Bristol Composites Institute Launch and ACCIS 10th Anniversary Conference

The Composites Age is Arriving

Prof Mike Hinton
HVMC Core Team
R&T Partnerships
15th November 2017
UK Composites Manufacturing - Some History (1971)
UK Composites Manufacturing - Some History (1971)

**RB211-22 The Hyfil fan**

- The Hyfil fan offered a 300 lb weight and two per cent fuel consumption benefit.
- High risk of Hyfil was recognised so a Titanium alloy alternative was designed in parallel:
  - as early as 1969 Hyfil blades were experiencing integrity problems
  - replacement with Titanium blades allowed continued testing
- The Hyfil blade was replaced by the Titanium blade in Spring 1970.
Strategy published Nov 2009

To develop an integrated and cross-sector composites industry

In a global market forecast to grow to £75bn by 2015

Driving composites growth using advanced manufacturing

Achieved by delivering improved
  — Strengthening capability
  — Increasing sustainability
  — Building capacity

With industry and stakeholder leadership
The National Composites Centre:

- Initiated by UK Composites Strategy (Nov 2009)
- Delivered on time and on budget
- Has more members and engagement than forecast
- Working on projects of utmost importance to UK
- Initiated the Composites Leadership Forum – advising BEIS etc. on needs of the sector
- Capability enhancements supported by HVM Catapult
- Major capex expansion underway to support ATI funded programs
Composites Leadership Forum

Established as a result the 2009 UK Composites Strategy to strengthen leadership in the sector.

The CLF is working to influence the Government and other bodies to bring together support for composites and ensure growth and industrial success for the UK.

Strategy refresh delivered 2016.

www.compositesleadershipforum.com

Stakeholders:
BEIS, Innovate UK, EPSRC, KTN Ltd, DIT (formerly UKTI).

Delivery Partners:
National Composites Centre, Composites UK, CIMComp.

Industry Groups:
UK Trade Body for Composites :-

[Image of Composites UK website]

- Supporting UK Composites
- Welcome
- New Initiative Delivers Savings for CUK Members
- Join Composites UK
- Benefits
- How to Join
- Latest News
- Tweets
- Partners
### UK Manufacturing of Composites – Political & Market View

- Significant global growth prospects for composite products

#### Global Composite Products

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Market (Bn)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2017</td>
<td>$79.6</td>
</tr>
<tr>
<td>2020</td>
<td>$97</td>
</tr>
</tbody>
</table>

CAGR 7%

#### Polymer Matrix Composites

<table>
<thead>
<tr>
<th>Material</th>
<th>2017 Market (Bn)</th>
<th>2020 Market (Bn)</th>
<th>CAGR (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon Fibre</td>
<td>$22.6</td>
<td>$30</td>
<td>10.5</td>
</tr>
<tr>
<td>Glass Fibre</td>
<td>$47.0</td>
<td>$57</td>
<td>6.6</td>
</tr>
<tr>
<td>Natural Fibre</td>
<td>$3.3</td>
<td>$4.3</td>
<td>9.7</td>
</tr>
</tbody>
</table>

#### Ceramic Matrix Composites

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Market (Bn)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2017</td>
<td>$3.3</td>
</tr>
<tr>
<td>2020</td>
<td>$4.3</td>
</tr>
</tbody>
</table>

CAGR 9.7%

#### Metal Matrix Composites

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Market (Bn)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2017</td>
<td>$518 M</td>
</tr>
<tr>
<td>2020</td>
<td>$619 M</td>
</tr>
</tbody>
</table>

CAGR 6.1%

#### Source:
Markets & Markets data compiled by NCC
The UK Market Opportunity

Potential growth from composite part production from £2.3bn in 2015 to £12.5bn in 2030.
Focus on High Growth Markets: Aerospace, Automotive and Defence
The UK Market Opportunity

Potential growth from composite part production from £2.3bn in 2015 to £12.5bn in 2030.

Focus on High Growth Markets: Aerospace, Automotive and Defence
UK aerospace industry given £2bn boost for future

Nick Clegg: "ATI will provide a long-term plan for success"

A £2bn investment to keep aerospace technology as the UK’s "jewel in our crown" has been announced.

Some 115,000 jobs will be secured as the funding, over a seven-year period, is provided by the government and the aerospace industry.

An institute will be created with the money to develop aircraft that are quieter and more energy-efficient.

Deputy Prime Minister Nick Clegg announced the strategy during a visit to Airbus in Filton, Bristol.

He said: "Aerospace experts with highly specialised skills are working..."
UK Manufacturing of Composites – Political & Market View

- Aerospace
UK Manufacturing of Composites – Political & Market View

- Aerospace

Sector Body: AGP
Planning Body: ATI

Headline ATI Portfolio Statistics

Projects developed in the last 18 months...

- 90 INDIVIDUAL PROPOSALS
- 70% SUCCESS RATE (67% WILL HELP TO SECURE OR GROW 40,000 UK HIGH VALUE JOBS)
- 60% SUCCESS RATE AT 74% SECURITY
- 108 SMEs DIRECTLY CONTRACTED WITH MANY MORE SMEs SUBCONTRACTED
- 200 UNIQUE ORGANISATIONS
- TOTAL VALUE: £1.45BN
- GRANTS OF £773M
- AVERAGE GRANT £4.4m WITH 4 PARTNERS

Map of ATI Participants

- There are 200 unique partners participating in ATI projects
- ATI partners are located in every nation and region of the UK

ATI Projects on Contract: 175

Source: ATI Analysis of Innovate UK Public Data (17th February 2015)
UK Manufacturing of Composites – Political & Market View

- Aerospace

- A350 and A400 in production (composite wings)
- Bombardier C-series EIS in service 2016 (composite wing)
- Increasing use of composites in engines (blades, cases, nacelles)
- (Production rates of A320 increasing)
- Next generation of single-aisle could use composite wing and engines with high composite content

Challenges:
- Production rates
- Globally mobile/ high value manufacturing
Government commitment to UK Automotive Sector

- Advanced Propulsion Centre: £1bn over 10 years
- Automotive Inward investment organisation
- Investment in Skills
High composites growth forecast: due to 2020 and 2025 emission targets

Applications include:
- Structures (body in white)
- Wheels and brakes
- Suspension and clutches
- Interiors (seat frames, consoles)

Challenges:
- Cost, rate and quality (surface finish, painting, joining)
- Capital cost of new production facilities
- UK supply chain?
McLaren Composites Technology Centre

- 1st UK McLaren facility outside campus
- In-sourcing the development and manufacture of carbon fibre chassis
- Using advanced know-how and technology developed with HVM Catapult (AMRC)
  - £50m combined investment
  - 200 high level jobs
  - Projected cost saving of £10m
  - £100m GVA to UK economy by 2028
- Value of UK sourcing of a McLaren car to grow by 8% (from current average of 50%)
UK Manufacturing of Composites – Political & Market View

- Oil & Gas

- UK’s largest sector by capital investment (£14b/pa)
- UK world leader in sub-sea technologies
- Major opportunities in deep water in Gulf of Mexico, West Africa (up to 30x deeper than North Sea)

Challenges:
- Well depths up to 3000m
- Well pressures increasing to >20k psi
- Regulation/assurance (hence IUK mJumper project)
UK Manufacturing of Composites – Political & Market View

- Oil & Gas

Risers Jumpers Downlines

Composites in the oil and gas industry

m-pipe is the first TCP product to complete qualification to DNVGL-RP-F119 with third party verification by DNV GL
UK Manufacturing of Composites – Political & Market View

Renewables

Siemens Manufacturing Facility – Hull, UK
UK Manufacturing of Composites – Political & Market View

- Renewables

DRAX
ELECTRIC INSIGHTS
Take a closer look at the supply, demand, price and environmental impact of Britain's electricity.

Wednesday June 7th 2017 12:30-13:00

35.4 GW
Electricity demand

£24.87/MWh
Electricity price

89g/kWh
Carbon emissions

Solar
Wind
Hydro
Gas

7.6 GW
9.5 GW
0.2 GW
7.4 GW

21.5%
26.7%
0.5%
20.8%

21.5%
26.7%
0.5%
20.8%

Coal
Biomass
Nuclear
Imports & storage

0 GW
2 GW
8.2 GW
0.6 GW

0%
5.7%
23.2%
1.7%

Data courtesy of Elexon and National Grid
Current UK Gov’t Initiative:

- **Industrial Strategy Challenge Fund**
  - Faraday (Auto Batteries)
  - (Digital Manufacturing)
  - (Materials)

- **Sector Deals**
  - Construction
  - (Chemical Industry)
  - (Composites Manufacturing)
Composites Sector Deal - Initial Thought Process

**Technology**

**Delivering:**
- Aerospace and Automotive Composites Roadmapping.
- EXX APC, EXX IUK, EXX ATI composite innovation projects.

**Ask:**
- Composite bridge demonstrator. Link to Construction Sector Deal?

**Cross Sector Work**

**Delivering:**
- HVM Catapult preforming Large Scale Project
- Scottish Lightweighting Centre.

**Ask:**
- Materials extension to CIMComp.
- Composite related extension to HVM Catapult Infrastructure.

**Sustainability**

**Delivering:**
- Climate Change Levy Scheme.

**Ask:**
- Support for iComposites-style collaborative research programme to address market failure.

**Supply Chain**

**Delivering:**
- Industry database.

**Ask:**
- Support for market & industry data refresh, cross sector & supply chain analysis.
- Funding to support engagement and communication with industry.

**Skills/Workforce**

**Delivering:**
- Composite Trailblazer Apprenticeship
- Composite Accredited Practitioner Scheme

**Ask:**
- HEFCE Catalyst fund proposal for curriculum development.
- Allow Apprenticeship levy to be used on other forms of skills.

**Regulations & Standards**

**Delivering:**
- Modernising Composite Materials Regulations Paper.
- Ongoing work challenging materials based standards.

**Ask:**
- TBC
Automation and process optimisation will lead to material cost dominating composite product cost. Need to capture the material supply chain in the UK, increasing UK GVA and reducing imported goods. (example: without action, up to £3.4bn of carbon fibre may need to be imported by 2030)
## NCMC - Indicative Academic Projects

<table>
<thead>
<tr>
<th>Matrix</th>
<th>Reinforcement</th>
<th>Intermediates</th>
<th>Sustainability</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1</td>
<td>Large scale production of monomers from bio-mass (as drop in replacements for selected polymers)</td>
<td>High performance discontinuous composites</td>
<td>High-speed weaving of broadcloth through machine development and tow sizing</td>
</tr>
<tr>
<td>M2</td>
<td>Application of multi-scale modelling techniques to optimise performance through rational design and formulation</td>
<td>Structured size</td>
<td>Variable width broadcloth weaving</td>
</tr>
<tr>
<td>M3</td>
<td>Development of lower temperature cure processing for thermoset composites</td>
<td>Next generation carbon fibres</td>
<td>Nearnet 2D preforming</td>
</tr>
<tr>
<td>M4</td>
<td>Developing new reactors to enable the rapid scale up of new monomers</td>
<td>Higher performance low-cost (glass) fibres</td>
<td>Direct preforming with long discontinuous tows into formable preforms</td>
</tr>
<tr>
<td>M5</td>
<td>Tailoring existing matrix/reinforcement interface regions to improve mechanical performance</td>
<td>High performance polymer tape composites</td>
<td>3D weaving of broadcloth (2.5D weaving)</td>
</tr>
<tr>
<td>M6</td>
<td>Development of reliable self healing polymer matrices</td>
<td>Next generation fibres to displace conventional carbon</td>
<td>3D weaving of thick and complex near-net preforms</td>
</tr>
<tr>
<td>M7</td>
<td>Developing tough, high operating temperature (350-400 C) matrices</td>
<td>In situ formation of reinforcing structures</td>
<td>Novel cutting technologies, for example laser based (with AMRC/MTC)</td>
</tr>
<tr>
<td>M8</td>
<td>Developing the next generation of multifunctional composites using new nanomaterials</td>
<td>New design tools</td>
<td>Yarns or tows from discontinuous (recycled) fibres and hybrid fibres</td>
</tr>
<tr>
<td>M9</td>
<td>Developing standards for routine use of nanocomposites across supply chain</td>
<td>Fibres as delivery routes for addition components (LINK TO MATRICES)</td>
<td>Novel cylindrical 3D preforms</td>
</tr>
<tr>
<td>M10</td>
<td>Reducing reliance on VOCs by developing water-borne technologies and moving towards circular processing</td>
<td>Hierarchical structured fibre tows</td>
<td>Just-in-time prepregging of 3D preforms</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Processing mixtures of recovered glass and carbon fibre</td>
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UK Manufacturing of Composites – Political & Market View

- Big Challenges

• Increasing demand for large components (aerospace, wind, construction...)

• Processes and costs that suit increased manufacturing rates ($10^5$/y not $10^2$/y)

• Automated manufacture

• Reducing cost and time to market (design >certification>in-service)

• Growing the UK skills/expertise to compete with the world (supply chains)
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There has never been a better time for Composites
Discussion and questions