

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<td>5</td>
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<tr>
<td>45 or more</td>
<td>6, plus 1 further case study per additional 10 FTE</td>
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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)
• 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/](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

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