High Efficiency Preforming
Composites Large Scale Project (CLSP)

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HVM Catapult

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Project Team

Composites Manufacturing Forum → Project Team ← Industrial Advisory Board

- Advanced Manufacturing Research Centre
  - Hannah Tew and a team of 19.

- MTC Manufacturing Technology Centre
  - Redland Sanders and Staff

- WMG Innovative Solutions
  - Geraint Williams and Ken Kendall with a team of 5

- National Composites Centre
  - Chris Young and David Jewell with a team of 14
Aims:
Identify and develop high efficiency composite preforming processes suitable for automotive applications by 2019, and capture process data including:

- Cost
- Rate
- Repeatability
- Sustainability
Manufacturing Processes Requiring Preforming

- Infusion
- Automated Spray-up
- Wet Pressing
- Thermoplastic Overmoulding

- Low Volume (<10000)
- Mid Volume (10000 – 100000)
- High Volume (>100000)

- RTM
- Thermoplastic RTM / HPRTM

HP-RTM (Benchmark Process)
Why Focus on Improving Preforming?

- Preforming is a significant contribution to manufacturing cost and cycle time
  - Rate challenge
  - Repeatability challenge – High reliance on post manufacturing inspection
  - Process scrap can be high

Indicative % of Overall Component Cost:
- Materials: 55%
- Preforming: 22%
- Consolidation: 18%
- Trimming and Finishing: 3%
High Efficiency Preforming Targets

Preforming

% of Overall Component Cost

22%

Reduce process waste by 20%
Reduce process time by 40%
Reduce quality costs by 30%

Identify Carbon footprint for preforming options in order to support life cycle analysis
## High Efficiency Preforming Targets

<table>
<thead>
<tr>
<th>Targeted Funding</th>
<th>UK (Affordable Composites)</th>
<th>Supported by HEP</th>
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<tbody>
<tr>
<td><strong>Baseline 2017-19</strong></td>
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<tr>
<td>Production Cost of Finished Components</td>
<td>Reduce by 40%</td>
<td>Reduce by 75%</td>
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<tr>
<td>Demonstrate Technologies for Recyclability</td>
<td>&gt;80%</td>
<td>&gt;95%</td>
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<tr>
<td>Cycle (Takt) Time</td>
<td>90s TP</td>
<td>60s TP</td>
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<tr>
<td></td>
<td>180s TS</td>
<td>120s TS</td>
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<tr>
<td>Reduction of Process Steps</td>
<td></td>
<td></td>
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<tr>
<td>Material Cost Reduction (Includes Waste Reduction)</td>
<td>25%</td>
<td>50%</td>
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<tr>
<td>Reduction in CFRP Embodied Energy</td>
<td></td>
<td>50%</td>
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Process Improvement Opportunities

Materials
- Nesting and ply cutting waste
- NCF and weaving waste
- Material selection
- Material Characterisation

Preforming
- Automation and Rate challenge
- Verification and process control
- Automated Fibre Placement
- Predictive Simulation
- Near Net Shape

Baseline Process

NCF and Woven Fabrics → Cut then Pick and Place → Lay-up → HP-RTM

Preform Assembly
- Automation and Rate challenge
- Verification and process control
- Joining

Consolidation & Infusion
- Automation and Rate challenge
- Fibre Wash
- Fibre Clamping Waste
- Preform Positioning
- Predictive Simulation Required

Required Supporting Activities:
- Costing, life cycle analysis, automation plan, inspection procedures as well as process monitoring and control.
Enabling Technologies

This project will investigate enabling preforming processes which appear to offer the most potential to meet cost, rate, repeatability and sustainability targets.

- **Pre-form Simulation and Stamping** - Warwick Manufacturing Group (WMG)
- **3D Woven materials simulation and manufacture** - Advanced Manufacturing Research Centre (AMRC)
- **Preform Joining and Near Net-shape Blanks** - National Composites Centre (NCC)
- **Non Destructive Evaluation, Cost Modelling and life cycle analysis** - Manufacturing Technology Centre (MTC)
- **Virtual Pilot Line** - Manufacturing Technology Centre (MTC)
Stamped Preforms

Key Benefits

- Significantly reduced process time – Increased rate and reduced cost

Current Work

- Characterisation of stamp forming process
- Process simulation
- Permeability studies
- Process demonstration

Forming Process Simulation Set-up
3D Woven Preforms

Key Benefits

- Reduced waste
- Reduced number of process steps – Reduced cost
- Tailored preform structure
- Reduced Defects – Improved repeatability

Current Work

- Manufacturing methodology for 3D woven preforms
- Process demonstration
Preform Joining

Key Benefits

- Joining sub-preforms
- Reduced process times – Increased rate and reduced cost
- Improved process robustness and repeatability

Current Work

- Characterisation of stitching and tufting processes
- Capability demonstration
Near Net-Shape Blanks

Key Benefits

• Reduced waste and cost

Future Work

• Market Review
• Current Equipment Evaluation
• Potential Equipment Modification
• Blank Optimisation
• Part Characterisation

Picture to be inserted 16/02
(Shaw currently modelling)
Development of Supporting Activities

Key Benefits

• Reduced cost

Current Work

• Virtual pilot line
• Automated visual inspection of plies
• Cost modelling
• Life Cycle analysis
Proposed Programme Structure

Year 1
Jun 16 – Mar 17

Year 2
Apr 17 – Mar 18

Year 3
Apr 18 – Mar 19

LSP-C programme
Mid Complexity, Cost Effective (Joined Preforms)
High Complexity, High Performance (3D Woven)

2019
Industry Lead Pilot Line

2021

Production Ready (MRL7)
Production Capability (MRL 6)

100% Catapult
50% Catapult
33% Catapult

50% Collaborative R+D
66% Collaborative R+D & Industry
Summary of Industry Benefits

- Candidate components identified – industry support required.
- Process demonstrated and optimised
- Factors critical to quality identified
- Manufacturing guidelines produced
- Qualified component cost at volume to build business case
- Generic plan for automation
- Qualified processes for quality control, monitoring and inspection.
Thank you for listening