A Technology Framework for the East Midlands 2008-2011

A framework prepared by *emda* and East Midlands Innovation

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A Technology Framework for the East Midlands 2008-2011

Developing and exploiting technology for long-term prosperity

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Foreword

In a rapidly changing world, businesses large and small cannot afford to underestimate the importance of technology. Competing on cost alone is no longer an option; we must strive for innovation in everything we do and exploit such innovation to profitable effect.

Innovation is one of the ten strategic priorities of the East Midlands Regional Economic Strategy (RES), which aims to develop "a dynamic region focused on innovative and knowledge-focused businesses competing in a successful global economy." Fundamental to achieving this aim will be our ability to identify and prioritise investment in new technologies, as highlighted in one of the elements of the Regional Innovation Strategy, prepared by East Midlands Innovation.

This document has been developed by East Midlands Innovation and endorsed by East Midlands Development Agency (*emda*). It is the result of meticulous consultation with the technology stakeholders in the region - major companies, SMEs, universities, key industry bodies, iNet consortium members, *emda* - and represents a consensus of opinion concerning:

- what our technology priority areas should be

where we should focus investment to best develop and exploit technology for the long-term economic benefit of the region

- what our key strategic objectives should be

the four broad aims which together will create a supportive, attractive and profitable environment for technology-based companies and individuals

- what actions we need to take to achieve our goals

whether that be encouraging collaborative working, attracting inward investment, promoting the region or influencing policy makers

This Regional Technology Framework (RTF) adds to the tools we need to respond to the global competitive technology threat; it provides us with a framework for targeting support for technology development by focusing on a limited number of priority areas; and it allows us to demonstrate a clear understanding of our technology strengths to investors, potential collaborators and EU and national policy makers.

We have the RTF, now we need to put it into practice. East Midlands Innovation has endorsed this document and, along with the iNets, will have a key role in implementing RTF actions, and promoting and coordinating support for the technology priorities.
The success of the RTF depends upon all regional technology stakeholders taking an active role in implementation, working with us to make the East Midlands a leading world player in technology development and exploitation.

Barry Stickings
Chair, East Midlands Innovation

Introduction

Excelling at science or technology is a major part of being a dynamic region. But equally important and a fundamental part of regional economic success, is putting that excellence to profitable use; the ability of the region's businesses to exploit scientific knowledge through innovation, to the benefit of society in general.

In the East Midlands, we possess many of the characteristics we need to compete on the basis of technological innovation. We have a rich tradition of technology development in our companies and universities and numerous examples of internationally recognised excellence in the development and exploitation of new products and processes.

Other regions and nations are also moving ahead with new technology development. It is no longer about competing on cost alone, but about the race to provide the best, most innovative solutions; as the rapid growth of China as a global economic power clearly illustrates.

Therefore, without concerted action to support the region's capacity for technology development and exploitation, we risk being left behind by our global competitors.

What is the Regional Technology Framework (RTF)?

The RTF is an integral part of the Innovation Strategy and Action Plan for the East Midlands 2007-2010[1] (Innovation Strategy)[2] and supports the theme of 'Fostering enabling and emerging technologies'. It describes how we will respond to the challenge outlined above by targeting support for technology development around priority technology areas and improving the region's success rate in drawing in funding from national and European sources, such as the UK's Technology Strategy Board and the European Union's Seventh Framework Programme for Research and Technological Development (FP7).

How will the RTF be implemented?

Successfully responding to the challenge of improving the region's technology development and exploitation will require a shared and concerted effort by stakeholders, such as *emda*, the Sub-regional Strategic Partnerships (SSPs), local authorities, companies, universities, further education colleges, the NHS and Nottingham Science City.

What are iNets?

iNets are being established in each of the region's priority sectors where they will take responsibility for delivering the Innovation Strategy. Each iNet comprises of a concentration of businesses, universities, public sector representatives and individuals (the innovation stakeholders), all brought together around a shared interest in a market sector or the technologies that underpin it. The activities of an iNet are supported by a dedicated iNet team that operates on behalf of the innovation stakeholders.

1 www.eminnovation.org.uk

2 The Innovation Strategy identifies four interconnected strategic themes for directing innovation investment. This includes: Knowledge Exchange, Innovation Support for Business, Creating the Environment for Innovation and Fostering Enabling and Emerging Technologies.

East Midlands Innovation[3] will provide strategic leadership of the RTF and will advise and guide *emda* and the iNets in implementing the actions. This will include regularly feeding into the Framework critical intelligence regarding the progress of the RTF and any necessary re-focusing.

In addition to supporting the important role of East Midlands Innovation and the iNets, the RTF provides a framework for action for all organisations in the region. It will, therefore, require a partnership-based approach that shares responsibility, effort and funding from regional partners

How was the RTF developed?

Our priority technology areas have been identified through a process of research and consultation. They represent those technologies that are likely to be most important to the future prosperity of the East Midlands. Their importance may reflect their current position in the region's economy or the opportunity that they represent for future exploitation by the region's businesses.

We have identified these technology areas as priorities by:

- mapping technology strengths in both the university and business sectors
- analysing policy drivers for the RTF at regional, national and EU levels
- drawing lessons from good practice approaches and themes adopted by other leading regions

We were also able to draw on a debate of emerging priority areas, facilitated through workshops that encouraged participants to consider the likely trajectory of technologies important to the region.

The RTF priority technology areas and strategic objectives have been further validated through policy briefings with regional stakeholders and a survey of companies in the the regional priority sectors: healthcare and bioscience, food and drink, sustainable construction and transport equipment. Key findings from this research are set out in this document.

How is the RTF structured?

The Regional Technology Framework identifies the priority technology areas where we need to focus our attention if the development and exploitation of technology is to make a full contribution to achieving our overall economic objectives, established in the Regional Economic Strategy[4] (RES). It also highlights the relevance of priority areas to our business sectors and the extent to which we can build on existing strengths in our companies and universities.

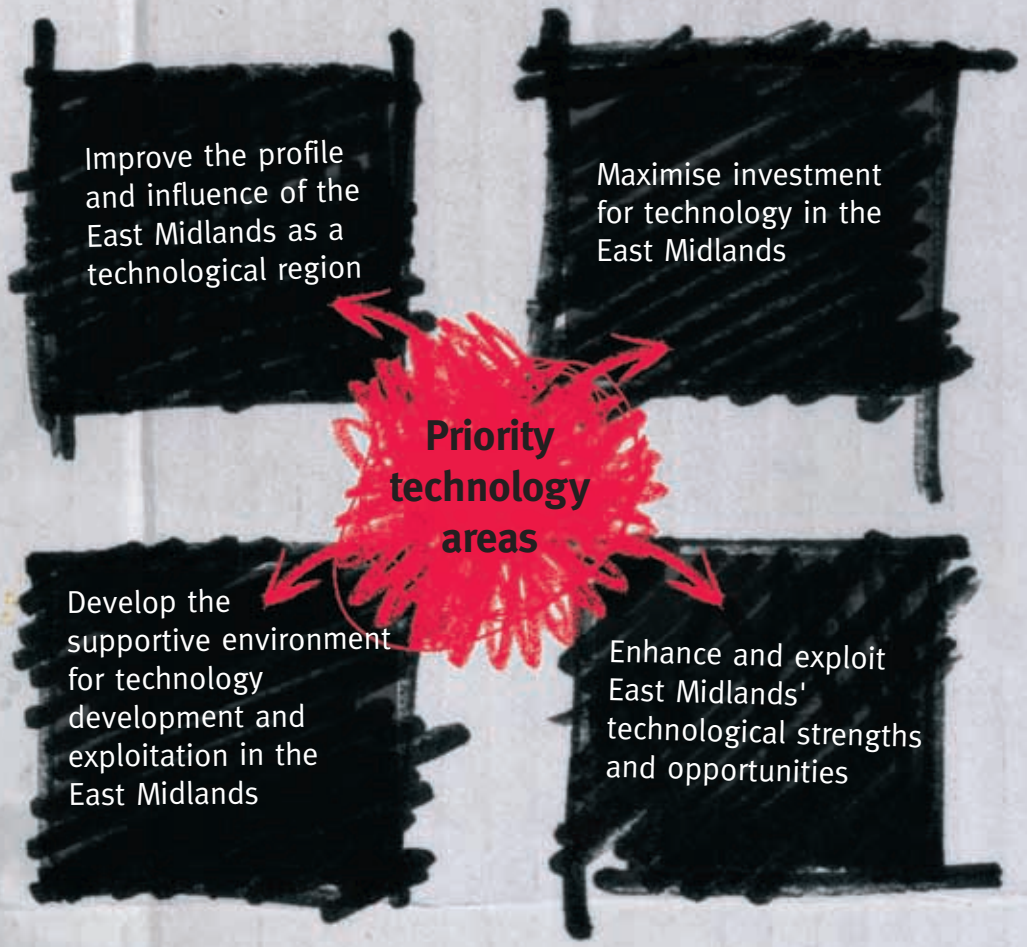
As well as prioritising our technologies, we also need to understand what practical actions we can take to implement the RTF and to support the priority technology areas. Therefore, the RTF first of all sets out the strategic objectives that we will address and the actions that we will take, in specific cases but also in more general terms, to support technology in the region.

3 East Midlands Innovation is the Regional Science and Industry Council which was established in 2005 by *emda*. Its principal responsibility is to provide strategic leadership and guidance on innovation including science and technology with the aim of growing a long term, sustainable, innovation-led economy.

4 See www.*emda*.org.uk/res/

RTF Strategic objectives

Underpinning the RTF and guiding stakeholder actions in our priority technology areas are four strategic objectives, as follows:



Each objective, along with the reasoning behind it and the actions required to implement it, is set out in detail on the following pages. The required actions will inform the activities of the newly created iNets and provide all stakeholders in the region with a framework for action.

Strategic objective 1

Improve the profile and influence of the East Midlands as a technological region

In the region there are significant numbers of major, technology-led companies and world-class university research facilities. We also have a relatively strong technology base on which to build. However, we are currently not perceived as a leading region for technology excellence.

To achieve our economic objectives and encourage investment, we must improve then sustain the profile of the East Midlands as a region where technology excellence exists and is supported. In addition, a positive technology profile will underpin a number of the Innovation Strategy's key aspects, including the annual iFestival[5], together with the activities of partners such as UK Trade and Investment (UKTI).

We also recognise that the region, like others in the UK, is subject to European and national policies, programmes and priorities for the funding of world-class technology development. The RTF will enable those making the policies to take on board East Midlands' priorities, maximising our chances of accessing relevant funding.

Actions required to implement strategic objective 1

Influence European, national and regional technology policy processes, ensuring they reflect East Midlands' technology priorities

To access the investment we need to support our science, technology and innovation activities

The RTF is the consensus of technology stakeholders in the region, and as such will give policy makers an invaluable understanding of East Midlands' priorities and funding requirements.

The RTF will now play a significant role in communicating the consensus around technology priorities through a coordinated, structured approach to EU and national policy makers. In addition, *emda* and East Midlands Innovation will fully contribute to European and national policy discussions, while full support from the region's universities, researchers and businesses will also be key.

Together, we will implement a partnership plan setting out our priorities and approach to engage with important policy bodies, such as the EU, UK Government (particularly DIUS), the Technology Strategy Board and Research Councils. *emda* will take ownership of this process.

Promote the East Midlands as a region of technology excellence

To underpin the RTF and Innovation Strategy and attract both private and public sector investment

All East Midlands' stakeholders must work to promote the region as a home of excellence in the development and exploitation of technology.

emda and the iNets will lead and coordinate marketing activities, but in addition to this, we must take every opportunity to demonstrate our strengths to a wider audience.

5 The iFestival is a region-wide festival. It will encompass an inspiring, inclusive programme of events, designed to help foster a culture of innovation in the region with activity targeted at young people, businesses, communities and organisations supporting or involved within an innovation environment. The iFestival is being co-ordinated by East Midlands Development Agency (*emda*) and East Midlands Innovation. For further information please visit: **www.eminnovation.org.uk**

Strategic objective 2

Maximise investment for technology in the East Midlands

In the global market for inward investment, the region has a competitive offer in a number of technologies and knowledge-driven business sectors. Building on these, along with actively pursuing new opportunities from Research and Development (R&D)-intensive companies and projects, will be crucial in attracting significant private and public sector investment.

The performance of the East Midlands' economy in respect of R&D expenditures is patchy. Evidence suggests[6] that our large companies account for a significant proportion of R&D activity, particularly for high-value R&D job opportunities.
The international nature of such companies and the growing importance of global competition mean we cannot take it for granted that such activity will remain in the region. The RTF will enable us to maintain and increase our leading edge technology base, ensuring the region continues to be an attractive location for existing and new large-company R&D, and thereby retaining high-level, high-wage employment opportunities for our skilled workforce.

While large companies are of vital importance to technology in the region, for many smaller companies R&D is not a priority, and in the university sector R&D expenditure lags behind the UK average. The RTF will assist large companies, SMEs and universities to participate in, and take up, European and UK technology programmes and awards; a key way to increase technology investments in the region.

Given the current relatively poor position of the region in terms of public sector investment in research and development[7], the RTF will also enable collaborations with neighbouring regions[8], as well as within the region, to attract UK government and national R&D and technology investments.

Actions required to implement strategic objective 2

Attract new inward investments from companies, government and other national research and technology activities

To strengthen existing technology excellence in the priority areas and to develop opportunities in new or emerging areas

The RTF will enable the region to step up its activities to attract new inward investment by developing collaborative proposals and opportunities with partners within the region, as well as across adjacent regional boundaries.

In addition, the Investor Development function within *emda*'s International Investment team is developing an international business strategy for the region, which brings together various themes, including innovation and R&D. It will use the RTF priorities to help maximise investment flows into the region's key technology areas.

6 Figures from 2002 suggest that East Midlands Business Enterprise Research and Development (BERD) was 1.8% of GVA, compared to 1.4% for the rest of the UK. Source: 'The East Midlands in 2006: Evidence Base for the East Midlands RES 2006-2020' (see Economy and Productivity chapter).

7 For example, the East Midlands is behind the rest of the UK in relation to its potential investment by the Central Government sector in R&D. In 2003 Central Government expenditure on R&D within the region (excluding expenditure on R&D within the NHS) was £22m, which was 87% below the national average of £167.4 million. Source: Office for National Statistics: 'Research and experimental development (R&D) statistics, 2003', published in 'Economic Trends 621, August 2005'.

8 As demonstrated by our recent success, in collaboration with the West Midlands, in securing funding for the Energy Technologies Institute in the region.

Encourage large companies to make strategic technology investments in the region by providing targeted support

To retain existing and locate new technology R&D activities within the East Midlands in support of the technology priority areas

emda will help large companies access technology and R&D support, with a specific emphasis on the priority technologies identified in the RTF. The iNets will be a key source of critical intelligence on technology areas relevant to the region and will ensure that this is available to *emda* when considering how best to support large companies.

Encourage East Midlands' businesses and universities to participate in EU and national technology programmes

To strengthen the technology base by maximising new opportunities emerging from university research and business R&D

iNets will be responsible for encouraging universities and companies to participate in EU and national R&D activities, particularly with regard to opportunities arising from the Seventh Framework Programme for Research and Technological Development (FP7) and from the UK's Technology Strategy Board.

emda will ensure that the information, diagnostic and brokerage activities of the region's Business Link structures are able to provide information and encouragement to companies that could benefit from national and European R&D programmes.

The activities of the Innovation Relay Centre (IRC) in the East Midlands[9] also have a vital role to play in encouraging greater participation.

9 Currently the Midlands IRC is operated by Coventry University in the West Midlands, and recently the European Commission awarded a contract to operate the service in line with regional business support.

Strategic objective 3

Develop the supportive environment for technology development and exploitation in the East Midlands

The RTF will stimulate a business environment that supports companies and institutions committed to developing, exploiting and using new technologies. This will also involve using the RTF to influence other organisations - those providing funding or training, for example - to refocus their activities in support of our priority technologies.

Currently, a relatively small proportion of East Midlands business is actively engaged with the region's universities seeking other forms of technology support and collaboration. The RTF will make such collaborations more extensive, thereby stimulating and supporting new start-ups and spin-outs from universities or larger technology-based companies. Using the influence of the RTF as described above will also ensure that these businesses have access to the innovation funding they need.

In addition to funding, companies will also need to draw on specific technology skills. To ensure that the right pool of talent is available in the region will mean first using the RTF to communicate to education bodies the technology priority areas, then influencing training provision at Further Education (FE) and Higher Education (HE) level to reflect business demand in these areas.

Actions required to implement strategic objective 3

Ensure that companies working in the technology priority areas have access to support

To enable them to undertake research and development and effectively exploit and use the technology available in the region

As *emda* continues to enhance its access to finance support for SMEs, including in innovation and technology, the RTF will inform the way funds are targeted. In particular, by working with and influencing existing business support activities, including Connect InvoRed, we can ensure that technology-focused SMEs are 'investment ready' to maximise the opportunities available to them to raise finance.

The RTF will also influence the action of the iNets to bring businesses and universities together in supportive and profitable collaborations.

Improve the focus and impact of technology education and skills in the region

To provide the specific technology skills businesses need, to raise the volume of 'technician-level' skills being generated by FE/HE institutions, and to retain high-level graduate technology skills in the region

By identifying technology priority areas, the RTF will help the Employment, Skills and Productivity Partnership (esp) to respond to demand from businesses operating in these areas for a workforce with technology-focused skills.

The RTF will also help the esp to support successful and sustainable businesses and better quality employment. This will provide real reasons for students to train in our priority technology areas and for high-level graduates and technician-level professionals to remain in the region. Strong linkages between education providers and employers working in the technology priority areas will be crucial to this, with the iNets playing a key role as they implement the Innovation Strategy.

Strategic objective 4

Enhance and exploit East Midlands' technological strengths and opportunities

In the East Midlands, we have a history of developing world-class technologies[10]. But in many cases, such technologies have been exploited elsewhere, so the long-term economic benefits have not accrued to the region.

The RTF identifies priority technology areas where technology excellence is not matched by the exploitation needed to bring us long-term prosperity. It also highlights areas where new technologies have been developed but take-up by the region's companies is limited.

This is the first step to more widely and more fully exploiting the region's technology excellence. Indeed, where we have 'pockets' of world-class technology, we will exploit these technologies more fully. In other technology areas, we will seek new opportunities to build new strengths and critical mass by investing in research and exploitation collaborations.

Actions required to implement strategic objective 4

Increase R&D and technological collaboration between higher education and companies across the region

To make the best possible use of our technology strengths and enhance the long-term prosperity of the region

Implementing this action will require strong, focused relationships and collaborations between businesses and universities in the region.

As part of the Innovation Strategy, the iNets are charged with optimising collaborations across the region and working on behalf of stakeholders to help them access appropriate funding. iNets themselves have access to a shared fund to support higher education collaborations connected with implementing research programmes. This fund will lever additional finance for technology projects on a competitive basis from research and development sources such as the Higher Education Funding Council for England (HEFCE), the Technology Strategy Board Calls, the Higher Education Innovation Fund (HEIF), and the European FP7 programme.

In addition, iNets will be aware of other potential sources of funding available to support the implementation of this document.

Support the concentration of R&D and the exploitation of technology around the priority technology areas

To encourage and support greater 'critical mass' and collaborations between the region's research centres and key industry exploiters

Creating clusters around areas of strength has been demonstrated as a key way to grow these areas. The iNets and other business networks will become the focus around which R&D activities are concentrated, and university research centres will be a prime focus of action.

The key requirement here will be the willingness, ability and ambition to create a recognisable and sustainable critical mass of technology excellence in the region through a concentration of expertise in research and exploitation of a priority technology area.

The iNet partners, the region's universities and other research centres will be encouraged to bring forward projects and funding that relate to the priority technologies being developed and exploited in their business sector areas.

10 Examples include ibuprofen, Magnetic Resonance Imaging technology and genetic fingerprinting.

Priority technology areas for the East Midlands

To deliver the RTF actions, we will focus attention on five priority technology areas:

- Materials
- Design, engineering and manufacturing
- Energy and waste
- Information and communication technologies (ICTs)
- Biotechnologies and therapeutics

These technology areas will be used to guide action and focus investments ensuring that the needs of key sectors as identified in the RES and the Innovation Strategy are taken into account.

Figure 1 on page 13 shows the main technology areas and their related sub-areas. The relevance of the technologies to key business sectors is also provided on page 27.

The remainder of this section contains:

- a description of the scope of each technology area
- its regional strengths in business and the research base
- our assessment of its current status: is it already core to the region's economy, or is it emerging with potential for exploitation in the future?
- the broad focus for action needed for each technology area

In this section, we use a number of examples of companies and research base activity. These are not intended to provide an exhaustive review but to give a flavour of activity and associated strengths. Company examples were identified from their participation in technology development programmes and activities, while university examples are based on departments with relevant research activity and strong RAE (Research Assessment Exercise) performance. It should also be recognised that the region has technology companies, such as Pera Innovation, that are active across many of the priority areas.

Addressing additional opportunities

Clearly, opportunities may also emerge outside the priority technology areas, and indeed, outside the broader scope of expertise contained in the iNets. In such cases, investment opportunities will require specific discretionary assessment by East Midlands Innovation and *emda* based on need. Difficult choices between technology areas of competing priority are necessary if we are to maximise the overall impact of the RTF and the technology investments that can be made.

Annually reviewing our progress and objectives

We recognise that the technology environment is constantly changing, so evolution during the lifetime of this RTF is inevitable. Therefore, we will continually review developments in emerging technologies. The mechanism for this is already set out in the Regional Innovation Strategy and will be significantly based upon the work of the iNets. The results will be fed into the annual strategic review process, to be undertaken via an independent audit as part of the monitoring of the Regional Innovation Strategy. The audit will be presented to both East Midlands Innovation and the *emda* Board.

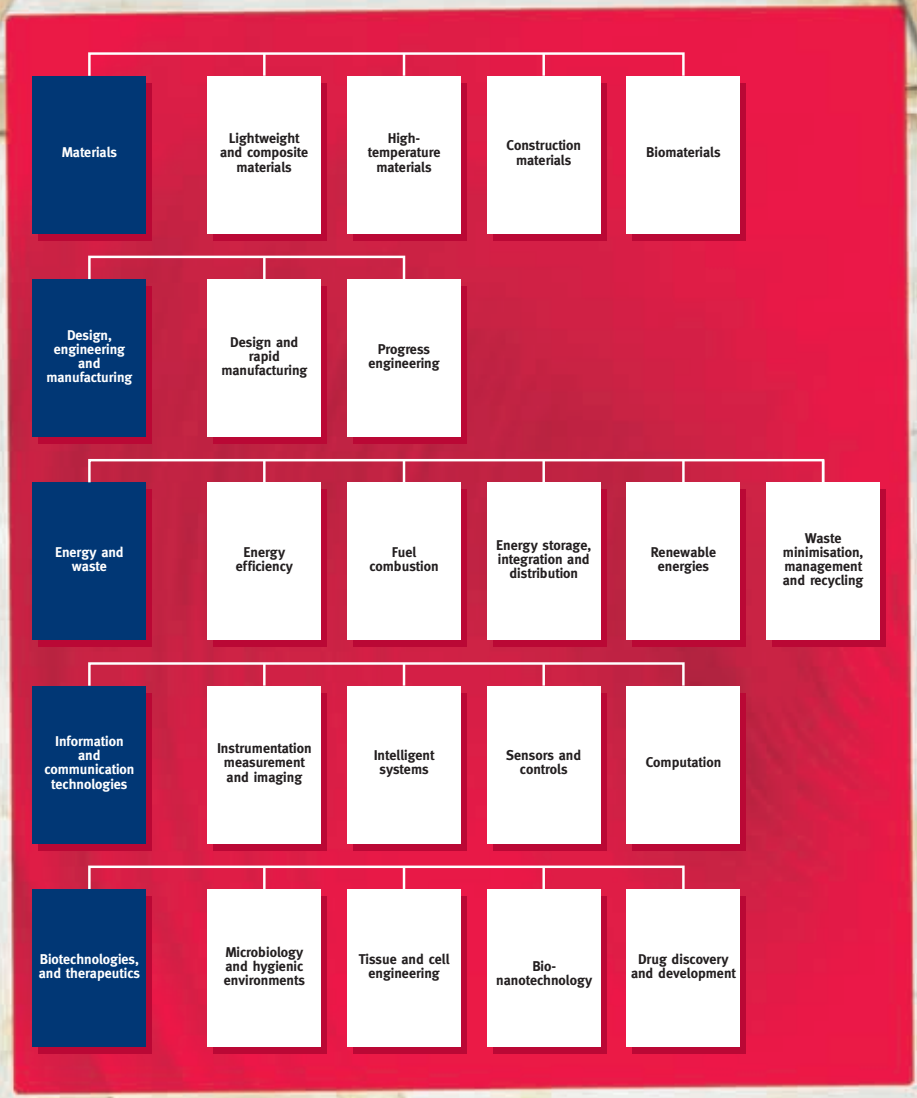


Figure 1. Priority technology areas for the East Midlands

Materials

Materials is an important technology area for the East Midlands, encompassing activities across the value chain that include research, design and development, raw materials, primary production, processing and fabrication, standards, testing and end-of-life management[11].

Materials technologies have applications in a range of business sectors, such as transport equipment and sustainable construction, and are expected to experience continued growth in future years.

These technologies have also been identified as areas of priority within FP7[12] (Materials and New Production Technologies) and the UK Technology Strategy Board[13] (Advanced Materials).

The RTF prioritises four materials technology areas:

Lightweight and composite materials

Encompassing new and existing forms of metals, plastics and composites and their fabrication, including those with advanced properties in areas such as reduced weight, improved strength, durability and vibration resistance.

Regional assets

A number of the region's universities have research strengths and engineering expertise in this technology area, several of which host interdisciplinary centres to support research and development; notably UNIMAT (the University of Nottingham Institute for Materials Technology) and Loughborough University IPTME (Institute of Polymer Technology and Materials Engineering).

Examples of businesses developing or using such technologies include Honda Racing F1 Team, Force India, Advanced Composites Group, Scott Bader, Formax, Fibre Technology and Fairline Boats. The market for such composites is growing rapidly and exploitation by the region's businesses could be greatly enhanced.

Priority action

To support the exploitation of lightweight and composites technologies, the RTF will facilitate greater links between the research base and commercial development. We will also help SMEs to understand how to integrate advanced materials into their products and processes.

Priority sector relevance

Transport equipment, healthcare and bioscience and sustainable construction

High-temperature materials

Incorporating materials capable of withstanding high temperatures and associated with technology developments in areas such as thermodynamic properties of materials, kinetic reactions and new processing methods.

Regional assets

There is a strong research base in this technology area within the leading engineering departments of the University of Nottingham, Loughborough University, University of Leicester and De Montfort University, including interdisciplinary centres such as UNIMAT (Nottingham) and the IPTME (Loughborough).

11 East Midlands Materials 'Advanced Materials Strategy', October 2006.

12 Visit http://www.fp7uk.co.uk/ for more information.

13 Visit http://www.innovateuk.org/ for more information.

There are also examples of companies exploiting these technologies in areas such as aerospace, with Rolls-Royce and Bodycote HIP. Whilst high-temperature materials are particularly important to our aerospace industry, there is also scope for greater industry-academic collaboration in the motorsport, rail and automotive sectors.

Priority action

To maximise the benefit from this priority technology, the RTF will actively encourage closer links and greater collaboration between the research base, leading companies and their supply chains in the region.

Priority sector relevance

Transport equipment

Construction materials

Comprising materials technologies used in construction projects which can address a range of challenges, such as the need for improved thermal properties, improved characterisation and fabrication readiness, durability, weather properties and water/gas transport/electrical conductance.

Regional assets

The region has internationally recognised construction materials expertise within its universities, for example in Loughborough University's Department of Civil and Building Engineering and the School of the Built Environment at the University of Nottingham.

We also have a significant number of companies that rely on advanced materials technologies, including large construction groups and manufacturers of materials, such as Lafarge, Hanson, Tarmac, British Gypsum, Dow Hyperlast, Wilson Bowden and Bowmer and Kirkland. Plus, there is a range of companies in the region's construction supply chain that undertake technology development activities.

Priority action

To improve the rates of commercial exploitation of existing technologies, the RTF will address the barriers to take-up by companies (e.g. lack of awareness and knowledge about applications already available for use) and encourage companies to develop longer-term links with the research base.

Priority sector relevance

Sustainable construction

Biomaterials

Focusing on natural or man-made materials employed in, or used as, a medical device which performs, augments or replaces a natural function within a living organism, for example building scaffolds for tissue engineering.

Regional assets

Our real strength is in the research base within institutions such as the University of Nottingham School of Pharmacy, the University of Leicester School of Biological Sciences and Leicester Medical School, and Nottingham Trent University Biomedical Research Centre.

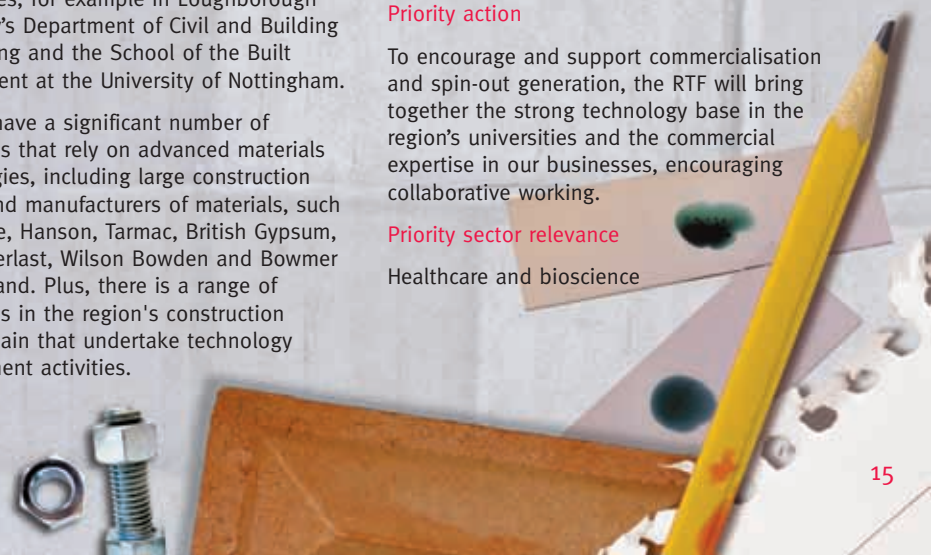
Biomaterials are being developed by a number of leading technology-intensive SMEs in the region, such as Attenborough Dental, Regentec and Orthogem.

Priority action

To encourage and support commercialisation and spin-out generation, the RTF will bring together the strong technology base in the region's universities and the commercial expertise in our businesses, encouraging collaborative working.

Priority sector relevance

Healthcare and bioscience



Design, engineering and manufacturing

The East Midlands' industrial and research strengths in design, engineering and manufacturing technologies are long established and widely recognised. Indeed, compared with the UK output figure of 15.9%[14], manufacturing in the East Midlands remains important, accounting for some 23.2% of regional output in 2004.

While this technology area is significant in the transport equipment sectors of aerospace and automotive, there is considerable potential for application elsewhere, including within healthcare and bioscience, and food and drink sectors.

These technologies have also been identified as areas of priority within the European FP7[15] Programme (New Production Technologies) and the Technology Strategy Board[16] (High Value Manufacturing).

The RTF prioritises two design, engineering and manufacturing technology areas:

Design and rapid manufacturing

Focusing on the computer-aided design, prototyping and rapid manufacturing of physical components. The production process may use a range of additive technologies, with most building up models through a layered process. Such technologies make it easier to test the validity of a design, as well as speeding up the overall design and production process.

Regional assets

There is considerable expertise in our universities: Loughborough University's Innovative Manufacturing and Construction Research Centre, and its Centre for Rapid Manufacturing within the Wolfson School of Mechanical and Manufacturing Engineering, De Montfort University Centre for Manufacturing, and the University of Nottingham Rolls-Royce University Technology Centre in Manufacturing, and the Nottingham Innovative Manufacturing Research Centre.

This technology has a strong exploitation base in some of the region's leading companies, including Rolls-Royce, Thales, Cosworth, Datalink Electronics, Gardner Aerospace - Ilkeston Ltd, SPS Aerostructures Ltd and Meridian Technologies.

Priority action

To harness the substantial development and application expertise of our universities and leading companies, the RTF will act to ensure more widespread adoption and use of these technologies by manufacturing and engineering companies; from those serving automotive and aerospace supply chains, to those active in pharmaceutical and healthcare markets.

Priority sector relevance

Transport equipment, healthcare and bioscience and sustainable construction

14 *emda* (2006) 'The East Midlands in 2006: Evidence base for the East Midlands Regional Economic Strategy 2006-2020'.

15 Visit http://www.fp7uk.co.uk/ for more information.

16 Visit http://www.innovateuk.org/ for more information.

Process engineering

Concerning the design, operation and maintenance of chemical, material and food manufacturing processes and including the development of new processes, project engineering and troubleshooting.

Regional assets

The region has significant academic expertise at De Montfort University's Centre for Manufacturing, the University of Nottingham Innovative Manufacturing Research Centre and its Rolls-Royce University Technology Centre in Manufacturing Technology and Loughborough University's Innovative Electronics Manufacturing Research Centre and Innovative Manufacturing and Construction Research Centre.

This technology is core to the region, with strong development expertise in many manufacturing companies, from automotive and aerospace to food and drink: Toyota Motor Manufacturing UK, Rolls-Royce, Caterpillar (UK) Ltd, Bombardier Transportation, Pandrol, PepsiCo and Laing O'Rourke, for example.

Priority action

To strengthen technology development, we will support more and more-concerted collaborations between the research base and supply chain companies in the region. The iNets will also encourage the transfer of existing process technologies into new industry areas (e.g. aerospace applications into motorsport, automotive applications into the food and drink sector).

Priority sector relevance

Sustainable construction, food and drink, healthcare and bioscience and transport equipment

Energy and waste

Energy and waste embraces a number of related energy, materials and process technologies that are of primary importance to all sectors in the region. They also contribute to important national agendas, such as improving competitiveness, accessing new markets and meeting environmental responsibilities.

These technologies have been identified as areas of priority within the European FP7 programme[17] (Materials and New Production Technologies, Agriculture, Energy and Transport) and Technology Strategy Board[18] (Energy Generation and Supply and Environmental Sustainability, and the Innovation Platform of Low Impact Building). In addition, the Energy Technologies Institute based at Loughborough[19] will be an important driver for technology development, with match funding to support technological development in the sectors of energy generation and supply, and transport.

The RTF prioritises five energy and waste technology areas:

Energy efficiency

Referring to technologies associated with products or systems designed to use less energy for the same or higher performance than regular products or systems. Such technologies can be used in a number of ways, including insulation, lighting, equipment and machinery, energy generation and distribution, as well as Combined Heat and Power (CHP) and engine design.

Regional assets

Within the region's academic research base, there is considerable expertise in these technologies at the University of Nottingham (Institute of Sustainable Energy Technologies, Institute of Building Technology, Rolls-Royce University Technology Centre for Gas Turbine Emissions), Loughborough University (research groups within the Department of Aeronautical and Automotive Engineering, and Cenex - the Centre for Excellence in Low Carbon Technologies), University of Lincoln (Centre for Sustainable Architecture and Environments) and De Montfort University (Institute of Energy and Sustainable Development).

Companies developing new products and services for energy efficiency include Xtratherm and Ibstock Brick in the construction sector and Zytek Engineering and Mahle Powertrain in the motorsport sector.

Priority action

To strengthen further our research base in this emerging area for the region, the RTF will concentrate efforts around initiatives such as the Energy Technologies Institute. To support exploitation by companies in particular, we will stimulate demonstrator activities, notably in the construction sector.

Priority sector relevance

Food and drink, transport equipment and sustainable construction

17 Visit http://www.fp7uk.co.uk/ for more information.

18 Visit http://www.innovateuk.org/ for more information.

19 Visit http://www.energytechnologies.co.uk/ for information.

Fuel combustion

Including all technologies associated with fuel combustion engines, focusing in particular on reducing carbon fuel consumption and the associated exhaust gas emissions and increasing utilisation of biofuels.

Regional assets

The region's university base boasts a number of strengths, including Loughborough University (various research groups within the Department of Aeronautical and Automotive Engineering, Rolls-Royce University Technology Centre in Combustion Aerodynamics) and the University of Nottingham (Energy Technologies Research Institute and the Thermofluids research group within the Department of Mechanical and Manufacturing Engineering).

This technology area is core to the region, and we have significant strengths in both exploitation and research. Examples of companies active in this technology area include Rolls-Royce, Bombardier, Perkins, Mercedes-Benz High Performance Engines, Cosworth, Ilmoor Engineering and Zytek Engineering.

Priority action

To attract increased public and private sector funding in the coming years (e.g. via the Low Carbon Vehicle Innovation Platform and the Energy Technologies Institute), the RTF will work to strengthen existing research in emerging technologies. We will also actively seek to encourage greater exploitation by encouraging academic and commercial collaboration.

Priority sector relevance

Transport equipment

Energy storage, integration and distribution

Referring to technologies and systems that enable energy to be stored and drawn upon at a later time, including hydrogen storage, batteries and supercapacitors.

Regional assets

Our universities are also developing expertise in this area through research, for example the Energy Technologies Research Institute and Nottingham Fuel and Energy Centre, both at the University of Nottingham, and Loughborough University's Centre for Renewable Energy Systems Technology.

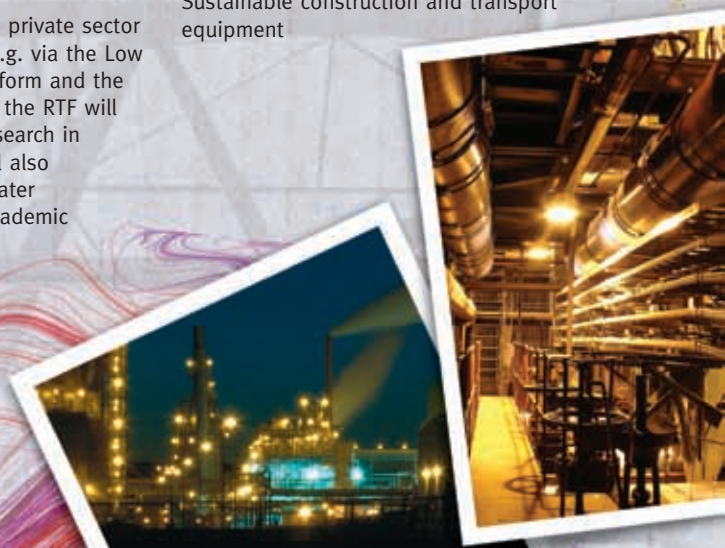
This is an emerging technology area within the region, with a number of innovative companies working on exploitation, such as Zytek Engineering, E-On UK and Intelligent Energy.

Priority action

To capitalise on this emerging technology area, the RTF will strengthen and concentrate existing technology developments in the region and, where possible, more effectively demonstrate the existing technologies to East Midlands companies.

Priority sector relevance

Sustainable construction and transport equipment



Renewable energies

Encompassing technologies that generate energy from renewable sources, such as biomass, solar and wind, and integrate renewable energy systems into buildings.

Regional assets

This technology area is still emerging within the region, with examples of research expertise evident in the activities of the University of Nottingham (interdisciplinary Energy Technologies Research Institute, Institute of Sustainable Energy Technologies), Loughborough University (Centre for Renewable Energy Systems Technology) and De Montfort University (Institute of Energy and Sustainable Development).

An example of a company active in this area is Rolls-Royce Fuel Cells.

Recent research to identify the region's strengths in low carbon technologies[20] has found that East Midlands' companies are active in the principal alternative energy technologies, particularly in the area of micro-generation (solar sources and heat pumps).

Priority action

To promote greater technology transfer and dissemination, the RTF will target the manufacturing, transport and construction supply chains with the aim of building on our technology strengths in large companies. At the same time we will work to strengthen the research base.

Priority sector relevance

Transport equipment, food and drink, healthcare and bioscience and sustainable construction

Waste minimisation, management and recycling

Referring to technologies that minimise and reduce waste output and increase recycling, for example via bioremediation.

Regional assets

Our universities have recognised research expertise in relevant science areas, including environmental sciences and chemistry, notably at the University of Nottingham School of Chemical Engineering and Environmental Management, Loughborough University Centre for Environmental Studies, and the University of Northampton SITA Centre for Sustainable Wastes Management.

Waste minimisation, management and recycling are areas in which companies such as Northern Foods (which has located its Technical Services Centre within BioCity), Toyota and Recresso have introduced innovative approaches. There is also demand for technology solutions from food and drink manufacturers in the region in response to changes in the regulatory environment for waste and emissions.

Priority action

To continue building the technology strengths in the region and to encourage greater take-up of existing applications, the RTF will raise awareness of, and demonstrate, new developments, as well as providing support for the exploitation of new technologies.

Priority sector relevance

Transport equipment, food and drink and sustainable construction

20 Undertaken for *emda* in 2007 by Enviros Consulting

Information and Communication Technologies (ICTs)

ICTs are enabling technologies with the potential to increase efficiency and effectiveness in all sectors and activities. ICTs also have the ability to transform the way we do things, opening up entirely new possibilities in research, markets, products and services.

These technologies have been identified as areas of priority within the European FP7 programme[21] (Transport, and Information and Communications Technologies), the Technology Strategy Board[22] (Software Applications, Systems & Services and the Innovation Platforms on Intelligent Transport Systems and Services and Network Security), and technology developments taking place within the National Aerospace Technology Strategy[23].

The RTF prioritises four ICT technology areas:

Instrumentation, measurement and imaging

Referring to instruments and/or methods used to measure, capture, store, process, analyse, transmit or produce data, including images. It includes technologies associated with global positioning and earth observation that will be key to future development in areas such as satellite navigation and medical imaging.

Regional assets

Within global positioning, earth observation and imaging, the University of Nottingham and University of Leicester have both generated new developments as a result of collaborations between physics, mathematics, computer science and the natural sciences. At Leicester, an example of this is the Space Research Centre, which hosts the University's Bioimaging Unit. At Nottingham, the Institute of Biophysics Imaging and Optical Sciences and the Institute of Engineering Surveying and Space Geodesy are examples of centres that support multi-disciplinary research. The latter also hosts GRACE (GNSS Research and Application Centre of Excellence) which provides industry training and support in response to the growth in applications for satellite navigation and positioning systems.

This university expertise exists alongside a number of innovative companies that serve transport equipment and healthcare markets in particular. For example, Delta Rail, Cosworth, Race Technology, Infoterra, Nottingham Scientific Limited (all in the transport equipment sector) and GE Medical (healthcare).

Priority action

The RTF will focus on further strengthening the research base, encouraging commercial exploitation of new developments as these gain momentum and ensuring that a wider community of companies is aware of new market opportunities likely to develop as a result of the availability of ubiquitous and increasingly accurate global positioning systems.

Priority sector relevance

Food and drink, healthcare and bioscience, transport equipment and sustainable construction

21 Visit http://www.fp7uk.co.uk/ for more information.

22 Visit http://www.innovateuk.org/ for more information.

23 Visit http://www.sbac.co.uk/pages/96230125.asp for more information.

Intelligent systems

Encompassing technologies that support multimedia data handling (the processing of multiple streams of information), gathering and processing of distributed information (i.e. from different geographical locations), information storage and retrieval and data security. This includes the integration of information and communications technologies into transport infrastructure and vehicles, as well as healthcare applications, such as medical robotics.

Regional assets

This an emerging technology area in the region, based on the expertise of our universities in electrical and mechanical engineering and computer sciences. Examples include Loughborough University Department of Computer Science, the University of Nottingham School of Computer Science and De Montfort University Department of Computer Science and Engineering. Nottingham Trent University's School of Computing and Informatics has also been building up its expertise in the areas of networks and computational intelligence.

The region's companies are also active in this area, including Bombardier Transportation, Balfour Beatty and Delta Rail.

Priority action

To ensure that we can react quickly and capitalise on the significant commercial opportunities in this area, we will strengthen technology development and exploitation by facilitating interactions and public/private sector collaborations across sectors and disciplines.

Priority sector relevance

Food and drink, healthcare and bioscience, transport equipment and sustainable construction

Sensors and controls

Referring to the interconnections of components that form system configurations intended to provide a desired system response as time progresses. Such systems typically comprise a computer, process control equipment and process interface systems.

Regional assets

Use of sensors and control technologies are core to the region's manufacturing companies, which rely on them to accurately monitor production and distribution processes. Although industry use of these technologies is well established, advances in engineering, electronics and materials continue to lead to fresh developments.

The expertise of the region's universities in electronic and mechanical engineering and computer sciences means they are well placed to support technology development. Several universities have interdisciplinary centres relevant to sensors and control technologies, including Nottingham Trent University's General Engineering and Applications Science Group, De Montfort University's Centre for Manufacturing, the Loughborough University Research School of Systems Engineering and the University of Nottingham Innovative Manufacturing Research Centre.

Examples of companies in the East Midlands that produce sensors and control technology are Laserail, Delta Rail and GE Sensing.

Priority action

This technology area is already strongly exploited by companies in the region, but there is scope for us to further strengthen industry links with the region's research base.

Priority sector relevance

Food and drink, healthcare and bioscience, transport equipment and sustainable construction

Computation

Associated with the use of combined techniques, including applied mathematics, informatics, statistics, computer science, artificial intelligence, chemistry and biochemistry. Computational technologies support activities such as finite element analysis, computational fluid dynamics, aerodynamics, engineering simulation and visualisation, Computer Aided Design (CAD) and software programming for engineering applications. They are important in civil, mechanical, aerospace and electronic engineering and also have applications in biosciences (e.g. bioinformatics).

Regional assets

Computational technologies are relevant to key industries in the region, including transport equipment (automotive and aerospace) and healthcare. Given the presence of industrial users of the technologies and the research strengths of our universities, we are well placed to be part of new developments in this area.

Universities undertaking research of relevance include University of Nottingham (Spencer Institute of Theoretical and Computational Mechanics, Centre for Structural Engineering and Construction), Loughborough University (various research groups within the School of Aeronautical and Automotive Engineering), University of Leicester (Thermofluids and Environmental Engineering Research Group in the Department of Engineering, plus research groups within the Department of Computer Science) and De Montfort University (Mechanical Engineering Research Centre in the Faculty of Computing Science and Engineering).

Examples of companies with expertise in the development and application of computational technologies include Rolls-Royce and Honda Racing F1.

Priority action

To ensure that our companies can take advantage of future potential for exploitation at the global level, we will continue to strengthen the region's research base.

Priority sector relevance

Food and drink, healthcare and bioscience, transport equipment and sustainable construction

Biotechnologies and therapeutics

By prioritising biotechnologies and the range of technologies associated with therapeutics, we reflect and build on the region's strengths in developing applications concerned with the structure and behaviour of living organisms and the prevention and treatment of illness.

Overall, the region has a strong heritage of technology development in this area, including Magnetic Resonance Imaging (MRI) at the University of Nottingham and genetic fingerprinting at the University of Leicester. The East Midlands is also home to more than 450 companies operating in the pharmaceutical, biotechnology and medical instrument manufacturing markets and some 700 in related food and drink sectors.

These technologies have also been identified as areas of priority within the European FP7[24] Healthcare theme (Biotechnology, generic tools and technologies for human health, Translating research for human health and Optimising the delivery of healthcare to the European citizen). Similarly, the NHS Strategy 'Best Research for Best Health'[25] is a key national policy, identifying the Government's intention to raise R&D investment in the UK.

The RTF prioritises four technology areas within biotechnologies and therapeutics:

Microbiology and hygienic environments

Referring to food and medical-related applications of industrial microbiology, with a focus on hygienic environments. These technologies are associated with testing, measurement, cleaning, products and safety procedures in such environments, for example textiles with antimicrobial properties.

Regional assets

There is a strong research base in this area within the region's universities. The University of Nottingham (Schools of Molecular Medical Sciences, Medical and Surgical Sciences, Pharmacy and Biosciences), Leicester University (School of Biological Sciences and Leicester Medical School) and Nottingham Trent University (School of Biological and Natural Sciences); all have microbiology expertise relevant to medicine and pharmaceuticals. In food science and technology, there are research groups at the University of Nottingham (School of Biosciences' Division of Food Sciences) and Nottingham Trent University (Schools of Animal, Rural and Environmental Sciences, and Biomedical and Natural Sciences). In addition, the University of Lincoln's Holbeach Campus is recognised as a specialist food technology and food manufacturing centre in the region.

Companies active in this area include FDAS (Food and Drug Analytical Services) and Safepharm.

Priority action

We will ensure that support for technology exploitation is made available, particularly to SMEs in the region.

Priority sector relevance

Food and drink, healthcare and bioscience

24 Visit http://www.fp7uk.co.uk/ for more information.

25 Department of Health (2006) 'Best Research for Best Health'.

Tissue and cell engineering

Encompassing technologies that use a combination of cells (including stem cells), engineering and materials methods, and suitable biochemical and physio-chemical factors to improve or replace biological functions, for example cell culture technology, matrix technology and scaffold technology. Technologies emerging from this area of bioscience are likely to have diagnostic and therapeutic applications in the longer term (circa 10 years +).

Regional assets

The region has research strengths within this area and, therefore, the potential to develop new technologies. Key assets include the School of Pharmacy at the University of Nottingham and the University's interdisciplinary Centre for Biomedical Sciences. Research is underway into new methods of engineering liver, nerve, cartilage, muscle and bone tissue for drug screening and medical applications.

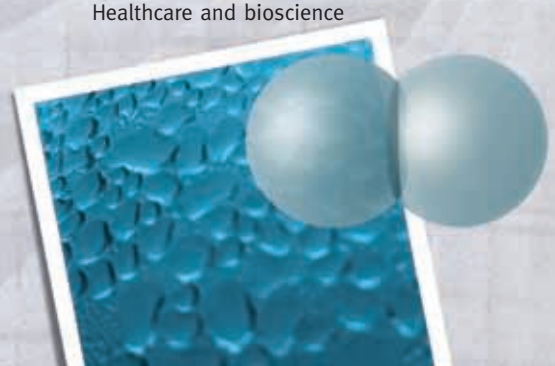
Examples of companies active in this area are start-ups such as Regentec and Evocell. Commercialisation of new technologies by companies has been limited to date, but there is potential for greater business activity over time.

Priority action

The RTF will strengthen interdisciplinary research where breakthroughs are likely and support the exploitation and commercialisation of the technology, taking note of the potential medium to long-term time horizons associated with this area.

Priority sector relevance

Healthcare and bioscience



Bio-nanotechnology

Reflecting the expectation that new areas of research, technology and application will arise from this crossover in the bio- and nanosciences. For example, new applications in biosensing, biocontrol, bioinformatics, genomics, medicine, computing, information storage and energy conversion.

Regional assets

Research strengths include Nottingham Trent University's Interdisciplinary (Biomedical Research Centre) which conducts research in cell biology and pathology, immunology, cancer, neuroscience, food microbiology, pharmacology and toxicology. The University of Leicester is an internationally recognised centre of research in computer science, medical and biological sciences. The University of Nottingham also has a global reputation in these areas and has recently established an Interdisciplinary Centre for Biomolecular Sciences that brings together researchers from the University's faculties of Engineering, Science and Medical and Health Sciences.

In addition, seven of the region's universities are collaborating in EMINATE, a research and innovation centre based at BioCity in Nottingham that supports take-up by industry of micro- and nanotechnologies, particularly for incorporation into new products and processes. Application areas supported by EMINATE include pharmaceuticals, medical devices, coatings and food.

Examples of companies active in this area include 3M and Astra Zeneca.

Priority action

To ensure that the region contributes to the development of world class technologies, we will strengthen research activity and thereby grow our academic and company expertise in this emerging and multidisciplinary field.

Priority sector relevance

Healthcare and bioscience and food and drink

Drug discovery and drug development

Referring to technologies associated with the discovery and testing of drugs for safe use in humans and preparing them for commercial-scale manufacture. This includes technologies that support the provision of specialist services associated with this process.

Regional assets

Drug discovery and drug development technologies have a strong base in the region's universities, with several institutions producing internationally-recognised research in relevant disciplines. The University of Nottingham has several interdisciplinary centres, including the Centre for Biomedical Sciences (led by the School of Pharmacy) and the Institute of Pharmaceutical Sciences and Experimental Therapeutics (led by the School of Medical and Surgical Sciences).
The University of Leicester is home to the Medical Research Council Toxicology Unit, the largest academic establishment for toxicology in the UK, while the School of Biological Sciences undertakes important research in biochemistry and pharmacology. Leicester Medical School has departments specialising in cancer studies, cardiovascular sciences and infection, immunity and inflammation, Nottingham Trent University has expertise in pharmacology and toxicology and De Montfort University's School of Pharmacy has expertise in drug action and novel drug delivery mechanisms.

Several multi-national companies undertake technology development in the region, including Astra Zeneca and 3M Healthcare, and there are significant numbers of small companies such as Peakdale Molecular, Pepceuticals and Sygnature that pursue exploitation or provide services to support drug discovery and drug development processes.

Priority action

To encourage commercial exploitation of innovative technologies, the RTF will support spin-out activity from the region's universities by facilitating access to specialised advice and funding and bringing industry and the research base together. To strengthen our reputation for excellence in clinical research, we will build strong relationships with the relevant UK Research Councils.

Priority sector relevance

Healthcare and bioscience

Priority technology areas and our key business sectors

Our technology priorities have been designed to complement the needs and opportunities of the RES priority sectors. Table 1 indicates how our technology priorities relate to these sectors:

Table 1. Priority areas for future investment

Technology priorities	Sustainable construction	Food & drink	Healthcare & biosience	Transport equipment	Commercial status	Research status	Focus for action
Lightweight and composite materials	•		•	•	Core	Core	Exploit & strengthen
High-temperature materials				•	Core	Core	Exploit
Construction materials	•				Core	Core	Exploit
Biomaterials			•		Emerging	Core	Exploit
Design and rapid manufacturing	•		•	•	Core	Core	Exploit
Process engineering	•	•	•	•	Core	Core	Strengthen
Energy efficiency	•	•		•	Core	Core	Exploit
Fuel combustion				•	Emerging/Core	Core	Exploit & strengthen
Energy storage, integration and distribution	•			•	Emerging	Emerging	Strengthen
Renewable energies	•	•	•	•	Emerging	Core	Strengthen
Waste minimisation, management and recycling	•	•		•	Emerging	Core	Exploit
Instrumentation, measurement and imaging	•	•	•	•	Core	Core	Exploit & strengthen
Intelligent systems	•	•	•	•	Emerging	Emerging	Exploit & strengthen
Sensors and controls	•	•	•	•	Core	Core	Strengthen
Computation	•	•	•	•	Emerging/Core	Core	Strengthen
Microbiology and hygienic environments		•	•		Core	Core	Exploit
Tissue and cell engineering			•		Core	Core	Exploit & strengthen
Bio-nanotechnology		•	•		Emerging	Core	Strengthen
Drug discovery and drug development			•		Core	Core	Exploit & strengthen

KEY

Status:	**Commercial status**	
	Core	Of key importance to the industry
	Emerging	Beginning to be a key issue for industry
	Research status	
	Core	Evident in the East Midlands research base
	Emerging	The focus of some activity in the East Midlands research base, but yet to be exploited commercially
Action:	**Exploit**	Support for the commercialisation of existing East Midlands technologies
	Strengthen	Support for existing technology development activities within companies or the research base

Summary

The Regional Technology Framework highlights the region's priority technology areas, identified after much in-depth research and consultation. We must now concentrate our efforts in these areas in order to fully develop and exploit technology for the long-term prosperity of the region.

In addition to prioritising our technologies, it is also important for us to understand the practical actions we can take to implement the RTF and to support the priority technology areas. The RTF addresses this by setting out our four strategic objectives:

Improve the profile and influence of the East Midlands as a technological region

Helping to attract public and private sector investment to support our science, technology and innovation activities

Maximise investment for technology in the East Midlands

Strengthening our existing technology base and developing new opportunities by supporting business R&D activity and university research

Develop the supportive environment for technology development and exploitation in the East Midlands

Influencing funding, support and training providers in the region to ensure their activities are focused on research and businesses within the priority technology areas

Enhance and exploit the region's technological strengths and opportunities

Encouraging full exploitation of our technology base for the long-term prosperity of the region's businesses and the region as a whole

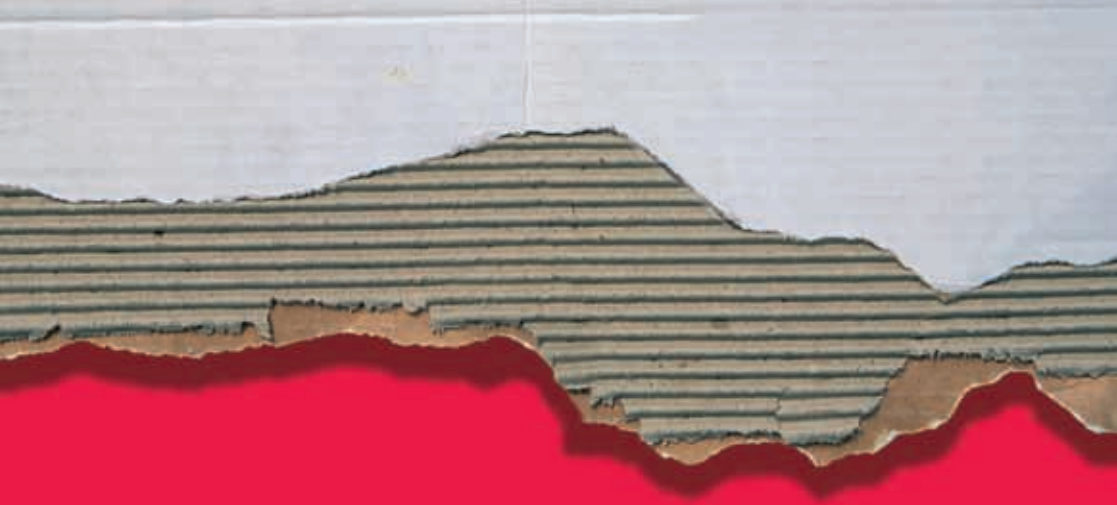
Now we have our priority technology areas and our key objectives, we need to focus on implementing the RTF. This will be led by East Midlands Innovation who will advise and guide *emda* and the iNets in implementing the actions and will include regular monitoring of changes in technology to ensure the RTF takes advantage of new opportunities presented by emerging technologies. In 2011, subsequent to the 2010 refresh of the Innovation Strategy, we will review and republish the whole Framework document.

Implementation of the RTF will also require the full, active support of all East Midlands' technology stakeholders. It now falls to organisations such as *emda*, the Sub-regional Strategic Partnerships (SSPs), local authorities, large companies and SMEs, universities, further education colleges, the NHS and Nottingham Science City, to make this RTF a successful reality.

East Midlands Innovation, March 2008.

Glossary of terms

Cenex	Centre for Excellence in Low Carbon Technologies
CHP	Combined Heat & Power
DIUS	Department of Innovation Universities and Skills
emda	East Midlands Development Agency
esp	Employment, Skills and Productivity Partnership
EU	European Union
FDAS	Food & Drug Analytical Services
FE	Further Education
FP7	European Union Seventh Framework Programme for Research and Technological Development
GDP	Gross Domestic Product
GNSS	Global Navigation Satellite System
GRACE	GNSS Research and Application Centre of Excellence
GVA	Gross Value Added
HE	Higher Education
HEI	Higher Education Institutions
HEFCE	Higher Education Funding Council for England
HEIF	Higher Education Innovation Fund
ICT	Information and Communication Technologies
iNET	innovation Network
IPTME	Institute of Polymer Technology and Materials Engineering (Loughborough University)
IRC	Innovation Relay Centre
MRI	Magnetic Resonance Imaging
NHS	National Health Service
RAE	Research Assessment Exercise
R&D	Research and Development
RES	Regional Economic Strategy
RIS	Regional Innovation Strategy
RTF	Regional Technology Framework
SME	Small and medium sized enterprises
SSP	Sub-regional Strategic Partnership
UKTI	UK Trade and Investment
UNIMAT	University of Nottingham Institute for Materials Technology



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