Exploitation pathways – Joining the dots between research and industry

Steve Rowley

NWTF Conference 2023

25-26 May 2023

QINETIQ/23/02213

QINETIQ

Personal Introduction

- Steve Rowley
  - Aeronautical Engineer
  - 25+ years in business - QinetiQ
  - Evidence Based Decision Support
  - 5m Wind Tunnel Project Engineer 2015 – 2021
  - NWTF Advisory Board since 2020
  - Futures Lab Command Lead 2021 – current

Futures Lab
Powered by EDP

- Today = share personal reflections and perspectives about:
  - An effective research exploitation pathway
  - Stakeholder engagement and collaboration
  - Enablers and systems based thinking

NASA CRM-HL model in QinetiQ 5mWT in 2019

QINETIQ

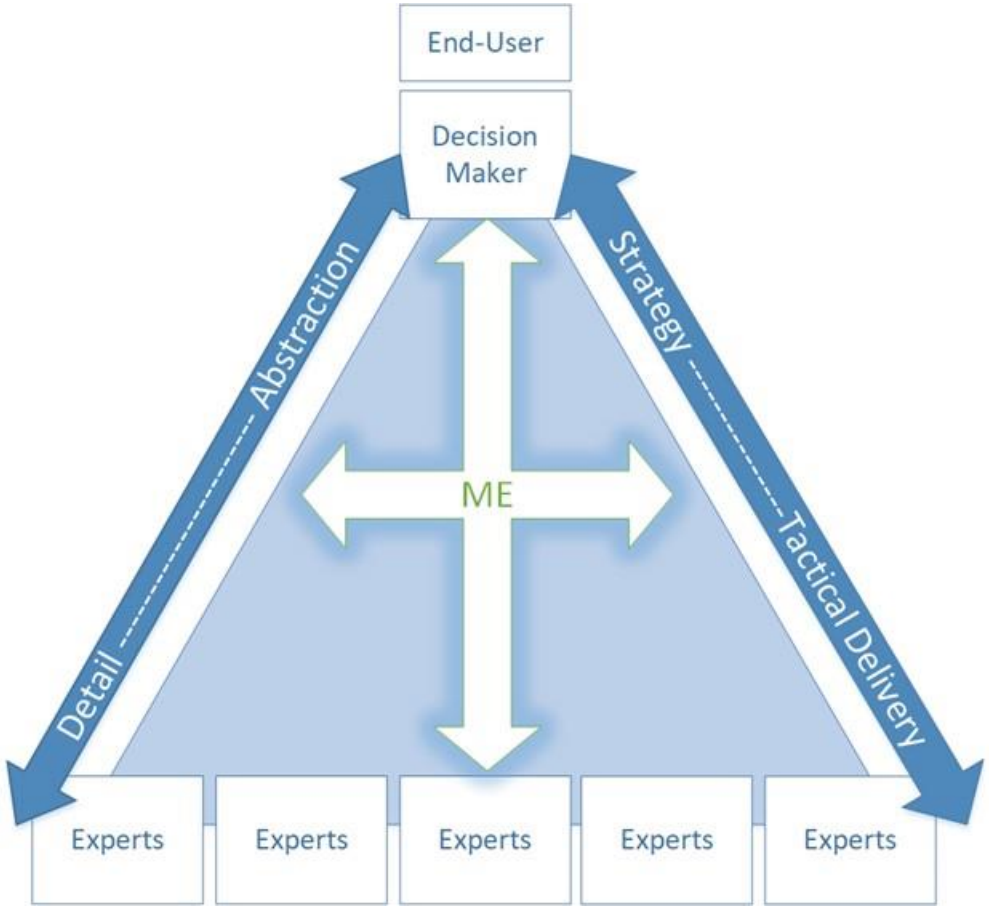
Contents

QINETIQ

1 Introduction

Exploitation pathways – Joining the dots between research and industry

- Why this presentation topic?
  - Passion about detail and big picture
  - Career lessons to connect research through to end-user
  - Advocate for collaboration
  - Benefits based approach
- Provide audience a non-technology perspective to consider in NWTF research and exploitation
- What this presentation is not:
  - Detailed insight into specific clients, projects or facilities
  - Authoritative definitions of research and exploitation terminology



2 Exploitation Pathway

- Language and Terminology
  - Counted from NWTF Conference presentations to date…

Benefit

Readiness / Maturity

Customer / End User

Leads to….

Return on Investment

Collaboration

Risk

Exploitation

Impact

Outcome

QINETIQ

2 Exploitation Pathway

- What is an exploitation pathway?
  - Articulation and realisation of a journey from a recognised starting point towards a sponsored outcome
  - Reflects appropriate maturation of technology and enablers cognisant of challenges, risks and opportunities along the journey
- Three main dimensions
  1. The journey
  2. The enablers
  3. The stakeholders
- Do not become fixated on the technology
  - Research output needs to say more than “we need to do more research”
  - Consider non-technology factors e.g. industrial readiness, commercial, end-user, integration, operational factors etc…
  - Defence uses Through Life Capability Management process

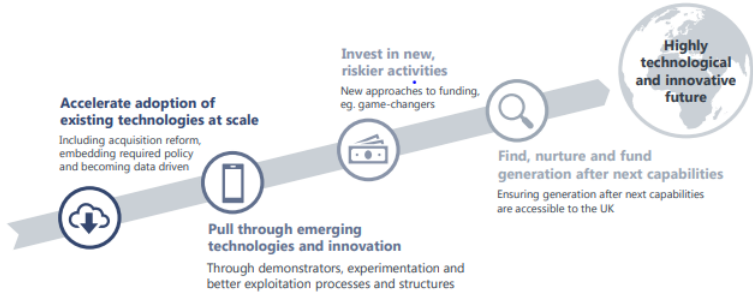
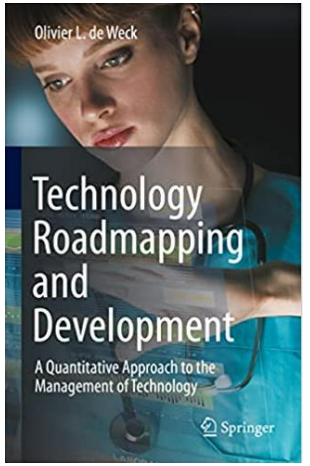


Figure 1 - Defence’s streamlined approach to science, technology and innovation to ensure we continue delivering valuable incremental innovation while pursuing truly new, game changing capabilities.

From MOD S&T Strategy 2020



ISBN 978-3-030-88345-4, 2022

QINETIQ

2 Exploitation Pathway – The Journey

- Lifecycle
  - Exploitation opportunities – big-bang vs. agile
  - Research sequence / type - Fundamental and Applied, Demonstrators, Design Optimisation, Operational Innovation (e.g. Niteworks study)
- Readiness and Maturity Factors
  - More than just Technology (TRL) and system performance
- Ongoing defence initiatives to improve exploitation
  - Avoid the “Valley of Death”
  - Establish an Enterprise Readiness Level (ERL)
  - Effective non-technology enablers inc. Commercial
  - Innovation Funding - Freedom of Action
  - Coherence and Knowledge management
  - Establish Centres for Expertise and Exploitation Programmes
  - Encourage collaboration by clients and (competing) suppliers
- Push or Pull? Anecdote from a project workshop

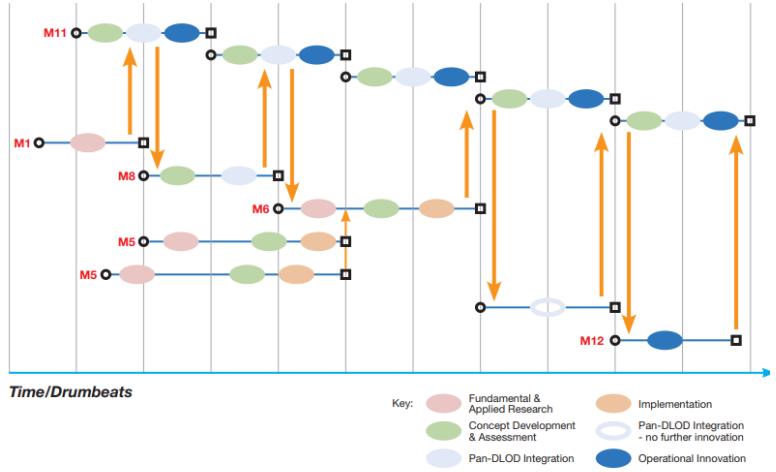


Figure 7: Continuous Innovation Model Pathway
From Niteworks Report - .gov.uk

Pre-Concept Refinement		Concept Refinement		Technology Development		Systems Development and Demonstration				Production and Deployment	
TRL 1	TRL 2	TRL 3	TRL4	TRL 5	TRL 6	TRL 7		TRL 8		TRL 9	
Basic principles observed and reported	Technology concept	Proof of concept	Basic validation in laboratory environment	Basic validation in a relevant environment	Model or prototype demo in a relevant environment	Technology prototype demonstration in an operational environment		Actual technology qualified through test and demonstration		Actual technology qualified through successful mission operations	
		MRL 1	MRL 2	MRL 3	MRL 4	MRL 5	MRL 6	MRL 7	MRL 8	MRL 9	MRL 10
		Mfg. process concept proposed	Mfg. process concept vetted	Mfg. process proof of concept developed	Mfg. process validated in a laboratory environment	Demonstration Mfg. process in a relevant environment		Capability and rate confirmed in factory environment	Pilot line capability demo for low initial production	Low rate production demon-strated	Full rate production
				Supply Chain Readiness Assessment		Supply Chain Readiness Development		Supply Chain Integration			

2 Exploitation Pathway – The Enablers

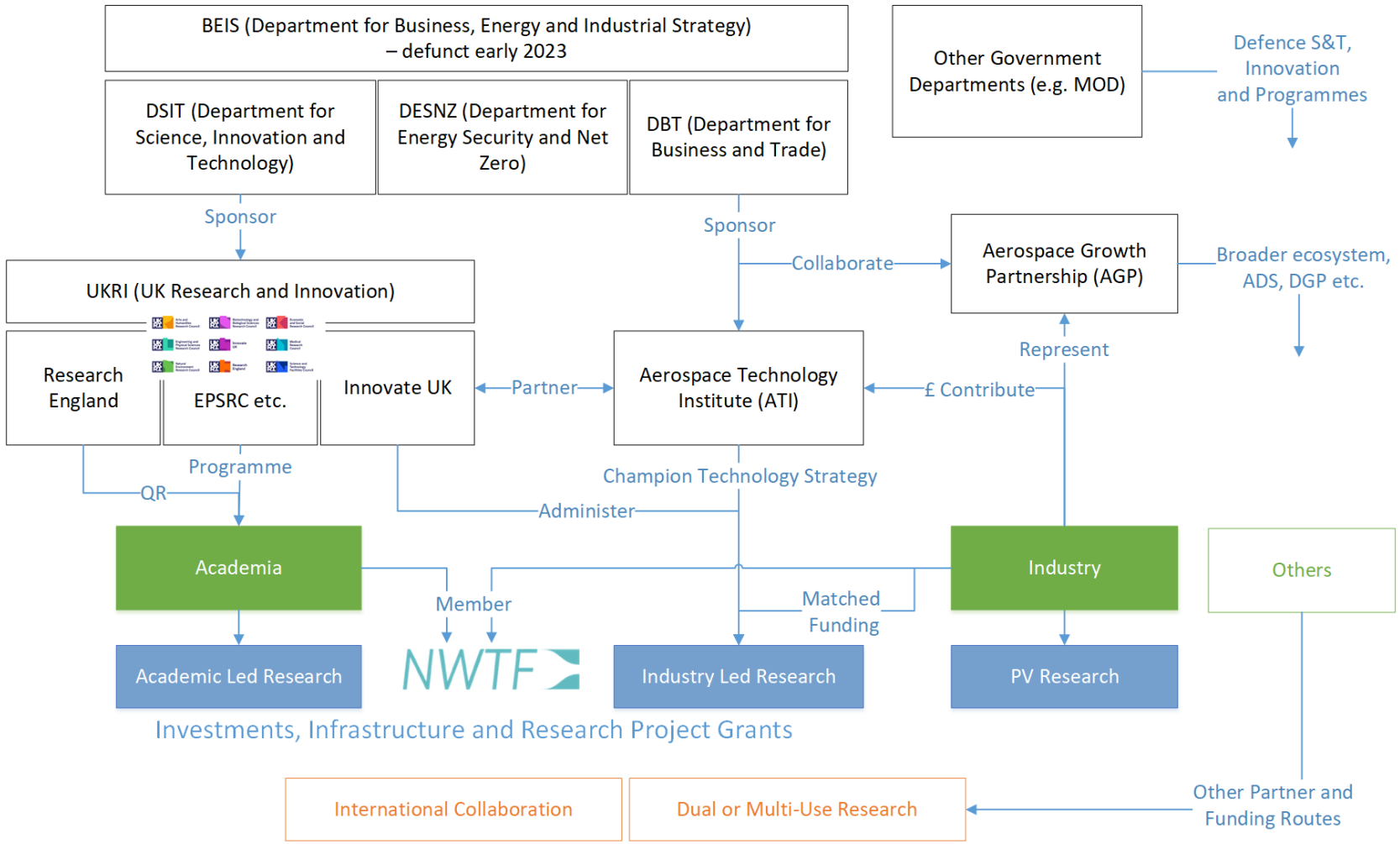
- Research enablers
  - Research capacity – Supported infrastructure, people, culture
- Exploitation enablers:
  - Solution developer enablers - Design, manufacture, test etc.
  - Assurance enablers - Regulatory, Certification etc.
  - Route to Market enablers – societal, commercial model etc.
  - End user enablers – integration, training etc.
- Whole pathway capability enablers
  - Funding with clear output benefits, ROI / VFM
  - Lines of Development principle
  - Stakeholders with a compatible vision and culture
  - Collaboration / Ecosystem / Knowledge Management
    - Standards or Reference models and data e.g. CRM-HL
    - Tools e.g. ATI Fixed Trade Calculator
    - NWTF and others

2 Exploitation Pathway – The Stakeholders

- Tips
  1. Know the stakeholders, implement an engagement plan
  2. Establish activities to collaborate across boundaries
  3. Establish an agreed baseline about current situation and desired outcomes
- Examples
  - 5mWT OPEN project collaboration through CRM-HL with NWTF / Industry and broader into AIAA
  - DE&S FCG sponsored challenges and ecosystems
- Stakeholders in the NWTF ecosystem
  - Agreed vision
  - Diversity of membership
  - Collaboration
  - Reflecting and continuous improvement
  - Baseline with other expert communities and ecosystems ?

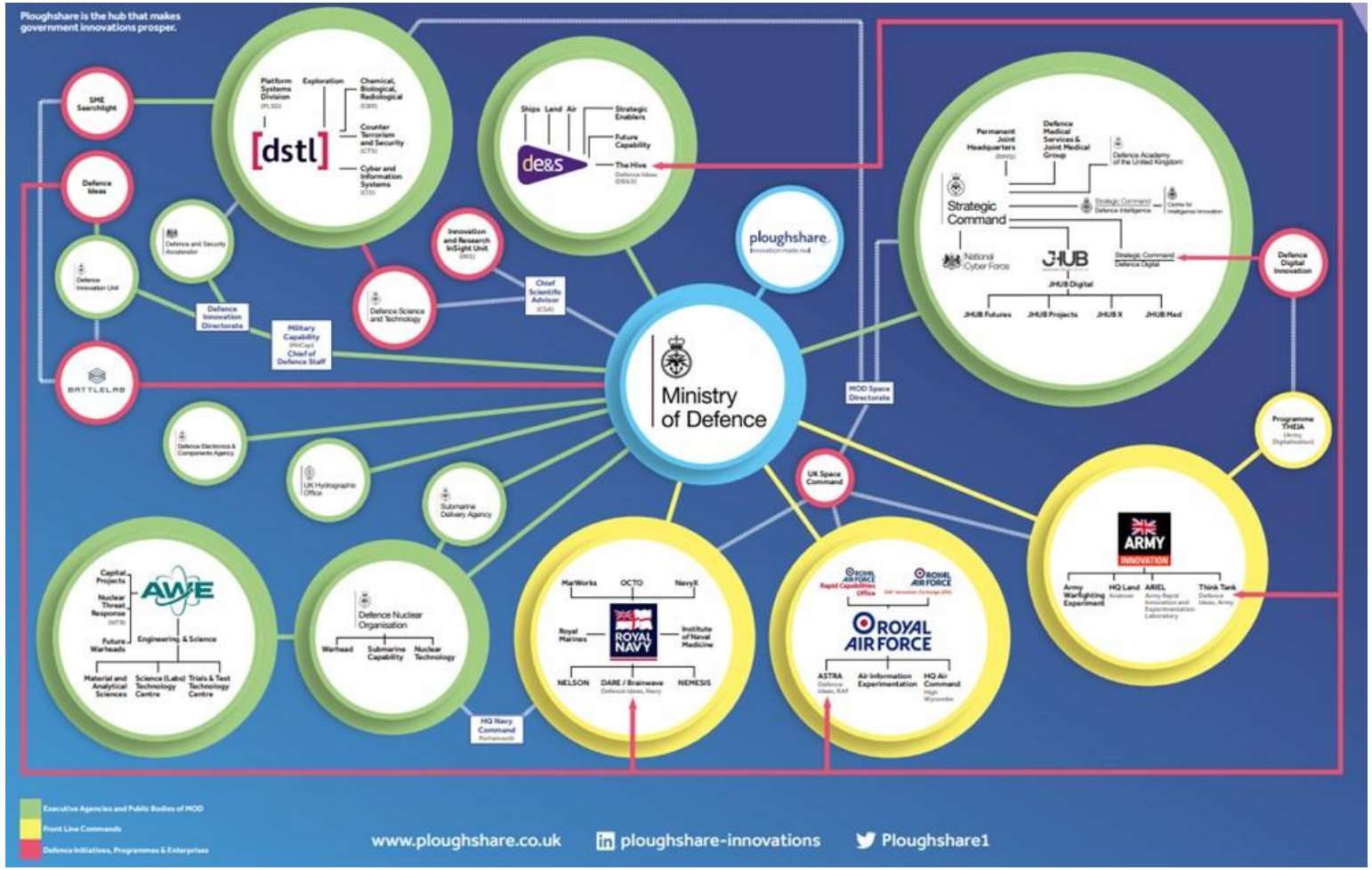
From DE&S Website - 2023

2 Stakeholders: UK Aerospace Research funding (roughly)..



QINETIQ

2 Stakeholders: Defence Innovation



As posted by Peter Wilkins and Ploughshare team members on LinkedIn 2023

QINETIQ

3 The Big Picture

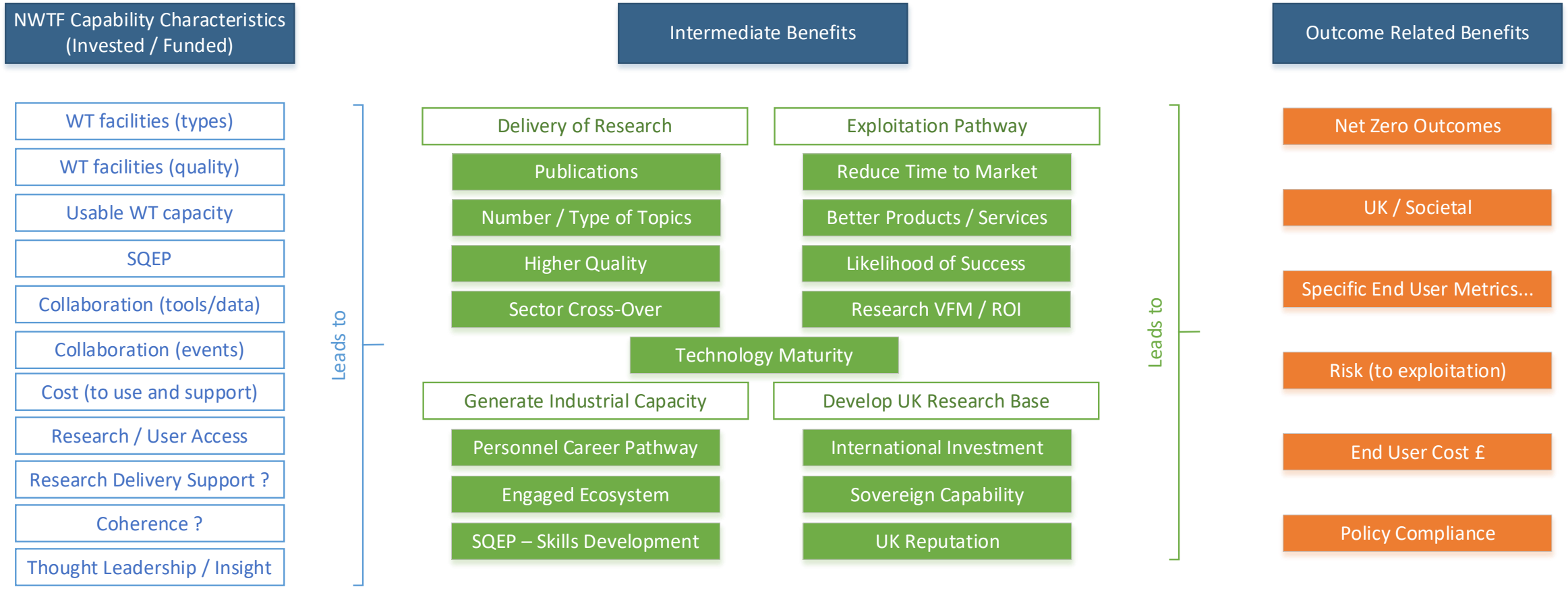
- Goal = Relate research to exploitable outcomes and outputs
  - Doing high quality research is fantastic – what did it achieve?
  - Top-down strategy driven versus bottom-up innovation and evolution
- Topics or themes relevant for NWTF stakeholders
  - Anything contributing to Net Zero
    - Air vehicle efficiency
    - Concepts incorporating alternative power technologies
    - eVTOL concepts
  - Defence *
    - Hypersonic capabilities
    - Novel concepts e.g. “loyal wingman” and adjunct capabilities
  - Other transportation
    - Rail, Automotive….
  - MBSE, Digital Thread/Twin, Certification by Analysis
  - Novel/advanced sensors, materials and structures

* Caveat: Involvement in defence can be limited by security aspects

QINETIQ

3 The Big Picture

- Benefits map for NWTF (Steve's starter)



QINETIQ

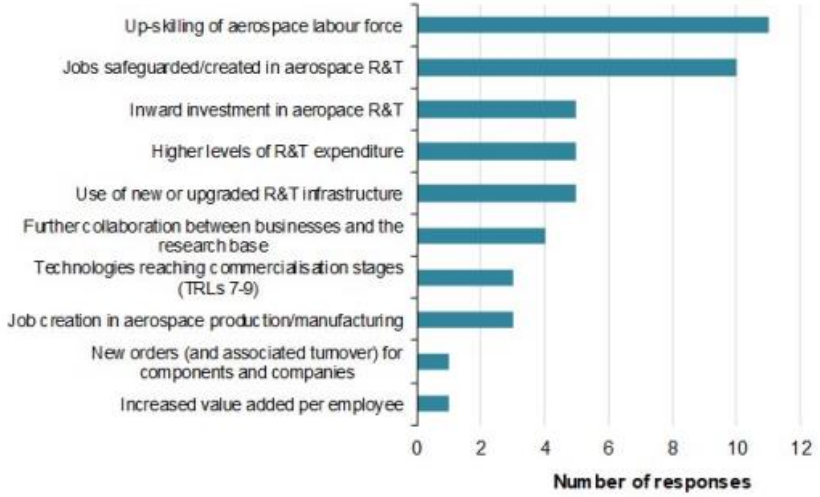
3 The Big Picture: Case Study 1

Collaboration working

ATI projects had increased collaboration within the industry, particularly at the tier one level. Companies that were competitors had worked collaboratively for the first time through ATI funded projects and had continued to do so. This was thought to be partly linked to companies' increased ability to take risks within ATI projects. Many collaborations were between businesses as well as business and research centres, and had grown or retained the UK skills base. It was also suggested that ATI had facilitated international collaborations through its links with similar organisations in other countries.

From ATI Website - 2020, with refresh planned 2023

Figure 4-1: Outcomes achieved as a result of the ATI programme (project leads)



In response to the second part of EQ1, **there is strong evidence that the 15 ATI-funded projects assessed have led to subsequent R&T or R&D projects, thereby leveraging further industry investment. In this context, ATI should be seen as one part of a complementary set of activities.** The key points of evidence supporting this conclusion were as follows:

- In almost all cases (14 out of 15 case study projects), ATI-funded projects generated subsequent industry investments in R&D at TRLs 7-9 or R&T at slightly lower TRLs.

QINETIQ

3 The Big Picture: Case Study 2

Brookdale CONSULTING

Impact Assessment of EPSRC's Manufacturing the Future Programme 2005-2020

Final Report 1.0

October 2022

From UKRI Website

The 4 Key Added Value Benefits from the CMI Funding Approach

The four key added value benefits from the CMI funding approach are illustrated in Figure 6.1 starting with the level of business R&D investment and proceeding in a clockwise direction. Each is discussed below.

Figure 6.1 Added Value Benefits from Investment in CMIs

Industry R&D Investment

When industry engages in a low TRL pre-competitive research project, it does not know if the project will produce anything of use. Understandably, industry is reluctant to invest when the risks are so high, and hence governments bear much of the burden of funding basic research.

National R&D Leadership

CMIs have the critical mass to attract strategic investors and to grow into national centres of excellence through a virtuous circular process whereby the more businesses they engage (especially strategically important companies), the more other businesses want to engage too as it becomes riskier not to be involved.

QINETIQ

4 NWTF So-what:

- Personal observation - Joining the dots between research and industry
  - The Journey
  - The Enablers
  - The Stakeholders
  - The Outcomes

- NWTF right now?
  - Agreed vision
  - Diversity of membership ✓ ✓
  - Collaboration ✓
  - Reflecting and continuous improvement ✓
  - Baseline with other expert communities and ecosystems ?
    - Are there Critical Mass Investments (CMI) for Experimental Aerodynamics > Wind Tunnels > NWTF > UKRI > ATI > AGP > DBT ?
    - Alignment with UK Fluids Network etc..

QINETIQ

4 NWTF So-what: Vision and strategy – Unofficial starter from Steve

“The chosen partner around the world for experimental aerodynamics research, providing world-class capabilities”

UK

Maintain a service based approach, with relevant wind tunnel infrastructure and supporting enablers, by working in partnership with Government, NGO, RTO, academic and industrial parties

International

Build a reputation to deliver world-class research to attract international investment and collaboration in research and innovation projects, with tangible business exploitation opportunities

Innovation

Align planning and delivery activities with national and global strategic initiatives across a range of markets

****** Please share your own ideas ******

QINETIQ

4 NWTF So-what

- Lead into to the Panel Session at the end of the conference
- Questions for all stakeholders to ponder:
  - What do you want to achieve?
  - What would good look like?
  - What does the journey involve?
  - How can NWTF enable the journey?
  - What additional support is needed?
- Consider the questions from your own perspective, whether as a researcher, a sponsor, interested stakeholder
- Prerequisites
  - Are you prepared to collaborate?
  - Are you committed to collective success?

QINETIQ


QINETIQ