



Government
Office for Science

The Future of Manufacturing: A new era of opportunity and challenge for the UK



Paul McCaffrey, UK Government Office for Science
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- **Project scope**
- **Current context**
- **Findings about the future**
- **Challenges for Government**



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Aims:

To analyse important long term changes, out to 2050, affecting the UK manufacturing sector

To advise how policy needs to evolve to support the future growth and resilience of UK manufacturing



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Key people

Government Chief Scientific
Adviser, Sir Mark Walport



Lead Expert Group, chaired by
Sir Richard Lapthorne



Industry High Level Stakeholder
Group, chaired by Vince Cable MP



300+ industry & academic experts

International input from 25 countries

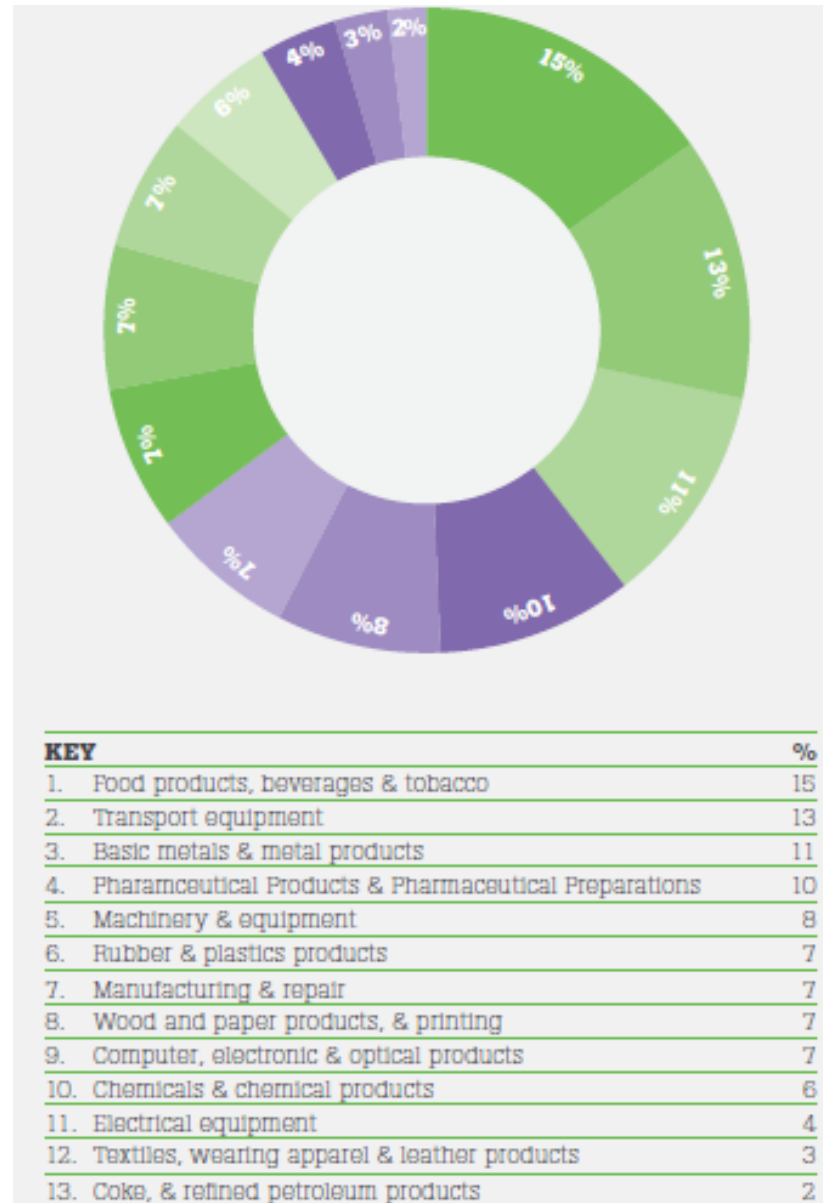


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The UK
manufacturing
sector is diverse,
with sub-sectors
generating
significant value...

Gross Value Added (GVA) by manufacturing industries during 2012 (total £139.1 billion)





**... most
manufacturing
firms are
small, with
large firms
generating
most overall
value.**

*UK manufacturing gross value added and
employment by firm-size, 2009*

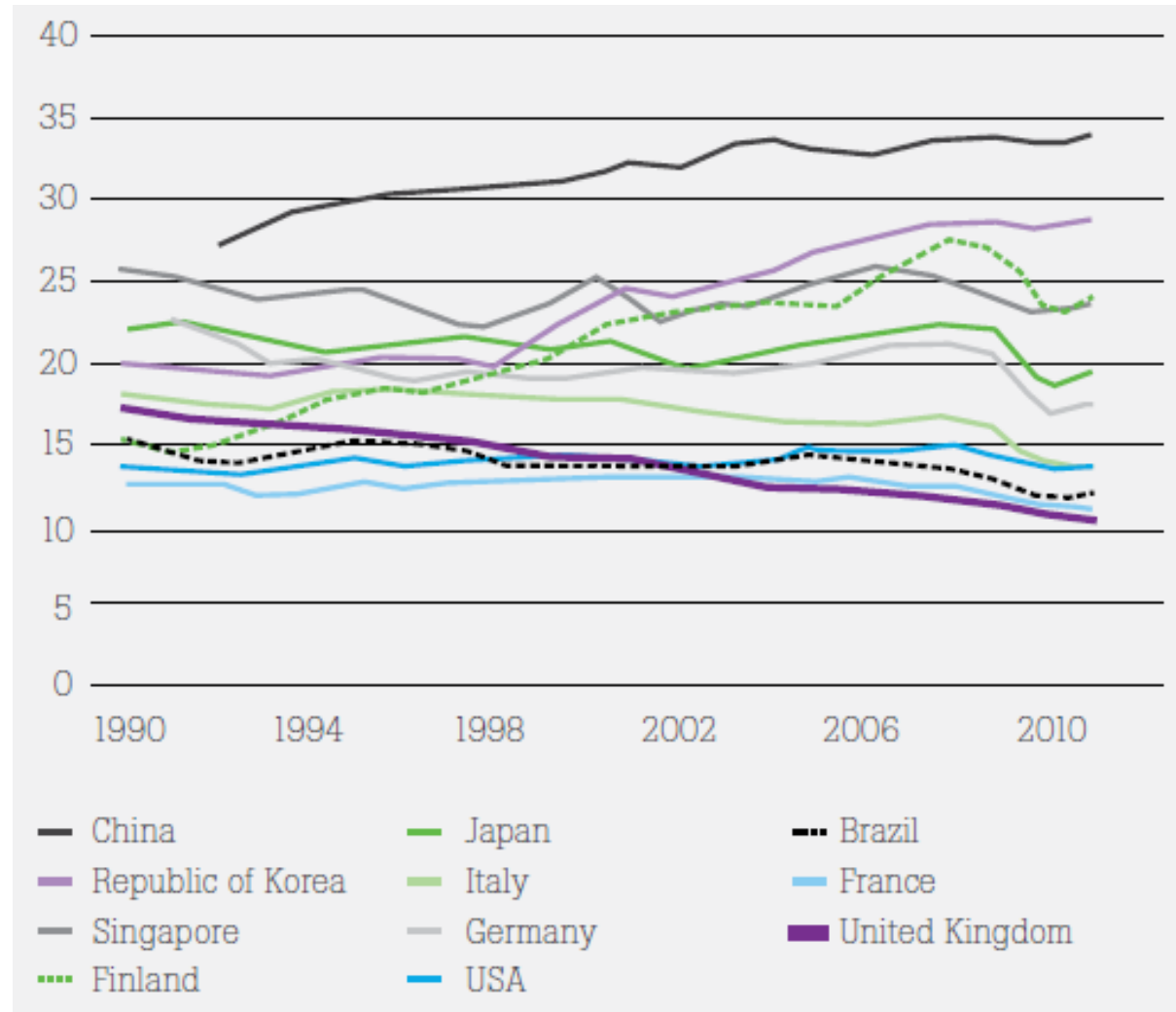




A recent context of historical shifts...

- 10% of UK economy (1973: 29%)
- Employs under 3m people (1966: 9m)
- Similar trends elsewhere

Manufacturing share of GDP 1990-2010





With areas of weak relative performance...

- Expenditure on manufacturing R&D
- Levels of capital investment
- Falling share of global exports

...and some areas of strong relative performance

- Strong total factor productivity
- Increasing proportion of output exported



The sector makes powerful contributions to the UK economy

- **Absolute value:** 10% of GDP (£139 bn in 2012)
- **Exports:** 53% of UK exports in 2012 (£256 billion)
- **R&D:** 72-79% UK business R&D spend 2000-11
- **Productivity:** growth 2.3% p.a. (1980-2009) UK 0.7%
- **Jobs:** high skilled and well paid
- **Resilience:** provides resilience in face of recession



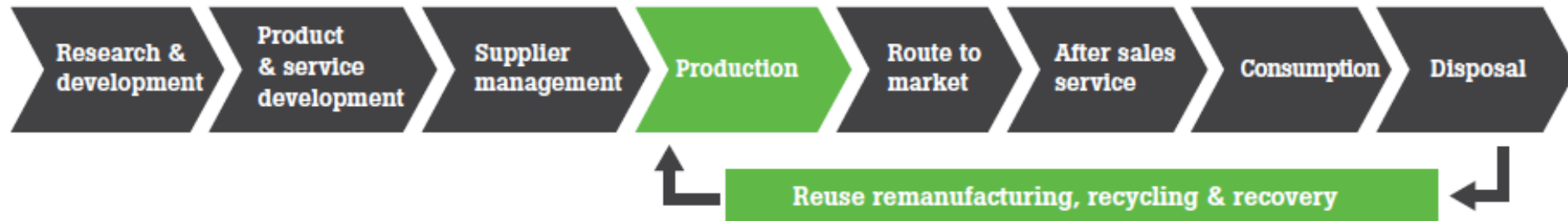
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1. More than making a product and selling it

- **Services with products** e.g. Rolls Royce
- Selling of **technological 'know how'** e.g. ARM
- **Remanufacturing** of products e.g. JCB / Caterpillar

Manufacturers will increasingly make use of a wider value chain to create revenue.





2. Faster, more responsive and closer to customers

- Mass **personalisation** of products on demand
- **Distributed**: big high-tech, modular, home, mobile
- Greater **design freedom**
- More **digital connections** along value chains

Primary / underpinning technologies

- **ICT**
- **Advanced Materials**
- **Sensors**
- **Biotechnology**
- **Sustainable / green technologies**
- Numerical modelling & algorithms
- Mechatronics
- Photonics
- Knowledge systems
- Micro electronics
- Tribology
- Nanotechnology
- Networks
- Artificial intelligence
- Human-machine interfaces

Secondary technological developments

- **Mobile internet**
- **Knowledge-based automation**
- **The 'internet of things'**
- **Big data**
- **Cloud computing**
- **Autonomous robotics**
- **Energy intelligence**
- **Additive manufacturing**
- **Printable electronics**
- **Integrated safety systems**
- Virtual product creation
- Low impact transportation
- Virtual manufacturing
- Adaptive systems

Impacts & consequences

- **Product personalisation**
- **Sustainability and the 'circular economy'**
- **Intellectual property mobility & protection**
- **Cyber security & counterfeiting**
- **Changing skills requirements**
- Supply chain volatility
- Export control
- Standardisation
- Communication protocols
- Medical ethics
- Continuous quality verification of products

Collaborative Model of Manufacturing Growth & Success

Industrial Exploitation

- Competitive Products
- Profit & growth
- Wealth creation
- Intellectual Property
- Product Technology gaps
- New material needs
- Poor process capability
- Environmental challenges

Early Research

Lead - Universities
Partners – Industry, EPSRC, Catapult



Exploitation

Lead - Industry
Partners: Supply chain, TSB / BIS, Catapult



- Business Need
Product Need
Know-How
- Proven Capabilities
Know-How
High Calibre Staff

- Innovative Ideas
Scientific Knowledge
High Calibre Staff
- Intellectual Property
Papers & Growth
Exploitation Pull

Production Demonstration

Fundamental Research

Pre-production

Lab Demonstration

Prototype Demonstration

Technology Pipeline

Solution

Problem

- Devt Funding
Economic Context
Partnering



Technology Development

Lead - Catapult
Partners: Industry, TSB / BIS, Universities

- Generic capabilities
Spill-over Benefits
Business Ideas



Capability Demonstrators

Lead – Industry
Partners – TSB / BIS, Catapult
Universities

- Capital Funding
Business Advice
Skills Support
- UK Growth
Skilled Labour
Wealth Creation



3. Exposed to new market opportunities

- Changes to **personal wealth** / **ageing** populations
- **BRICs** and the **'Next 11'**
- Continued **global 'fragmentation'** of the value chain
- Some **'onshoring'** back to the UK



4. More sustainable

- Growing / urban populations **raise resource demand**
- **Climate change** and global supply chain vulnerability
- Resulting volatility in **price of commodities**
- Reuse, **remanufacturing**, recycling: circular economy



5. Increasingly dependent on highly skilled workers

- **Strong demand** for manufacturing workers
- A need to accommodate more **older workers**
- Importance of **STEM** qualifications
- Blending of technical & commercial **‘hybrid’ skills**
- Potential for **human enhancement**



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Policy makers will need new approaches to ensure that the UK is a place where manufacturing thrives

- Better **intelligence** - beyond production output
- Better **targeting** of support, using wider policy system
- Enhancing **capability** in evaluating and coordinating
- **Scaling up** a number of existing initiatives



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Any questions?

paul.mccaffrey@bis.gsi.gov.uk