



KNOWLEDGE CENTRE
**MATERIALS
CHEMISTRY**

KNOWLEDGE CENTRE MATERIALS CHEMISTRY ANNUAL REPORT 2012–13

CONNECT ► FACILITATE ► DELIVER



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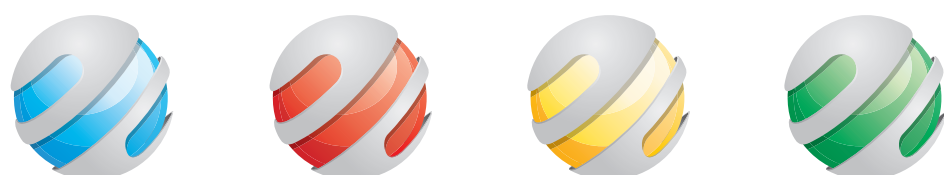
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NEW IDENTITY FOR AN EXPANDING ROLE...

Reflecting an expanded and now nationwide role in the UK innovation landscape of 2014 and beyond KCMC has refreshed its corporate identity.

Marking a second business phase for the Centre, founded in 2008, the revised branding signals growth and innovative, “next generation” work in advanced materials.

The new logo emphasises KCMC's role as a proven, single point of contact to access facilities and expertise at the forefront of innovation in applied materials chemistry.



FOREWORD....

KCMC WIDENS ITS ROLE IN THE UK INNOVATION LANDSCAPE

Spring 2013 saw successful completion of KCMC's initial grant period and transition under a new funding partnership with the Technology Strategy Board towards a widened future role in the UK's innovation landscape.

Despite the exceptionally challenging economic background to its first five years, the Centre has consistently delivered well ahead of year-to-year expectations.

Over the four years 2009-13 KCMC achieved collaborative innovation projects across knowledge transfer grant and industry income valued at over £13m. - representing over 500 proactive industry engagements.

In parallel, future materials chemistry innovation capability by KCMC's research institution partners has benefited from funding of more than £100m. since 2010.

Among specific 2012-13 highlights, KCMC added 72 first time company introductions to the research partners, with 35 projects formally contracted and 233 industry engagements progressed.

Looking ahead, the 2013 Chemistry Growth Strategy places high priority on speeding innovation to serve the UK's key industry growth sectors. KCMC's proven business model for collaborative research, driving UK

innovation by connecting leading edge science with commercial needs and opportunities, can help to fuel this advance.

The Centre has a natural fit with the EPSRC strategic priority to bring the research and business communities even closer together and a strategy that is well aligned with the Technology Strategy Board's High Value Manufacturing (HVM) Strategy and, consequently, with that of the HVM Catapult.

As emphasis turned towards 2013-14 and beyond, the Technology Strategy Board tasked KCMC to lead the new Materials Chemistry Special Interest Group.

Formed to enhance the development and commercialisation of advanced materials, the Group will benefit from KCMC's ability to align university capabilities and industry need – and equally from its now nationwide remit.

For the materials chemistry journey from product concept to commercialisation in a host of advanced applications, the Centre is an increasingly valuable enabler.

KCMC is well placed to play an expanding role as we build on the strong foundations in this, one of our “Eight Great British Technologies”.

Will Barton

*Head of Manufacturing,
Technology Strategy Board*



“The Materials Chemistry SIG will benefit from KCMC's ability to align university capabilities and industry need”

EXECUTIVE SUMMARY



KCMC – CONNECT ► FACILITATE ► DELIVER

Materials chemistry is a vital enabler of the new advanced materials required for sustainable solutions for society and industry, especially in energy, health and in developing replacements for scarce raw materials.

KCMC uniquely connects and networks academia and industry, facilitating collaborative R&D that can help companies to deliver accelerated innovation-to-market timescales. Key highlights of KCMC achievements in the year to 31 March 2013 included:

By the end of its fourth full year, KCMC has delivered projects to the value of –

£13.6M

nearly double the original government investment and contributing to estimated 5 year GVA benefits of ten times this figure.

2012-13 saw **72** first time company introductions to the four university partners – of which 47% were SMEs.



35 new projects were formally contracted and

233 industry engagements progressed last year –

taking total engagements since KCMC start-up well beyond

700



37 companies have now benefited from multiple interactions with the KCMC research partners.

72% of businesses engaged are UK owned – this has risen from 62% in 2011-12.

£2M grant funding dedicated to national priorities in energy, sustainability and critical materials, advanced materials (for health, electronics and personal care) and next generation manufacturing technology.

50% of industry projects are repeat business.

Key five-year project targets have been exceeded within KCMC's first four years, with the one remaining target ahead of plan.



KCMC AT A GLANCE

KCMC's mission is to enable companies to enhance and accelerate product and process innovation through collaborative R&D in materials chemistry.

Under a new partnership with the UK Technology Strategy Board - aligned with the UK's 2013 Chemistry Growth Strategy – KCMC has taken a national role in the innovation landscape, to link companies throughout the UK with a widening network of academic institutions offering materials chemistry expertise and facilities.

KCMC collaborations are a key influence where materials chemistry meets the materials science that translates advanced materials into commercial opportunity and marketplace advantage.

KCMC is a virtual centre hosted by the UK Knowledge Transfer Network. KCMC provides highly flexible access to multi-disciplinary academic research by its partners – currently the Universities of

Manchester, Liverpool and Bolton and the Science and Technology Facilities Council (STFC) at Daresbury.

Dedicated resources deliver competitive advantage for businesses in industrial timescales with reduced business risk.

KCMC catalyses innovation in advanced materials across applications in energy, health, home and personal care, transport, construction and ICT. It offers companies single-point access to its research partners, rapid project start-up via dedicated scientists and ready access to support grants.

materialschemistry.org.uk

KCMC Leadership Team

Dr. John Conti-Ramsden
KCMC Director

Prof. Mike Turner
University of Manchester

Prof. Matt Rosseinsky
University of Liverpool

Prof. Elias Siores
University of Bolton

Dr. Paul Sherwood
STFC

“KCMC has taken a national role in the innovation landscape”

IMPACTS & CASE STUDIES

KCMC case studies have spanned many key sectors of UK manufacturing – with new materials bringing cross benefits in industry sectors including automotive and aerospace, construction, energy generation and supply, life sciences, home and personal care, chemicals manufacturing and electronics.

In 2012-13, five new case studies have highlighted sector benefits aligned with the Chemistry-using Industry Growth Strategy - in **transport** (materials for light-weighting in aerospace, automotive and other sectors), **energy** (energy efficiency and energy harvesting) and chemicals **manufacture**.

The following case studies highlight the role of new materials in delivering the functionality required for development of business opportunities in fire retardant composites and plastics, next generation power electronics, high performance polymers and smart materials. Equally, they illustrate the powerful leverage of public sector investment in KCMC, through people and capital employed.

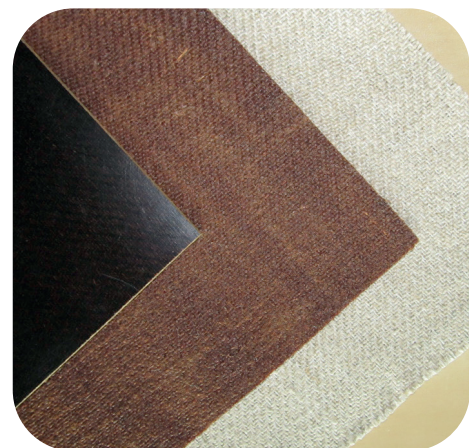
BIOCOMPOSITES – evolving FR capabilities for transport applications:

At a glance: Biocomposites - where the resin and/or reinforcing fibre are from biological sources - are of interest because they are lightweight and sustainable.

The FRBioComp project aims to produce biocomposite materials with fire retardant qualities for use in construction and mass transportation applications.

This Technology Strategy Board-funded project embraces companies active in natural materials - NetComposites, Sam Weller & Sons, Exel Composites, Drake Extrusions and Tilsatec - and the expertise of the University of Bolton.

Challenge: Vehicle construction materials need to be fire retardant to prevent fire spread and maximise escape time.



Due to their combustible resins or reinforcing fibres, nearly all biocomposites are combustible. This is a significant barrier to wider application of these materials.

Approach: FRBioComp is investigating intrinsically fire retardant biobase materials (such as polyfurfuryl alcohol resins) and treating fibres/fabrics or matrix polymer resins with environmentally friendly flame retardants.

Different methodologies for continuous treatments of fibres/fabrics and/or resins with flame retardants are being explored.

Fire retardant biopolymer fibres incorporating synergistic flame retardants and polymer layered silicates are also being developed. These fibres will be commingled with natural fibres, woven into fabrics and subsequently processed into composites.

Benefits: Biocomposites' weight-saving is key in transport applications, through reduced emissions, track wear (rail vehicles) and stopping distances. Lightweight panels allow for faster buildings construction. Inherent fire retardance is essential to prevent injury/loss of life.

KCMC Support: The project utilises equipment purchased with the initial KCMC grant and the KCMC provided support during the proposal process.

Timeline: The three-year FRBioComp project is scheduled to complete in October 2014.



NXP – next generation power electronics:

At a glance: Semiconductor manufacturers are growing gallium nitride (GaN) on silicon substrates to create discrete devices for high-voltage power electronics applications.

The Technology Strategy Board has funded a consortia-based project focused to explore performance and reliability gains for these “next generation” devices.

Challenge: To reduce system losses and enable higher efficiency at lower cost than current solutions.

Approach: Under the ‘PEARGaN - Power Electronics Applications for Reliability in GaN’ - initiative the partners are looking to develop new system-level concepts and circuit architectures, evaluate advanced manufacturing process technologies and create demonstrators to fully understand device behaviour and failure mechanisms.

Led by NXP Semiconductors UK Ltd., partners include Manchester University's Power Conversion Group and Liverpool University's Materials & Structures Centre. (Holland's NXP Semiconductors N.V. is a leader in high performance, mixed signal electronics with operations in over 25 countries.)

Benefits: Unlocking potential delivery of superior performance in breakdown voltage, on-state resistance and higher switching speeds.

Demonstration that the devices are robust and can deliver life-time reliability levels demanded by early adopters in a range of power management/control applications.

KCMC Support: The KCMC atomic layer deposition facilities are being exploited to integrate high-performance dielectrics in GaN-based devices. The integrated design is targeting higher operating voltages for more efficient and compact electrical power management systems.

Timeline: Ongoing. The two-year project started in October 2012.

VICTREX – growth through collaborative R&D:

At a glance: A leading global player in high performance polymers, Victrex plc has revenues of £220m. through sales to the aero, auto, medical, energy and electronics market sectors.

A three-year Knowledge Transfer Partnership (KTP) with the University of Manchester (OMIC) has been a sharply focused and highly cost-effective R&D route, contributing to rapid innovation in extreme temperature plastics.

Challenge: Victrex targets business growth through product leadership, translating rapid market-focused innovation into high performance, market leading products.

Yet speedy, cost-effective R&D with rapid project start-up can pose both investment and timeline challenges.

Approach: The KTP approach accesses University expertise and resources, freshening and broadening the scientific perspectives to address the challenge.

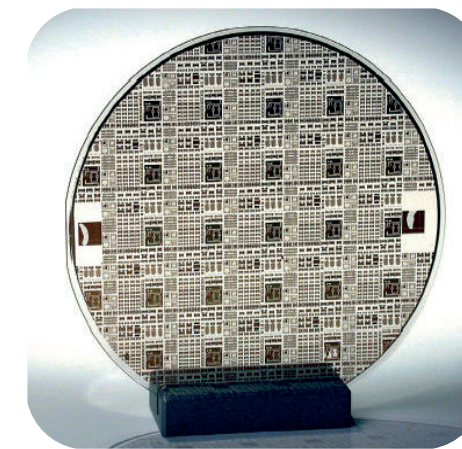
The project model (“small is beautiful” collaboration) ensures retention of sharp focus on delivering objectives – and avoidance of compromises impacting on efficiency, timeline and value-for-money.



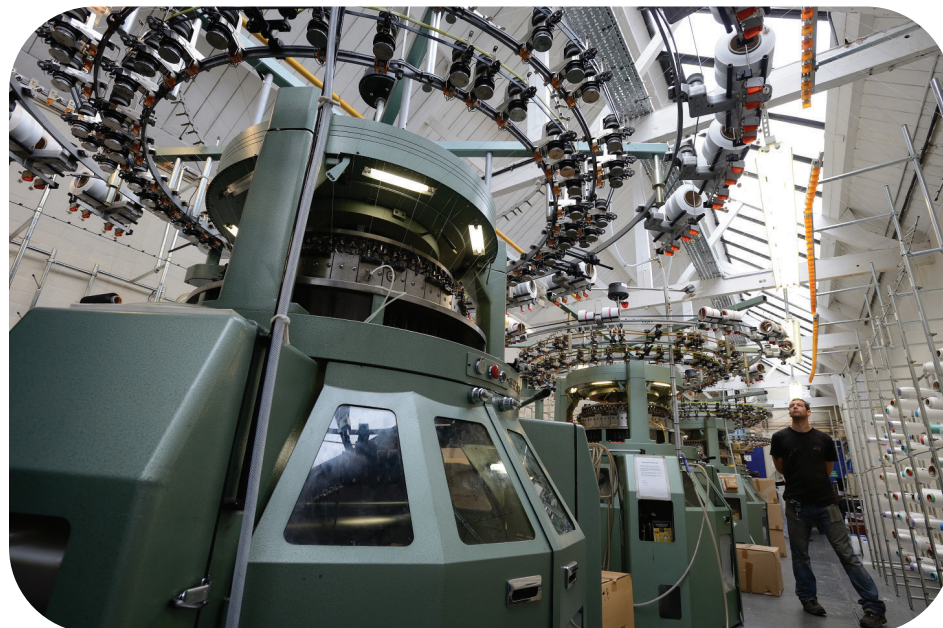
Benefits: The Partnership enabled de-risking of high innovation potential projects. The KTP additionally generated an effective, “beyond core competence” network - fostering further collaboration. Cost-effectiveness - where permanent R&D resource investment would be deemed inappropriate – was a further benefit.

KCMC support: Facilitating development of the KTP with OMIC at the University of Manchester and negotiation of the KTP agreement. Ensuring an excellent match between Victrex's requirements and UOM's expertise and extensive facilities.

Timeline: Three-year project - ongoing.



FIBRLEC – harvesting energy with smart materials:



At a glance: By coupling flexible solar cells with piezoelectric material in a hybrid and relatively low cost film/fabric structure, energy can be economically harvested from movement generated by wind, rain and light energy.

With many applications “FibrLec” material, based on flexible, extruded polymers, is expected to be a “game changer” in renewable energy. (FibrLec Ltd. was formed in March 2013 to commercialise enabling materials and technologies for low-cost renewable energy sources.)

Challenge: To integrate organic voltaic cells with polymeric piezoelectric material, thus overcoming the fragility/durability and cost issues with current technologies.

Approach: With deep expertise in smart materials science, Bolton’s Institute of Materials Research and Innovation (IMRI) developed novel technology integrating piezoelectric polymer substrate with a photovoltaic coating in a hybrid textile.

Materials chemistry and a new continuous process were key to creating a flexible structure, featuring conducting organic polymers.

Benefits: The piezoelectric polymeric substrate and photovoltaic coatings are able to transform both mechanical energy and light energy, to provide enhanced functionality.

The piezoelectric or hybrid films and fibres can be incorporated in textiles for a wide variety of applications - such as smart floors, energy generating carpets, backpacks, tents and sails. The technology also points towards future “self-charging” wearables, cellphones, laptops and tablets etc.

“FibrLec” material is significantly cheaper and much more durable and flexible than traditional photovoltaic devices.

KCMC support: Research resource that secured IP - plus equipment investment.

Timeline: First hybrid film/fibre device unveiled in 2010. Commercialisation of “FibrLec” for various applications is ongoing.

WILLIAM BLYTHE - developments in fire resistant materials:

At a glance: A leader in inorganic chemistry, William Blythe’s products include flame retardants Flamtard H and Flamtard S. These counteract flame/smoke formation, whilst having no hazard classifications for health or the environment.

For both halogenated and halogen-free systems, work at Bolton University has identified flame retardants with which Flamtard S and Flamtard H can show synergistic activity in commercial polymer systems.

In a parallel work with EPSRC CASE studentship, novel, non-toxic, environmentally benign, synthetic inorganic compounds are being researched. These can impart fire retardance and smoke suppression to selected high performance polymers without use of conventional halogen-containing flame retardants and synergists.

Challenge: Meeting the polymer industry’s aspiration to use non-hazardous and environmentally benign products, William Blythe Ltd. wished to understand the effectiveness of the Flamtard range in greater detail in order to promote it even more effectively and to develop new such systems.

Approach: Wm. Blythe sponsored a work programme at the University of Bolton, led by a highly skilled post-doctoral researcher. Flame retarded polymer compounds based on commercial formulations were prepared at the Fire and Materials Laboratory. Using measurement techniques including Cone Calorimetry the effectiveness of Flamtard products was established.

With CASE studentship other inorganic flame retardant chemicals are being studied.

Benefits: Project data is being used to advise on the most effective ways to use Flamtard and to assist sales expansion into new applications.

KCMC Support: KCMC assisted Wm. Blythe to win an EPSRC funded PhD Studentship (2011) and assisted in securing funding for a further two PhD Studentships to continue the research, commencing in Q4 2013.

Timeline: Ongoing, to end 2016.

KCMC’S ROLE IN THE UK INNOVATION LANDSCAPE

Under a new funding partnership with the Technology Strategy Board for 2013-14 onwards, KCMC has transitioned to a widened, national role in the UK’s innovation landscape.

Through discovery and development of innovative new materials and new materials technologies needed for next generation products, KCMC is uniquely positioned to drive innovation in high value manufacturing in the UK at the earlier stages of product and process innovation.

Developing from its regional focus, KCMC is looking to expand the number of its UK research institution partners, with an enlarged network bringing the benefits of engagement with industry nationwide, new strategic opportunities and extended capabilities.

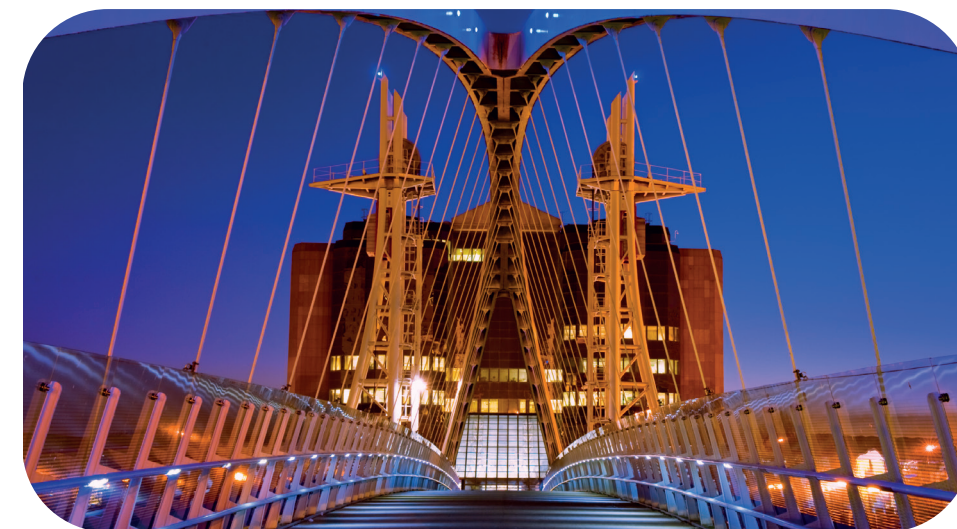
Using a powerful combination of science leadership, knowledge transfer experts and flexible resources in its research partners, KCMC links expertise and specialist capabilities within industry and academia to deliver collaborative research to industry timescales.

KCMC collaboration themes are formed by an internationally competitive group of chemistry-using companies and academic experts. They provide a bridge to connect the leading edge science of the research institution partners with UK industry’s commercial market needs and opportunities.

The proven KCMC business model for collaborative research has directly addressed major challenges to maintain and enhance innovation in the UK economy. KCMC builds on the leadership skills of academics and industrialists and brings them together in a coherent organisation with clear management accountability.

KCMC is also integral with key recent developments in the UK’s innovation landscape.

“The proven KCMC business model for collaborative research has directly addressed major challenges to maintain and enhance innovation in the UK economy”



A crucial recent example has been the launch of the High Value Manufacturing Catapult, one of a network of elite technology and innovation centres. This provides a completely new national capability to bridge the gap between emerging innovation in both the research community and companies and stimulate growth in UK High Value Manufacturing. KCMC works closely with the High Value Manufacturing Catapult to create a seamless transition in innovation support, from discovery through to commercialisation.

Recognising that the ultimate success of all the UK’s key growth sectors – including automotive, aerospace, construction, energy, life sciences and home and personal care - depends on chemistry the Chemistry Growth Strategy Group has produced a strategic vision of business and government in partnership with accelerating innovation as one of the critical priorities.

Similarly, KCMC is closely aligned with the EPSRC strategic priority of developing enduring relationships embracing business and the research community, with its partnership with the Technology Strategy Board and shared

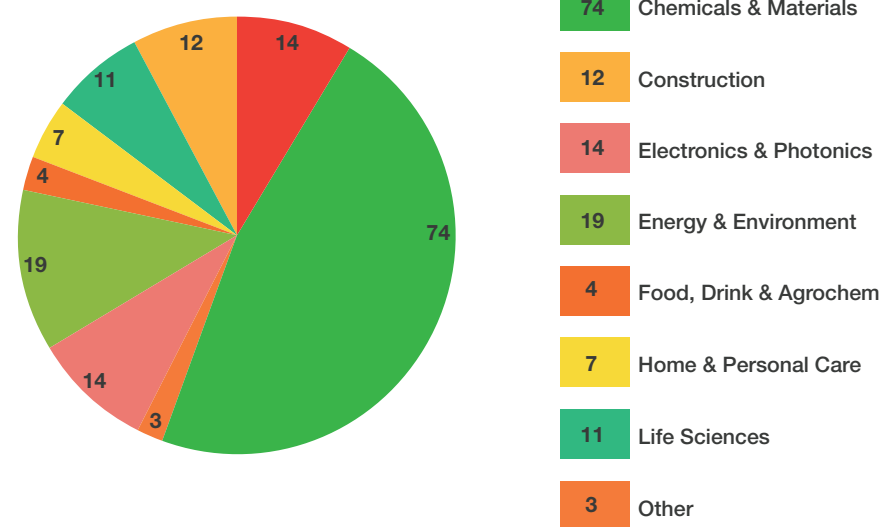
emphasis on high value manufacturing. KCMC has been tasked to lead the recently formed Materials Chemistry Special Interest Group (SIG), funded by the Technology Strategy Board with the aim to enhance the UK’s capability to develop and commercialise novel materials to meet future industry needs. (See page 12)

KCMC is notably aligned towards:

- Sustainable products and processes: Reduction and replacement of critical raw materials, bio-sourced materials, materials recycling and reuse.
- Supporting SMEs and bridging the innovation gap “valley of death”.
- Creating innovative novel materials: For electronics, photonics and sensors; formulated products; biologically relevant materials; multi-functional materials; enabling new manufacturing technologies.
- Addressing societal challenges in energy, health and sustainability.
- Networking, facilitation and grant funding support for access to leading edge materials chemistry skills and capabilities.

CONNECT.....

Figure 1:
KCMC Collaborators by Company Type



In the first full year after the initial grant funding period, KCMC market penetration has both broadened and deepened in key UK growth areas. In parallel, continued investment in new materials research within the research institution partners is expanding the range of capabilities and expertise available to industry.

KCMC progressed 233 industry engagements in 2012-13, connecting up with more than 40 senior academics from the four research partners. While in many cases these drew on the expertise of well established science leaders, a significant number of cases involved working with younger academics to facilitate their involvement in industry challenges.

As in previous years the number of industry engagements has been approximately evenly split between UK SMEs, larger UK-owned companies and foreign-owned enterprises. However, there is a trend to an increased proportion of UK businesses engaged (up from the prior year's 62% to 72% in 2012/2013) - see Figure 2. Altogether, 85 new companies have been introduced to the KCMC of which 47% were UK SMEs. In total, 173 new technical challenges were explored outside of existing business contacts between industry and the research institutions.

Overall, industry sectors supported are led by chemicals and materials companies working across a broad range of end application areas, but in aggregate the largest number of

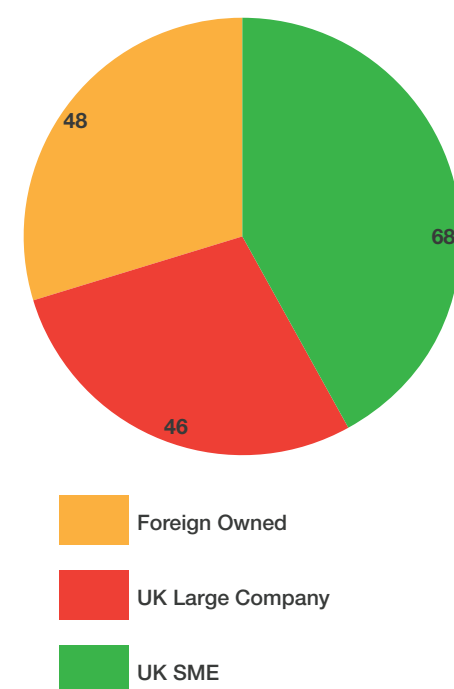
companies supported are specialised in other industries eg in energy, health, fast moving consumer goods and electronics (Figure 1).

For the SMEs (numbering 66 companies), the focus is evenly split between those businesses which develop and commercialise new chemicals and materials for multiple industry sectors, and those businesses which apply novel materials in specific applications.

SMEs driving development of new materials with cross cutting industry applications reflect a diverse range of technologies – Organic Materials (12 SMEs of which 6 are focused on polymers), Inorganic Material (5), Hybrid Materials (4), Nano Carbon (2), Engineering, Processing and other support activities (10). The application focussed SMEs cover all the KCMC industry sectors with particular concentrations in energy, health and transport.

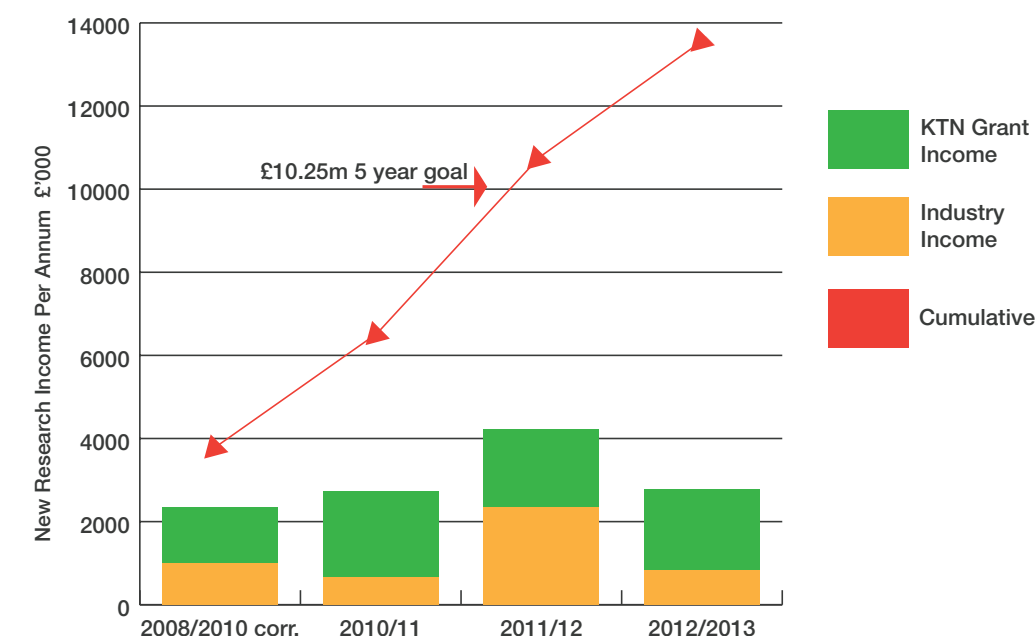
For larger enterprises, there is a group of 19 companies with multiple interactions with the KCMC research partners and where KCMC has raised awareness of academic capabilities and connected up the relevant experts. These companies span chemicals & materials (7 companies), energy (2), life sciences (1), fast moving consumer goods (2), food & drink (1), engineering (4) electronics (1) and construction (1).

Figure2:
KCMC Support by Company Origin



.....FACILITATE
AND DELIVER

Figure 3:
KCMC Growth in Research Income



The project portfolio continued to grow in 2012-2013 with more than 30 projects contracted during the year (Figure 4). Grant funded projects show a strong focus on science themes aligned with key enabling technologies identified as national priorities. These include advanced materials for:

- Energy (energy transmission and renewable energy generation)
- Sustainability and materials security (catalytic routes to platform chemicals and replacement of critical metals)
- High value products for health, electronics and personal care (materials for regenerative medicine, power electronics)
- Next generation manufacturing technology (digital manufacture)

The spread of project sizes has shown the power of KCMC's flexible approach to project resourcing. There have been strong contributions from both medium sized and major projects.

When comparing 2012-2013 with 2011-2012, the overall balance has shifted towards more major projects (> 1 year) compared to small and mid-sized projects. The average size for the medium sized, flexible projects typically using project scientist resource has remained constant at £36,000 - or roughly one third of an FTE experienced post doctoral researcher (Figure 4).

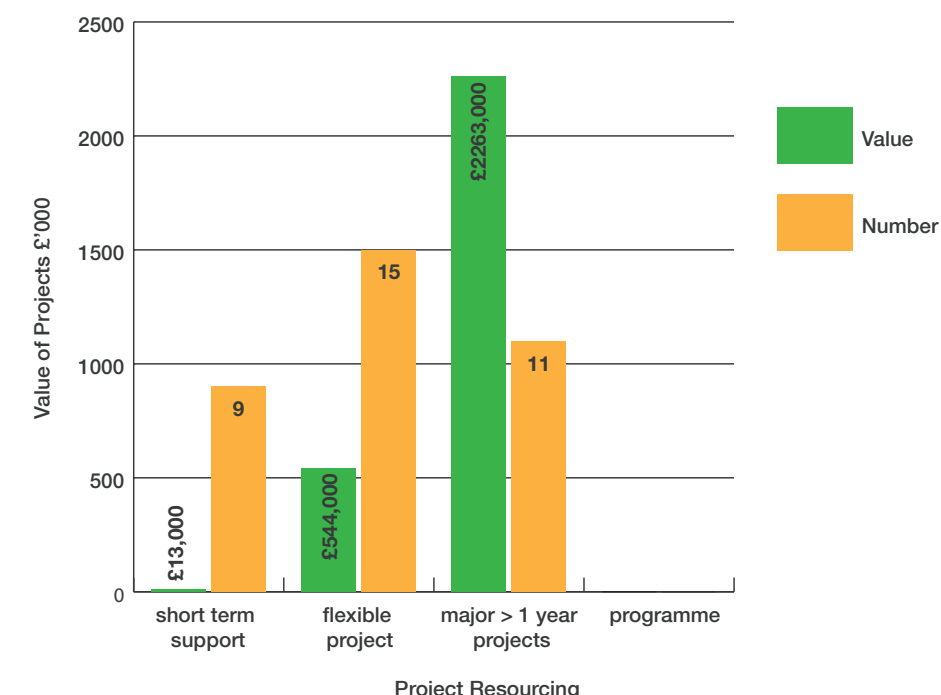
A high proportion of the industry projects are repeat business (ca 50%) with a good rate of introduction of new business relationships.

A notable trend following the launch of the Hartree Centre has been the growth of large industry projects exploiting the use of High Performance Computing in the development of new materials.

The split of KCMC industry projects against industry sectors is similar to that of the industry engagement data shown above in Figure 3. Against the societal trends and challenges where materials chemistry can make an impact, the projects contracted by KCMC broadly align with the themes highlighted above for grant funded projects, and the three major KCMC themes of Energy, Health and Sustainability.

“A significant number of cases involved working with younger academics to facilitate their involvement in industry challenges”

Figure 4:
KCMC Project Resources



MATERIALS CHEMISTRY SIG RECOGNISES OPPORTUNITY

Materials chemistry has a vital role in enabling the breakthroughs in materials and product functionality which drive the innovation across much of the UK's chemistry-using industries.

The UK Technology Strategy Board has funded the Materials Chemistry Special Interest Group (SIG), with the aim of enhancing UK capability to develop and commercialise novel materials to meet future industry needs.

The move also recognises the critical importance of collaborative working between materials chemistry and materials science and engineering to translate this innovation into commercial success.

The Materials Chemistry SIG will be led by the KCMC, working with sector experts from the UK Knowledge Transfer Networks (KTNs) in chemistry, materials and other key industries.

It will build on KCMC's five-year track record in delivering value from collaborative research, accelerate the development of KCMC as a national resource and aid cohesion in connecting industry need to the capacity and expertise of the universities.

KCMC has proven ability to address the recognised challenge of aligning university capability with industry need - and where the diverse impacts for materials chemistry research, fragmented industry activity and the formidable entry barriers to building and maintaining individual company/organisation capabilities each need careful management.

Key objectives for the Materials Chemistry SIG are to:

- Identify/develop priority areas for materials chemistry collaborative research which directly support UK manufacturing industry growth strategies...
- Accelerate development and strategic expansion of KCMC as a national centre, via additional



- Research institute partners...
- Work with Knowledge Transfer Networks and Catapults to maximise breadth of meaningful connection with industry needs...
 - Underpin ongoing engagement/collaboration with knowledge-intensive SMEs....

Targeted benefits include shorter time-to-market for innovation dependent on materials chemistry; better connection of industry need to leading edge university research and enhanced connection of universities' materials chemistry expertise to manufacturing innovation - including to the High Value Manufacturing Catapult.

“The Materials Chemistry SIG offers a standout opportunity to deepen and broaden understanding of UK industry needs in new materials development....”

Materials Chemistry SIG Chair John Grasmeder - Technical Director of Victrex PLC - comments:



“UK manufacturing operates in a global environment where competition demands that companies accelerate innovation and

leading edge technology development in order to maintain long term competitiveness of their products and processes.

“Materials chemistry has a key role to play as a driver of specific technology development in advanced materials. This must then crucially link with materials science, for translation into new materials developments and product design opportunities that industry can then fully exploit to secure competitive advantage in key growth sectors.

“UK universities and research institutions have a great opportunity here where they can offer competitive skills and capabilities.

“The Materials Chemistry SIG offers a standout opportunity to both deepen and broaden our understanding of the needs of UK industry in new materials development and, crucially, to use this knowledge to develop a more strategic approach across multiple universities and academics.

“More broadly, and with increased Government focus on the strengthening of UK manufacturing and supply chains, there is also an opportunity through the Materials Chemistry SIG to drive key new material developments through value chain collaboration and projects.”

Materials KTN Director Robert Quarshie noted:



“The Materials Chemistry SIG provides a unique opportunity to align the expertise and capabilities of two of the UK's great science communities to accelerate the development and exploitation of novel materials by UK industries.”

KCMC PARTNERS' CAPABILITIES EXPAND

For all four KCMC research institution partners, 2012-13 marked significant steps across a combination of expanded capabilities, future investments and commercialisation of key innovations....

UNIVERSITY OF LIVERPOOL:



In October 2012, the University was awarded a share of the Government's £1bn. investment in science to establish Europe's first Materials Innovation Factory (MIF).

Being established in collaboration with Unilever, the £53m. centre will develop

a new generation of functional materials for science and industry and be home to around 140 University researchers.

The 8,300 sq. m. state-of-the-art lab facility will feature both industrial and University labs; £7m. worth of equipment and a “Research Village” facility for flexible provision of lab space.

Late 2012 also saw the opening of the £44m./710-bed Vine Court city centre campus - while the year also marked the first for the new centralised teaching laboratories for science disciplines, commissioned under a £25m. investment programme.

The University of Liverpool is planning to invest £600 m. in its facilities as part of its commitment to providing a world-class student experience and research environment.

UNIVERSITY OF MANCHESTER:

A key 2012 event was the announcement of BP's US\$100m. international research centre for advanced materials - BP-ICAM. - which will have its “hub” at UoM's Faculty of Engineering and Physical Sciences.

Initial focus in the 10-year programme will be on structural materials - such as new alloys and composites - and smart coatings.

The University is receiving £23m. from the European Regional Development Fund towards the £61m. National Graphene Institute (NGI) - UK home of research into the world's thinnest, strongest and most conductive material. With £38m. in EPSRC funding, the 7,600 sq. m. facility will also operate as a “hub and spoke” model.

A notable 2012-13 success was a successful EPSRC bid to investigate electrochemical energy storage using graphene-enabled materials. The five-year programme began in February 2013.

The University is to invest £1bn. over the next 10 years to create a single world-class campus. The first phase of the plan, costing around £700m., will be delivered over the next six years. It includes the building of a new engineering campus, as well as new centres for the School of Law and Manchester Business

School, a major refurbishment of the University Library, a bigger and better Students' Union and a new Medical School.

UNIVERSITY OF BOLTON:



In recognition of global demand for sustainable energy, University of Bolton initiated the Institute for Renewable Energy and Environmental Technologies (IREET) in 2011, where it is now at the forefront of technologies to support renewable energy development.

March 2013 saw the formation of FibrLec Ltd. to commercialise the University's innovative smart materials - beginning with extruded polymers for energy harvesting, described as a “game changer in the renewable energy sector”.

“FibrLec” sustainable energy fibre is piezoelectric and photovoltaic, able to convert sun, wind and rain energy into usable electricity.

For 2013-14, major research expansion is a key theme for University of Bolton, with 30 - 50 new appointments planned across its research portfolio.

SCIENCE AND TECHNOLOGY FACILITIES COUNCIL (STFC):

STFC's Hartree Centre at Daresbury is dedicated to realising the potential of energy efficient computing - including applications to speed chemistry and materials modelling.

A 2012-13 highlight was the signing of a strategic partnership agreement between STFC and Unilever, under which Hartree will undertake specific projects including further work in simulation as a predictive tool in formulation science.

During the year, £19m. of new investment was allocated to the Hartree Centre for work in energy efficient computing technologies.

KCMC METRICS:

Following the completion of the initial grant funding period, metrics for KCMC have been simplified to reflect the goals of the key stakeholders in KCMC, the research institutions and industry partners.



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KEY METRICS ARE:

Metric Activity	2012/2013 Actual	Cumulative 4.5 years* Actual	Comment from KCMC 5 year business plan
Business Engagements	236	>750	5 year target exceeded
Industry Income	£826,000	£5,642,000	Ahead of plan
Grant Income – Knowledge Transfer	£1,965,000	£7,919,000	5 year target exceeded
Total Income	£2,791,000	£13,561,000	5 year target exceeded

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**since launch of KCMC*

In the 2012-13 reporting period strong progress continued against all financial metrics and in most cases five-year project targets have now been exceeded.

A new development - to be reported in the next financial year - is the contracting of KCMC to lead the Materials Chemistry Special Interest Group, which will bring in new metrics to reflect KCMC's expanded role in the national innovation landscape.





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