NPL REPORT MAT 90

Increasing UK competitiveness by enhancing the composite materials regulatory infrastructure

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**Approved on behalf of NPLML by Fernando Castro,
Head of Materials Science and Engineering**

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Increasing UK competitiveness by enhancing the composite materials regulatory infrastructure

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Foreword

The UK is recognised, globally, for pioneering the development of advanced composite materials and their deployment into engineering products. The next decade will provide an unprecedented opportunity for the UK to capitalise on its inherent capabilities and build the foundations for growing the composites industrial base from present levels of £2.3bn/y to £12.5bn/y in 2030 (a CAGR of 12%). The principal driver for creating these market opportunities is the growing public pressure on Gov'ts to act even more quickly in response to climate change, sustainability and resource efficiency. With transportation accounting for 40% of UK energy use, significant vehicle weight reduction (>25%) is required to reduce the energy demand and thereby assist the UK in achieving its 2027 carbon emission targets.

The UK has a globally competitive aerospace and automotive industry base, and great strides are already being made in exploiting the properties of advanced composites to begin the delivery against these targets. In the aerospace sector these materials have come of age. We, as passengers, notice the benefits of direct flights from the UK to Australia and the significant increases in cabin comfort, without realising that they are the direct result of the widespread adoption of carbon fibre composites in aircraft, such as the latest families of A350 and 787 Dreamliner aircraft. The automotive sector is now beginning to follow suit, building on the UK dominance in the application of advanced composites within the F1 motorsport and luxury car sectors and now beginning to migrate into the wider automotive supply base. The combined progress from the aero and auto sectors towards meeting the transportation emissions and sustainability targets are fundamental to achieving the UK Gov't 'Future Mobility' targets.

The growth potential for advanced composite materials is, of course, not entirely restricted to the automotive and aerospace sectors. Significant opportunities exist in the construction, offshore energy and sub-sea exploration and production. In several of these applications high-tech composite materials could be combined with embedded sensors to deliver greater functionality and added value. Improved recyclability of engineering materials and design of components for end-of-life are essential to delivering the projected market growth. Both considerations contribute significantly to the UK Gov't 'Clean Growth' targets.

The foregoing remarks provide an overview of the major opportunities for UK economic growth if we are successful in creating the appropriate foundations for the UK supply base. The creation of efficient and clear product assurance processes is critical in the successful adoption of new materials into new markets. Recent insightful studies, facilitated by Southampton University and NPL, have highlighted the stark differences across the sectors in the level of maturity within the different product assurance & regulatory frameworks when trying to introduce composite solutions. The studies illustrate that there is good reason for the aero and auto sectors (for example) being at the forefront of the adoption of composites - The industries and their global regulatory bodies have worked together to establish a highly sophisticated '21st century' assurance culture, which is understood by all, retains safety at its centre and is now a key enabler in driving the adoption of composites. In contrast, the studies have highlighted clear examples where the regulatory frameworks are a major barrier to progress, especially in blocking the adoption of composites.

It is against this backdrop that the study 'Increasing UK competitiveness by enhancing the composite materials regulatory infrastructure' was carried out by NPL, in partnership with the Composites Leadership Forum and the wider UK composites community. I commend this report to the reader, as it reflects the consolidated views of composites experts drawn from a wide cross section including academics, RTO's, SME's, OEM's, regulators and UK Gov't. The report contains important findings and recommendations which require careful consideration as part of the wider plan to attain, or indeed exceed, the UK grow targets for the UK composites industry of £12.5b/y by 2030.

Prof Mike Hinton,

R&T Partnerships, High Value Manufacturing Catapult and World Fellow of ICCM

Endorsements

Composite materials are light, strong and durable and will play an increasingly important role in sustainable transport, energy and infrastructure programmes across the world. Ensuring the regulations codes and standards are fit for the 21st century is a fundamental key to unlocking growth and maximising the potential for UK to take an international lead. The National Composites Centre looks forward to collaborating with NPL to deliver the recommendation of this important report.

Richard Oldfield, Chief Executive Officer, National Composites Centre

This report supports the findings of a parallel study conducted by Composites UK for BSI which focused on the transport sector. One of the key barriers identified in the 2016 UK Composites Strategy was the need for suitable regulations, codes and standards across all sectors to enable new materials to be introduced to existing and new markets. Development of standards is an essential enabler for UK innovators to accelerate the rate of commercialisation of new materials and technologies. Standards underpin our existing trade relationships and will be a lead factor in whether future trade deals are beneficial for UK industries. Thus, it is imperative that suitable standards are in place to enable innovation and allow the UK composites industry to compete in the global market.

The report also identifies the key issue of knowledge and understanding within the industry of where to find and how to apply appropriate standards to material and product development, and subsequent application. Composites UK would support development of the online tool and mentoring scheme proposed. Establishment of an advanced materials assurance centre to coordinate this activity and bring together the regulations, codes and standards community will only help to develop the UK composites sector and increase UK competitiveness.

Dr Sue Halliwell, Operations Manager, Composites UK

BSI welcomes the NPL study on Fibre Reinforced Polymers (FRPs) which highlights the central role that standards play in the adoption of these materials by industry. We look forward to working with NPL and stakeholders from government, industry and academia to deliver the international standards needed by the relevant advanced manufacturing sectors, supporting the UK's ambitions to create leadership in this emerging field.

Dr Katerina Busuttil, Senior Standards Manager, BSI

The ATI supports NPL's report as this seeks to address the needs of the aerospace industry that will enable broader adoption of composite technologies, whilst reducing the cost and time to market. The engagement of a diverse range of stakeholders from across different industries for a standardised approach and building a unique capability will have far reaching impact whilst demonstrating UK plc once again leading the way for Composites.

Alex Hickson, Head of Technology – Structures, Manufacturing & Materials, Aerospace Technology Institute

Executive summary

The UK Composites Strategy forecasted that a greater uptake of composite materials could result in significant economic growth for the UK. The use of composites has the proven potential to make real improvements in the safety, energy efficiency and sustainability of products and systems. They can be applied to a multitude of industry sectors, applications and scenarios, offering unparalleled weight savings due to their exceptional strength and stiffness-to-weight ratios, provide high energy absorption for improved strength and crashworthiness and can create value through opportunities for parts consolidation. They require lower maintenance compared to more traditional materials hence significantly reduce through life costs of finished products.

Despite significant advances in their development, barriers still exist that are slowing, and in some cases preventing, the uptake of these materials and the realisation of the benefits available. These barriers exist in the areas of technology, skills, sustainability and regulation and must be addressed. There are still regulations, (design) codes and standards (RCS) that are not performance-based and explicitly name other, more traditional, materials, preventing the adoption of novel and potentially superior materials for a given application.

This study has taken steps to identify the barriers in place that prevent the adoption of composite materials, and in particular Fibre Reinforced Polymers (FRPs), in advanced manufacturing applications. Consultation with industry, through a deep-dive cross sector workshop, and review of relevant studies published over the last five years, has enabled the identification of a series of actions that must be taken to unlock the current regulatory barriers and increase the use of composite materials across the advanced manufacturing sectors. These include:

- **Accelerate the standardisation and publication of technical documentation**, in the form of guides, specifications, and standards, through a 10-year roadmap that addresses the identified gaps in the RCS infrastructure
- Create a partnership that includes industrial stakeholders and relevant regulatory bodies to **design and implement a digital tool and a mentoring scheme to help industry** adopt and certify novel materials
- Establish an advanced materials assurance centre, to bring together the materials supply chain and regulators and **deliver a central resource for providing access to trusted materials data**, act as the driving force for the realisation in the 10-year roadmap while maintaining the digital tool and mentoring scheme

A ten-year roadmap focusing on eleven key areas is proposed with the aim of translating existing technologies into widely acceptable and usable documentation in the form of guides, specifications and standards as well as developing new technologies where these do not exist. These areas reflect the most immediate needs expressed by industrial stakeholders and will have a direct impact on how composite material products are designed and made. A close collaboration between industrial stakeholders, research organisations and academia is envisaged to realise this roadmap, coordinated by an independent overarching centre.

In addition, the authors propose the development of a digital tool and a mentoring scheme that, acting in tandem, will address the disjointed RCS framework as well as the lack of industry awareness of what is available in terms of agreed specifications, codes and standards and how these connect to the relevant regulations. The introduction of such a digital tool and mentoring scheme will also increase the number of Suitably Qualified and Experienced Personnel (SQEP) that would guide companies, especially SMEs, through the product approval process, saving time and cost. An appropriate partnership that will bring together regulators and industrial stakeholders will steer

the initiative through the design and implementation phases, however its longevity will only be guaranteed through ownership by an independent and overarching centre.

Most importantly, it is proposed to establish an overarching advanced materials assurance centre that will bring together regulators and the materials supply chain i.e. materials suppliers, product manufacturers and end-users to specify and qualify materials for several different industry sectors. Equally, the centre will act as the focal point for curating and digitally organising already existing material data enabling ease of access to organisations, while coordinating composite RCS activities between different groups and centres. Ultimately it will assume responsibility for the realisation of the RCS roadmap and ensure longevity of the digital tool and mentoring scheme described above, connecting the RCS infrastructure through ownership and continuous improvement.