The High Value Manufacturing Catapult (HVMC)

**UK Catapult Network**

- Cell and Gene Therapy
- Compound Semiconductor Applications
- Digital
- Energy Systems
- Future Cities
- High Value Manufacturing
- Medicines Discovery
- Offshore Renewable Energy
- Satellite Applications
- Transport Systems

**HVMC is the biggest of the UK’s 10 Catapult Networks**

- 7 centres
- 27 technologies
- 3500 people
- £700m assets
- 1/3 government funded
- 2/3 industry funded
- c.2000 projects per year

All key industry sectors covered
Catapult mission: Bridging the Valley of Death

It is estimated that **80% of innovations fail** in this so-called Valley of Death. The NCC, a member of the UK’s High Value Manufacturing catapult, fits in the transitional space.
Industrialised capability
Pre-competitive capability
Deployed capability
Deployed technology
Applied technology
Applied knowledge

TRL1 TRL2 TRL3 TRL4 TRL5 TRL6 TRL7 TRL8 TRL9

Academic input
Technology transfer
Technology progression

Private Venture & Member Directed
Collaborative R&D

Core Programme
Capability Development Programme

Knowledge Transfer Partnership
Technology Pull-Through

Innovation Sprints

NCC Academic Chairs
EngD Programme

EPSRC Programmes
MSc & PhD Projects
Researchers in Residence & UKRI Fellowships

Fundamental research
Industrialised capability

Pre-competitive capability

Deployed capability

Deployed technology

Applied technology

Applied knowledge

NCC led

Industry led

Academic input

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TRL6

TRL7

TRL8

TRL9
What is the NCC Technology Pull-Through Programme?

The Technology Pull-Through programme is a collaborative R&D scheme to industrialise and transfer technologies and methods ready to leave the lab environment from academia to industry.

- Over four years, the programme has:
  - Received 49 proposals from 18 universities across the UK
  - Approved for funding 30 projects worth approx. £1.5M in total
NCC Technology Pull-Through Programme

The outreach

2017/18
(Open to UoB only)

2018/19
(Open to CIMComp hub)

2019/20
(UK wide)

2020/21
(UK wide)

Application received
Application approved for funding

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NCC Technology Pull-Through Programme
A case study: Dismantlable Joints (in collaboration with Oxford Brookes University)

- Use of functionalised adhesives for reversible bonding composite substrates.
- Additives triggered by specific external stimuli (i.e. heat) allow dismantling the joint enabling easier reworks, repairs, modifications, and end-of-life disassembly.

- Technology conceived, tested and demonstrated in academic environment
- Developed to lab-scale and tested at coupon level
- Technology matured and transferred into industrial pre-competitive environment
- Performance, usability and durability investigated
- Technology successfully applied to medium-size demonstrator for automotive sector
- Potential applications identified, including rework for repair, repositioning and disassembling of multi-materials structures

Technology currently supported by industrial partners and members in collaborative R&D programmes

TRL1  TRL2  TRL3  TRL4  TRL5  TRL6

* [Link to video]

** [Link to video]
Industrialised capability

Pre-competitive capability

Deployed capability

Deployed technology

Applied technology

Applied knowledge

Faculty input

Technology transfer

Technology progression

Private Venture & Member Directed

Collaborative R&D

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Fundamental research

Technology transfer

Technology progression

TRL1 TRL2 TRL3 TRL4 TRL5 TRL6 TRL7 TRL8 TRL9
What is the NCC CapDev Programme?

The Capability Development programme extends the NCC offer by developing and implementing new capabilities either acquired off-the-shelf or scaled-up through lower TRL research.

<table>
<thead>
<tr>
<th>Project</th>
<th>Aim</th>
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<tbody>
<tr>
<td>TankCap</td>
<td>Develop the tools for design, manufacture and test of pressure vessels that support the growth of the UK hydrogen economy.</td>
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<tr>
<td>HarshCap</td>
<td>Generate techniques, tools and knowledge to allow the NCC to select and assess materials in harsh environments.</td>
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<tr>
<td>LargeCap</td>
<td>Offer lower cost manufacturing solutions for large composite components, through direct savings and access to diversified and novel technologies.</td>
</tr>
<tr>
<td>FastCap</td>
<td>To provide NCC with new capabilities on digitalised design, manufacture, and testing of small load-transferring components and their interaction with the entire system.</td>
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The CapDev Programme 2020/21 in 4 Projects

**FastCap**
- Manufacturing of small (<1m) load-transferring components to demonstrate:
  - Design capability for injection overmoulding, TFP or other high-rate manufacturing methods
  - Capability to process different materials (short fibre, long fibre, reused fibres)
  - Capability to integrate metallic inserts
  - Tooling cost reduction practices for prototypes

NCC is a provider of **complete** and **sustainable** composite-based solutions for **mechanical system integration**

**HarshCap**
- Develop toolkits that:
  - Enable discussions, decisions and designs across different sectors when addressing use of composites in harsh environments
  - Provide a blueprint to understand the effects of absorption on composite performance
  - Bring a first-pass mass screening capability at the NCC – where material selection is based on experimental data specific to the project challenge

Accurately predict **performance degradation** over time to increase customer **confidence** in composite solutions

**LargeCap**
- Large component design and manufacture exercise to enable:
  - Lowering the manufacturing cost of large (~10m) components for cost-driven applications
  - Large scale tooling design
  - Liquid moulding process design and prediction
  - Large scale inspection and quality control

Position the NCC as a **hub of access** to technological expertise and a network of cost effective continuous and single processing options for **large scale composites**

**TankCap**
- Hydrogen pressure vessel demonstrator as learning exercise for:
  - Pressure vessel design and manufacturing capability
  - Rapid know-how build up and workforce up-skilling
  - Material performance
  - Identification of certification requirements and test methodologies
  - Enabling design and manufacturing of cryogenic tanks for liquid hydrogen storage

Enable the development of a UK supply chain for state-of-the-art components and equipment for the **hydrogen economy**, competitive in the world market.
What should you expect to see?

- A hydrogen pressure vessel
- An integrated construction panel
- A load-transfer bracket
- A multi-joint truss node
- A large infused structure
- A novel design for a composite 
  $\text{H}_2$ tank end-fitting
- A dedicated simulation tool for large scale infusions

12 November 2020
Bristol Composites Institute Virtual Conference 2020
Case study: TankCap – the landscape

12 November 2020

Bristol Composites Institute Virtual Conference 2020
Case study: TankCap – exploitation routes

Enablers

Products

Customers

[redacted]
What is the NCC Core Research Programme?

The Core Research programme is a collaborative R&D programme steered by the NCC’s Members to deliver pre-competitive composite technology.

The NCC Core Programme is successful if:

- The output feeds into a follow-up higher-TRL research activity, or
- The members decide to protect the output for further exploitation, or
- The output is disseminated externally through technical publications.
Benefits of the Core Research Programme

- Access research outputs >12* times the value of the contribution made
- Cross sector learning and liaison with other Members
- Direct steer on projects sponsored
- Ability to propose projects for other Members and NCC to buy in to
- EngDs deployed across the programme increasing resource value
- Direct engagement with the Bristol Composites Institute leveraging expertise and capabilities

*Increases with more NCC T1s and any T2s/Associates that join a project
*Increases with EngDs in the programme due to UoB support (currently 4 deployed on projects)
2020/21 Core Research Programme

Thermal Management of Cured Composites
- £100k
- Develop a validated modelling approach for the thermal behaviour of larger components/tools and exploit to increase temperature uniformity and efficiency during curing.

Overmoulding Butt Joined Aerostructures: 2
- £75k
- Demonstrate the validity in using TP overmoulding for mfg aerospace structures by providing mfg solutions and assessing the performance of the components.

Combination of TFP and TTR
- £75k
- Demonstrate and provide design guidelines on the application of TFP and/or TTR to high stress features such as bolted joints to increase performance or reduce weight.

Modular Infusion for Large Complex Components
- £100k
- Demonstrate the use of multiple fibre architectures within a structure to offer performance optimisation and increase rate of production.

Linerless Composite Pressure Vessels: 2
- £100k
- Validate a representative material test method for cryogenic hydrogen pressure vessel applications through comparative studies on testing variables.

Disbondable Adhesives
- £100k
- Demonstrate the ‘Dismantlable Joints’ technology (TPT) against an industrial application’s set of requirements increasing confidence in use across industry.

Effective Use of Recycled Composites
- £150k
- Demonstrate the use of recycling methods with EOL composite structures (aircraft) and demonstrate the use of the recycle material through designing and manufacturing a component.

Long Term Durability Prediction
- £50k
- Develop a framework for using modelling tools to predict material’s durability performance for a set of given environmental and loading conditions.

Continuous Tow Shearing
- £75k
- Determine the breaking point for switching to CTS from steered AFP and assess the infusion characteristics of DF CTS sheered material incl provide a strategy for mitigating any permeation challenges.

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Case study

Effective Use of Recycled Composites

Value: £150k  Sponsors: Airbus, Network Rail, Shell and NCC

Challenge
The use of composite materials has rapidly increased in recent years but there are currently limited solutions for dealing with end-of-life composite components and a lack of confidence in the use of recycled composite material.

Aim
Demonstrate the use of existing reclamation and reprocessing methods that can be applied to composite materials and demonstrate the use of the recyclate material through designing and manufacturing a second life component.

Benefits
Increase confidence and proficiency of using recycled composite material for it to be considered alongside virgin material increasing its uptake in mainstream products across multiple industries.
Case study

Effective Use of Recycled Composites

Value: £150k  Sponsors: Airbus, Network Rail, Shell and NCC

Deliverables

- Technical report encompassing the recyclate material and process assessment leading into the design and manufacture of the final component
- Commercial and environmental impact analysis report, including supply chain requirements
- Skeleton framework for utilising composite waste streams into second life structures, detailed for the considerations within the project scope
- Demonstration of framework via manufacture of technical demonstrator
- Summary project presentation for dissemination
Work with us

- Generate impact from research through the Technology Pull-Through scheme
- Engage with our Core and CapDev research as a material/technology/equipment provider
- NCC Connect now offers complimentary SME support services connect@nccuk.com
- We are developing new and inclusive membership benefits and options membership@nccuk.com

Thank you for your attention!