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The Advanced Materials & Manufacturing Landscape: a UK perspective

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- UK initiatives in advanced materials & manufacturing
- Introduction to Dstl Programmes
- Defence Agility, Adaptability and Cost Reduction (DAACR) Programme
- Materials for Strategic Advantage (MSA) Programme
- Points for debate



UK Initiatives



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Eight Great Technologies

HM Government

Eight Great Technologies

Advanced Materials

Engineering superior, stronger, lighter materials

UK research strength

UK researchers have developed LED bulbs which could turn lights into wireless transmitters

UK industrial capability

The UK produces a revolutionary bone replacement material used by surgeons worldwide

Multiple applications

New materials are being created to absorb greenhouse gases such as carbon dioxide

British-discovered graphene is the strongest, thinnest material known

UK growth opportunities

UK material-related industries have a yearly turnover of £197bn

Accelerating the commercialisation of technologies
www.gov.uk/bis/industrial-strategy

#8Great



HM Government

Eight Great Technologies

Synthetic Biology

Harnessing the power of biology to fuel and heal us

UK research strength

UK researchers have developed a new method for copying DNA which is up to 10,000 times faster than before

UK industrial capability

UK chemists have reduced the steps required to create synthetic hormones from 20 to 7

Multiple applications

A British company has created a DNA-based solution to control insects that spread disease and damage crops

Researchers are developing an artificial 'leaf' to convert the sun's energy into fuel

UK growth opportunities

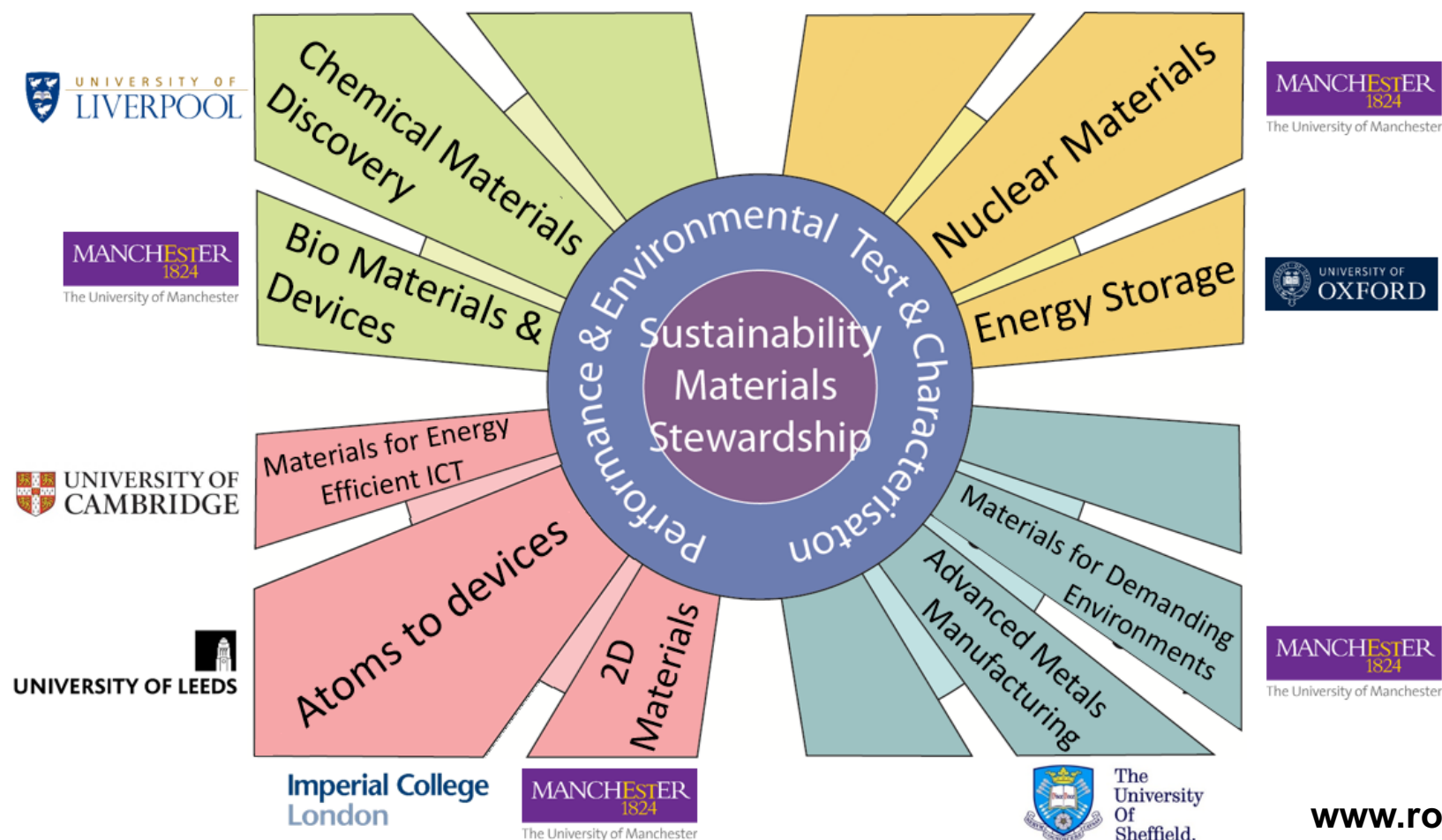
The synthetic biology global market is expected to reach £62bn by 2020

UK Advanced Materials Government support

- Funding



- A £235m investment from government plus £80m by the nine partner organisations to create an international flagship for the accelerated discovery and development of new materials systems.



UK Advanced Materials Government support

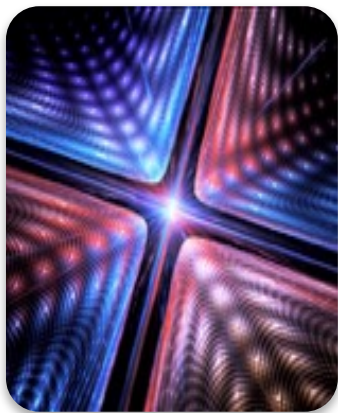
- Funding



Innovate UK

£137m pa on
materials &
manufacturing

Sector focus to accelerate growth



**Emerging
and
Enabling**

**Health
and Life
Sciences**

**Infrastructure
Systems**

**Manufacturing
and
Materials**

**Open
Programme**

UK Advanced Materials Government support

- Funding



Innovate UK

£137m pa on
materials &
manufacturing



[dstl]

~£12m pa

[dstl]

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UK Advanced Materials Government support

- Funding



Innovate UK

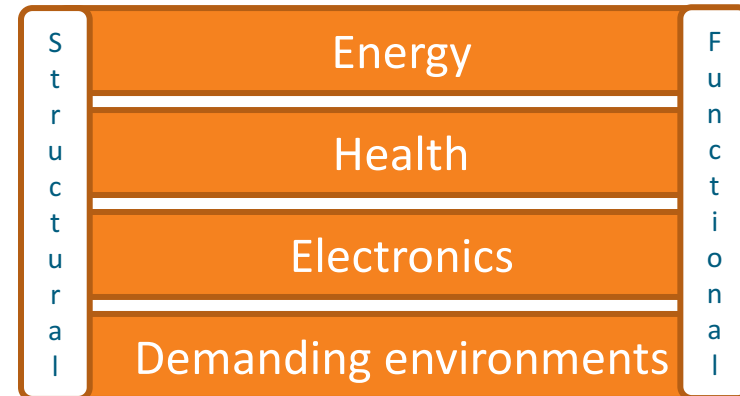
£137m pa on materials & manufacturing



~£12m pa

- Strategy

- Advanced Materials Leadership Council (AMLC)



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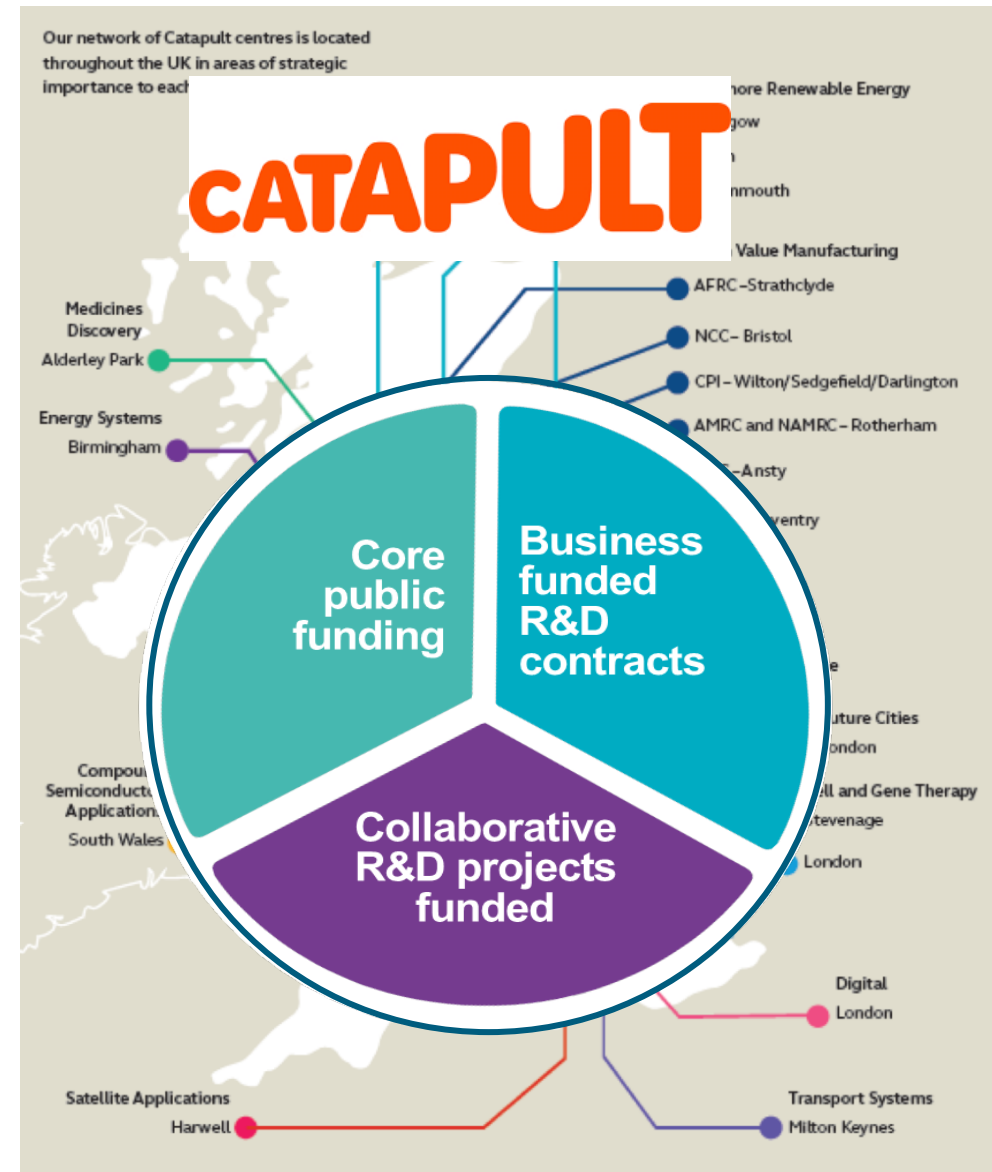
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Support to Advanced Manufacturing:

- 11 Catapults, including the 'High Value Manufacturing' Catapult
 - 7 individual centres
 - Provide access to state of the art equipment
 - Helping to bridge 'the valley of death'



Dstl Programmes



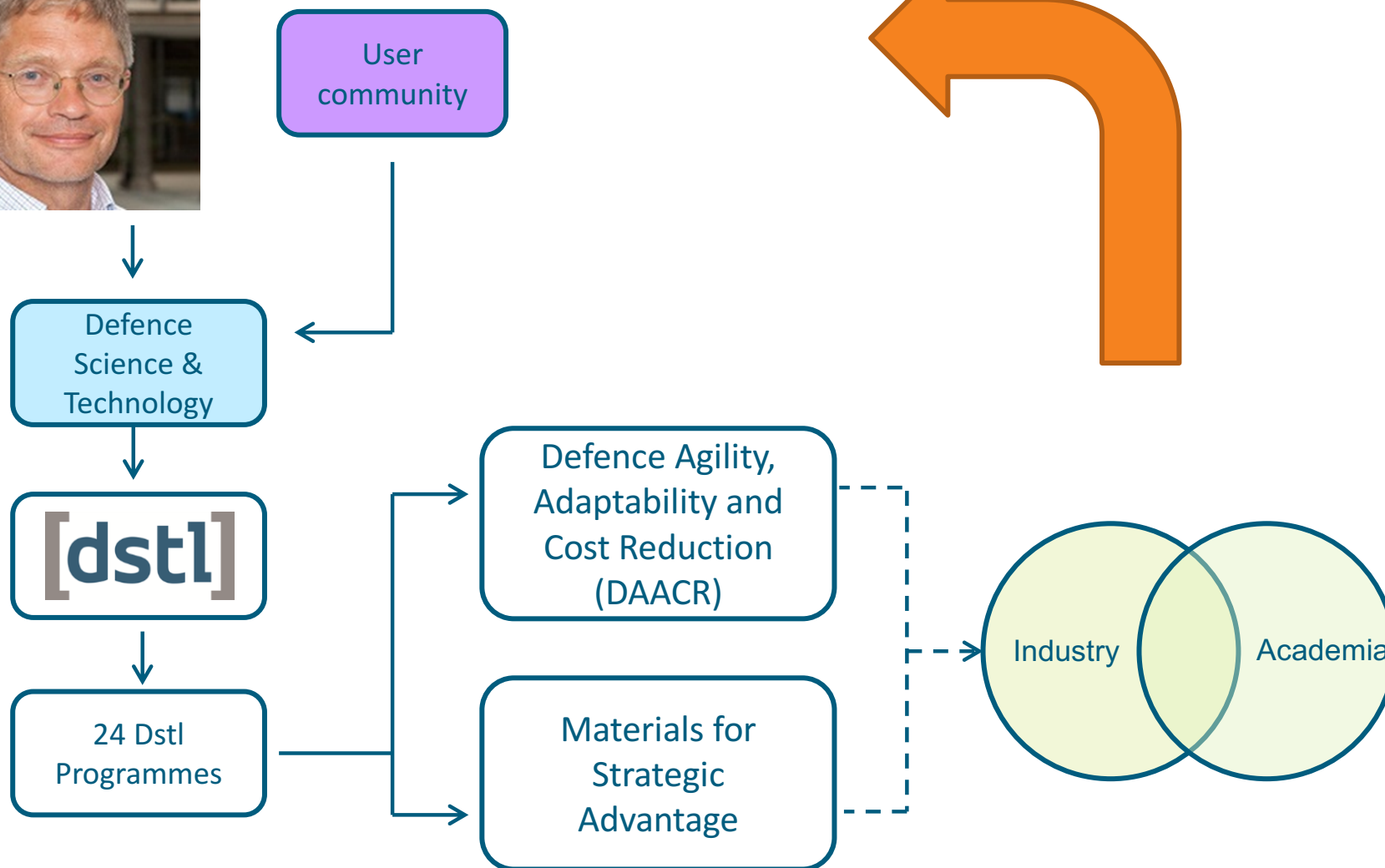
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Defence Agility, Adaptability and Cost Reduction



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Programme Vision

Driving the understanding of emerging technologies with the defence and security Innovation Initiative to bring about fundamental change in the global security landscape.

- In **searching**, we describe what is (likely to be) interesting *before* we retrieve it.
- In **scanning**, we realise what's interesting *after* we've retrieved it.



**Horizon
Scanning &
Emerging
Technologies**

**Innovative
Models,
Methods &
Tools**

**Innovative
Enablers**

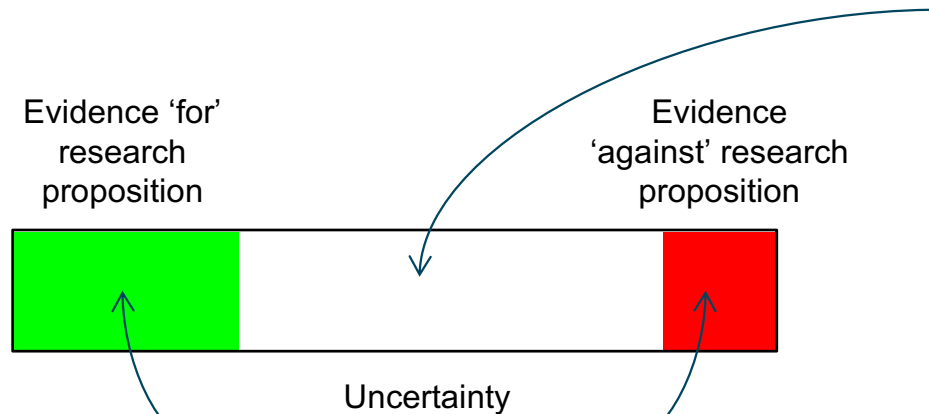
Programme Design Elements

Example technology exploration areas

- Synthetic Biology
 - Big Data
 - Social Sciences
 - Quantum
 - **Advanced manufacturing**
 - Quantum Biology (for navigation, sensing and light harvesting)
 - Power Sources Remote Avatars
 - Laser Plasma Effects
 - 2D Nanomaterials
 - ***High Impact High Uncertainty S&T***
- 
- Now in core
Programmes

Evidence summary for decision makers

(Italian Flag, Credit: University of Bristol)

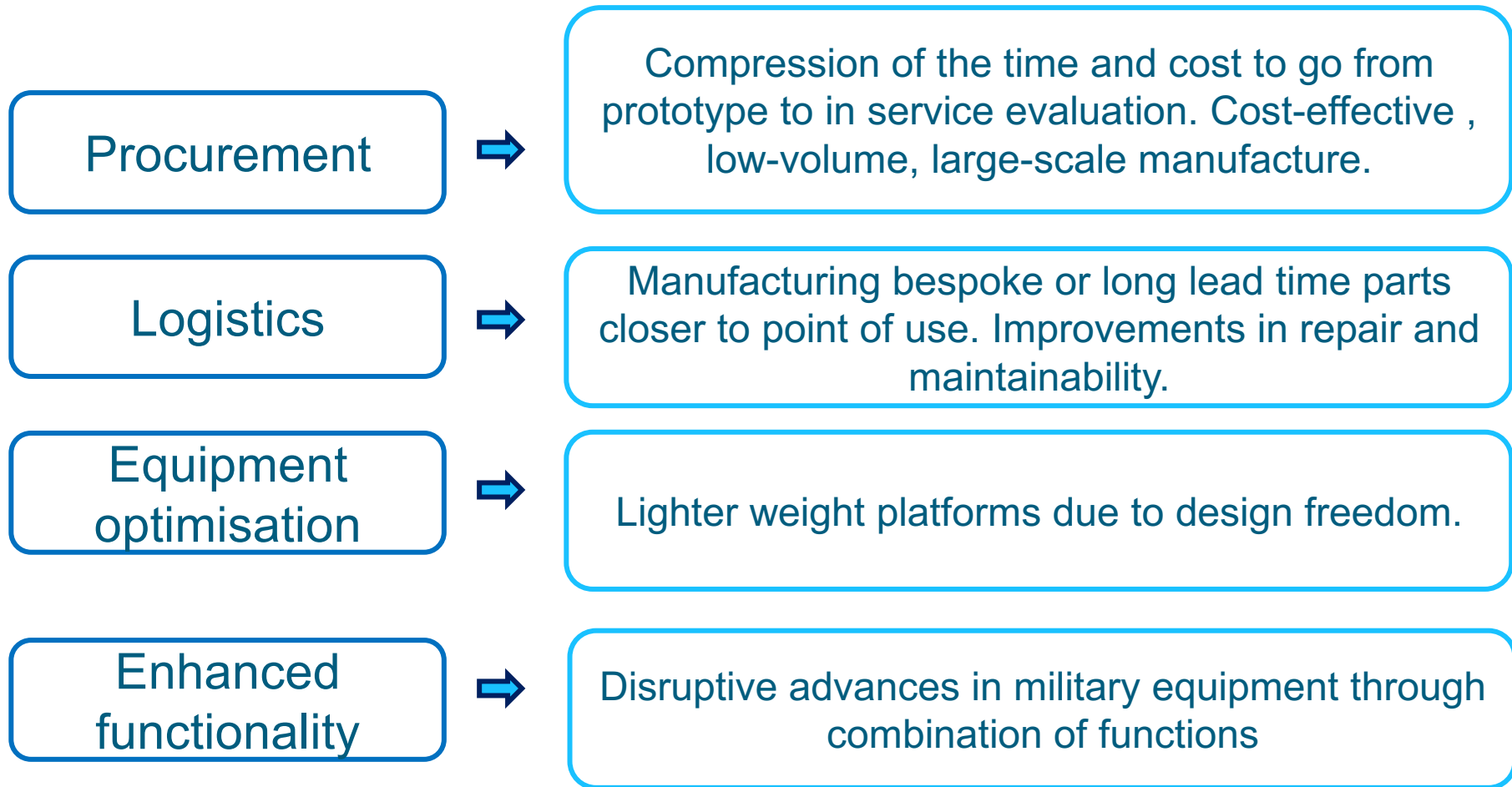


The relative balance of green and red is apportioned using pair-wise comparison across available evidence.

Missing evidence is estimated against what would constitute 'complete' scientific evidence.

- *To counter surprise, the principal strategy is then to identify means to reduce uncertainty.*

Military Interest in Advanced Manufacturing



Dstl Activity in Advanced Manufacturing

- Assessing the role of **Advanced** Manufacturing in defence
 - Technology watch, determining the global landscape and understanding the state of the art
 - Engaging with Research Council, University and Catapult Centres
 - Understanding implications for future warfare, logistics and supply chains, cost reductions and technology advance
 - Cooperation with other MOD leads in AM in concept demonstration
- Technology Investigations – **Additive** Manufacturing
 - Structural Materials (e.g. deposition methods, repair techniques, joining, graded structures, design and topologies)
 - Functional materials (e.g. explosives, power sources, antenna, meta-materials, sensors)
 - Certification, validation and qualification



Materials for Strategic Advantage

Why does Defence need Advanced Materials?



- Military systems pose extreme and unique challenges for materials
 - Operate in harsh environments over extended lifetimes
 - Operate effectively when deliberately placed in harm's way
 - Operating environment is uncertain when system design decisions have to be made
- Achieving the necessary performance in these environments at an affordable cost requires advanced materials and design.



- [illegible]

Points for debate

What do we mean by emerging and disruptive?

Emerging?

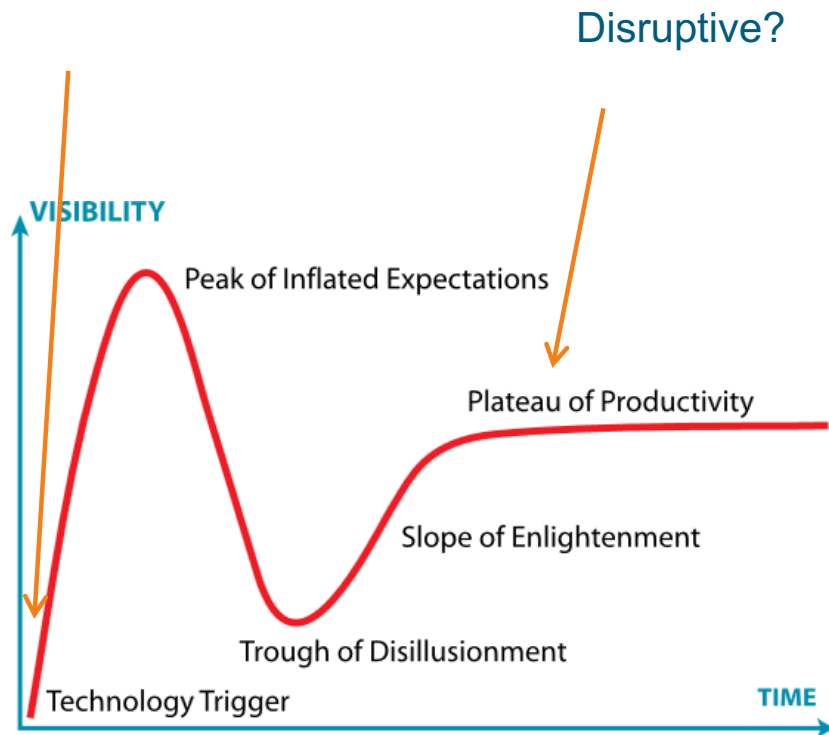
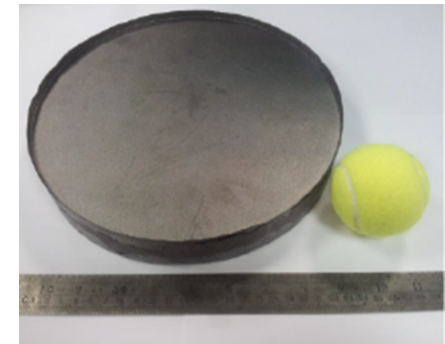


Image Attribution: [Jeremykemp](#) at [English Wikipedia](#), concept Gartner Inc.

- **Disruptive Change** can be defined as a 'game changing' development which 'unfolds' faster than an organisation's ability to adapt to its consequences.

Forged titanium from sand in 3 steps – down from 47!



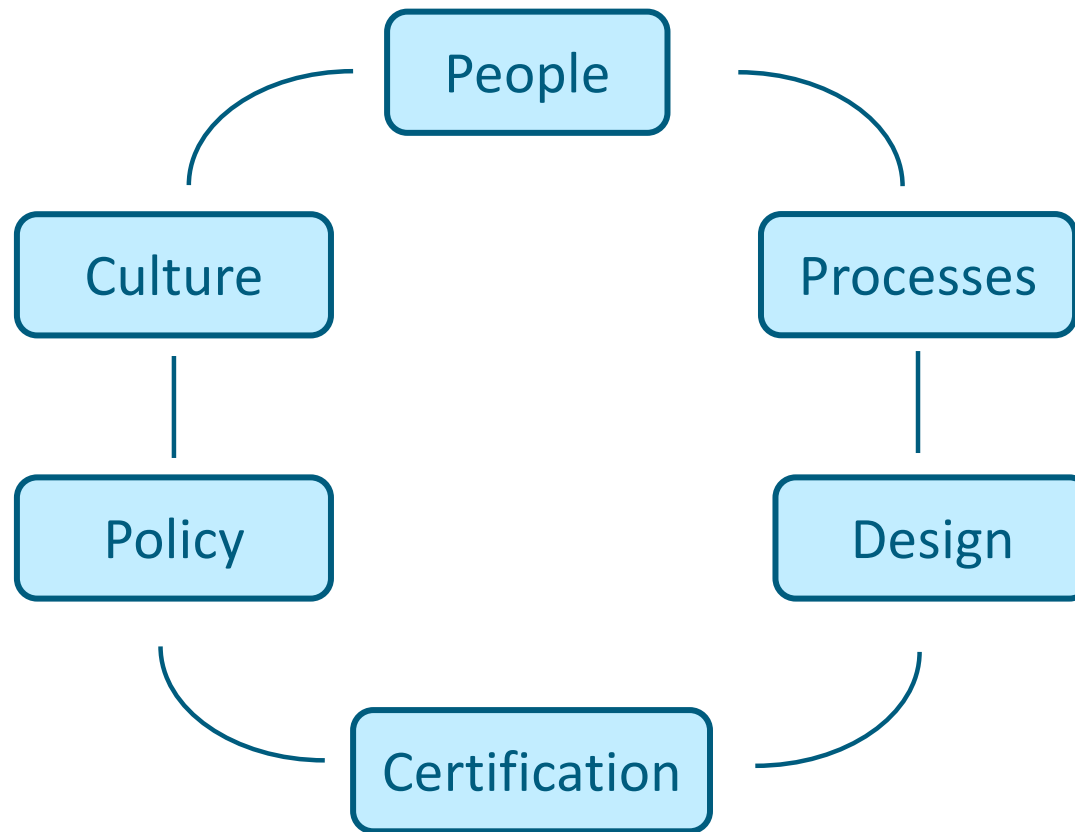
Systemic causes of S&T surprise

- Historical examples reveal patterns such as:
 - the lack of underpinning theory leading to repeated rejection of empirical evidence;
 - incorrect assumptions about how Nature works leads to mis-application of natural laws;
 - disbelief of new ideas is based on the claimants' backgrounds, and
 - positions become polarised and entrenched



Credit: Wikipedia

It's not just about the 'material'.....



Summary

- Advanced materials and manufacturing remain a key area of interest within the UK
- Materials and manufacturing are vitally important to defence
- The MOD, through Dstl is investing in Programmes to:
 - Harness global innovations in materials & manufacturing
 - Understand and exploit emerging and disruptive technologies
- Disruption isn't just a new 'widget'.....



Useful links

- <https://www.epsrc.ac.uk/>
- www.royce.ac.uk
- <https://www.gov.uk/government/organisations/innovate-uk>
- <https://www.ktn-uk.co.uk/>
- <https://ktn-uk.co.uk/events/materials-research-exchange-2018-save-the-date>
- <https://www.ktn-uk.co.uk/perspectives/a-vision-of-the-opportunities-for-advanced-materials-short-vision-papers-from-the-advanced-materials-leadership-council>



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