



GLOBAL CARBON COMPOSITE SOLUTIONS

**Design for Performance**

# Advanced Composites and Product Innovation

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Global Automotive Lightweight Materials  
Birmingham 26<sup>th</sup> - 28<sup>th</sup> April 2016

# Sigmatex – Overview



Established Thirty Years, Sigmatex is the world's largest independent supplier of Carbon conversion textile solutions in the advanced composites industry

- Global manufacturing presence
- Volume material processing
- AS9100C, DNV type approvals
- Widest range of single source Conversion technologies in the market
- 10% of Sigmatex work force dedicated to research & development
- Material Innovation
- Technology Leadership



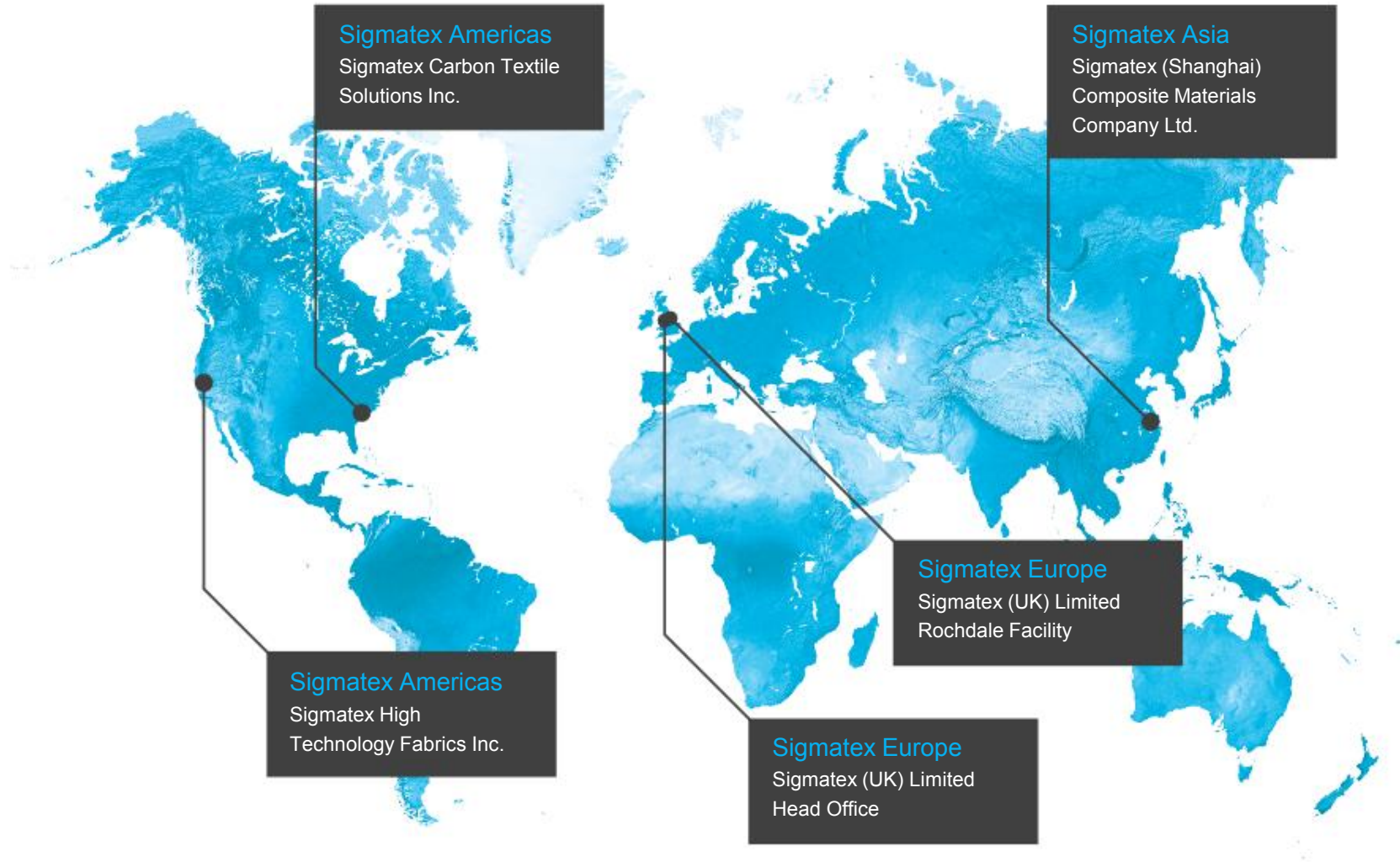
# Sigmatex – Textile Developments

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- Objective is to meet and exceed Customer expectations
- We listen to the customer and design a textile to meet their requirements.
- The new textile design may require new production equipment which we would design and implement into our production process.
- The new textiles could incorporate non-carbon materials, non-standard textile construction or secondary processes.





# Market Sectors



Automotive



Aerospace



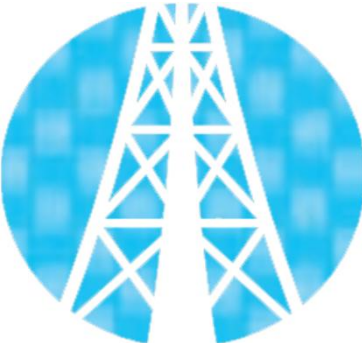
Construction



Defence



Industrial



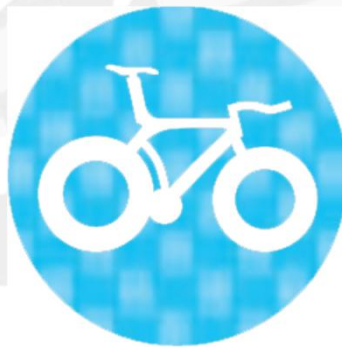
Marine



Space



Sports/Leisure



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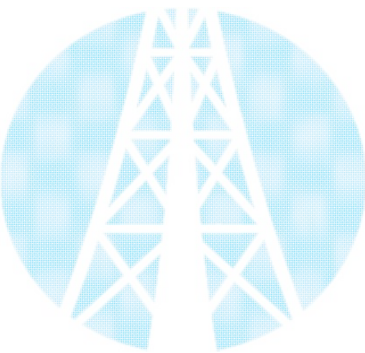
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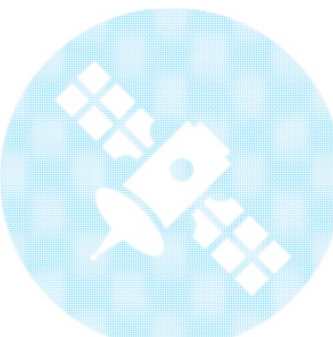
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# Automotive

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Alfa Romeo 4C



Porsche 911 Spider





# The Lightweighting Centre of Excellence





# Sigmatex – R&D



Sigmatex as a material converter is well placed in the advanced composites supply chain focusing technological developments End User needs, e.g. cost, integrated technical solutions for Lightweighting.

Key Current Public Domain Research Programmes;

- Composites Innovation Cluster – Materials and Process innovation
- LX – Automotive Lightweighting
- BAM – CAE for 3D Woven Aerospace Structural Components
- Carboprec – Low cost precursors from renewable materials (lignin and cellulose) reinforced by carbon nanotubes to produce high performance CF.
- EIROS – Composite Materials for severe operating conditions, including added-value functionalities.



# 3D Fabrics



Sigmatex has developed continuous 3D fabrics which offer a lower cost alternative to traditional 3D fabrics.

These fabrics can produce tube or I beam structures in roll formats up to 100 yards in length in a tapered or constant cross section design.





# The Lightweighting Excellence Programme



# Lightweighting Excellence (LX) Programme



## Advanced Manufacturing Supply Chain Initiative (AMSCI) funded £7.15m programme.

Objectives;

- Address lack of capability in the UK supply chain to manufacture composite parts at Automotive medium to high volume rates.
- Connect UK companies with expertise in design, processing and manufacturing thereby providing an integrated supply chain and a commercially viable solution for Automotive OEMs.
- Re-shore Automotive Composites Component Supply to UK
- Create new UK jobs – approx. 238
- Safeguard existing UK jobs – approx. 144



# LX Consortium Partners

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- Sigmalex - Programme lead - Material innovators
- Axillium Research – Programme governance
- Cranfield University – Materials forming & lay up simulation
- Expert Tooling & Automation
- Engenuity – Component design, materials characterisation / crash test simulation
- Granta Design . Materials database
- Group Rhodes – Automated press manufacturer
- LMAT – Manufacturing cost model & material formation
- Surface Generation – Specialised press tool manufacture
- Tilsatec – Material manufacturer



# Automotive Lightweighting Drivers



- Current (2015) Emissions Target; Fleet Avg. 130 g CO<sub>2</sub>/km
- EU Emissions Target; Fleet Avg. 95 g CO<sub>2</sub>/km by 2021
  - 27% reduction
  - Scale?, Current BMW Mini One 3-Door, 1.5L Diesel, 89 g CO<sub>2</sub>/km  
1.2L Petrol, 108 g CO<sub>2</sub>/km  
Current VW Touareg, 3.0 TDI, 174 g CO<sub>2</sub>/km
- To meet these stringent targets and to allow Automotive Manufacturers to incorporate added functionality as well as emerging electro-mobility technologies Vehicle weight needs to be reduced.
- Drivetrain and rolling efficiency improvements alone are not going to achieve EU Emissions Target

# Automotive Lightweighting with Advanced Composites



- Weight reduction can be achieved by innovative design using carbon fibre reinforced advanced composites for structural and non-structural components
- To achieve this more effectively components need to be designed for the material used and not a simple replacement of Metal with Carbon
- CFRCs are a viable alternative to metals at a fraction of the weight but only account for 1-2% of the weight of an average mass produced car
- Typically 1kg weight reduction reduces emissions by 0.08 g CO<sub>2</sub>/km this equates to a reduction of 120 kg to 200 kg per vehicle to meet foreseen targets
- Cost of Advanced Composites needs to be considered as a holistic cost and benefit analysis

# LX Programme Activities

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- Material Innovation
- Material Characterisation for CAE Data Cards
- Design Innovation, DfX
- CAD, Virtual Testing e.g. Crash Simulation
- Production Process Innovation
- Component Demonstrators, TRL6





# Lightweighting Excellence Programme



## OEM Involvement



# Bentley Technical Use Case



- Bentley use-case, addresses the challenge of replacing a structural Door-Inner sub-assembly, currently made of numerous metallic parts, with a simplified carbon composite assembly.
- FEA has applied Load Cases to component models. Door-Inner assembly anchors the anti-intrusion beams and mountings for numerous components such as electric window motors, window frame guides and exterior skin connection.
- Design concept based on advanced composite material used and not 'black metal'. The LX consortium will produce a lightweight concept that reduces the number of parts used, while retaining strength, stiffness and crash integrity. Weight reduction could ultimately enable increased functionality that is sometimes prohibitive due to the inherent weight of the metallic structures.



BENTLEY



# Bentley Technical Use Case



## Bentley Motors Use Case

- Component; Door Components
- Materials; sigma $UD$ ,  
sigma $2D$ ,  
sigma $RF$ ,  
sigma $RM$
- Aim; Component count & complexity reduction  
Function enhancement  
Ease of Assembly  
3,000 Units p.a.  
Takt time < 35min
- Weight reduction; circa 50%
- Use case lead; [Sigmatex](#)



BENTLEY

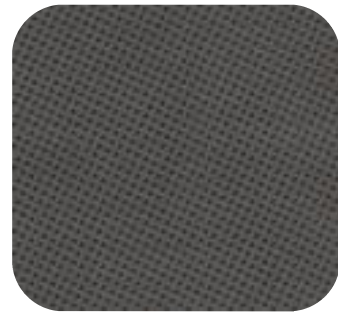


# Unidirectional Fabrics



These fabrics with carbon fibre only in the warp (0 degree) direction are produced in a wide range of weights with fill fibres that stabilise the fabric during fabrication. The degree of crimp of these fabrics can be varied for fibre translation performance.

# 2D Woven Fabrics



Sigmatex offers these fabrics in traditional fabric constructions such as plain weave, twill and satin patterns.

Sigmatex's computer controlled looms also allow the use of ultra high modulus and unsized fibres which are very delicate and require precise process control.



# SigmaRF



sigma<sup>RF</sup> is an innovative, sustainable, commingled thermoplastic composite material based on recycled/reclaimed carbon fibre and thermoplastic PET matrix.

sigma<sup>RF</sup> is suitable for many applications which currently use virgin carbon fibre-thermoplastic materials, especially in the automotive, sports and leisure, medical and energy sectors.



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# Emerald Technical Use Case



- Emerald Automotive is developing a lightweight commercial vehicle that could utilise thermoplastic exterior body panels.
- Need to achieve a high quality Class A surface finish on a panel that is lightweight, durable and dent resistant.
- LX consortium has produced some door skins and proven the potential for appropriate Takt times. Currently refining process and quality whilst assessing the true cost of component production.
- Component volumes are anticipated to be low to medium volume.





# Emerald Technical Use Case



## Emerald Use Case

- Component; Door skin for Emerald Development Programme
- Material; sigma<sup>RF</sup>
- Aim; Class A Surface Finish  
Impact tolerance  
Ease of Assembly  
Takt time <10min
- Weight reduction; circa 50%.
- Use case lead –[Sigmatex](#)



# Nissan Technical Use Case



- Nissan believes that significant lightening of the weight of a passenger vehicle by replacing an existing metallic body structure with lightweight carbon composite is a future requirement.
- The key challenges are producing a floor that is significantly lighter than the existing metallic part, at a price that is comparable with the existing metallic component it replaces, while maintaining consistent high quality, structural performance and just-in-time delivery to the production line.



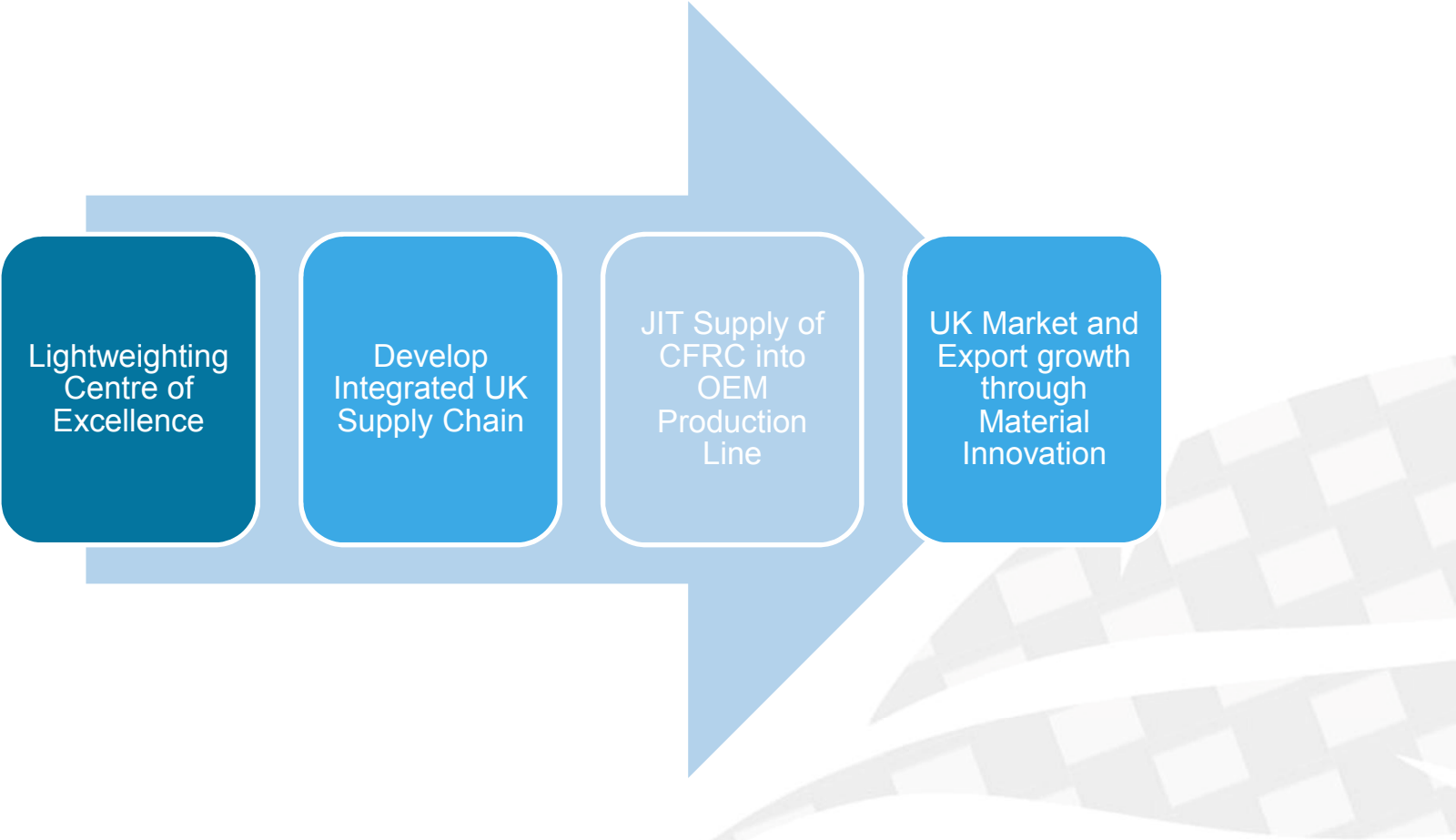
# Nissan Technical Use Case



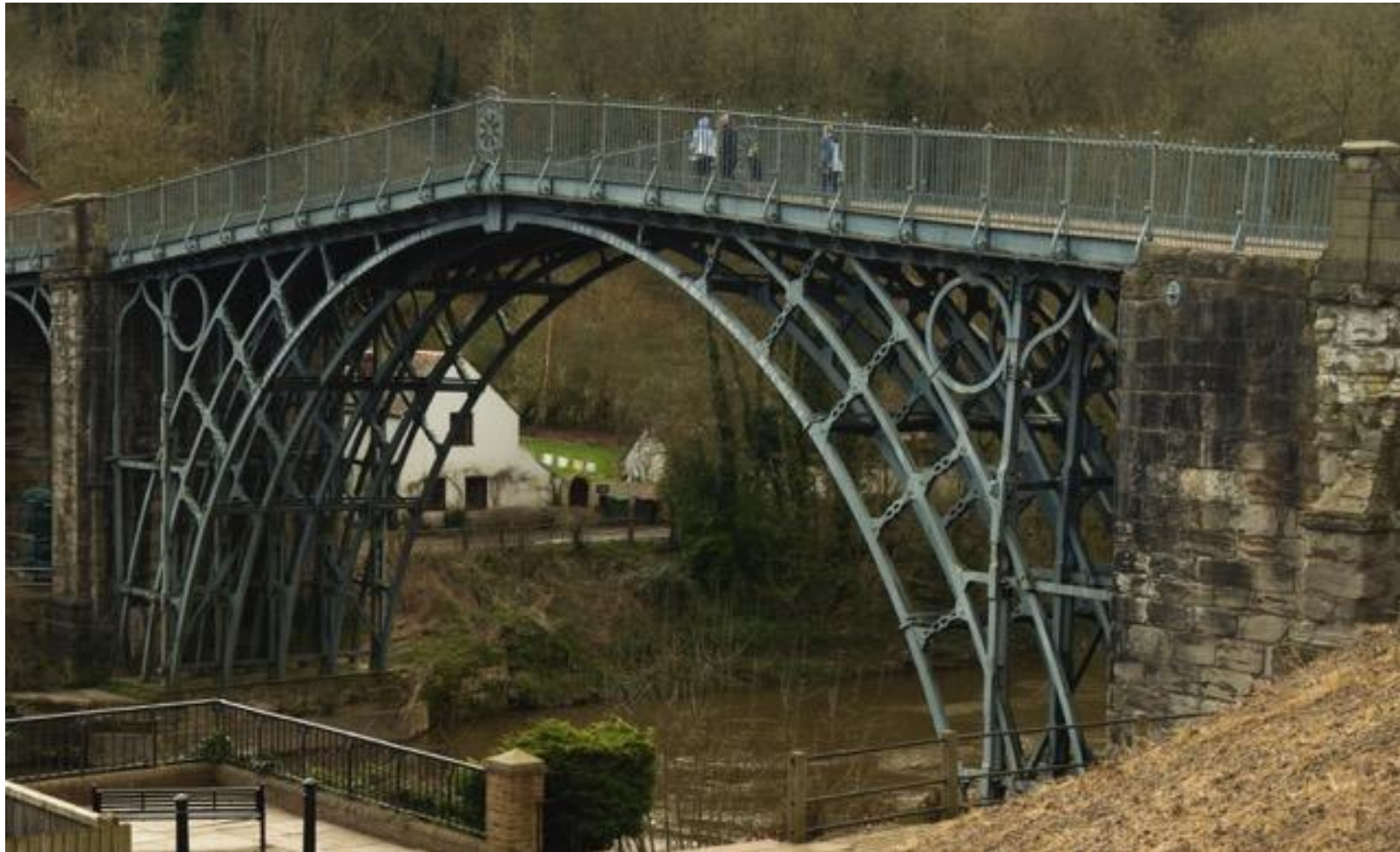
- Component; Vehicle Floor Pan
- Material; sigma<sup>UD</sup>  
sigma<sup>RM</sup>
- Aim; Equivalent performance to metal solution  
Component count & complexity reduction  
Cost competitive  
Ease of Assembly  
Takt time <10min
- Weight reduction; circa 58%.
- Use case lead – [Engenuity](#)



# Future Development – LX2



## The Future of Carbon Reinforced Composites?



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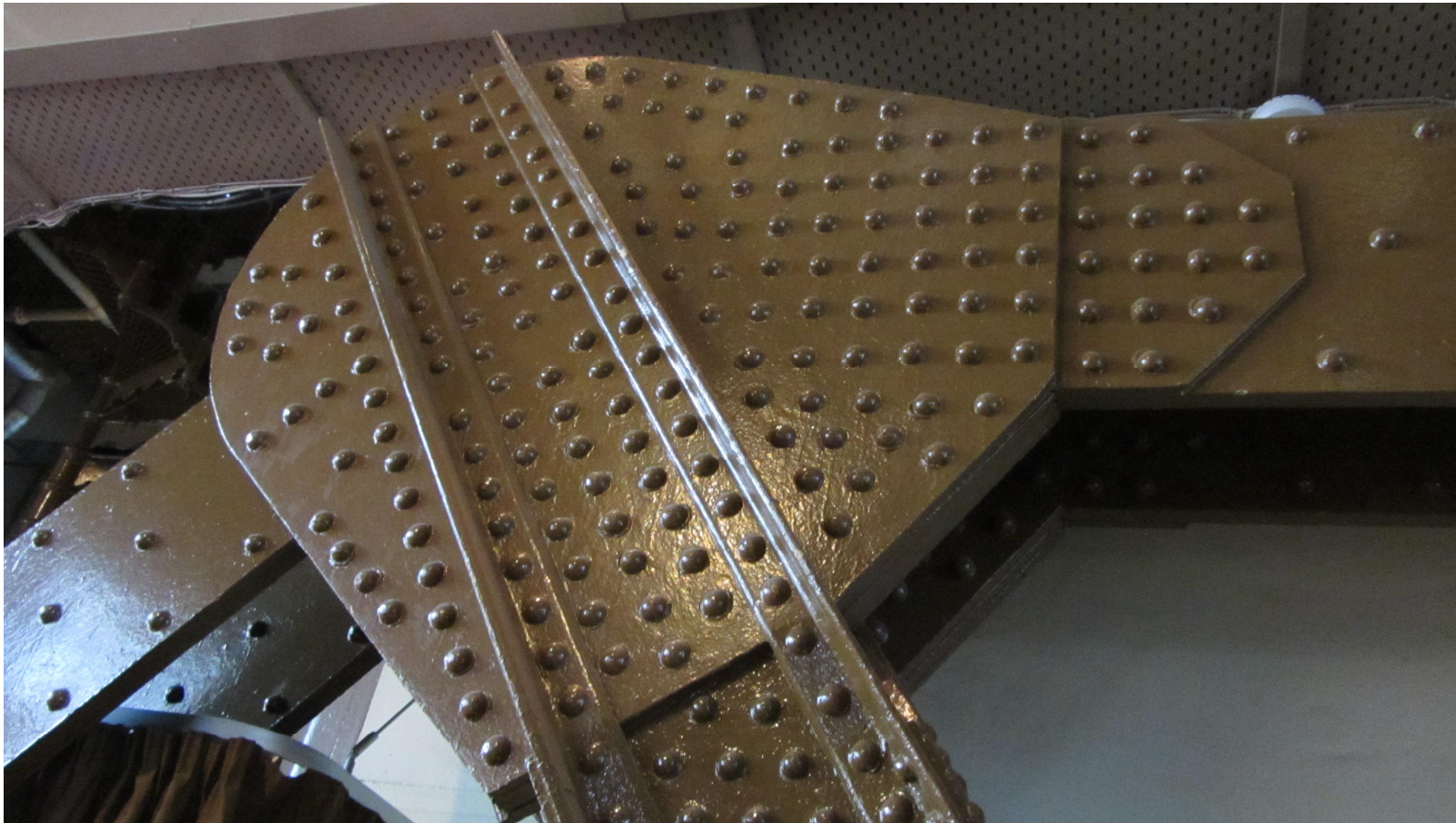


# The Future of Carbon Reinforced Composites?





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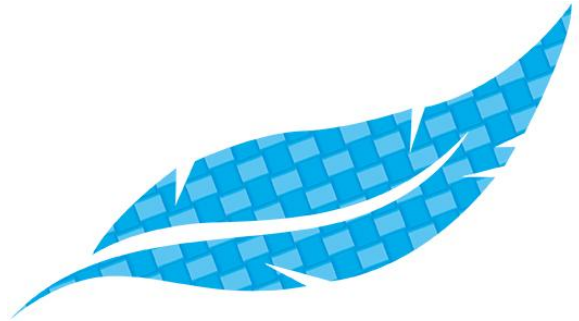


# The Future of Carbon Reinforced Composites?



## The Future of Carbon Reinforced Composites?





**LX** LIGHTWEIGHTING  
EXCELLENCE

**Visit Sigmatex stand to see examples of materials and LX use cases**

Further Information;

[www.sigmatex.co.uk/lx](http://www.sigmatex.co.uk/lx)

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Advanced Manufacturing Supply Chain Initiative (AMSCI): A funding competition designed to improve the global competitiveness of UK advanced manufacturing supply chains.

