COMPOSITES INNOVATION CLUSTER

Composites Innovation Cluster //

Final Programme Report 2012-2016

17 Projects | 4 Themes | 31 Organisations

The Composites Innovation Cluster (CiC) was supported by the Advanced Manufacturing Supply Chain Initiative (AMSCI)

CONTENTS

CLUSTER LEADS

PROGRAMME PARTNERS

SUPPORTED BY

COMPOSITES INNOVATION CLUSTER

A WELCOME FROM SOLVAY, CIC LEAD PARTNER

As the Composites Innovation Cluster draws to a close, we are offered a great chance to reflect on its achievements. The thirty-one organisations involved have made great steps in multiple directions – revelations in technology and capability, through collaborations between academia and industry, across projects and partners. The cluster's support for the training and development of our scientists, engineers and technicians has also fuelled progress and the formation of a much more credible, competitive UK composites supply chain.

Whilst Solvay has had the pleasure of being the official lead for the cluster, the project partners have, themselves, all led in the developments of technologies and collaborations that make up the wider success of the programme. It has truly been an honour to be involved with such a diverse group - blue sky thinking care of our excellent academic sector, punchy, agile innovation from a slew of talented SMEs, with pull through and market insight from the largest corporations.

We at Solvay believe the UK's composites sector is at a critical juncture. The cluster has demonstrated what is possible when we work together – and underlined the value of ongoing investment in developing a supply chain that can hold its chin high on the challenging global stage. The first steps have been made and notable technology improvements exhibited – it is now time to follow this through and exploit these in high value manufacturing that the UK can pride itself upon. Of course, to fully deliver will require customers – the existing developments and future improvements must focus on proving stable, mature technology and supply options to those customers sufficiently to win business.

We trust this report will give an insight into the themes and technologies developed by the cluster's efforts – and identify the key partners for ongoing collaborations. Solvay urges active participation in taking these capabilities forward to the next level.

Mark Steele - Global Technical Service Director for Solvay Composites Materials Industrial Business Line

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ABOUT AMSCI

The Composites Innovation Cluster was funded by the Advanced Manufacturing Supply Chain Initiative (AMSCI). AMSCI supported manufacturing supply chains in England to re-shore in the UK and improve global competitiveness by encouraging innovative, collaborative projects which established strong, sustainable and balanced growth. Complementing the Regional Growth Fund, AMSCI offered flexible funding support for R&D, skills, training, capital finance and leveraging private sector investment.

Birmingham City Council oversaw the competition to award funds for this national scheme. Innovate UK supported Birmingham City Council in running the competition process. The programme is managed by Finance Birmingham.

The funding supported a combination of investment in capital equipment, research and development, and training and skills in recognition of the flexibility needed to overcome the barriers that suppliers and supply chains can face.

COMPOSITES INNOVATION CLUSTER

PROGRAMME OVERVIEW AND IMPACT

Will Searle, Axillium Research

The CiC has combined government and industry investment strategically to support the UK composites industry. By working together we have had substantial impact by creating new skills and employment to enable UK capacity.

47 jobs safeguarded*

118 jobs created*

£££££££

CiC investment has supported 165 jobs across the composites value chain

85% of partners have grown their market position either in the UK or abroad

£ £ £ £ £ £
£ £ £ £ £ £

£11.5m private investment*

£ £ £ £ £ £
£ £ £ £

£10.9m public funding*

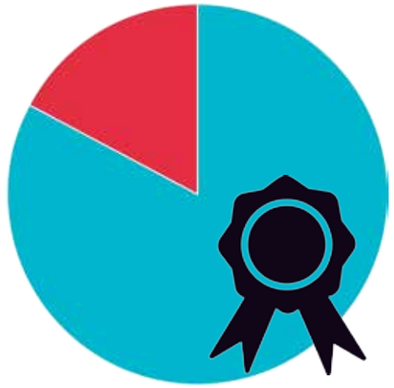
19 instances of intellectual property (IPR) created

24 new products, services or processes resulting from the programme

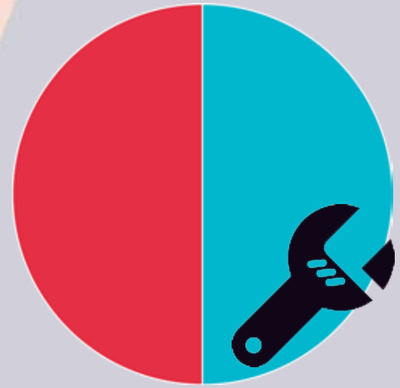
*All figures pending final reporting and approval by Birmingham City Council

The CiC has responded to manufacturing technology and skills shortages over the three years of the project by developing a sustainable manufacturing capability across the UK composites supply chain. With the support of UK leaders in the Automotive, Aerospace, Defence and Marine industries, the CiC has created new synergies and sustained collaborative relationships throughout the supply chain.

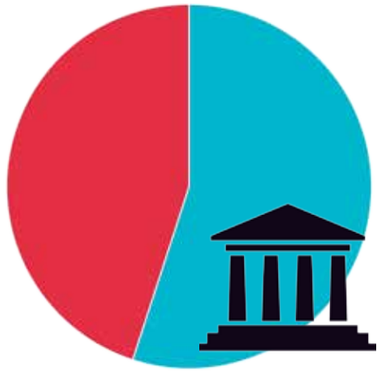
By working together, Solvay, Composites UK, Axillium and the CiC Partners have established a value chain which has brought the composites community together with impact:



82% of respondents said they achieved the intended result



50% of partners worked with a catapult centre during the programme



53% of partners worked with an academic institute during the programme

100% of partners expect to continue collaboration with cluster partners

60% of partners expect to use their own funds to finance further R&D

60% of partners see that their commercial opportunity has increased

SKILLS AND TRAINING


Paul Shakspeare, NCC

The skills side of the Composites Innovation Cluster was led by Axillium Research in collaboration with Brian Thornton and Paul Shakspeare of the National Composites Centre. Work was designed to assist partners to determine their training requirements, provide the right courses and educate project staff to assist them to work towards their project aims successfully.

The initial intent was to:

1. Work with each partner to understand need and seek the most effective training solution across the Cluster.
2. Using a matrix, capture demand and to jointly procure training supply to meet demands from a corresponding catalogue.
3. Where courses not already available, development would be procured on behalf of partners
4. Focus on meeting CiC needs but able to deliver wider training guidance.

Skills Analysis

A skills analysis took place in two stages.

A Joint Approach to Skills

- Support for understanding skills needs and delivering opportunities.
- Sharing of partner skills activities to seek collaborative opportunities (cost sharing).
- For CiC project and wider through awareness of growing range of training solutions.

Analysis of Partner Demand

- Advise on shape of likely need.
- Provide competence structure.
- Assess gaps – now and future based on technology plans.
- Gap filling where no standard course offers.

Approach

Following on from the skills analysis, an initial approach was determined and implemented.

- Establish better understanding of scope and process.
- Ascertain and understand Partner skills demands.
- Identify suppliers and their provision.
- Work to priorities.
- Aggregate demand where possible and organise courses.
- Where gaps, define responses, organise provision.

Lessons

Suitable courses were offered but with slow initial response from partners:

- Usual 'optimistic' project start up plans.
- Projects were built on Partners' existing capability.
- Greater current skills base than anticipated.

Training was delivered to meet all need but low take up from partners:

- Relatively small numbers involved.
- Difficulty to release for external training.
- More 'on-the-job' training than anticipated.
- Work-ready recruits to meet relatively small numerical demands at early project stages.

Aggregated demand because of small numbers

- Less flexibility on timing and location, but viable cohorts.

Refining the Offer

The skills and training offer was refined by partner led demand.

Prioritised by:

1. Demand from single partner - ease of delivery
2. Project requirement - prevent blockages
3. Numbers - is course financially viable?

Courses Sourced and Delivered

Courses that were sourced and delivered to partners were:

- Advanced MS Project
- Awareness of Composites
- CATIA
- Introduction to Abaqus
- Introduction to Composites Materials
- Introduction to Materials, Properties, Processes
- Introduction to MS Project
- Introduction to Robotic Programing
- Introduction to RTM/RI
- Introduction to Thermoplastics
- Managing a Composites Facility
- Pamcrash
- Prepreg Manufacturing

Ongoing Support

Commercial Offers
Providers, including the National Composites Centre, were flexible in their approach and prepared to bespoke delivery to meet demand.

HE & CPD
Higher Education and professional bodies (IMechE) supported the industry with short courses and taught doctoral modules.

Apprenticeships
A new Trailblazer Apprenticeship has been developed with significant input from CiC partners.

Was it a Success?

The training element of the CiC was one of a number of parallel initiatives at the outset of the AMSCI project. The support from the Cluster Partners stimulated areas of new training provisions and course development, this encouraged a well-established skills base as Partners moved their projects towards industrial readiness.

Going forward there will be significant opportunities to further develop the skills offer to meet the needs of the larger numbers of people requiring training as the projects reach industrial maturity.

COMPOSITES INNOVATION CLUSTER

DISSEMINATION


Claire Whysall, Composites UK

Composites UK undertook the management of the dissemination side of the CiC. Here's an overview of what was achieved.

Website

- Launched on 26/06/2013 - www.the-cic.org.uk
- Reached over24,000 unique users viewing 65,000 pages
- Visitors located in UK (56%) and US (12%) - rest spread worldwide
- 78% found the site via direct link or search engine, a further 20% via referrals from other sites.
- Most viewed pages were:

1. Home
2. About CiC
3. Project Themes
4. AMSCI
5. News

Social Media

Two social media channels were opened to disseminate project information.

Launched: 26/06/2016
Followers: 248
Posts: 270

The CiC Twitter was used to give brief project updates and promote events as and when they took place.

Launched: 26/06/2016
Followers: 220
Posts: 115

The CiC LinkedIn group gave more detailed updates, prepared by the partners themselves which were also uploaded to the website news section

Press

Over the three years of the programme, 24 press releases and articles were published about the CiC by the following outlets. These were either prepared by the CiC or the programme worked with editors to put articles together.

That's a combined audience of a whopping... **908,886** people

Events

Between 2013 and 2016 the partners of the CiC presented at..

- 35 external events such as the Composites UK Annual Conference, SAMPE and Global Automotive Lightweight Materials (GALM).
- At the public meetings organised by the CiC, the partners met over 160 people from companies outside of the Cluster.

That's a reach of over... **5,455** people

Exhibitions

Composites Engineering Show

The CiC had a large presence at the Composites Engineering Show.

- Over 18 presentations given by CiC partners between 2014 and 2016 about their projects on the show floor of the exhibition. These were open to the public to attend free-of-charge and gained high audience numbers.
- A 9 sqm stand in both 2015 & 2016 where partners could showcase their projects and meet potential clients.

JEC World 2016

The Cluster presented an afternoon of presentations at the JEC World 2016 show in Paris on 10th March 2016.

The afternoon included updates from four projects plus an overview by Axillium of how the programme was put together and how it worked, showcasing the UK at the forefront of supporting its composites industry to move forward.

Going Forward

Although the programme has come to an end, the partners of the Cluster would be more than happy to speak to anyone interested in the technologies they have developed going forward. These are detailed in the coming pages. Should you wish to be put in touch with a partner please contact Composites UK:

Telephone: 01442 275365
Email: info@compositesuk.co.uk
Address: Innovation House, 39 Mark Road, Hemel Hempstead, HP2 7DN.

KNOWLEDGE

The Knowledge theme is a strategic element that looked at the future of composites through trends and demand.

COMP-FORE allows companies to make informed judgments about specific competing technologies, plan training and implementation programmes as well as create jobs that are anchored in the UK within the composites supply chain.

UK-DATACOMP has a central focus on simulation capability. It established a knowledge base, in response to market demands for next generation design tools.

PROSEL developed a software tool for composite component design and manufacturing which provides recommendation of materials and process selection, as well as design &and manufacturing guidelines, depending on product application and requirement specifications.

COMP-FORE

Cross sector modelling tool for strengthening supply chains by technology insertion

Lead Partner:

Royal Holloway, University of London

About the Project:

COMP-FORE created a sustainable model of the composites supply chain that allows companies to make realistic engineering decisions on technology insertion to strengthen the UK supply chain, based on real-world data as well as the technical merits of that technology.

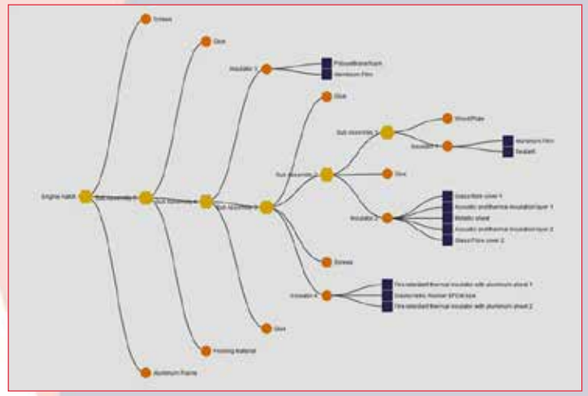
Use of this tool allows companies to make informed judgments about specific competing technologies, plan training and implementation programmes, as well as create jobs that are anchored in the UK.

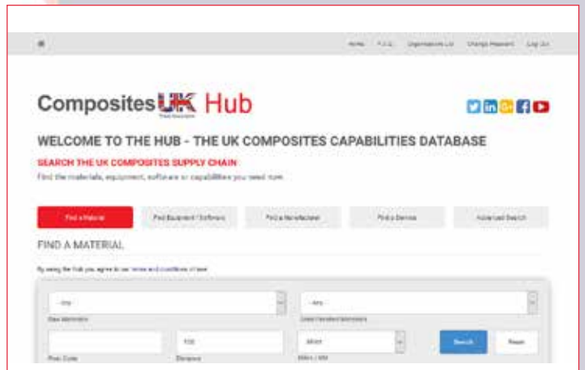
A key objective was to ensure that technologies are introduced into the UK supply chain when the supply chain is equipped to assimilate them domestically without introducing a demand elsewhere in the chain that can only be met by outsourcing operations overseas.

The COMP-FORE project included the creation of The Hub, a composites capabilities database. At the time of completing the project, 204 organisations had registered for their listing on the Hub database providing information to enable full search options including material, equipment, software, manufacturer, service and more.

The Hub will continue collecting information to support the UK composites industry under ownership at Composites UK. It acts as a free way to advertise companies and find other composites organisations in the UK. The Hub can be found at www.compositeshub.co.uk.

The COMP-FORE tool is available via www.compfore.co.uk.





Lead Partner Contact

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UK-DATACOMP

Composite material characterisation for simulation driven engineering

Lead Partner:

Altair Engineering

Collaborating Partners:

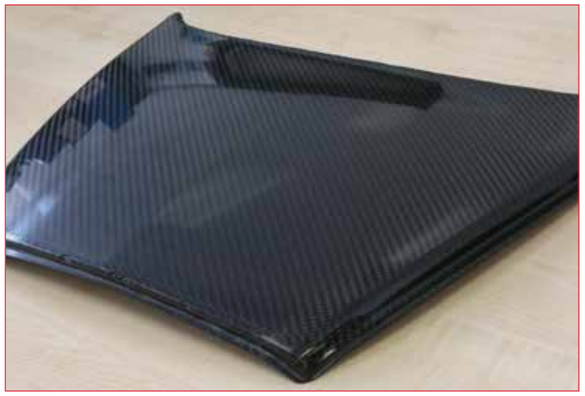
Axon Automotive, Solvay, Granta Design, Imperial College London, NCCEF, Sigmatex

About the Project:

The UK-DATACOMP project created a database of correlated finite element material models and supporting test data for a range of composites for automotive crashworthiness applications. The use of virtual prototyping technologies is well established in the automotive industry, but these are highly reliant on high quality material data to give accurate predictions, especially for crashworthiness applications. In order to fully characterise a material model for such highly non-linear and high energy crash load cases, a significant amount of testing was needed for each material both at coupon and component level. The large amounts of data generated from such testing was collated into the database and processed for use in simulation models. Each of the tests were simulated using finite element modelling and the models correlated. The final validated material models were then fed back into the database where automated processes were developed to speed up what is otherwise a time consuming and complex process.

A wide range of materials have been manufactured and tested. Sigmatex provided and developed non-crimped fabrics, spread tow woven carbon, fabrics with combined reinforcement of carbon with Innegra, Vectran, and Panex, and SigmaRF (a recycled fibre weave), and Axon provided its braided Axontex™ material. Solvay provided matrix material for the project and manufacturing capability. NCCEF, a UCAS certified test house, provided services for manufacturing and standard composite testing, and Imperial College London developed novel test methods to validate the material cards for damage behaviour at the coupon and subcomponent levels, and provided manufacturing capabilities.

Altair and Axon provided simulation expertise for the project, both applying a coupon correlation technique for major explicit solvers (Radioss, LS-Dyna, Abaqus and Pamcrash). Altair have developed a tool that streamlines the characterisation process by taking processed data from the database and running single element and coupon models in an automated process for the major solvers listed above. The tool allows the user to achieve a best fit of the materials properties from the various tests, enabling a good level of correlation to be achieved. The validated material models will be accessible from the database via Granta's interfaces and gateway products including one developed for Altair Hypermesh.



Lead Partner Contact

Altair Engineering
Imperial House Holly Walk, Royal Leamington Spa, CV32 4JG

Website: www.altairengineering.co.uk

PROSEL

A software tool for composite component design & manufacturing

Recommending materials & process selection

Lead Partner:

Cranfield University

About the Project:

The PROSEL project has developed a software tool for composite component design and manufacturing.

In the UK composites industry there is a vast array of both well-established and emerging material forms and process techniques for the manufacture of advanced composite components. Outside niche sectors, there is insufficient understanding of their applicability and limitations for component shape and affordable manufacturing.

The aim of the project was to:

- Provide recommendations for materials and process selection as well as comparative manufacturing costs, tailored to the product application and requirement specifications.
- Provide design and manufacturing guidelines, insight and advice for composites applications using both established and emerging manufacturing processes.
- Enable the development of smarter, more efficient composite components and structures.

The beneficiaries of such are:

- Engineers new to composites.
- Experienced composites design and manufacturing engineers.
- Company Directors considering manufacturing investment or application feasibility.
- Material suppliers.

UK and European materials suppliers alongside specialist design and manufacturing engineers have contributed advice to complement the tools highly comprehensive knowledge base.

For further information:
http://prosel.herokuapp.com

Lead Partner Contact

Prof. Andrew Mills, Cranfield University
Milton Keynes, Cranfield, MK43 0AL

Website: www.cranfield.ac.uk

With the rate of innovation in the composites sector, resulting in a growing selection of new materials and manufacturing methods, the future of composites design must utilise decision/expert software tools to accurately and efficiently compare the suitability and cost of materials and process combinations for new projects.

MATERIALS

The Materials theme developed the use of new materials including biocomposites and thermoplastic composites, investigated design methodologies alongside manufacturing and tested techniques for new materials.

COMBINE developed dry fabric stabilisation processes and automation to ensure that the UK Supply Chain is ready for anticipated opportunities in non-prepreg composites systems including 3-dimensional woven fabrics and multi-axial non-crimp fabrics for resin infusion.

Geneos modelled the feasibility of using graphene to enhance the thermal properties of aerospace grade tooling materials and to manufacture prototype tooling materials which will subsequently be tested and compared against the model predictions.

UK-ECOPROCESS developed a unique, flexible manufacturing process that can produce structural thermoplastic automotive components at competitive cost , thus allowing OEMs to take advantage of the lightweight, superior impact properties, clean manufacture and full recyclability of these materials.

COMBINE

Enhancing the UK composites supply chain through cross process stabilisation for non-prepreg materials

Lead Partner:

Sigmatex

About the Project:

Sigmatex has developed a dry fabric stabilisation and automation processes to ensure that the UK supply chain is ready for anticipated opportunities in non-prepreg composites systems.

Dry fabric is the core business supplying the composites prepreg supply chain. By developing a dry fabric stabilisation capability, future business opportunities will be realised with respect to diversifying the current supply chain and will ensure UK composites remains at the forefront of technology and materials development.

The stabilisation uses powder deposition and lamination techniques to enable automatic cutting and deposition by the end user.

The project has developed dry fabrics in various forms including multi-axial non-crimp fabrics for resin infusion, which the European automotive sector is looking to the supply chain for. The project has a view to develop 3D fabrics in its final stages.

Lead Partner Contact

Sigmatex
Manor Farm Road, Manor Park, Norton, Runcorn, Cheshire, WA7 1TE

Website: www.sigmatex.com

GENEOS

Using graphene to enhance thermal properties of aerospace grade tooling materials

Lead Partner:

Haydale Composite Solutions

About the Project:

Working with BAE Systems, Haydale Composite Solutions both modelled the feasibility of using graphene to enhance the thermal properties of aerospace grade tooling materials and manufactured prototype tooling materials which were subsequently tested and compared against the model predictions.

In recent years, research has shown that the addition of graphene can improve the thermal conductivity of composite resins. This project investigated the use of graphene enhanced resins for the manufacture of aerospace grade composite tooling prepreg with inherent multi-functionality, i.e. improved fracture toughness, CTE, impact resistance and thermal and electrical conductivity. The project modelled the graphene enhanced prepreg composites to determine the theoretical improvements in thermal conductivity and also manufactured test specimens from prototype prepregs to determine whether the materials produced matched the theoretical models. The innovative materials that were developed were also assessed against current aerospace grade tooling materials, specified by BAE Systems, with a view to commercialisation.

The work conducted in the GENEOS project has demonstrated that graphene enhanced composite tooling has the capability to deliver benefits in terms of thermal conductivity performance over conventional tooling materials, whilst improving on damage tolerance, reducing through life costs and maintaining good mechanical properties.

Lead Partner Contact

Haydale Composite Solutions
Unit 10, Charnwood Business Park, North Road,
Loughborough, LE11 1QJ

Website: www.haydalecompositesolutions.co.uk

UK-ECOPROCESS

Developing a flexible manufacturing process to produce hybrid, structural thermoplastic automotive components cost effectively

Lead Partner:

Haydale Composite Solutions

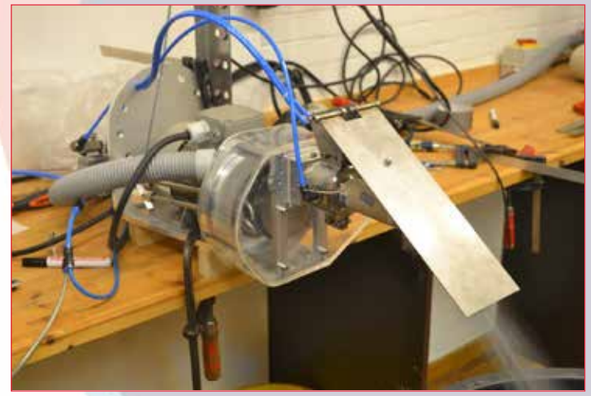
Collaborating Partners:

Solvay

About the Project:

UK-ECOPROCESS developed a unique, flexible manufacturing process that produces hybrid, structural thermoplastic automotive components cost effectively. This allows OEMs to take advantage of the lightweight, superior impact properties, clean manufacture and full recyclability of thermoplastic composites. The use of thermoplastic composites had previously been limited by inefficiencies in material and process.

The project focussed on delivering a step change in process speed, waste levels and material performance necessary to make structural thermoplastics cost viable to OEMs. A key objective was to convert raw material yarns directly into net-shaped prepregs ready for forming, thereby removing the intermediate bulk prepreg step. High performance, hybrid thermoplastic yarns and robotic technology were developed to produce aligned, net-shaped material pre-forms. This was achieved by building upon a previous EU research programme and collaboration with a prominent material supplier (Solvay) and OEM (Bentley Motors).



Lead Partner Contact

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PROCESS

The Process theme covered innovative methodologies for efficient manufacture using existing and novel materials including 3D weaving, design for 3D materials, thermoplastic technology and design for manufacture.

UK-BIOCOMP developed the materials and process technologies necessary to manufacture the novel biopregs via an integrated continuous process.

UK-THERMOCOMP developed a short cycle time, high-volume manufacturing process for carbon fibre-reinforced thermoplastic components, as well as production technologies for the rapid “stamp-forming” of CFRP parts similar to the stamping of sheet metals.

ThermoCARB proved a UK capability in the production of overmoulding thermoplastic composite components for the automotive sector.

LOWPRO developed and established a low cost, flexible prototyping service for complex thermoplastic composite components.

LiRIC increased the range of composite components which are suitable for liquid resin infusion.

FAR-MFD set up a demonstration manufacturing facility that focussed on industrial research to bring cost effective and affordable manufacturing of composite components and structures to a range of Primes.

UK-BIOCOMP

Developing the next generation of flax-based composites

Lead Partner:

NetComposites Limited

Collaborating Partners:

Axon Automotive, Henniker Scientific, Tilsatec, University of Hertfordshire

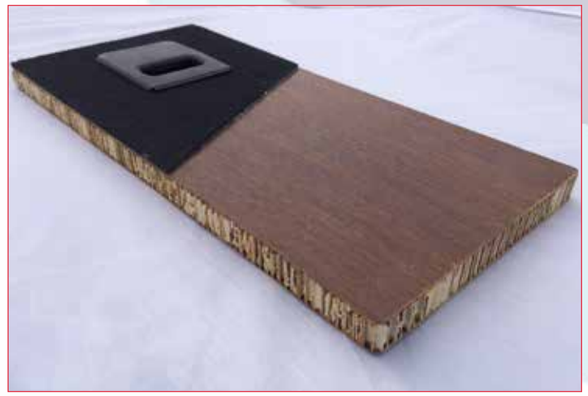
About the Project:

The UK-BIOCOMP project has developed high-performance flax-based materials for the manufacture of both thermoset and thermoplastic composites, for use in a variety of markets including sporting goods and the automotive sector.

The partners in the UK-BIOCOMP project have developed an innovative family of reinforcement products based on highly aligned natural flax fibres. The new reinforcements, which offer a unique combination of low weight, good vibration damping and sustainability, are specifically targeted at applications such as skis, snowboards, hockey sticks, automotive load floors, door modules and decorative components.

Compared to existing woven flax reinforcements, these next generation materials have significantly improved mechanical properties whilst being lower cost. The high performance flax reinforcements can be supplied as unidirectional tapes in widths of up to 1270 mm, with work currently under way to produce non-crimp multiaxial fabrics. Variants can be supplied for use in thermoset applications such as RTM and prepreg, as well as those blended with thermoplastics such as PP or PLA for direct consolidation.

A key aspect of the project involved the plasma treatment of the materials for further property enhancement, including improved infusion speed, wet-out and mechanical performance. The project also conducted a life cycle assessment which showed advantages over glass and carbon fibre reinforcements.



Lead Partner Contact

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UK-THERMOCOMP

Stimulating the UK supply chain for high performance thermoplastic composites

Lead Partner:

Technical Fibre Products

Collaborating Partners:

AGC AeroComposites, Altair, Axon Automotive, NetComposites, Sigmatex, Tilsatec, WMG

About the Project:

UK-THERMOCOMP focussed on the development of carbon-fibre reinforced thermoplastic (CFRTP) based on innovative laminate and fabric forms. A range of carbon-fibre reinforcements (CF) or staple recycled (rCF) and thermoplastic matrices were investigated. These were selected based on performance and application specific requirements. The most promising material architectures explored were hybrid non-crimp fabrics (NCF) and pre-consolidated discontinuous rCFRTP tapes. In the case of the hybrid NCF, thermoplastic nonwoven layers were interleaved between unidirectional CF base layers and stitched throughout. Whereas the rCFRTP tapes consisted of a commingled arrangement of rCF and partially melted staple thermoplastic fibres.

Outputs from the project included a number of demonstrators, including:

- Automotive-type longitudinal beam demonstrators. Manufactured via a rapid isothermal stamp forming (RISF) process by Surface Generation Technologies. Fully consolidated CFRTP demonstrator parts were manufactured in under five minutes.
- Automotive internal door module demonstrators. Also manufactured via stamp forming using both pre-consolidated rCFRTP tapes and hybrid NCF. The demonstrators exhibited good geometrical stability and good dimensional tolerance.
- Aerospace clip demonstrators. Manufactured to near-net shape using the RISF process with preformed tailor blanks. A two-step process was necessary for the intricate geometry of the clip and to minimise part trimming.

UK-THERMOCOMP also incorporated virtual modelling to simulate the thermoforming of the CFRP demonstrators. This was successful with initial wrinkle formation issues and the eventual solution correctly predicted. Mapping of the final reference parts also enabled the influence of the manufacturing process to be captured in the part performance analysis.

Lead Partner Contact

Technical Fibre Products
Burneside Mills, Kendal, Cumbria, LA9 6PZ

Website: www.tfpglobal.com

THERMOCARB

Proving a UK capability in the production of overmoulding thermoplastic composite components for the automotive sector

Lead Partner:

Formaplex

About the Project:

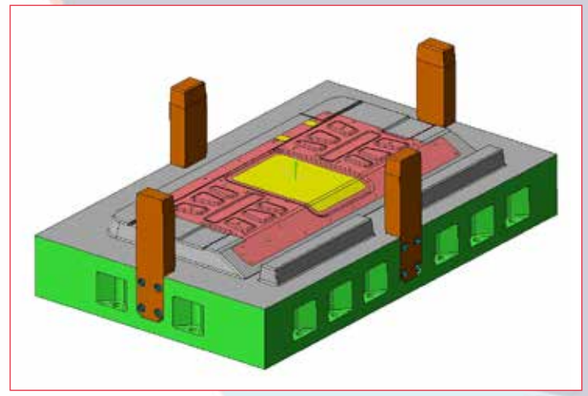
ThermoCARB served to prove a UK capability in the production of overmoulding thermoplastic composite components for the automotive sector.

Thermoplastic composites are generating huge interest in the automotive sector for their recycling, processing and weight reduction benefits. With this in mind, Bentley Automotive asked Formaplex, as part of the Composites Innovation Cluster to develop a high volume, thermoplastic, over-moulded composite alternative to an existing thin shell aluminium rear seat bulkhead. The objective is to increase the stiffness compared with the aluminium part while saving weight.

The ThermoCARB project established a production process and cell at Formaplex to manufacture a thermoplastic composite rear bulkhead component by:

- Sourcing rapid heating and cooling and IR heating equipment.
- Sourcing of alternative organo-sheet thermoplastic materials to understand their behaviours and limitations including carbon fibre, glass fibre, polypropylene and biocomposites.
- Designing for manufacture a substitute component based on an existing Bentley aluminium rear bulkhead with the intention of increasing stiffness and reducing mass.
- Designing and manufacturing mould tools.
- Setting up a production cell to prove out the manufacturing process.

This process was not believed to be available in the UK so by establishing and proving the capability, Formaplex increased UK technological and commercial competitiveness whilst providing a UK supply source for over-moulded thermoplastic composite automotive components.



Lead Partner Contact

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Website: www.formaplex.com

LOWPRO

Low cost prototyping for structural thermoplastic components

Lead Partner:

Haydale Composite Solutions

About the Project:

This project was aimed at solving issues associated with uptake of thermoplastic composite manufacture, mainly the lack of efficient prototyping options before committing to high cost production tooling.

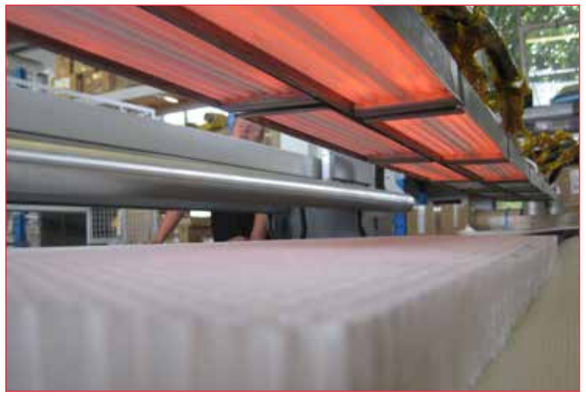
LOWPRO focussed on two emerging prototyping technologies: diaphragm forming and continuous thermoplastic panel lamination. The project conducted the practical research and development work necessary to implement process, tooling and systems efficiency enhancements to make these technologies commercially viable for prototyping.

A key development within the project was the conception and validation of the low cost, 'consumable' tooling concept. This allows tooling to be designed and manufactured (direct from the client's CAD file of the part) at low cost (typically sub £2,000) that is capable of making 50-200 parts before expiry. The validation of the consumable tooling concept is a major step in the viability of a low cost prototyping service.

During the project three components were prototypes for established external companies with a real need for the benefits of thermoplastics, but without a means to prototype the parts to allow testing. The three prototypes were:

1. A highly novel alpine sports component with complex hybrid structure.
2. A fully recyclable, lightweight, corrosion resistant sandwich panel, made from 100% polypropylene.
3. A novel natural fibre reinforced sports footwear insert.

This practical approach maximised the opportunity to generate the knowledge and skills to establish a prototyping service. Haydale Composite Solutions has now developed a business plan for a commercial prototyping service for consideration by potential investors.



Lead Partner Contact

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LIRIC

Liquid resin infusion of high temperature composites

Lead Partner:

Meggitt Polymers and Composites

Collaborating Partners:

Sigmatex

About the Project:

The widespread adoption of liquid-resin infusion processes for structural composite components is a necessary step forward to achieve the required cost reduction for the UK to remain competitive in the global composites industry. Resin infusion technology is extensively used in the manufacture of large composite components for the boat building and wind energy industries.

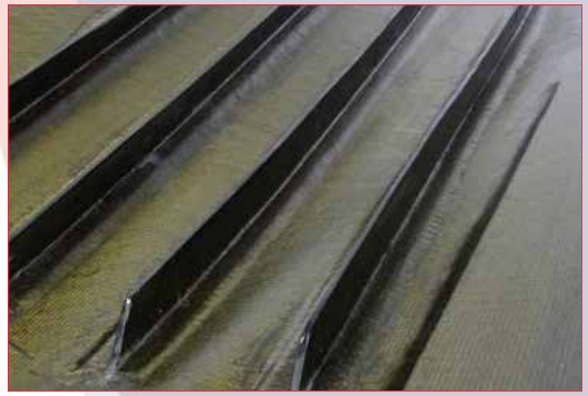
LiRIC has developed and demonstrated liquid resin infusion for high temperature structural aerospace components, utilising 3D woven technology supplied and developed by Sigmatex.

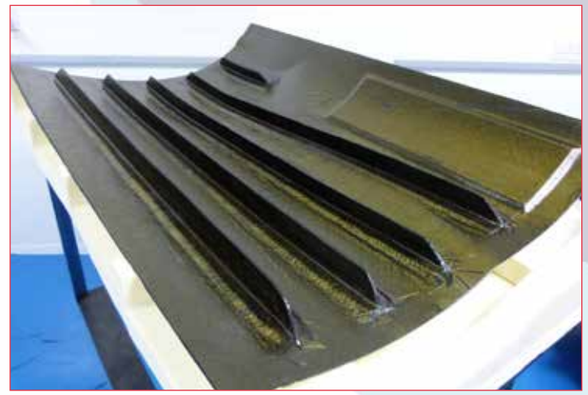
LiRIC has demonstrated the range of features of composite components which are suitable for liquid resin infusion and the potential to replace processes such as hand layup of prepregs which require high value manufacturing labour.

The particular technology focus for the project was on the following three areas:

- High-temperature liquid-resin systems, which offer greater thermal performance than epoxies.
- 3D woven preforming technology.
- Affordable self-heated tooling technology.

Together these technologies resulted in a demonstration of an affordable manufacturing process for aerospace components, demonstrating an out-of-autoclave processing route for high-quality composite components, and expanding the use of UK based 3D woven preforms.





Lead Partner Contact

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Horizon Technology Park, Six Hills Way,
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FAR-MFD

A demonstration manufacturing facility

Lead Partner:

Far Composites

About the Project:

FAR-MFD set up a demonstration manufacturing facility. The focus was on research, to bring cost effective and affordable manufacturing of composite components and structures to a range of Primes.

Far Composites is established to fulfil the requirements of a range of clients who want both innovative design solutions and the support of a robust manufacturing facility, with a route to market.

Far's team has an extensive background in composite material technology, high-volume manufacturing, design for manufacture and lean production techniques. These skills are supported by expertise in CAD design and Finite Element Analysis.

The team took its proven patented technology, Axontex™, which has been used to make the FPC and Hyundai Intrado prototype frames, pictured, and is developing further, next generation processes to fulfil this brief. This work is continuing in collaboration with Loughborough University.

Lead Partner Contact

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AUTOMATION

The Automation theme developed design guidance, automation, design for manufacture, high volume and high value manufacturing techniques, production engineering and testing to enable the UK Composites industry to better compete in the competitive global market.

ACTIVATE improved affordability of advanced composites for mid- & high-volume automotive production. Its global market will reach £600m by 2020.

MACoB developed manufacturing techniques and design for manufacture guidelines for complex composite structures.

ATTOM designed and manufactured selected mouldings for automated/mechanised production methods for tidal turbine applications.

RITAA established a working HP-RTM facility at Solvay's facilities and subsequently to developed and demonstrated the effective and affordable manufacture of automotive structural components through HP-RTM.

ACTIVATE

Improving the affordability of advanced composites for mid- and high-volume automotive production

Lead Partner:

Solvay

Collaborating Partners:

Assyst Bullmer, Formaplex, Güdel, LMAT, The University of Nottingham

About the Project:

ACTIVATE set out to improve the affordability of advanced composites for mid- and high-volume automotive production. The global automotive market will reach £600m by 2020. Moulded converted part costs for the low-volume supercar sector are at best €100/kg. ACTIVATE aimed for €60/kg with near-term commercial viability to enable significant growth for mid-volume automotive, targeting its demonstrator at leading OEMs.

ACTIVATE built on outcomes from previous work by developing highly bespoke manufacturing skills and equipment, enabling cost reduction through automated handling and waste reduction at the production cycle's material formatting, preparation and moulding stages.

The project developed and demonstrated:

- Techniques to improve quality, repeatability and manufacturing throughput for multi-layer, selectively discontinuous prepreg materials.
- Automated cutting, kitting and 2D preforming technologies.
- Cost-effective manufacture of a case study component. It will do this by bringing together enabling technologies currently dispersed across the supply chain.

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MACOB

Developing manufacturing techniques and design for the manufacture guidelines for complex composite structures

Lead Partner:

Dowty Propellers (GE Aviation)

Collaborating Partners:

Solvay

About the Project:

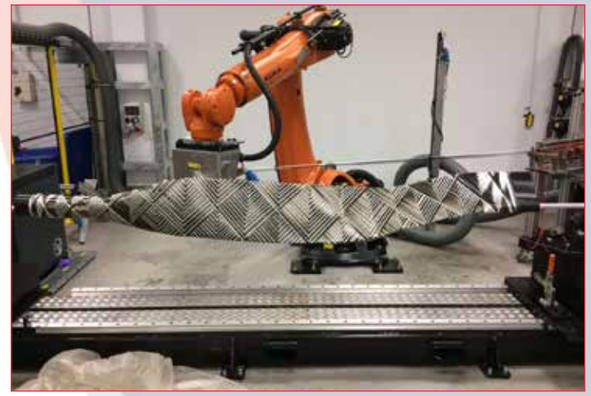
MACoB has developed various manufacturing techniques and design for manufacture guidelines for complex composite structures within propeller blades.

Multiple technologies such as Automated Fibre Placement (AFP), Filament Winding and Triaxial Braiding have been developed not only to enable the manufacture of more complex structures with new innovative root configurations, but also to introduce more flexibility and accuracy into the propeller manufacturing process.

Alongside the technology development within this project, new design software has been utilised at multiple UK research centres to conduct design and analysis on these new structures. These activities have shown how different software packages can to be utilized to conduct finite element analysis on complex structures such as propeller blades.

With the combination of manufacturing technology and design software development, the MACoB project will enable bids for contracts on highly swept propeller blades required in future applications for superior acoustic and performance, such as next generation turboprops and open rotors, as well as other products with highly curved geometries that cannot be made effectively or efficiently with today's methods.

Turboprop aircraft are up to 20% more efficient than turbojet aircraft of the same size over short-to-medium distance flights today, giving considerable environmental benefit.



Lead Partner Contact

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Anson Business Park, Cheltenham Road East,
Gloucester, GL2 9QN

Website: www.dowty.com

ATTOM

Developing affordable tidal turbines via optimised manufacture

Lead Partner:

Solvay

Collaborating Partners:

Assyst Bullmer, Aviation Enterprises, Güdel

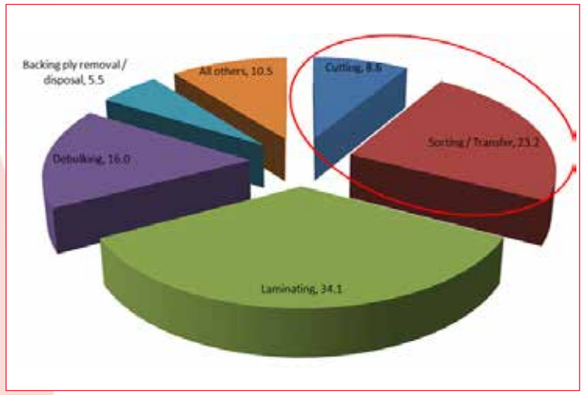
About the Project:

The ATTOM project aimed to investigate the potential for automation or improved materials handling methods as a route to cost reduction, as well as factors that effected production line layout and the possible solutions to specific quality control problems. The specific aim of the ATTOM project was to reduce the costs associated with tidal turbine blade manufacture by 20% by improved design and through the use of automated handling and storage techniques.

Project partner AEL carried out a bench marking exercise highlighting potential areas for automation and time saving that could contribute towards a 20% reduction in cost and time saving associated with the manufacture of a single blade.

The project targeted the ply cutting, handling and sorting. Currently plies are cut in the most efficient order which maximises material utilisation. In turn, this means plies are not cut in the correct order for deposition, therefore as plies are cut they are stacked, then manually sorted into the correct order for deposition/lamination.

The ATTOM project has demonstrated, using smart nesting algorithms an improvement in efficiency. The ATTOM automation cell demonstrates the automated cutting, ply handling and storage of ply geometry which has been cut in the most efficient order. The system then has the ability to present the cut ply geometry in order of deposition for hand lamination or potentially automated deposition.



Lead Partner Contact

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RITAA

Resin injection technologies for automotive applications

Lead Partner:

Solvay

Collaborating Partners:

Formaplex, Formax, Krauss Maffei UK, LMAT

About the Project:

High Pressure Resin Transfer Moulding (HP-RTM) processing will be one of a variety of manufacturing solutions employed by OEM's and Tier 1 suppliers to manufacture automotive structures. Solvay has developed initial resin formulations designed for this process. Characterisation of processing windows and mechanical performance of resulting laminates is ongoing.

The UK had limited access to laboratory level HP-RTM facilities let alone application (or sub-scale) level facilities, with the country lagging behind continental Europe (in particular Germany) in this regard. Large scale facilities have since been implemented at the National Composites Centre, Warwick Manufacturing Group and at least by one UK Tier1 automotive supplier.

The purpose of the RITAA project was to establish a working HP-RTM facility at Solvay's facilities in Heanor, Derbyshire, and subsequently to develop and demonstrate the effective and affordable manufacture of automotive structural components through HP-RTM. The creation of a HP-RTM facility at Solvay and the resulting increase in technology readiness level (TRL) significantly improved the UK technological and commercial competitiveness.

The RITAA project drew together a partnership of material supplier (Solvay), equipment supplier (Krauss Maffei), tooling supplier (Formaplex), reinforcement supplier (Hexcel) and simulation experts (LMAT) who worked collaboratively to implement and commission an operational facility and then to embark upon a process of characterisation, simulation and refinement of the materials and process technologies.

The project produced an automotive structure using optimised materials, process and simulation technologies.

Lead Partner Contact

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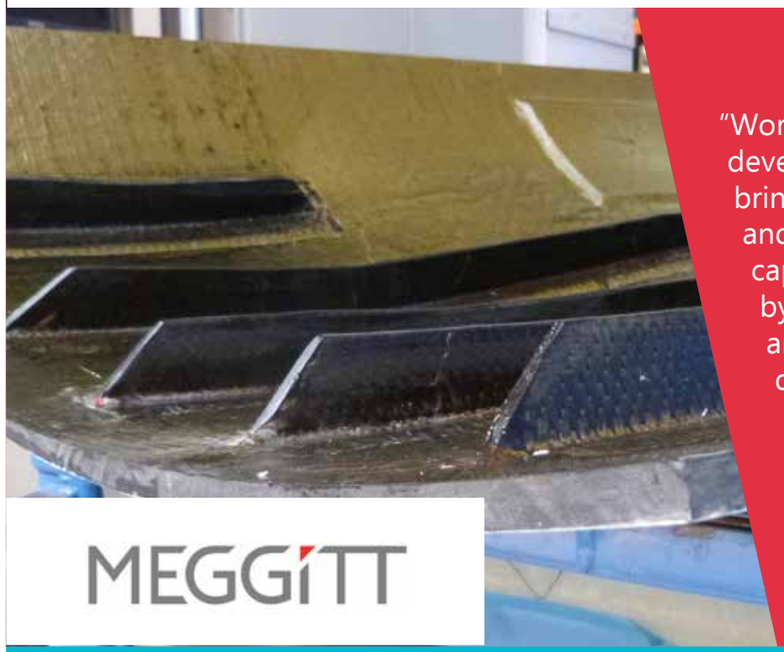
CASE STUDIES

The following pages take a look at the successes of five of the project partners.

- Meggit Polymers and Composites
- Haydale Composite Solutions
- Granta Design
- Formaplex

SUCCESS STORY: MEGGITT POLYMERS AND COMPOSITES

Creating additional funding opportunities



"Working as part of the CiC has developed our supply chain by bringing additional knowledge and understanding of industry capabilities and limitations explored by each of the partners - all of whom are at the forefront of research and development in composites."

Michael Moor, Technology Development Engineer, Meggitt Polymers & Composites

The overarching goal of LiRIC was to establish the liquid resin infusion process parameters required to manufacture high temperature composite components using non-autoclave processes. This was successfully achieved and demonstrated through the successful manufacture of the technology demonstrator.

- Achieving up to 20% reduction in manufacturing costs.
- Addressing the defence market's need for damage tolerant composites.
- Increasing the UK's competitiveness in the use of 3D woven materials.

Meggitt's commitment to research and development through LiRIC created an additional funding opportunity called BAM, increasing the TRL and exposing the resin infusion process and use of 3D woven materials to a wider audience of potential customers. Existing customers were also informed of on-going development activities in an effort to align our research roadmap with their requirements, and prompt a joint development project to increase the TRL of this technology.

MEGGITT FACTS

- The group employs 12,000 people across 53 operating facilities
- 6% increase in annual revenue
- Research and development expenditure in 2015 was c. £158.7 million, representing 9.6% of revenue

Contact:
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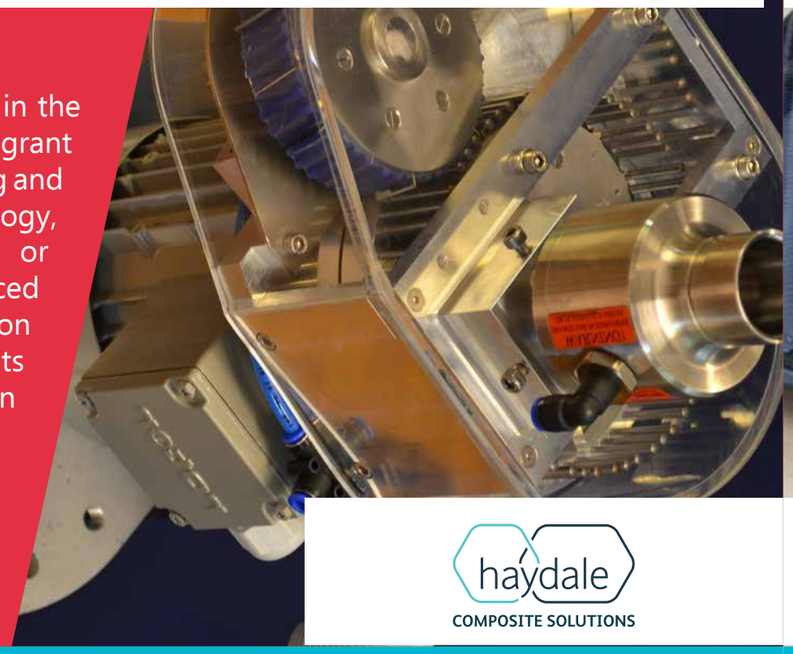
Website: www.meggitt.com

SUCCESS STORY: HAYDALE COMPOSITE SOLUTIONS

Leading three successful projects

"The benefits of being a partner in the CiC programme were multi-fold; grant funding to reduce risk, networking and access to complimentary technology, ideas generation for current or future developments, and enhanced marketing and exploitation opportunities. All of these benefits had a natural postitive impact on our supply chain as a whole."

Nigel Finney, Director - Commercial Projects, Haydale Composite Solutions



haydale
COMPOSITE SOLUTIONS

Haydale Composite Solutions was involved in three CiC projects - LOWPRO, UK-ECOPROCESS and Geneos, all as lead partner.

LOWPRO identified a supply chain gap – a company who can manufacture a low volume of a number of different prototype components to a client for assessment – at low cost in a reasonable timeframe – in order for the client to make an informed decision if thermoplastic composites can improve their product offering. Don and Low, Bromley Technologies and Healus Technologies engaged with Haydale to prove the technology that the company had developed.

UK-ECOPROCESS developed a unique process system where chopped fibres were sprayed on to a mesh in the desired layout, before being placed into a forming jig and transferred to an oven and a vacuum is applied to exert consolidation pressure. Once removed from the oven and cooled, this fully formed pre-form is then ready for manufacture in a high pressure press.

The Geneos project was a short, six-month feasibility study funded through the CIC virement competition. The project was led by Haydale Composite Solutions as the only grant funded partner whose responsibility was to lead the project and develop a UK based supply chain for the development and supply of graphene-enhanced carbon fibre composite tooling prepreg.

HAYDALE FACTS

- The company has seen a 35% turnover increase year-on-year since the start of the project
- It also saw a 118% increase on R&D spend
- Three patent applications made

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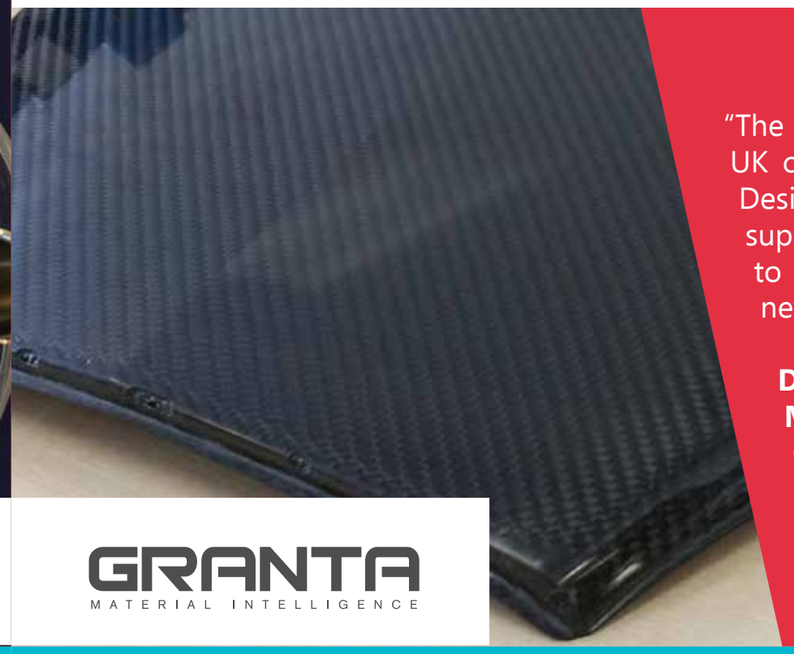
COMPOSITES INNOVATION CLUSTER

SUCCESS STORY: GRANTA DESIGN

Providing a material properties database for the composites industry

"The CiC programme advanced the UK composites supply chain. Granta Design benefited from funding to support employment, training and to reduce the risks associated with new technology development."

Donna Dykeman, Senior Project Manager - Collaborative R&D, Granta Design



GRANTA
MATERIAL INTELLIGENCE

Understanding how composites behave in a vehicle collision is critical to gaining confidence for wider use in the automotive sector. The UK-DATACOMP project established a database to facilitate material selection in the sector using established simulation methodologies for composite product development.

Granta designed and hosted the materials information database underpinning the project by creating a central location for all partners to access materials, processing, test and simulation information.

The end goal was to provide a source of credible, validated and consistent materials data, enabling engineers and designers to better understand, model and work with composite materials. Granta already offers a range of composites data for selection, design and simulation to the aerospace industry, and the target for Granta and UK-DATACOMP was to develop a viable value chain for the automotive market.

Key results include a new GRANTA MI:Materials Gateway for Hypermesh within which the UK-DATACOMP Database will be accessible. Granta also enhanced its Composites Qualification Services through training and technology development. The outcome is a system that makes it faster and easier to define test programmes and to capture, analyse, and use data, ultimately reducing costs and time-to-market for OEMs.

GRANTA FACTS

- The company has seen sustained double-digit turnover growth in the past decade
- R&D commitment continues to be greater than 25% expenses
- Composite R&D will continue to be a primary area of focus

Granta's wider business grew, with the cluster supporting nine new jobs.

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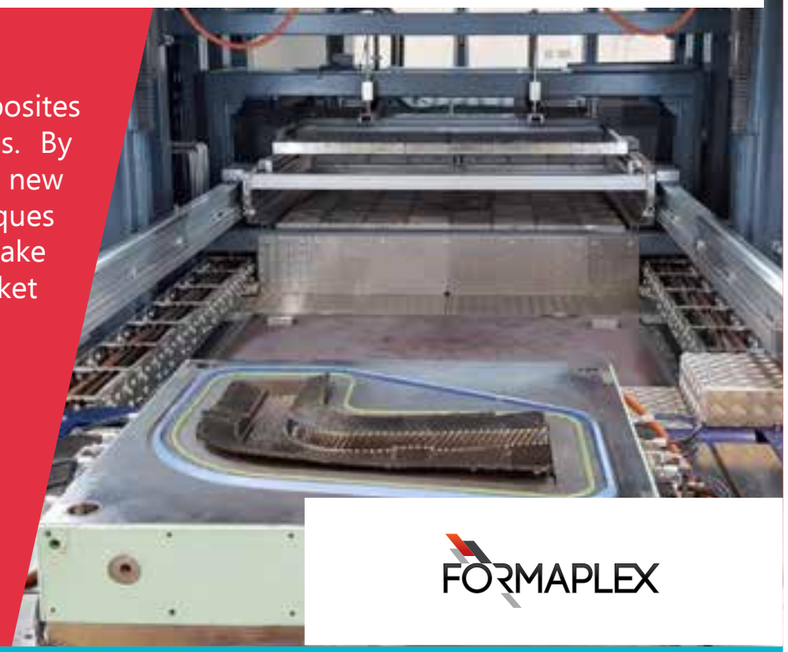
CB1 7EG

Website: www.grantadesign.com

COMPOSITES INNOVATION CLUSTER

SUCCESS STORY: FORMAPLEX

Taking on a third project as lead partner for the final year



"High volume automotive composites is a growth opportunity for us. By developing and demonstrating new UK based production techniques through the CiC we are able to take validated solutions to the market place."

Matt Sellens, Business Development Manager, Formaplex

Formaplex was a collaborating partner in ACTIVATE and RITAA as well as lead partner in ThermoCARB.

Formaplex were invited to join RITAA to bring tool making expertise to the consortium. This offered the company the opportunity to establish a capability that utilised its established thermoplastic injection mould tooling business and its composites production business as well as allowing it to demonstrate and develop its tooling capability for a growing requirement in the automotive sector.

In ACTIVATE, Formaplex's role was tool design and manufacture, and support to LMAT for validating their compensated tool design.

As lead partner of ThermoCARB, Formaplex developed and established a production process and cell to manufacture a thermoplastic composite rear bulkhead component. This came through a successful virement bid in the CiC's final year.

As the process was not available in the UK before this bid, by leading on TheroCARB Formaplex has increased the UK's technological and commercial comptitiveness whilst providing a UK supply source for over-moulded thermoplastic composite automotive components.

FORMAPLEX FACTS

- £15m invested over the past 4 years
- Turnover increased by 100%
- Number of permanent employees increased from 200 to 430
- Facilities increased by 150,000 sq. ft.

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