Executive Summary

Of all material classes, structural materials, directly and indirectly, make one of the greatest contributions to employment and GDP in the UK. They represent a highly diverse and strongly multidisciplinary area, with links to numerous industrial sectors such as aerospace, energy, construction, automotive, leisure, security and defence. Structural materials comprise a number of classes such as metals (ferrous and non-ferrous), composites (eg. ceramic, metal and polymer matrix), construction materials (eg. glass, concrete, steel, ceramics, wood) and others such as structural & refractory ceramics and polymers. Whilst the range of materials may be diverse, many common technical challenges have been identified:

- the need for materials to withstand more aggressive environments eg. extreme temperatures, stresses, impact & weather conditions.
- the requirement to reduce environmental impact both in their production, end-use and recyclability.
- the need to understand complete materials 'systems' (eg coated components, sandwich structures, composites, joints)
- the need to improve the modelling of materials through the full life cycle (alloy design, production, processing, manufacture and end-use) including life time prediction.
- the requirement for better condition monitoring and NDE of structural materials and their manufacturing processes.
- the drive for lower cost through innovative production and processing methods.
- the need for technology transfer between materials sectors and novel alternative uses for existing materials.

Structural Materials

Historically, significant benefits have been gained by ‘incremental’ developments in structural materials. This philosophy must be maintained and supported, whilst an environment for the development of applicable ‘disruptive’ technologies is encouraged in the longer term through the UK research base.

Despite the UK being world leaders in many sectors involving the development and utilisation of structural materials, such as in aerospace, energy, F1 racing, etc, they generally have an image of being ‘low-tech’ which impacts on the level of priority and support they receive and also on the recruitment into the sector. Materials UK (MatUK) and the Materials Knowledge Transfer Networks (KTNs) should raise the profile of structural materials and promote an ‘integrated’ approach involving industry, research councils, government and Regional Development Agencies (RDAs). A sustainable long-term strategy should be put in place that will ensure the promotion of the structural materials sector, provide increased added value through the development of cross-sector synergies, facilitate technology transfer and ensure the alignment of R&D priorities. All of this must be underpinned by a sustainable funding strategy.

Strong market drivers currently exist to develop value added products across a number of sectors. The support and development of the UK as a world leader in many aspects of structural materials will provide an excellent opportunity to exploit these markets.

Introduction.

Of all material classes, structural materials make one of the greatest contributions to employment and GDP in the UK. They represent a highly diverse and strongly multidisciplinary area, with links to numerous industrial sectors such as aerospace, energy, construction, automotive, transport, leisure, packaging, security and defence, all of which are important to the sustainability and growth of the UK economy.

This report on structural materials has been produced as part of the Materials IGT initiative and has provided input, both into the Science and Technology Task Group Report and the IGT final report (1). It follows a series of consultations, discussions and meetings, which sought to engage with a broad cross-section of the UK structural materials community. This involved town hall meetings, focus group meetings and discussions with the material KTNs.

The input has been considered and consolidated into a set of specific recommendations for the future development of this part of the materials sector. Whilst it is recognised that this report, given the broad scope of the technology area, has not been able to capture all possible points of view, many common challenges and synergies have been identified and are reflected herein.

Scope

In the context of this study, the term 'structural materials' is defined to be any material or material 'system' whose primary function is to be load or stress bearing (induced either mechanically, thermally or a combination of both), often under extreme environmental conditions. The scope also covers issues related to their production, processing, manufacture, end-use and recyclability. Although there are clear synergies and overlapping areas with other material classes such as functional, multi-functional and bio-materials, these are the subject of other reports (2-4). It is recognised that many common issues will arise with these other material classes and this will only help to define and substantiate subsequent outputs and recommendations of the KTNs and Materials UK. The scope of this report has therefore been limited to:

- Metals (including surface-treated systems)
- Ferrous
- Non-ferrous
- Construction materials
- Glass
- Concrete
- Ceramics
- Wood
- Constructional Steel
- Composites
- CMC's
- PMC's
- MMC's

For each of these classes, the following key issues have been addressed:

a) Importance and value:- an attempt to assess the industry in terms of employment, turnover and opportunities

b) Key drivers:- eg. technical, socio-economic and regulatory

c) R&D priorities:- technology priorities for the UK

d) Barriers:- eg. technical, socio-economic and regulatory

e) Key recommendations:- priority areas to be taken forward

A brief section is also included that recognises the importance of other classes of material not falling into the above three categories such as, structural and refractory ceramics and non-reinforced polymers.

Findings

1. Metals

1.1 Importance and Value

The UK currently produces around 14 million tonnes of steel, 1.2 million tonnes of castings and 500,000 tonnes of Aluminium per year. In addition, metals manufacturing creates £15 billion of added value for the UK economy, equivalent to 10% of all UK manufacturing and employs over 470,000 people in the UK (5). Whist the greatest proportion of this is related to the steel and aluminium industry, contributions are also made from the titanium, magnesium, nickel and copper industries. Each year these businesses sell a combined total of £38 billion of metals into engineering, construction, automotive, aerospace, energy and other manufacturing sectors. All of these sectors and the companies within them (some of whom are recognised as world-leaders and represent a major source of employment and GDP in the UK) are dependent on the supply of high quality structural metals in the manufacture of their products. A more detailed breakdown of the UK metals sector is shown in Appendix 1.

Recent strong demand, particularly in ferrous materials, has led to a turnaround for parts of the UK metals sector. However, issues of mineral ore supply and rising energy prices means that the UK metals industry must continue to strive for production and supply chain efficiencies to deliver competitively priced materials that their customers need in order to succeed in their respective markets.

Regarding the environment, which is a key national and global issue, the fact that metals are highly recyclable means the sector is also central to the UK's success in achieving environmental sustainability.

1.2 Key Drivers

The key drivers identified for the sector are those of environment, cost, the creation of value added and government legislation.

Environment is currently seen as the priority driver for the structural metals industry. This arises from the need to significantly reduce CO2 emissions either through reduced fuel consumption or through the use of more environmentally friendly production and manufacturing processes. Reduced fuel consumption can be achieved through 'light-weighting' of structures, particularly for the transport, aerospace and military sectors, or by the burning of fuel more efficiently for energy production through the use of higher temperature alloy systems, such as those required for power generation, aerospace gas turbines and automotive engines. In terms of production and manufacturing, emissions can be reduced through the introduction of more efficient processes and procedures and by the introduction of benign downstream processes, such as finishing and coating. In addition, the introduction of technologies which maximise the capacity for recovery, recycling and waste reduction will also contribute to an improved environment. The scope to achieve greater recovery and recycling rates is exemplified by the fact that in 2004 the rate of recycling of Aluminium-based packaging in the UK was only 28% (6).

A second major driver is cost reduction. It is evident that competition from low-cost countries is impacting large parts of the UK metals sector and there is a constant need to drive down costs whilst improving quality. To optimise the cost reduction opportunities it is essential that the whole life cycle of the products must be considered from alloy production, processing, manufacture and end-use through to recycling. Whilst it may be difficult to compete on cost alone in certain areas, the UK is able to demonstrate a history of creating innovative solutions that provide effective cost reduction opportunities.

The provision of value added to the market was also identified as a key driver which the UK metals industries should address. The need to provide product differentiation in the market place, and the need to meet stringent legislative and environmental targets, continually creates the opportunity for innovation and the creation of custom built solutions to the end user.

Legislation in certain parts of the industry is also seen as a major driver. The need to meet increasingly stringent environmental demands has been dealt with above, however, additional regulation and health and safety legislation also have a key impact in certain sectors; specifically in the production, manufacturing, oil & gas and processing industries.

1.3 R&D Priorities

The UK still has world-class expertise in the development of many metallic systems, including steels, aluminium, high temperature superalloys, titanium, and magnesium. Supporting this expertise there is an extensive R&D infrastructure, providing a strong and innovative platform of skills in design, structural integrity, surface engineering, powder metallurgy, modelling, process development, fabrication and joining. The recommended R&D priorities largely reflect the above strengths of the UK skill-base and look to build upon them. The priority areas for the UK are:

- development of metallic systems to withstand more arduous operating conditions; including higher temperatures, impact loading, thermal and mechanical stresses and more aggressive environments. All these will enable increases in component lifetime, reliability, efficiency and reduce the impact of the harsh environments on the operating components. This was seen as a major cross-sector priority.
- development of novel production, manufacturing and inspection processes aided by the utilisation of on-line process control, condition monitoring and NDE, which will lead to significantly enhanced quality, improved properties, reduced cost, increased output and product liability.
- to build on the strong existing skill-base in modelling to evaluate the full life cycle of materials from alloy design, through to production, processing, manufacture, lifetime prediction, end-use and recycling. This can have a major impact in reducing time-to-market, increasing sustainability and reduced full life-cycle cost and cost of ownership.
- to design, develop and introduce light-weight, high performance structures; particularly for use in the defence and transport sectors.
- the development of high performance coatings and surface technologies for metallic systems are essential in creating high value added components and systems, including the creation of multifunctional and SMART systems(2-3)

A key generic recommendation in the area of structural metals is the need to recognise and support 'incremental' innovation in the sector. Slight modifications to alloy compositions or coating processes have historically lead to significant improvements in strength, impact, wear, corrosion and oxidation resistance which has helped maintain the UK's leading position in many sectors particularly automotive, aerospace and energy.

Not withstanding the above, it is still widely recognised and recommended that an environment must also be promoted within the UK research community that still encourages the innovative development of 'disruptive' technologies that can lead to the step-change demonstration and implementation of world-beating technologies.

1.4 Barriers

There are a number of barriers recognised within the structural metals sector, not least that they are perceived as being a well established technology with little scope for further development. For this reason, it has not historically been seen as a priority area for R&D funding by the government or research councils. For the reasons mentioned previously this should not be the case and both the value of incremental improvements and the overall value of structural metals to the UK must be better recognised. This will require the implementation of a coherent long-term strategy and funding mechanism involving industry, government, research councils and RDAs to support the area.

The globalisation of the supply chain and reduced UK supply base means that many of the required developments for structural materials are outside the control of UK industry. This has led to a lack of integration between alloy producers, processors, manufacturers and end-users. Equally, the supply chain is resistant to change and often pursues developments only on the back of regulatory or legislative instruction. This has led to a compromise in setting goals for materials and a stifling of innovation and has made international collaboration even more necessary. The global nature of material procurement also means that strategically important elements could be subject to export control for economic, political or military reasons. Security of supply therefore remains a key issue for UK users.

A barrier which is recognised throughout this report is the need to further develop our skills-base in the sector. The increasing scarcity of appropriately trained metallurgical graduates is a major concern. This is not detailed further here as it is one of the key findings of the IGT and reported separately though the People & Skills task group (7). The limited availability of skilled new entrants into the sector, may in
part be compensated by ensuring better transfer of knowledge, skills and technology

across sectors in the metals and materials community.

1.5 Key Recommendations

The following recommendations are put forward as being priorities for the UK structural metals sector:

1. The UK must continue to support R&D for the ‘incremental’ development and application of structural metals, whilst putting in place a research environment which can encourage ‘disruptive’ ground breaking R&D. Areas in which greatest payback will be achieved are:

    i) the development of metallic systems for more aggressive operating environments (temperature, stress, corrosion, etc),

    ii) improved quality, efficiency and cost reduction through innovative production, processing, improved process control and condition monitoring,

    iii) detailed understanding and mapping of full life-cycle issues.

    All of the above must be encouraged to include demonstration as well as R&D.

2. The UK has tremendous strengths in enabling technologies which can support the sector, including; alloy design, materials modelling, surface engineering, process development & control, condition monitoring, joining, repair, structural integrity, bespoke testing & databases. These should be further supported and developed.

3. There is a need to develop a long term integrated and sustainable structure and strategy for the sector, encompassing industry, government, RDAs, academia and funding agencies. This strategy needs to promote the development of skills and effective technology transfer within the sector. This should be an integral part of the UK materials strategy currently under development by the Materials

KTN and should be implemented by MatUK.

2 Composites

2.1 Importance/value to UK

The composite market in the UK has grown significantly over the last 10 years and is set to continue at an annual increase of over 4% for at least the next 5 years (8). The total turnover for composite parts for 2004 was estimated at over £800 million, compared with nearly £25 billion globally (8). The total number of companies undertaking composites part manufacturing approaches 1000, with a total number of employees approaching 6000. There are also more than 1500 companies supporting their business with services and equipment.

It is also important to highlight that some of Europe's largest composite materials supply companies (Hexcel Composites, Scott Bader, Gurit Suprem, ACG Ltd and Cytec Fiberite) are based or have production plants in the UK, with a collective turnover of nearly £1.2 billion. Their global exports and supporting supply chain benefit the UK significantly.

The key sectors in relation to the development and procurement of composite materials are the aerospace and defence sectors, which provide a significant technology platform for composites as a whole. At the other end of the spectrum are the engineering (pipe and tank) and construction sectors, which are characterised by a relatively low skills-base and a low level of technology insertion. In the marine sector, composite technology is making some ingress, resulting in improved performance and profitability, but largely through the adoption of lower technology labour intensive processes.

Whilst the composites industry is growing in its own right, it is increasingly having an impact on other industry sectors which are developing new products which contain composite components. There are therefore an increasing number of companies who rely on the development and supply of composite components but do not manufacture these parts themselves. Whilst this brings with it a number of multi-disciplinary challenges it also results in the adoption of best practice in lean manufacture and production optimisation in the composites industry.

2.2 Key Drivers

The main drivers within the composites sector primarily revolve around reducing cost, improving flexibility in design and reducing environmental impact.

Cost reduction is a particularly strong driver for composites because of their higher first-cost. The performance benefits of composites have been demonstrated extensively and in critical applications this will compensate for the higher up front costs of the product. In the last decade, significant technical developments in low cost manufacturing to reduce labour and scrap costs, have made considerable reductions in product costs possible. However, it is increasingly apparent that composites can also contribute considerably to reductions in operating costs due to a number of factors, including:

(a) improved durability and thus lower maintenance and repair costs.

(b) the absence of corrosion and the limited sensitivity of composites to environmental degradation, resulting in lower maintenance costs.

(c) the significant weight saving offered by composites contributing significantly to reduced fuel consumption and hence reduced environmental impact.

Composites can meet the drive for flexible and bespoke design due to the fact that the component performance can be optimised to meet the needs of a specific product. Making use of the often anisotropic nature of composites gives significant flexibility to designers, provided they have the right design tools. Composites also offer the ability to design and manufacture complex shapes as a single part, reducing the complexity and number of joints and the need for extensive machining operations. Both these factors contribute towards greater flexibility in design.

Environmental drivers mean that increasing emphasis is being placed on the total environmental impact of products, which includes their manufacture, operation and end of life disposal. As mentioned previously, composites can contribute positively towards fuel economy by reducing weight and also recycling into new feedstock for other products.

2.3 R&D Priorities

The main R&D priorities identified by the Composites community reflect the key drivers for the industry:

Relating to cost reduction, the increasing competition from low labour rate countries, particularly in the Far East has continued to put more pressure on the UK to reduce manufacturing costs for high/medium and low volume parts. As manufacturing still accounts for a significant proportion of the overall product development and full life cycle costs, R&D to support innovative solutions in manufacturing is essential.

Materials modelling is recognised as a strength of the UK which requires support. However, as part of this, in order to fully utilise the potential that composites can give to enhanced performance components, there is a specific need for improvements and refinement in the design and modelling tools available that are specific to composites.

As more composite components are integrated into products there is an increasing challenge to join mixed materials effectively. Whilst techniques do exist such as adhesive bonding and fastenings, these require optimisation and automation to improve performance and efficiencies. With an increasing driver towards reuse, repair and recycling of materials there is also a growing need to disassemble parts quickly, cleanly and economically.

2.4 Barriers

One of the major barriers facing the composites sector is supply of raw materials. Due to increasing demands from civil aerospace for future build programmes there is currently a world shortage of some forms of carbon fibre, leading to concerns around security of supply. This has caused particular issues for companies who do not buy large volumes of materials or who wish to expand their use of carbon composites in future products. Whilst it is expected that planned fibre plant build will address this short-term shortage, in due course, there is still an issue for small companies to command priority low volumes of materials.

The perceived cost of composite structures is also seen as a barrier for the sector. Whilst there are increasing examples where true life cycle cost analyses can be carried out, this is often commercially sensitive and therefore not widely publicised. To be able to promote the benefits of composites for new applications it is necessary to demonstrate this to operators and ultimate product owners.

The provision of skills and training for composites in the UK is disjointed. This pertains both to industrial provision and academic provision through universities and colleges. To address this, the knowledge and expertise that is developed within the large companies needs to be transferred down the supply chain to the ultimate manufacturer, whilst recognising the industry needs to operate within an accredited quality scheme. Certification of training against a national accredited framework is required which links the Sector Skills Councils and the Learning and Skills Council with trade bodies and key industry players.

2.5 Key Recommendations

The following recommendations are put forward as being priority for the UK composite materials sector:-

1. A series of composite technology demonstrators should be supported in order to:-

i) stimulate new markets and widely promote the technology both within the UK and as an export opportunity.

ii) enhance interest and assist in recruitment and training within the sector.

2. Support the generation of quantifiable data to provide evidence as to the full life cycle cost benefits of composites, thus promoting further opportunities for the UK composites sector.

3. Construction Materials

3.1 Importance/value to UK

The construction industry plays a vital role in the UK economy and delivers around 10 per cent of the nation's gross domestic product (9). The sector itself is an extremely large and disparate industry led by only a very small number of large companies. This is illustrated by the fact that 95% of construction companies have less than 14 employees, whilst the largest company has less than 3% of the market share (10). In terms of innovation its research is extremely fragmented across a large number of areas. The construction industry has historically been conservative, primarily due to the dictates of legislation, codes and standards and a culture of claims and litigation. It has therefore adopted a cautious approach providing incremental rather than step-changes in technologies. Whilst the industry is generally perceived as being low-technology, there are many examples in the UK (11) of where construction materials have been used to provide innovative solutions to the sector in terms of energy reduction, health and safety and resource management.

Regarding materials, the construction products industry is at the heart of the UK economy. The industry provides essential materials for our homes, schools, hospitals, factories, offices, roads and railways. Its products are vital to daily life and it makes an essential contribution to the UK economy.

Every year the construction products industry has an output of around £40 billion of which 10% is exported, it accounts for 40% of total construction output, 20% of the UK's manufacturing output, 4% of the UK's GDP and employs over 650,000 people in almost 30,000 companies (12).

The diverse nature of the construction industry is reflected in terms of the materials that they manufacture and supply, including steel, concrete, tarmac, composites, timber, glass, ceramics and insulation materials. Despite its disparate nature the value of constructional materials to the UK is reflected in the fact that the UK is the world leader in the application and use of metals in the construction industry.

3.2 Key Drivers

The main drivers within the construction materials sector primarily revolve around issues of:

(a) Sustainability (natural resource management, environment, recyclability)
(b) affordable housing and renewal of infrastructure
(c) legislation (particularly environmental and health & safety)
(d) cost reduction (through life-cycle and whole life asset management)
(e) improving flexibility in design (modular, off-site construction)
(f) provision of an appropriately trained workforce

Construction materials are produced and used in very large quantities and therefore contribute significantly to CO_2 emissions and hence have a major part to play in meeting the UK's environmental targets in CO_2 reduction. This challenge is being taken seriously by all parts of the sector, for example, the UK cement manufacturers have signed a Climate Change Levy Agreement with government to deliver an overall energy efficiency improvement across their sector of 26.8 per cent by 2010 against a base year of 1990 (9). This target goes beyond the government's own target of 20 per cent and the 12.5 % agreed in 1997 under the Kyoto protocol. For the construction materials sector there are major opportunities to reduce environmental impact both in production and by end of life recycling.

The construction industry is one of the most heavily regulated sectors and has numerous dictates of legislation, codes and standards and a culture of claims and litigation which it needs to work with. Whilst this is often seen as a barrier, it is also a driver and opportunity for innovation in the sector. In addition, the push towards reducing cost and whole life asset management means there is a need to evaluate the full life cycle costs of materials in construction as is the case in many other sectors.

There is an increasing drive towards 'off-site' construction, arising from a variety of site-based constraints, such as accessibility, health & safety, increasing complexity of design, and time and cost issues. This trend will require the better use of integrated and modular design methods and use of 3D CAD modelling, and greater consideration for configuration management, assembly and delivery constraints.

All of the above relies on the availability of a suitably trained workforce to address the main drivers of the sector. This in itself is a major issue for the construction materials sector.

3.3 R&D Priorities

There is a need for the further development of higher performance constructional materials that have improved strength to weight ratios, are more energy efficient through better insulating and emissivity properties and materials with optimised acoustic properties for sound insulation. In addition these materials must be able to withstand more arduous operating environments for long periods of time (decades) particularly related to changes that are occurring in our weather conditions and climate. Where thermal mass is not a consideration in the design, the materials should also be designed to be lighter and easier to handle in order to reduce H&S risks, improve ease of construction, whilst retaining their fitness for purpose.

Most constructions have to be designed within the restrictions of building codes, which thereby reduces the scope for innovation. However, it is recognised that conventional thinking is inadequate in the face of today's pressing globalisation and environmental challenges. There is a need for better innovation in terms of integration between design and materials, this can lead to opportunities for identifying such things as modern methods of construction and de-construction, compatibility of materials, structural health monitoring, improved joining methods, and an integrated approach to design, manufacture, assembly and delivery using modern information and computing technologies

Priority must be given to R&D into energy conservation materials, both in the production of the materials themselves (eg. by optimising production and manufacturing, component lifetime and recycling processes) and in their use (eg. development of highly insulating, low emissivity materials etc). Many such materials (eg. photochromics, electrochromics, photovoltaics), including Smart materials (eg. self-cleaning and healing coatings, embedded sensors, etc) have already been developed for use in other sectors. Therefore it is the transfer of these technologies on an affordable basis into the construction sector, where they must last for many years, that is required. The push towards whole life asset management means there is a need to understand and evaluate the full life cycle costs of materials in construction. This means from the extraction of raw materials through to production, manufacture, construction, use and end of life recycling.

3.4 Barriers

Only a small percentage of construction materials are recycled back into the sector. One of the barriers to re-use of materials is that of the perception that parts made from recycled materials will be of poorer quality leading to a consequent unwillingness of customers to accept them. There is no evidence to support this. There are other potential barriers to the use of recycled products relating to regulatory and approval bodies which also need to be overcome.

Across the sector there is a public perception of constructional materials being low-technology and responsible for damaging the environment. This is leading to difficulty in recruiting skilled staff into the sector. A stakeholder communication strategy is needed to demonstrate these materials as modern and sustainable and that the sector is playing a major role in tackling environmental issues

There is no coherent R&D strategy nor research leadership within the sector and both private and public funding in the sector for materials development is extremely limited and has been eroded over the years. The different parts of the sectors tend to work in isolation rather than looking at an integrated approach.

3.5 Key Recommendations

The following recommendations are put forward as being priority for the UK construction materials sector:

1) A coherent integrated construction materials R&D strategy and roadmap needs to be defined and an implementation plan put in place. This should be done through the Construction Materials Group being set up under MatUK.

2) A mechanism for the technology transfer and innovation from both within the construction industry and from other sectors involved in the development and use of materials needs to be put in place

3) The UK government is the largest customer of the construction sector. A public procurement policy that supports the introduction and use of low cost, whole life, energy efficient materials should be introduced.

4 Other Material Classes

It was mentioned in Section 1, due to the broad scope of the report and the diverse nature of the Materials sector, it would not be possible to incorporate details of all classes of materials or indeed all materials within a single class. Therefore, it is recognised that the three classes discussed in Section 3 are not exclusive and it is acknowledged that within the UK, there are inherent strengths in both industry and academia in the processing, manufacture and R&D capability of other materials such as structural ceramics (as used in automotive parts, membranes and seals), refractory ceramics (critical in the manufacture of metals, glass, ceramics and petrochemicals) and un-reinforced polymers (used in packaging, containers, domestic-ware, etc). To emphasise this, it is estimated that the UK structural ceramics industry has a sales turnover of around £150 million (13) and refractories a turnover of around £450 million (14).

It is felt that many of the key recommendations of this report given in Section 4 below are equally applicable to these materials as well as those that have been discussed in more detail.

Discussion & Recommendations

Discussion

This report has highlighted the importance of the structural materials industry to the UK, not only in terms of the number of people it directly employs and the contribution it makes to GDP, but also how it underpins most major industries in the country. Structural materials will always be required, however outsourcing and production offshore will inevitably continue, therefore identification and maintenance of our key ‘intellectual capital’ is vital to respond to future paradigm changes. It is the management of these shifts in materials processes and usage which will facilitate future innovation in structural materials.

Structural Materials are highly diverse in their nature (from concrete to single crystal superalloys) and in their use (from bridges to jet engines), yet this report has highlighted a number of synergies and common issues across the industry.

These are:

- the impact they can make on the environment both in their production and end-use.
- the common need to drive down costs through improved processes and innovation.
- the need to consider the full life cycle of materials from cradle-to-grave.
- the requirement to withstand more arduous operating environments.
- the perceived image as being ‘low-technology’.
- the need to consider structural materials at the design stage, as part of a ‘system’, (eg. incorporating coatings, surface treatments, welds, joints, etc). The issue of globalistation and outsourcing offshore is highlighted as a barrier for the entire structural materials sector. However, it is felt that the multi-national nature of many of the major UK Companies also creates an opportunity for the UK. To this end, the sector should look to influence the technical content of European programmes (such as EC Framework 7) through membership of relevant bodies, both in the UK and in Europe, in an attempt to align such programmes with UK priorities. This would thereby create access to a far greater funding stream both for pre-competitive R&D and demonstration than would ever be available in the UK alone.

Recommendations

Taking account of the overall findings of this report the following key recommendations are made:

1) MatUK and the KTNs should establish a sustainable, long-term strategy for structural materials; covering all the classes of materials identified in this report. This should include: the development a technology roadmap, promotion of the sector, increasing added value through the development of cross sector synergies, the promotion of innovation and transfer of technology and the alignment of R&D priorities; all underpinned by a sustainable funding strategy.

2) The UK must continue to support R&D for the ‘incremental’ development and application of structural materials, whilst putting in place a research environment which can encourage ‘disruptive’ ground breaking R&D.

3) The UK should invest in innovative approaches to the production, processing, and application of structural materials to maximise applicability across UK industries. This should include support for technology demonstration.

4) To have a major impact in reducing time-to-market, increasing sustainability and reducing cost of ownership, the UK should build on the strong existing skill-base in underpinning technologies such as materials modelling to evaluate the full life cycle of materials from their design, through production, processing, manufacture, lifetime prediction, end-use and recycling.

5) The UK should look to influence the content of large multinational programmes (eg FP7) in order to align them with UK priorities, thereby creating access to a far greater funding stream for R&D and demonstration.

References

1. Materials IGT report; ‘A Strategy for Materials’, March 2006
2. Materials IGT Science & Technology Group Functional materials report, July 2006
3. Materials IGT Science & Technology Group Multifunctional materials report, July 2006
4. Materials IGT Science & Technology Group Biomaterials report, July 2006
5. Metals Forum, annual review 2004-05 (www.metalsforum.org).
6. Aluminium Packaging Recycling Organisation (ALUPRO) (www.alupro.org.uk)
7. Materials IGT People & Skills Group report, March 2006
8. Global Composites Market 2004-2010, E-composites Inc.
9. British Cement Association. (www.cementindustry.co.uk) fact file.
10. DTI Construction Statistics Annual 2005, pub T50 October 2005
11. Construction products innovation and achievement. (www.constprod.org.uk)
12. Construction Products Association (www.constprod.org.uk)
13. ‘Advanced Ceramics; Powdermatrix Technology Roadmaps 2004’ (www.powdermatrix.org)
14. ‘PRA 26260 Refractory Products’ UK National Statistics, 2004’

Whilst it has not been possible to consult with all interested parties, the above organisations, associations and networks through their membership, represent over 1000 UK companies involved in the structural materials sector.

Acknowledgements

The authors would like to acknowledge the input received from the organisations that have taken the time to be involved in the Materials IGT, through attendance of workshops, 'town hall' meetings and informal discussions. In particular the authors would like to thank the following organisations, associations and networks who specifically contributed to the content of this structural materials report.

Advanced Power Generation Materials Forum
Airbus
Alstom Power
British Cement Association
British Constructional Steels Association
Building Research Establishment
CIRIA (Construction Industry Association)
Corus
DSTL
Innoval
Jaguar/Landrover
Metals Forum
National Composites Network
Pilkington
Powdermatrix
IoM3
Rolls Royce plc
Timber Research and Development Association
TWI