Regional Technology Framework Evidence Pack

A report prepared for *emda*

CM International

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This document forms part of the *emda* Knowledge Bank

east midlands
development agency

East Midlands Development Agency

Regional Technology Framework
Evidence Pack

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TABLE OF CONTENTS

TABLE OF FIGURES

1.2 Workshop Findings

3.4 Evidence of HEI-industry research collaboration

Annex VI. Industry Validation (undertaken in Phase 2)

Materials technologies

Design, engineering and manufacturing technologies

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Energy and waste

Information and Communication Technologies (ICTs)

Biotechnologies and pharmacology[1]

LIST OF TABLES

3.1   Results of the 2001 Research Assessment Exercise (RAE 2001)

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[1] The title of this priority technology area was later changed to Biotechnologies and Therapeutics.

0. Introduction to the evidence pack

The evidence pack is a body of evidence collected to support the strategic prioritisation contained in the Regional Technology Framework (RTF). It has been produced from a detailed process of desk research and consultation. This includes the following:

- Futures workshops with participants from transport equipment, construction, healthcare, food and drink, and enabling technologies sectors – focusing on future technology developments

- Desk based mapping of technology/R&D datasets, RAE results, regional assets (companies and university departments) and sector studies

- Desk based review of relevant European, national and regional policy documents

- Interviews with the iNet lead organisations and *emda* sector managers to discuss policy drivers, key issues, and regional assets.

- Policy briefings (3) in which the emerging priorities were discussed

- An RTF validation survey undertaken with companies

A summary of findings is provided overleaf for each priority technology area. The main evidence pack begins with section 1, page 7.

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0.1 Overview of Findings

Materials

	Policy supports technology development	Presence of regional assets		Stakeholder feedback on status of the technology					
		Business	HEI and other research centres	Workshops		Interviews		Industry survey	
Lightweight and composite materials									
European	X	X	X	Core strength of region	X	Core strength of region	X	Core strength of region	
National	X			Emerging strength of region		Emerging strength of region		Emerging strength of region	
Regional	X			Other		Other		Other	Critical for industry competitiveness
High temperature materials									
European	X	X	X	Core strength of region	X	Core strength of region	X	Core strength of region	X
National	X			Emerging strength of region		Emerging strength of region		Emerging strength of region	
Regional				Other		Other		Other	
Construction materials									
European	X	X	X	Core strength of region	X	Core strength of region	X	Core strength of region	X
National	X			Emerging strength of region		Emerging strength of region		Emerging strength of region	
Regional	X			Other		Other		Other	
Biomaterials									
European	X	X	X	Core strength of region	X	Core strength of region		Core strength of region	X
National	X			Emerging strength of region		Emerging strength of region	X	Emerging strength of region	
Regional	X			Other		Other		Other	

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Design, Engineering and Manufacturing

			Presence of regional assets		Stakeholder feedback on status of the technology					
	Policy supports technology development		Business	HEI and other research centres	Workshops		Interviews		Industry survey	
Design and rapid manufacturing										
	European	X	X	X	Core strength of region	X	Core strength of region	X	Core strength of region	X
	National	X			Emerging strength of region		Emerging strength of region		Emerging strength of region	
	Regional	X			Other		Other		Other	
Process engineering										
	European	X	X	X	Core strength of region	X	Core strength of region	X	Core strength of region	X
	National	X			Emerging strength of region		Emerging strength of region		Emerging strength of region	
	Regional				Other		Other		Other	

Energy and Waste

Technology	Level	Policy supports technology	Presence of regional assets		Stakeholder feedback on status of the technology					
			Business	HEI and other research centres	Workshops		Interviews		Industry survey	
Energy efficiency	European	X	X	X	Core strength of region	X	Core strength of region		Core strength of region	
	National	X			Emerging strength of region		Emerging strength of region	X	Emerging strength of region	
	Regional	X			Other		Other		Other	Increasing demand for solutions, driven by regulation and rising costs of energy and waste disposal
Fuel combustion	European	X	X	X	Core strength of region	X	Core strength of region	X	Core strength of region	
	National	X			Emerging strength of region		Emerging strength of region		Emerging strength of region	X
	Regional				Other		Other		Other	
Energy storage, integration and distribution	European	X	X	X	Core strength of region	X	Core strength of region		Core strength of region	
	National	X			Emerging strength of region		Emerging strength of region	X	Emerging strength of region	X
	Regional				Other		Other		Other	
Waste minimisation, management and recycling	European	X	X	X	Core strength of region	X	Core strength of region	X	Core strength of region	
	National	X			Emerging strength of region		Emerging strength of region		Emerging strength of region	
	Regional	X			Other		Other		Other	Increasing demand for solutions, driven by regulation and rising costs of energy and waste disposal
Renewable energies	European	X	X	X	Core strength of region	X	Core strength of region		Core strength of region	
	National	X			Emerging strength of region		Emerging strength of region		Emerging strength of region	
	Regional	X			Other		Other	Pockets of technology expertise	Other	Increasing demand for solutions, driven by regulation and rising costs of energy

Information and Communication Technologies (ICTs)

	Policy supports technology		Presence of regional assets		Stakeholder feedback on status of the technology					
			Business	HEI and other research centres	Workshops		Interviews		Industry survey	
Instrumentation, measurement and imaging										
European		X	X	X	Core strength of region		Core strength of region	X	Core strength of region	X
National		X			Emerging strength of region		Emerging strength of region		Emerging strength of region	
Regional					Other	Pockets of expertise	Other		Other	
Intelligent systems										
European		X	X	X	Core strength of region		Core strength of region		Core strength of region	
National		X			Emerging strength of region	X	Emerging strength of region	X	Emerging strength of region	X
Regional					Other		Other		Other	
Sensors and controls										
European		X	X	X	Core strength of region		Core strength of region	X	Core strength of region	X
National		X			Emerging strength of region		Emerging strength of region		Emerging strength of region	
Regional					Other	Pockets of expertise	Other		Other	
Computational technologies										
European		X	X	X	Core strength of region	X	Core strength of region		Core strength of region	X
National		X			Emerging strength of region		Emerging strength of region	X	Emerging strength of region	
Regional					Other		Other		Other	

Biotechnologies and therapeutics

			Presence of regional assets		Stakeholder feedback on status of the technology					
	Policy supports technology		Business	HEI and other research centres	Workshops		Interviews		Industry survey	
Microbiology and hygienic environments										
	European	X			Core strength of region	X	Core strength of region	X	Core strength of region	X
	National	X	X	X	Emerging strength of region		Emerging strength of region		Emerging strength of region	
	Regional	X			Other		Other		Other	
Tissue/cell engineering										
	European	X			Core strength of region	X	Core strength of region	X	Core strength of region	X
	National	X	X	X	Emerging strength of region		Emerging strength of region		Emerging strength of region	
	Regional	X			Other		Other		Other	
Bionanotechnology										
	European	X			Core strength of region		Core strength of region		Core strength of region	X
	National	X	X	X	Emerging strength of region	X	Emerging strength of region	X	Emerging strength of region	X
	Regional	X			Other		Other		Other	
Drug discovery and drug development										
	European	X			Core strength of region	X	Core strength of region	X	Core strength of region	X
	National	X	X	X	Emerging strength of region		Emerging strength of region		Emerging strength of region	
	Regional	X			Other		Other		Other	

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1.   Workshops

1.1 Introduction

A series of five workshops were held with stakeholders from industry and academia during June and July and 2007: one to cover each of the four iNet areas of Food and Drink; Sustainable Construction; Healthcare, and Transport Technologies, plus a fifth to pick up on the theme of 'emerging and enabling technologies', which figures in actions 10 and 12 of the Innovation Strategy and Action Plan for the East Midlands 2007-2010 (Innovation Strategy)[2].

Each workshop took the form of a facilitated discussion, in which participants were asked to:

1. a) Identify the critical technologies for each sector in a global context;
   b) Identify which technologies are likely to be critical in 5-10 years' time (i.e. where are the major breakthroughs expected);
2. Consider the position of these technologies in the East Midlands now, taking two points of departure:
   - Strength of the research base, and
   - Degree of exploitation by companies in the region
3. Consider what the region could do to improve the standing of these technologies in the region – in both research and business exploitation terms

The purpose of the workshops was to complement the desk research and interviews being undertaken by CM International to map out where the East Midlands has technology strengths. This research set out to identify strengths in terms of research by academia, and exploitation by industry. The feedback provided from the workshops highlighted where players in the region believe that technology strengths exist. The areas identified by the workshops became the subject of more detailed research by the consultants in order to determine whether they could be classed as strengths for the purposes of the Regional Technology Framework.

A list of participants for each workshop, and minutes of the discussions can be found at Annexes III and IV (pages 70-74 and 75-95)

1.2 Workshop findings

A summary of results emerging from the workshops is set out below. It is important to stress that the workshops produced findings of a general nature, firstly because of the nature of the discussion, which was intended to identify broad technology areas and not to drill down to the strengths and weaknesses associated with a particular technology; secondly, because of the modest size of the audiences involved (average attendance at each workshop was 16 people).

1.2.1 Transport Technologies

The discussions at the workshop tended towards the following conclusions about the strengths and weaknesses identified in figure 1:

The automotive and transport-related technologies in quadrant 1(high research; weak business exploitation) are a key strength and could be supported by demonstrator and exemplar activity, particularly where the potential for encouraging businesses to exploit to

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[2] East Midlands Innovation (2006) 'Innovation Strategy and Action Plan for the East Midlands, 2007-2010'.

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the technology is weak in the short term, but where the expectation is that new markets will develop that rely on these technologies.

The 'manufacturing' technologies (i.e. the cluster of technologies at the lower end of quadrant 2 – high research, high business exploitation) was deemed very important for the region. Group agreed that composites also important for the region. Group felt that these technologies would benefit from activities intended to maintain and build on region's strong manufacturing and development capacity.

For technologies in quadrant 3 (e.g. hybrid devices, electronic systems, condition monitoring, etc.), group felt they also had potential to be supported by exemplar or demonstrator activity, also with the aim of ensuring a wider base of companies understand the technologies and opportunities that the emerging markets present.

Figure 1. Transport-related technologies identified as strengths in the region
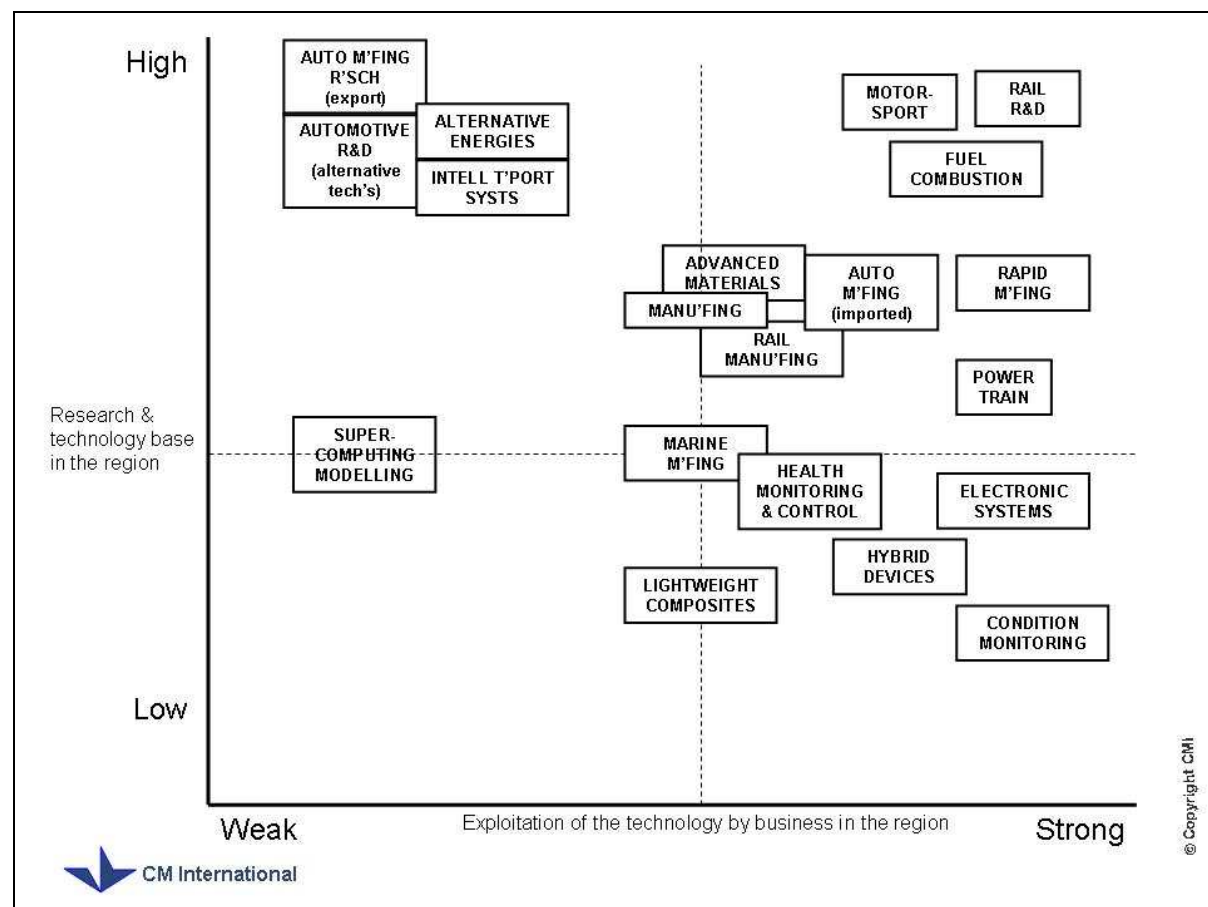
1.2.2 Emerging and enabling technologies

The discussions at this workshop identified several technology areas as containing activity that may be described as either 'emerging' (R&D with potential to find commercial applications in the future) or 'enabling' (technologies with commercial applications now). There was however limited consensus about whether these were strengths in the region or not (see figure 2 below, where several technologies appear at different points)

Figure 2. Technology areas identified as comprising elements that are either "emerging" or enabling
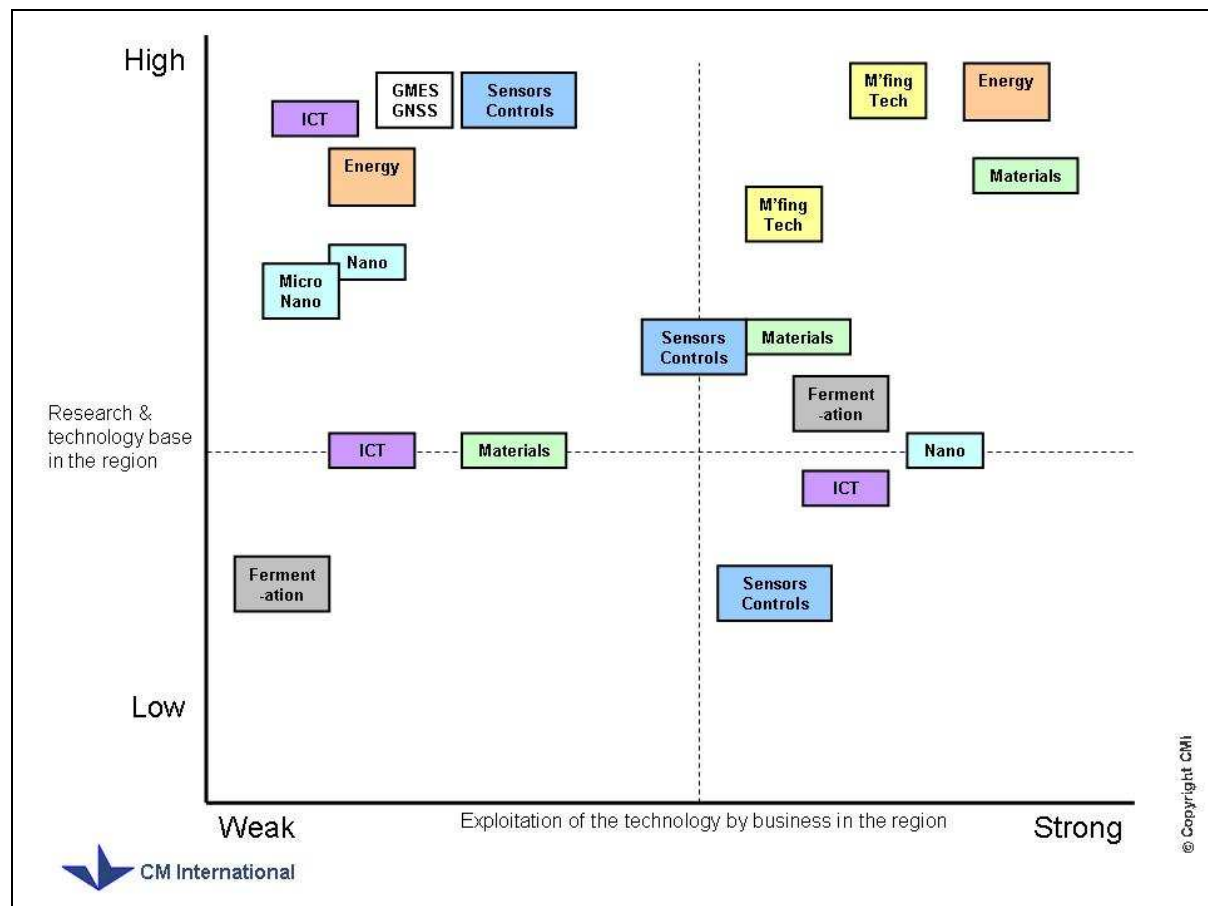
The group made the following conclusions:

Manufacturing Technology – region has research strengths across this broad technology area, and exploitation is also strong (i.e. presence of world-class companies).

Global Navigation Satellite Systems (GNSS) and Global Monitoring for Environment and Security (GMES) were recognised by all as a research strengths, which are now giving rise to commercial applications in the global market place, if not the East Midlands.

Energy deemed a strength in terms of research and exploitation, with the proviso that the prorportion of SMEs exploiting energy technology is low.

Participants agreed that the **ICT** research base was not as strong as Energy and GNSS/GMES, but again there was a difference in perceptions about exploitation. There was no consensus regarding the proportion of companies in the East Midlands that exploit ICTs, but one group noted that there are a small number of companies that are very successful at developing ICT methodologies.

The three groups each placed **Sensors and Controls** on a different part of the matrix; the general consensus was that the region is better at exploiting these technologies than at developing them, with the proviso that there is a strong pocket of sensors and control research and adoption in the Derby area.

There was also a discrepancy across the groups about the position of **Materials Technology** on the matrix. This was in part due to the fact that groups had different views on 'exploitation', with one group considering the level as a proportion the overall company population, and the others thinking about the question of terms of levels of world-class activity.

Participants agreed that the region should be focusing on pulling technologies from the upper left- towards the upper right-hand-side of the matrix by encouraging technology adoption.

1.2.3 Sustainable construction

Participants at the workshop agreed that the priority for the region is to support activities that encourage greater commercial exploitation of region's technology strengths (see figure 3).

However, the group also noted that:

The construction sector is very broad and made up principally of users, whereas most innovations come from the companies in the supply chain (e.g. providers of materials, equipment or services);

The technologies used for any given task (e.g. materials characterisation) will vary depending on the choice of materials and the context (e.g. what type of building; what level of performance is required).

There is growing policy pressure on the construction sector to meet higher environmental standards (e.g introduction of the Code for Sustainable Homes, which will require all new homes to achieve 'zero carbon' status after 2016) and to become more efficient. There is a need to get the technologies into the supply chain, and develop cost-effective technologies; at the moment many are too expensive to be used for large-scale developments.

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Figure 3.   Construction-related technologies identified as strengths in the region
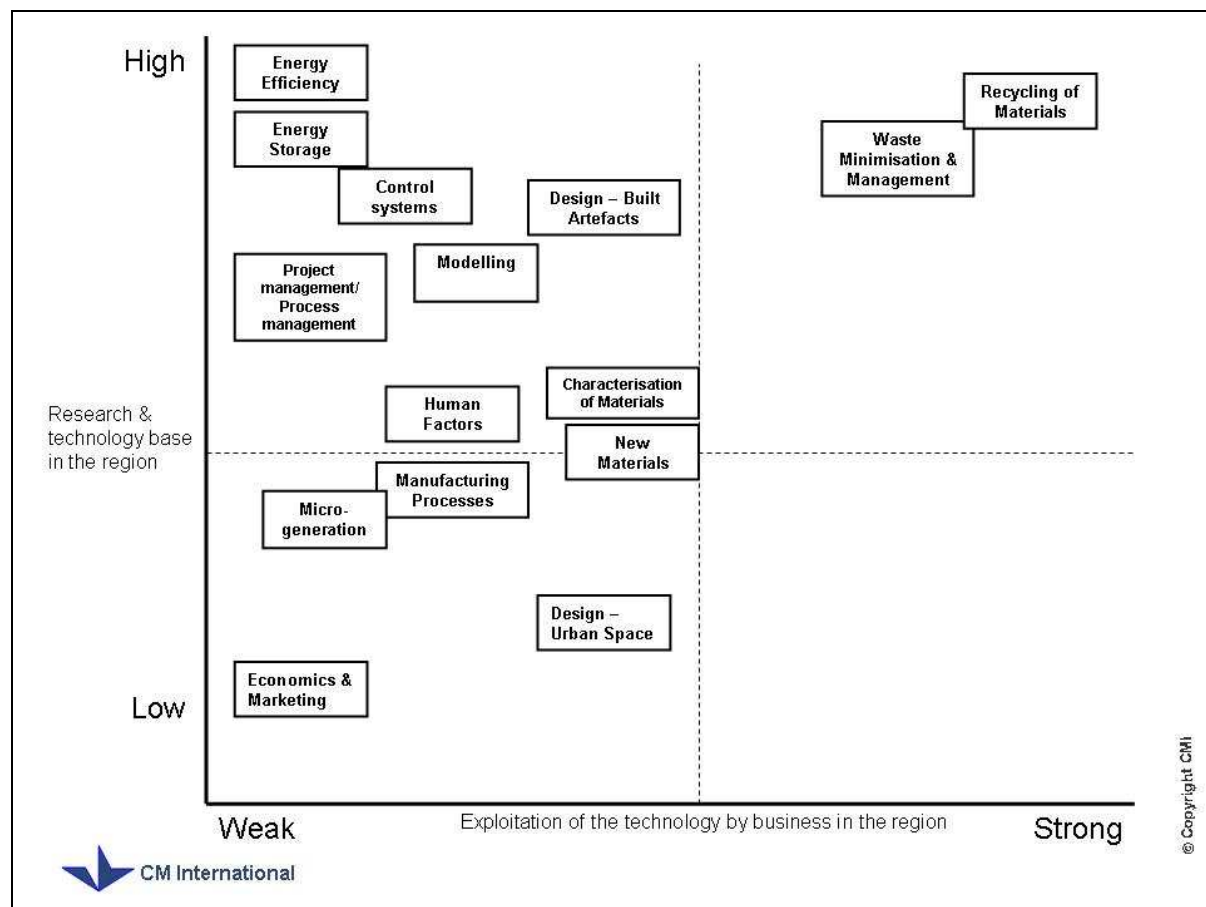
2.   Technology strengths in the East Midlands

The research and technological strengths of universities and companies located in the East Midlands region are illustrated by the following sources:

- Research Assessment Exercise 2001 results
- Higher Education Business and Community Interaction Survey 2003/04
- Office for National Statistics data on R&D expenditure and R&D employment in East Midlands
- Records of funding awarded to East Midlands HEIs and companies by DBERR (formerly DTI) Technology Programme

2.1   Results of the 2001 Research Assessment Exercise

The latest Research Assessment Exercise (RAE) for which results are available took place in 2001[3]. Higher Education Institutions in England, Scotland and Wales were invited to submit evidence on their research activity under one of 68 subject areas or 'Units of Assessment'. The submissions are subjected to a peer review by panels of independent

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[3] www.hero.ac.uk/rae

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experts and awarded a rating between 1 and 5* (Five star). This evidence base has examined the RAE 2001 in order to identify those East Midlands HEIs whose submissions were awarded a rating of 3b, 4, 5, or 5*, These ratings are define research excellence in the following way:

5*– Quality that equates to attainable levels of international excellence in more than half of the research activity submitted and attainable levels of national excellence in the remainder

5 – Quality that equates to attainable levels of international excellence in up to half of the research activity submitted and attainable levels of national excellence in virtually all the remainder

4 – Quality that equates to attainable levels of national excellence in virtually all the research activity submitted, showing some evidence of international excellence

3a- Quality that equates to attainable levels of national excellence in over two thirds of research activity, possibly showing evidence of international excellence.

2.1.1 Review of ratings achieved

In the RAE 2001, the following East Midlands HEIs achieved ratings of 3a, 4, 5 and 5* in the technology-related Units of Assessment shown at table 1 overleaf:

De Montfort University	Loughborough University
University of Derby	Nottingham Trent University
University of Leicester	University of Nottingham
University of Lincoln	

The Unit of Assessment areas that achieved most rated submissions across the four categories (3a, 4, 5 and 5*) are displayed first:

Table 1.   RAE submissions from East Midlands HEIs achieving a rating of 3a, 4, 5 or 5*

Rating Unit of Assessment	3a	4	5	5*	Total awards across the four ratings
Chemistry	2	2	1		**5**
Applied Mathematics	1	1	2		**4**
Art and Design	2	2			**4**
Built Environment	1	2		1	**4**
Business and Management Studies	2	1	1		**4**
Computer Science	1	2	1		**4**
Electrical and Electronic Engineering	2	1	1		**4**
Mechanical, Aeronautical & Manufacturing Engineering	1	1	2		**4**
Economics and Econometrics	1		2		**3**
Geography		1	2		**3**
Metallurgy and Materials	1	2			**3**
Other Professions and Studies Allied to Medicine		2	1		**3**
Physics		1	2		**3**
Psychology		2	1		**3**
Civil Engineering		1	1		**2**
Clinical Laboratory Sciences	1	1			**2**
Community-based Clinical Subjects	2				**2**
Education		2			**2**
General Engineering		1	1		**2**
Genetics			1	1	**2**
History of Art, Architecture and Design	1	1			**2**
Hospital-based Clinical Subjects		2			**2**
Library and Information Management	1		1		**2**
Pure Mathematics			2		**2**
Sociology		1		1	**2**
Sports-related Studies		1		1	**2**
Statistics and Operational Research	1		1		**2**
Agriculture			1		**1**
Biochemistry			1		**1**
Biology			1		**1**
Chemical Engineering		1			**1**
Earth Sciences		1			**1**
Food Science and Technology			1		**1**
Life and Environmental Sciences	1				**1**
Nursing	1				**1**
Pharmacology			1		**1**
Pharmacy			1		**1**
Social Policy and Administration		1			**1**
Total No. of ratings awarded	22	33	29	4	

Source: RAE 2001 (Note: Table does not list all 68 Units of Assessment used in the RAE 2001)

Key

	Subject with 5 awards across ratings
	Subject with 4 awards across ratings
	Subject with 3 awards across ratings

The RAE 2001 shows that East Midlands HEIs are undertaking research of national and international excellence in 26 subject areas of technological relevance (awarded 5 and/or 5*

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rating), with a total of 35 subject areas recognised for the national excellence of at least two thirds of their output

The region's HEIs achieved a total of four 5*-rated departments in key Unit of Assessment Areas relevant to the Technology Strategy. These were: Built Environment, Sociology, and Sports-related Studies - all at Loughborough University, and Genetics at the University of Leicester.

The RAE 2001 recognised East Midlands' HEIs' strong research performance in technology areas relevant to priority sectors identified in the Regional Economic Strategy. Table 2 overleaf shows that the region's HEIs have strengths in cross-cutting disciplines such as Applied Mathematics, Computer Science, Physics, and Chemistry. They also have strengths in technology areas directly relevant to the construction and transport equipment sectors, such as Civil Engineering, Built Environment, General Engineering, Metallurgy and Materials, Mechanical, Aeronautical and Manufacturing Engineering. Likewise, the RAE recognised the excellence of East Midlands research in biosciences and healthcare, where the region has expertise in Genetics, Pharmacology, Bioscience, Biochemistry, Clinical Laboratory Sciences, Pharmacy, Psychology, and Other Professions and Studies Allied to Medicine. Excellent research relevant to the food and drink sector is also present in the region, with the RAE recognising the quality of research in Agriculture and in Food Science and Technology: these two subjects achieved a 5-rating at the University Nottingham, with Food Science and Technology achieving a 3b-rating at Lincoln University.

The RAE recognised the excellence of research in Mathematics and Computer Science at the Universities of Nottingham and Leicester, with expertise at De Montfort (Computer Science) and Loughborough (Applied Mathematics). According to RAE 2001, research excellence in engineering disciplines is centred on the Universities of Nottingham and Loughborough (Built Environment, Civil Engineering, Electrical and Electronic Engineering, Mechanical, Aeronautical and Manufacturing Engineering), but with strong research also recognised at Leicester (General Engineering and Civil Engineering) and De Montfort (Mechanical, Aeronautical and Manufacturing Engineering, and Built Environment). Research excellence in biosciences and healthcare is concentrated in the Universities of Nottingham and Leicester, with related expertise present at Nottingham Trent University and De Montfort (Other Professions and Studies Allied to Medicine) and Loughborough (Sports-related Studies).

An overview of the RAE ratings by institution can be found at table 2 overleaf.

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Table 2. Overview of RAE 2001 ratings 3a, 4, 5, and 5* awarded to East Midlands HEIs

East Midlands HEIs	Nott	L'boro	Leicester	DMU	NTU	Lincoln	Derby	N'ton
Unit of Assessment								
Agriculture	5							
Applied Mathematics	5	4	5		3a			
Art and Design		4		4	3a	3a		
Biochemistry			5					
Biology			5					
Built Environment	4	5*		4	3a			
Business and Management Studies	5	4	3a	3a				
Chemical Engineering		4						
Chemistry	5	4	4	3a	3a			
Civil Engineering	5	4						
Clinical Laboratory Sciences	3a		4					
Community-based Clinical Subjects	3a		3a					
Computer Science	5	3a	4	4	3a			
Earth Sciences			4					
Economics and Econometrics	5	3a	5					
Education	4		4					
Electrical and Electronic Engineering	4	5		3a	3a			
Food Science and Technology	5							
General Engineering	4		5					
Genetics	5		5*					
Geography	5	5	4					
History of Art, Architecture and Design		3a	4					
Hospital-based Clinical Subjects	4		4					
Library and Information Management		5		3a				
Life and Environmental Sciences	3a							
Mechanical, Aeronautical and Manufacturing Engineering	5	5		4			3a	
Metallurgy and Materials		4		4				3a
Nursing	3a							
Other Professions and Studies Allied to Medicine		4		4	5			
Pharmacology			5					
Pharmacy	5							
Physics	5	4	5					
Psychology	5	4	4					
Pure Mathematics	5		5					
Social Policy and Administration	4							
Sociology		5*	4					
Sports-related Studies		5*		4				
Statistics and Operational Research	5				3a			

Source: RAE 2001 (Table does not list all 68 Units of Assessment used in the RAE 2001)

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Whilst the RAE 2001 results are now six years old, they do shed light on the 'high points' in the research landscape, measured by the quality of research produced. The RAE makes it possible to see which individual institutions have research areas that rank among the 'very best' (i.e. which institutions achieved a rating of 5 or 5* by Unit of Assessment area). However, by considering which areas received three or more ratings across the spectrum of 3b, 4, 5 and 5*, the RAE also sheds light on the range of academically excellent research that exists across the region's HEIs.

2.1.2 Research Groups and Centres linked to the RAE 2001 ratings

The RAE 2001 also sheds some light on the research groups that were included in the Unit of Assessment areas. The RAE does not always name specific research centres because strong HEI departments may have a large number of these, so table 3 can only provide a basic overview. Nevertheless it does highlight the fact that centres of expertise exist in many technology areas relevant to the East Midlands priority sectors of transport equipment, construction, food and drink, and bioscience and healthcare, including Engineering, Computer Sciences, and Biological sciences.

Table 3.   List of Research Groups linked to RAE 2001 ratings – sorted by HEI, then Unit of Assessment Area

HEI	Unit of Assessment Area	RAE 2001	Submissions (R'sch Gps)
Derby	Mechanical, Aero and M'fing Eng	3a	Integrated Manufacturing Research Centre
Derby	Mechanical, Aero and M'fing Eng	3a	Colour and Imaging Institute
DMU	Built Environment	4	Institute for Energy and Sustainable Development
DMU	Computer Science	4	Software Technology Research Centre
DMU	Computer Science	4	Centre for Computational Intelligence
DMU	Mechanical, Aero and M'fing Eng	4	Manufacturing Engineering
DMU	Mechanical, Aero and M'fing Eng	4	Mechatronics Research Centre
DMU	Mechanical, Aero and M'fing Eng	4	Mechanical Energy
DMU	Metallurgy and Materials	4	Textile Engineering and Materials Research Group (TEAM)
L'boro	Applied mathematics	4	Theoretical mechanics
L'boro	Applied mathematics	4	Mathematical physics
L'boro	Applied mathematics	4	Engineering mathematics
L'boro	Art and Design	4	Design education
L'boro	Art and Design	4	Design ergonomics
L'boro	Art and Design	4	Design research
L'boro	Built Environment	4	Construction management
L'boro	Built Environment	4	Building Services engineering
L'boro	Chemical Engineering	4	Sustainable process development group
L'boro	Chemical Engineering	4	Separation processes group
L'boro	Chemical Engineering	4	Product engineering group
L'boro	Chemistry	4	Analytical chemistry
L'boro	Chemistry	4	Organic and bio-organic chemistry
L'boro	Chemistry	4	Physical chemistry
L'boro	Chemistry	4	Inorganic and structural chemistry
L'boro	Civil Engineering	4	Geotechnical engineering
L'boro	Civil Engineering	4	Structures and materials
L'boro	Civil Engineering	4	Water engineering
L'boro	Civil Engineering	4	Survey and photogrammetry

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HEI	Unit of Assessment Area	RAE 2001	Submissions (R'sch Gps)
L'boro	Computer Science	4	Advanced Media Lab (AML)
L'boro	Computer Science	4	Information Systems Engineering Research (ISE)
L'boro	Computer Science	4	Graphics, Design and Intelligent Systems (GRADIENTS)
L'boro	Computer Science	4	Interactive Mechanisms for Process Control (IMPACT)
L'boro	Computer Science	4	Creativity and Cognition Research Studios
L'boro	Electrical and Electronic Engineering	5	Communications and Signal processing
L'boro	Electrical & Electronic Engineering	5	Electronic Systems and Control
L'boro	Electrical & Electronic Engineering	5	Power and renewable energy
L'boro	Geography	5	Geomorphological processes
L'boro	Geography	5	Ecological and hydrological processes
L'boro	Mechanical, Aero and M'fing Eng	5	Manufacturing
L'boro	Mechanical, Aero and M'fing Eng	5	Optical engineering
L'boro	Mechanical, Aero and M'fing Eng	5	Structures, Dynamics and Materials
L'boro	Mechanical, Aero and M'fing Eng	5	Applied Aerodynamics
L'boro	Mechanical, Aero and M'fing Eng	5	Automotive Engineering
L'boro	Mechanical, Aero and M'fing Eng	5	Mechatronic and Manufacturing Systems Integration
L'boro	Metallurgy and Materials	4	Polymer Research Group
L'boro	Metallurgy and Materials	4	Metals Research Group
L'boro	Metallurgy and Materials	4	Ceramics Research Group
Leic	Applied Mathematics	5	Approximation theory
Leic	Applied Mathematics	5	Applied Computational Dynamics
Leic	Applied Mathematics	5	Spectral theory
Leic	Biochemistry	5	Structural biology and molecular enzymology
Leic	Biochemistry	5	Cell regulation and signalling
Leic	Biochemistry	5	Biochemistry and gene expression
Leic	Biology	5	Plant cellular and molecular biology
Leic	Biology	5	Biodiversity, ecology and evolution
Leic	Clinical Laboratory Sciences	4	Microbial physiology and infection
Leic	Clinical Laboratory Sciences	4	Respiratory tract infections
Leic	Clinical Laboratory Sciences	4	Immunity and host defence
Leic	Clinical Laboratory Sciences	4	Oxidative stress
Leic	Clinical Laboratory Sciences	4	Cancer studies
Leic	Clinical Laboratory Sciences	4	Cell and stroma interactions
Leic	Clinical Laboratory Sciences	4	Molecular mechanisms in bleeding and thrombic diseases
Leic	Community-based Clinical Subjects	3a	16 research areas
Leic	Computer Science	4	Logic, Algorithms and Complexity
Leic	Computer Science	4	Distributed reactive systems
Leic	Computer Science	4	Semantics
Leic	Earth Sciences	4	Paleobiology
Leic	Earth Sciences	4	Geophysics
Leic	Earth Sciences	4	Borehole research
Leic	Earth Sciences	4	Magmatic and volcanic processes
Leic	Earth Sciences	4	Orogenic processes
Leic	General Engineering	5	Control and instrumentation
Leic	General Engineering	5	Electrical and Electronic power engineering
Leic	General Engineering	5	Mechanics of materials
Leic	General Engineering	5	Radio systems
Leic	General Engineering	5	Thermofluids and environmental engineering
Leic	Geography	4	GIS and Earth observation

HEI	Unit of Assessment Area	RAE 2001	Submissions (R'sch Gps)
Leic	Hospital-based Clinical Subjects	4	Cardiovascular Sciences
Leic	Hospital-based Clinical Subjects	4	Clinical Neurosciences
Leic	Hospital-based Clinical Subjects	4	Renal and Transplant Services
Leic	Hospital-based Clinical Subjects	4	Reproductive Sciences
Leic	Hospital-based Clinical Subjects	4	Respiratory sciences
Leic	Physics	5	Theoretical astrophysics
Leic	Physics	5	Condensed matter physics
Leic	Physics	5	Radio and space plasma physics
Leic	Physics	5	Space projects and instrumentation
Leic	Physics	5	X-ray and observational astronomy
Leic	Psychology	4	Neuroscience
Leic	Psychology	4	Human and experimental psychology
Leic	Psychology	4	Social and developmental psychology
Leic	Psychology	4	Applied psychology
Lincoln	Art and Design	3a	no research groups listed
Lincoln	Food Science and Technologies	3b	no research groups listed
N'ton	Metallurgy and Materials	3a	Material Science
N'ton	Metallurgy and Materials	3a	3 groups on leather and related materials
NTU	Applied Mathematics	3a	Industrial and Engineering Mathematics
NTU	Applied Mathematics	3a	Mathematical physics
NTU	Built Environment	3a	Environment
NTU	Built Environment	3a	Construction
NTU	Built Environment	3a	Centre for Research into the Built Environment
NTU	Built Environment	3a	Property and Housing
NTU	Computer Science	3a	Intelligent Simulation and Modelling
NTU	Computer Science	3a	Intelligent Recognition and Interactive Systems
NTU	Computer Science	3a	Real-time Machine Control
NTU	Electrical & Electronic Engineering	3a	Vision Systems
NTU	Electrical & Electronic Engineering	3a	Renewable Energy
NTU	Other Professions and Studies Allied to Medicine	5	Cell biology and pathology
NTU	Other Professions and Studies Allied to Medicine	6	Pharmacology and toxicology
NTU	Statistics and Operational Research	3a	Probability
NTU	Statistics and Operational Research	3a	Statistical Modelling
UoN	Applied Mathematics	5	Theoretical mechanics
UoN	Applied Mathematics	5	Mathematical physics
UoN	Civil Engineering	5	Environmental fluid mechanics division
UoN	Civil Engineering	5	Institute of Engineering and Space Geodesy
UoN	Civil Engineering	5	Pavement and Geotechnical Engineering Division
UoN	Civil Engineering	5	Structural Engineering and Construction Division
UoN	Clinical Laboratory Sciences	3a	Cancer biology
UoN	Clinical Laboratory Sciences	3a	Genetics and disease
UoN	Clinical Laboratory Sciences	3a	Infections, Immunity and Inflammation
UoN	Community-based Clinical Subjects	3a	Public Health Services
UoN	Community-based Clinical Subjects	3a	Primary Care
UoN	Community-based Clinical Subjects	3a	Psychiatry
UoN	Computer Science	5	Automated scheduling optimisation and planning
UoN	Computer Science	5	Interactive media
UoN	Computer Science	5	Foundations of programming
UoN	Computer Science	5	Image processing and interpretation

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HEI	Unit of Assessment Area	RAE 2001	Submissions (R'sch Gps)
UoN	Electrical & Electronic Engineering	5	Photonic Engineering
UoN	Electrical & Electronic Engineering	5	Instrumentation, Sensors and Systems
UoN	Electrical & Electronic Engineering	5	Electromagnetics Research
UoN	Electrical & Electronic Engineering	5	Power Electronics, Machines and Control
UoN	General Engineering	4	Fuel Technology
UoN	General Engineering	4	Visualisation and Simulation
UoN	General Engineering	4	Mining and Ground Engineering
UoN	General Engineering	4	Process Technology
UoN	Geography	5	Environmental and geomorphological sciences
UoN	Geography	5	Geographical Information Science
UoN	Geography	5	Cultural and Historical Geography
UoN	Geography		New Economic Geographies
UoN	Hospital-based Clinical Subjects	4	Rheumatology/Dermatology
UoN	Hospital-based Clinical Subjects	4	Vascular
UoN	Hospital-based Clinical Subjects	4	Gastro-enterology
UoN	Hospital-based Clinical Subjects	4	Imaging / neurology
UoN	Hospital-based Clinical Subjects	4	Oncology
UoN	Hospital-based Clinical Subjects	4	Pediatric Pharmacology
UoN	Hospital-based Clinical Subjects	4	Human development
UoN	Hospital-based Clinical Subjects	4	Respiratory/ therapeutics
UoN	Life and Environmental Science	3a	Animal behaviour and ecology
UoN	Life and Environmental Science	3a	Environmental Sciences
UoN	Life and Environmental Science	3a	Infection and Immunity
UoN	Life and Environmental Science	3a	Microbiology
UoN	Life and Environmental Science		Molecular toxicology
UoN	Mechanical, Aero and M'fing Eng	5	Structural Integrity and Dynamics
UoN	Mechanical, Aero and M'fing Eng	5	Thermofluids
UoN	Mechanical, Aero and M'fing Eng	5	Composite Materials
UoN	Mechanical, Aero and M'fing Eng	5	Advanced Materials
UoN	Mechanical, Aero and M'fing Eng	5	Advanced Manufacturing Technology
UoN	Mechanical, Aero and M'fing Eng	5	Management and Human Factors
UoN	Pharmacy	5	Biophysics and surface analysis
UoN	Pharmacy	5	Cardiovascular Sciences
UoN	Pharmacy	5	Cell Signalling
UoN	Pharmacy	5	Computational modelling and informatics
UoN	Pharmacy	5	Drug delivery and tissue engineering
UoN	Pharmacy	5	Drug discovery and cancer chemotherapy
UoN	Pharmacy	5	Drug metabolism and separation science
UoN	Pharmacy	5	Health services and pharmacy practical research
UoN	Pharmacy	5	Infections and Immunity
UoN	Pharmacy	5	Metabolism and nutritional sciences
UoN	Pharmacy	5	Neuroscience
UoN	Physics	5	Astronomy
UoN	Physics	5	Magnetic Resonance Imaging
UoN	Physics	5	Nanoscience
UoN	Physics	5	Quantum and statistical phenomena
UoN	Physics	5	Semiconductors
UoN	Psychology	5	Cognitive psychology and modelling
UoN	Psychology	5	Conceptual and linguistic development
UoN	Psychology	5	Cognitive neuroscience

2.2 HE-BCI Survey 2003-04

The 2003-04 Higher Education Business and Community Interaction Survey provides a snap-shot of English HEIs' infrastructure, capacity, outputs and income associated with their

'third stream' activities. Third stream activities is a term encompassing a range of activities that are separate from under universities' research and teaching roles and it includes commercialisation of new knowledge, delivery of professional training, provision of consultancy services, and any other activities intended to have direct social benefits. The 2003-04 survey is the fifth of its kind and is managed by the Higher Education Funding Council for England (HEFCE), which uses the results to inform its continued funding of third stream activity.

Key results of the HE-BCI survey in the East Midlands are:

- HEIs reported 244 active patents in their respective portfolios for the academic year 2003-04. Over two thirds of these were held by the Universities of Nottingham and Leicester (38.5% and 33% respectively). Other HEIs with significant patent portfolios were Loughborough (15.5% of reported active patents); De Montfort (7.7%) and Nottingham Trent University (NTU) (4.9%).

- During the academic year 2003-04, a total of 29 non-software licences were granted by the East Midlands HEIs, 19 of these (65.5%) to SMEs. Between them, the Universities Nottingham and Leicester accounted for 69% of all licence agreements, with the rest concluded by Loughborough (5), De Montfort (3), and NTU (1).

- During 2003-04 the HEIs generated £1,373m of revenue from commercial organisations in exchange for software licenses, other licenses, and related agreements. 79% of this sum was generated by the University of Nottingham, with the Universities of Leicester and Loughborough generating 11.9% and 3.6% respectively.

- For the survey, the HEIs between them reported 54 active spin-out companies with some HEI ownership. Over 2/3 of these firms were linked to the Universities of Loughborough (19) and Nottingham (17), with Leicester reporting 7, De Montfort 5, and Derby and NTU 3 each. In total these firms had an estimated turnover of £56.9m and 536 full-time-equivalent employees. Average turnover of firms ranged from £5.2m for the firms that had spun out from De Montfort, to £67k for the firms from Derby. Of the three research-intensive universities, average turnover was £153k for Leicester spin-outs; £763k for Loughborough spin-outs, and £882 for Nottingham spin-outs.

- 107 graduate starts were reported as still active during 2003-04. Derby (37), Lincoln (26) and NTU (21) accounted for 78.5% of all active graduate start-ups. Much lower numbers were reported by Nottingham (12), Loughborough (6) and De Montfort (5), with no returns from Leicester or Northampton. Not all the HEIs reporting graduate starts provided figures on employment and turnover, and therefore the average figures should be treated with caution. However, even with this proviso, average employment and turnover was clearly much lower in graduate start-ups than in spin-outs involving HEI ownership (presumably based on intellectual property). The average employment in graduate start-ups was 1.89 full-time-equivalent, and average turnover was £34.8k.

The results of the HE-BCI survey confirm that patents and income from licences is highest from research intensive HEIs, with the Universities of Nottingham and Leicester in taking the lead in this area. The survey also confirmed that the employment and turnover achieved by spinout companies based on intellectual property belonging to HEI tended to be high (see average turnovers achieved by Leicester, Loughborough and Nottingham), although De Montfort provides the exception to the rule here. In contrast, the turnover achieved by graduate start-ups, which do not usually require the HEI to reach an agreement on intellectual property, tends to be lower, although the strong performance of Derby, Lincoln

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and NTU indicates that graduates will consider this as a career option, given advice and support[4].

Less research intensive universities perform well on graduate starts, but generally speaking the turnover and employment created is lower, (again De Montfort is the exception in this category).

The results of the HE-BCI survey indicate that more research-intensive HEIs tend to perform better in terms of the scale and duration of their research relationships with industry and in the size and income generated by their spinout companies.

2.3 R&D expenditure and R&D employment in the East Midlands

In August 2005, the Office of National Statistics published a range of existing statistics on R&D expenditure and employment, including some data on performance at Government Office Region (GOR) level for the year 2003[5]:

Business Enterprise R&D (BERD) expenditure by East Midlands businesses was calculated at £929m, placing the region fifth of the 12 UK regions and countries - after the South East, East of England, North West and South West. Between them, the South East and the East of England account for 50% of all UK BERD expenditure.

East Midlands R&D private sector workforce is 14,200 people, representing 0.68% of the regional labour force and ranking as the third highest in the UK after the East of England and the South East.

R&D expenditure by East Midlands HEIs was £223m, 28% below the average of £307m for Wales, Scotland, Northern Ireland and all the English regions except London. (London's HEIs account for £1,069m, or 24% of all UK HEI expenditure on R&D).

R&D expenditure by Central Government[6] in the East Midlands was £22m, which was 87% below the regional average of £167.4m. However, it should be noted that the bulk of research undertaken by Central Government takes place in four regions and countries: South East, East of England, London, and Scotland. Between them, these account for 73% of all Central Government expenditure on R&D.

Only 200 people are employed in Central Government R&D in the East Midlands. This is just 0.01% of the regional labour force – only the North East had fewer people employed in this activity.

East Midlands performance in BERD compares favourably with the rest of the UK; the latest data for which the contribution of BERD to GVA are available, date from 2002, when East Midlands BERD was 1.8% of GVA, compared to 1.4% for the rest of the UK[7]. However, anecdotal evidence quoted in the RES Evidence Base suggests that R&D expenditure is concentrated in a small number of multi-national companies, with a large body of East Midlands companies spending very little on R&D. This is corroborated by more recent data from 2005[8] (see table 4), which shows that sectors employing large numbers of people such as services, extractive industries and construction account for only a small share of BERD

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[4] Inferred from the fact that all three of these HEIs have incubator facilities for graduate start-ups.

[5] Office for National Statistics: 'Research and experimental development (R&D) statistics, 2003', published in 'Economic Trends 621, August 2005'.

[6] These statistics do not include R&D undertaken within the NHS

[7] 'The East Midlands in 2006: Evidence Base for the East Midlands RES 2006-2020' (see Economy and Productivity chapter)

[8] Office for National Statistics: 'Research and Development in UK Businesses (Business Monitor MA14)', January 2007

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(12.66%, 0.34% and 0.10% respectively). Within the manufacturing sector, chemicals, electrical machinery, transport equipment and other manufacturing account for 46.8% of BERD, making it likely that mechanical engineering and aerospace (for which figures are not disclosed) could account for up to 40% of BERD between them.

Table 4. Expenditure & employment on R&D East Midlands businesses, 2005

	R&D expenditure (£m)	R&D expenditure %	R&D employment (FTE equivalent in 000s)	R&D employment %
Grand Totals	**1019**	**100.00%**	**11**	**100.00%**
Manufacturing				
Chemicals	211	20.71%	2	18.18%
Mechanical engineering	~	n/a	1	9.09%
Electrical machinery	44	4.32%	1	9.09%
Transport equipment	136	13.35%	~	n/a
Aerospace	~	n/a	~	n/a
Other manufacturing	86	8.44%	1	9.09%
Total Manufacturing	**884**	**46.81%**	**9**	**81.82%**
Total Services	129	12.66%	-	-
Other				
Agriculture, hunting and foresty; Fishing	~	n/a	~	n/a
Extractive industries	3	0.29%	-	-
Electricity, gas and water supply	~	n/a	~	n/a
Construction	1	0.10%	-	-
Total Other	**6**	**0.59%**		

Source: Research and Development in UK Businesses (Business Monitor MA14), ONS, January 2007

n/a   data not available
~   denotes non-disclosive figures
-           denotes value too small to display

2.4 Evidence of HEI-industry research collaboration

This section is intended to quantify the value of R&D investment made into East Midlands companies and HEIs via the Technology Programme, which is funded by various departments of Government and is a major source of funding for applied research and development. The Technology Programme is the delivery arm of the UK Technology Strategy, which aims to increase the quality and scale of technological innovation across all important sectors of the UK economy, but with a focus on seven Key Technology Areas that have been identified in consultation with industry by the Technology Strategy Board (see table 5, overleaf).

The Technology Programme is managed by the Department for Business, Enterprise and Regulatory Reform (BERR), but it is the strategic responsibility of the Technology Strategy Board, which comprises prominent members of industry and academia.

The function of the Technology Strategy Board, and the aims, objectives and delivery mechanisms of the Technology Programme are set out in . The current section provides details of investments made into the East Midlands companies and HEIs via two funding mechanisms of the Technology Programme: Collaborative R&D and Knowledge Transfer Partnerships, which both provide funding to projects that meet priorities set out in the seven Key Technology Areas.

Table 5. Technology Programme Areas

Key Technology Area	Priorities for Action
Advanced Materials	▪ **Materials for energy production and distribution** ▪ Materials in the development of **sensors and diagnostic technologies**

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	• **Structural materials**, in particular composite and high temperature resistant lightweight alloying technologies • **Multifunctional materials**, including damage tolerant, self-diagnostic, self-healing materials • **Biomaterials**, particularly the development of bioresorbable and bioactive materials • **Nanomaterials**, in particular developments that will enhance business capability in working at the nanoscale
Design Engineering and Manufacturing	**New business models for enterprises** • Lean manufacturing and processes (resource efficient; low-cost; sustainable) • Digital manufacturing businesses **Design, simulation and modelling** • Design for Reliability; availability, through-life support, health management and prognostics • Design, simulation and modelling of advanced structures • Validation, including non-destructive testing **Advanced manufacturing technologies and processes** • Advanced forming and assembling tools and technologies • Advanced manufacturing for micro- and nano-systems • Advanced instrumentation and control/use of radio-frequency ID
Bioscience and Healthcare	**Medical Devices** • Converging technologies/regenerative medicine (including bionanotechnology/nanomedicine) • Assistive technologies • Improved diagnostic and therapeutic equipment and techniques **Pharmaceuticals/Biopharmaceuticals** • Delivery of therapeutics • Therapeutic monitoring including the use of biomarkers • Biopharmaceutical bioprocessing technology **Exploitation of Bioscience by Industry** • New, easy and fast tools to discover bioactives functionalities and novel structural biomaterials • Integrated programmes in development of feedstock, innovative process and • extraction technologies and fermentation to deliver multiproduct processes • Biocatalyst design and process optimisation
Sustainable Production and Consumption	Build capacity and successful innovation in: • Energy efficiency • Resource efficiency • Waste and pollution management • Sustainable water and food
Emerging Energy Technologies	Various calls for projects have been made, concerning oil and gas, wind, bio-energy, photovoltaics, grid and fuel cell technologies, etc.
Information and Communication Technologies	• Pervasive systems • Telecommunications • Inter-enterprise • Intelligent systems • Modelling and simulation • Information security
Electronics and Photonics	• Organic/plastic electronics and displays • Photonics, lasers and lighting • Sensors and imaging • Electronics design and systems

Source: 'Technology Strategy: Developing UK Capability – Key Technology Areas', DTI, 2006

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2.4.1 Collaborative R&D Projects

Collaborative R&D is a primary delivery mechanism of the Technology Strategy. It is designed to assist the industrial and research communities to work together on R&D projects in strategically important areas of science, engineering and technology - from which successful new products, processes and services can emerge. Regular competitions for funding of Collaborative R&D projects have been held since 2004, and by June 2007 a portfolio of over 600 projects was being supported with a combined business, and Government investment in excess of £900 million.

The seven Key Technology Areas are important for the Collaborative R&D projects because they not only set the priorities for funding calls but also the agenda for discussion and development of future competitions.

Since 2004, 62 companies based in the East Midlands and 6 East Midlands HEIs (with consortium partners from elsewhere in the UK) have participated in 81 Collaborative R&D projects with a combined value of £112.3m (£52m from the Technology Programme). Projects have been supported in the following technology areas (in order of number of projects supported):

Table 6.   Overview of projects supported by the Technology Programme that involve East Midlands HEIs and/or companies

	No. projects	Total value (£m)	Average per project (£m)	Tech. Programme contribution (£m)
Design engineering and advanced manufacturing	23	39.1	1.7	18.8
Electronics and photonics	16	18.2	1.1	9.2
Sustainable production and consumption	13	11.9	0.91	5.7
Advanced materials	11	13.3	1.2	5.9
Bioscience and healthcare	8	13.0	1.6	5.1
ICT	5	10.3	2.1	4.2
Emerging energy technologies	5	4.3	0.86	1.7

Source: Technology Programme database[9]

East Midlands companies and HEIs have received 10% of the £516m public funding available from the Technology Programme to the 9 English regions, Wales and Scotland.

A breakdown of project participants and R&D areas supported can be found at Annex I on pages 53-60.

Take-up of Collaborative R&D projects among the 62 companies and other organisations in the East Midlands that are involved in the programme reveals a strong interest in the technology areas of Design Engineering and Advanced Manufacturing, Electronics and Photonics, Sustainable Production and Consumption, and Advanced Materials (see figure 4).

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[9] http://www.technologyprogramme.org.uk/site/publicRpts/default.cfm?subcat=publicRpt1

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Figure 4. Collaborative R&D Projects involving East Midlands companies and other organisations

Figure 4. Collaborative R&D Projects involving East Midlands companies and other organisations
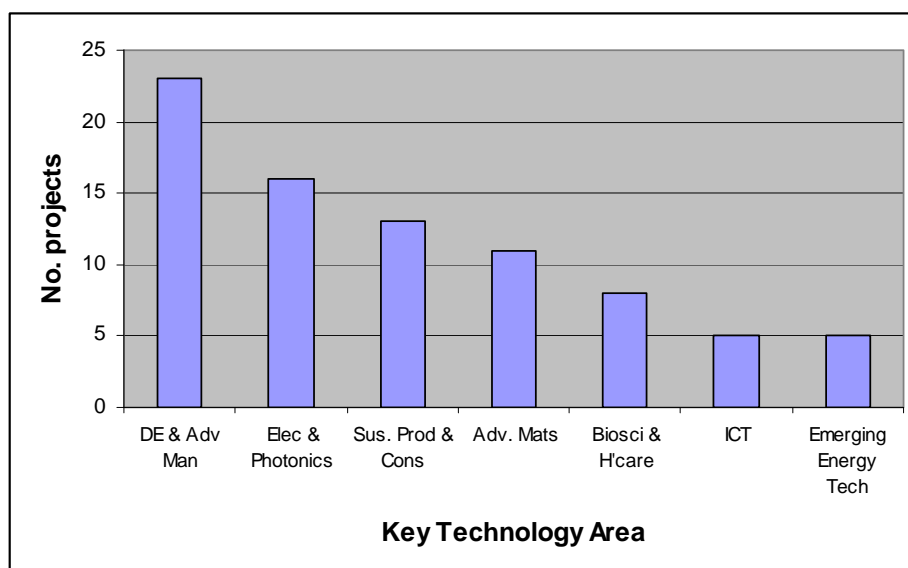
Of the 62 companies and other organisations, 27% (18) are leading projects, and 19% (13) are engaged in multiple projects, either as members or as leaders. The field is dominated by Rolls-Royce, which is leading 13 projects – this is 16% of all projects involving East Midlands organisations. Other significant players are Pera Innovation, Advanced Composites Group, The Boots Company (now Boots Alliance), and E.On UK.

East Midlands HEIs are involved in 43% (35) of the 81 Collaborative R&D projects that involve organisations from the region. The highest involvement is from institutions that also achieved high ratings in he RAE exercise (compare figure 5 with table 2 on page 15).

Figure 5. No. Collaborative R&D Projects involving East Midlands HEIs – by institution

Figure 5. No. Collaborative R&D Projects involving East Midlands HEIs – by institution
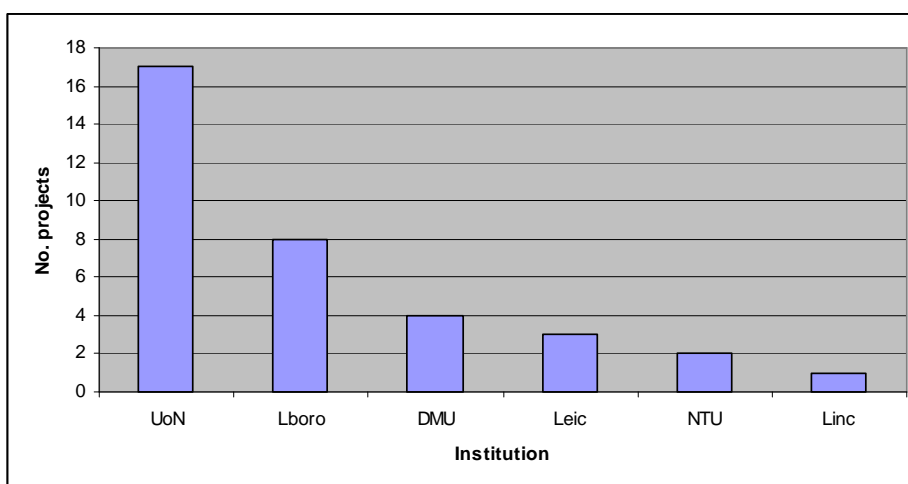
Figure 6 overleaf shows that the involvement of East Midlands HEIs in Collaborative R&D projects also echoes the research strengths recognised by the RAE 2001. For Collaborative R&D projects, HEIs perform strongly in technology areas such as Design Engineering and Advanced Manufacturing; Sustainable Production and Consumption, and Electronics and Photonics, echoing the highly-rated RAE Unit of Assessment Areas such as Mechanical, Aeronautical and Manufacturing Engineering; Civil Engineering; Built Environment; Chemistry, and Computer Science. HEIs in the region are also involved in 8 Collaborative

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R&D projects under the Bioscience/Healthcare theme, reflecting the strong research expertise that exists in the Universities of Nottingham and Leicester.

Figure 6. *Collaborative R&D projects involving East Midlands HEIs – by Technology Area*
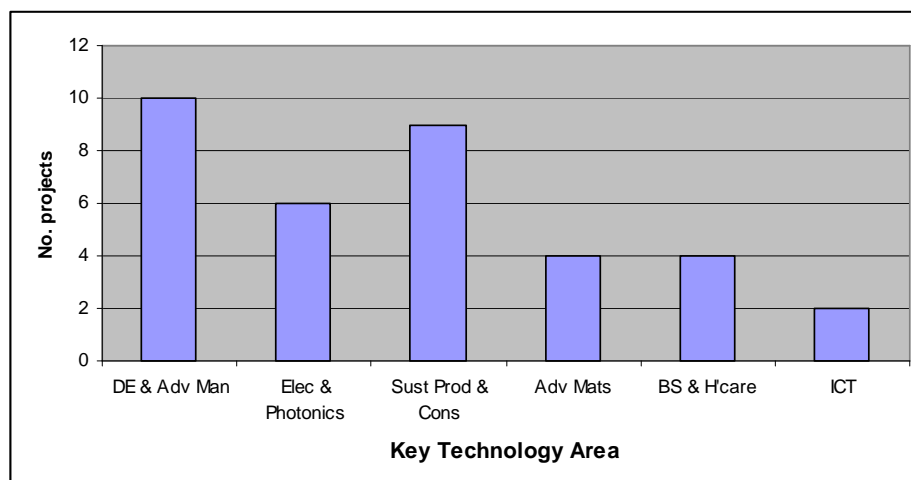
The relatively small number of companies involved in Collaborative R&D projects is in part a reflection of their purpose within the Technology Programme, which is to support industrial research in areas where the UK has a strong competitive position now or the research capacity to develop a leading position in the future. The region's take-up of Collaborative R&D by 62 firms indicates that there is a small, but significant community of companies that have experience and capacity to engage in collaborative research relationships, both with other firms and with academia. As such, this group constitutes a basis for any activity supported by the Regional Technology Framework. Nevertheless, the take-up Collaborative R&D funding by a small group of companies relative to the business base also reflects the BERD statistics for the region, which indicate that business R&D tends to be concentrated in a few companies, prepared to match public funding for R&D with significant investments of their own. This low level of R&D involvement by companies in the region remains a challenge for the Regional Technology Framework.

2.4.2 Knowledge Transfer Partnerships

The Knowledge Transfer Partnerships (KTPs) programme is a long-running and well-established scheme that now operates under the aegis of the Technology Programme. KTPs are intended to strengthen the competitiveness, wealth creation and economic performance of the UK by supporting collaborative projects between business and the knowledge base. Companies use the programme to obtain knowledge, technology or skills that are of strategic competitive importance to them, either from the further/higher education sector or from a research and technology organisation. Whilst companies gain access to out-of-house expertise, the base develops and increases its capacity to work on research projects with business. The main mechanism for transferring knowledge between the provider and the company is the KTP associate, who may be a graduate, postgraduate, or have an NVQ Level 4 or equivalent qualification. The Associate is recruited to work on a project agreed been the company and its chosen research provider, and is employed by the company.

The KTP programme is funded by 15 Government organisations; this pays for the costs of the knowledge base partner while the business pays the rest.

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The KTP project database[10] records that 322 KTP projects have been undertaken by East Midlands companies since 1985, whilst the 8 HEIs in the region have been involved in 213 projects during that time[11]. The value of current and completed projects (i.e. funding provided by the programme to knowledge base) is £20.19m (see table 7).

Table 7.   Total grant value of KTPs in the East Midlands

Technology Area	Grant amount (£m)
Electrical and Mechanical Engineering	3.80
Manufacturing Engineering	3.30
Design	2.80
Computing	2.00
Marketing	1.70
Materials	1.40
Advanced Information Technology	0.99
Science	0.92
Process Engineering	0.88
Food	0.49
E-commerce	0.42
Civil Engineering	0.37
Clean Technology	0.33
Quality	0.30
Biotechnology	0.29
Multi-media	0.14
Agriculture	0.07
Total grant value	**20.19**

Source: Database at www.ktponline.org.uk

In terms of project numbers and monetary value, KTP activity is highest in the areas of Electrical and Mechanical Engineering, Manufacturing Engineering and Design, and this not only reflects the expertise of the HEIs (see the high levels of activity by De Montfort, Nottingham Trent and Loughborough in figure 8, which all have capabilities in engineering and computing), but also reflects the industrial profile of the region.

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[10] www.ktponline.org.uk

[11] Since KTPs are a UK-wide programme, companies are not restricted in their choice of research organisation, and vice versa.

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Figure 7. KTPs undertaken by East Midlands companies - by technology area
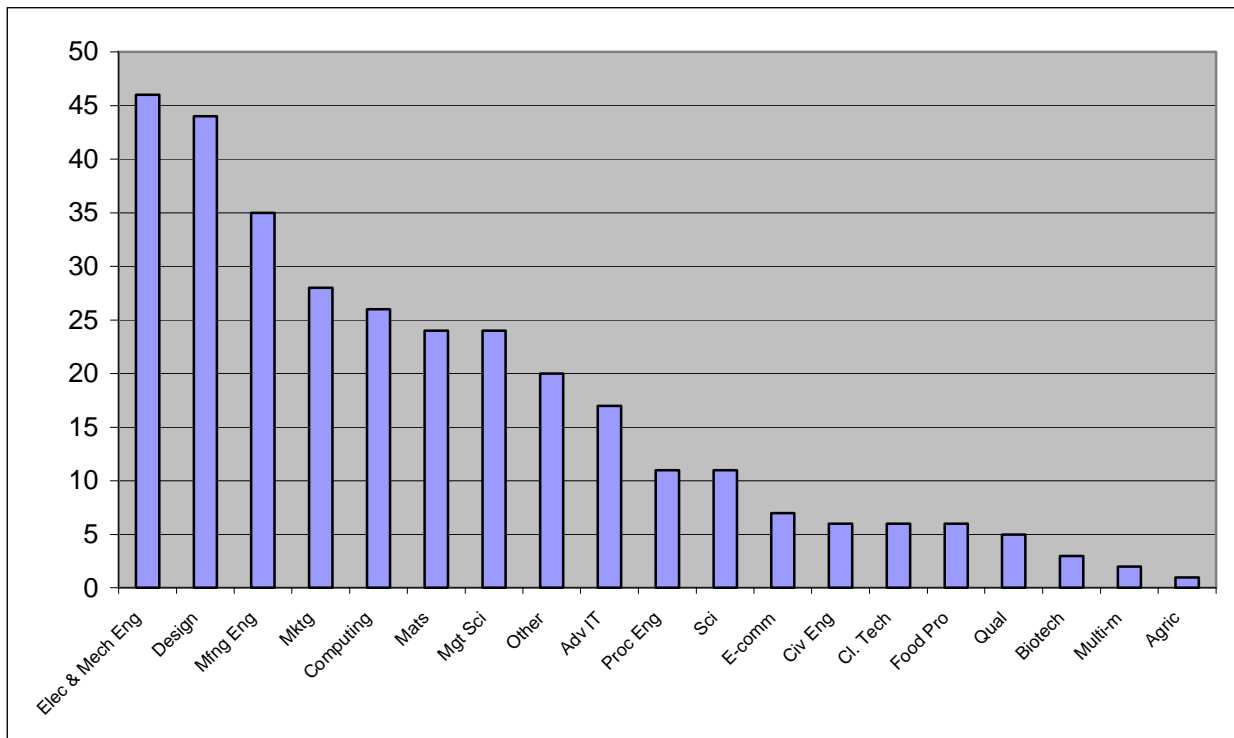
Figure 8. Numbers of KTP projects undertaken by East Midlands HEIs
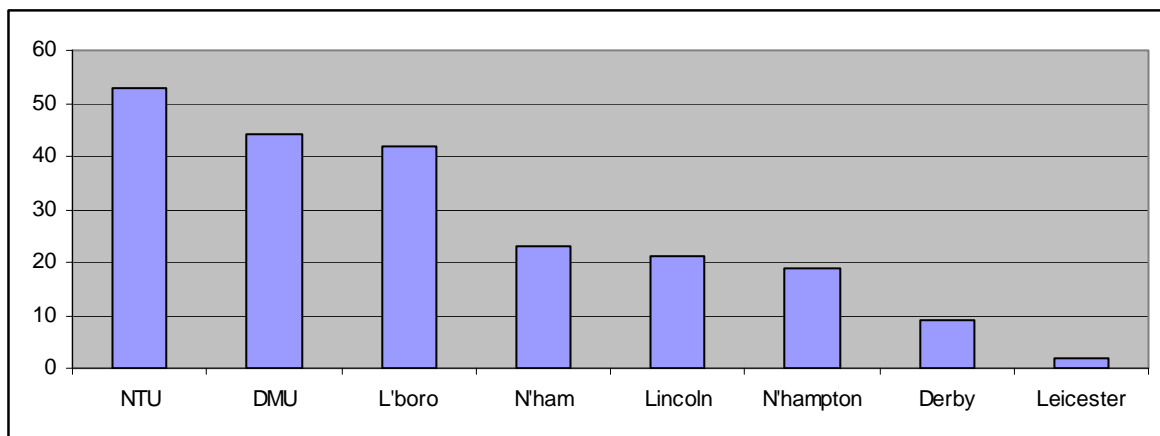
Figure 9. Value of KTP projects to East Midlands HEIs

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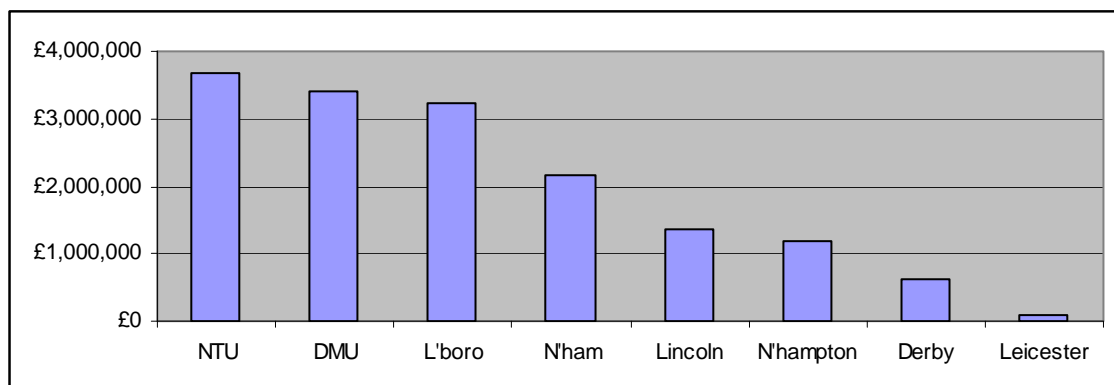
Figures 8-9 show that HEIs with a track record of working with local industry and producing research of national quality are successful at delivering KTP projects, which are about supporting innovation in areas of strategic importance to beneficiary companies, rather than delivering ground-breaking developments.

A detailed breakdown of KTP topic areas, with company and HEI activity levels, can be found at Annex II on pages 61-69.

Table 8. *East Midlands HEIs' involvement in KTP projects*

	Derby	DMU	Linc	Leics	L'boro	N'hpton	NTU	N'ham	Total
Advanced Information Technology		2	2		2	1	1	1	**9**
Agriculture									**0**
Biotechnology/Biology									**0**
Civil Engineering					3		1	1	**5**
Clean Technology				1			1	1	**3**
Computing		7	3		4	2	2	2	**20**
Design	3	4	2		7	5	7		**28**
E-commerce		1				3	2		**6**
Electrical & Mechl Engineering		7	1		8		6	4	**26**
Food Processing			1				1	1	**3**
Materials	1	3			5			1	**10**
Manufacturing Engineering	1	7			5	1	10	2	**26**
Management Science	2	3	2		3		7	2	**19**
Marketing	2	3	9			5	6	2	**27**
Multi-media				1					**1**
Other		3			3	1	5	3	**15**
Process Engineering		1	1			1		2	**5**
Quality		2					2		**4**
Science		1			2		2	1	**6**
	9	**44**	**21**	**2**	**42**	**19**	**53**	**23**	**213**

Source: KTP project database (www.ktponline.org.uk)

2.4.3 Conclusions

The performance of the East Midlands in the KTP programme highlights important differences between KTPs and Collaborative R&D projects. The latter focus on technology areas deemed key for the competitiveness of the UK economy as a whole, while the KTPs exist to facilitate knowledge transfer of strategic importance to individual companies. In the East Midlands, the majority of Collaborative R&D projects are undertaken by strong research performers, with the Universities of Nottingham and Loughborough having the highest involvement amid East Midlands HEIs (see figure 5, page 25). In contrast, HEIs such as De Montfort and Nottingham Trent, which have a tradition of strong links with local industry, are performing well on delivery of KTPs alongside the engineering resources of Loughborough and Nottingham.

In the case of both the Collaborative R&D and the KTP programmes, the East Midlands has high levels of activity in four broad areas of Electrical and Mechanical Engineering, Manufacturing and Process Engineering, and ICT, reflecting the strengths of the research base and the concerns of local industry.

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3. External drivers of the Regional Technology Framework

This chapter sets out the various policies and programmes with capacity to exert an influence on the direction of the Regional Technology Framework. The first section provides basic information on drivers that arise from outside the East Midlands. The second section examines the main sectoral and regional plans in place in the region, and highlights where the Regional Technology Framework could contribute to their achievement.

3.1 Cross-cutting external drivers

The main external programmes that will exert an influence over the Regional Technology Framework are the **Seventh Research Framework Programme 2007-2013** of the European Union, and the **UK Technology Programme**, funded by various departments of UK Government.

Within the UK, the **Energy White Paper** is a key policy document that provides the basis for a number of national strategies (including the UK Biomass Strategy and the Low Carbon Transport Innovation Strategy) and announces investment in a national **Energy Technologies Institute**. Since these provisions have implications for the energy sector, transport and construction, all of which are important in the East Midlands, an overview of the White Paper has been included in this section.

3.1.1 Seventh Research Framework Programme 2007-2013

Worth €50.5bn (£43.3bn) over seven years, the Seventh Research Framework Programme (FP7) programme includes 10 sub-programmes, or thematic areas that together will receive €32bn (£21.8bn) of research funding (see table 9, page 32). The thematic areas have a variety of delivery mechanisms intended to involve research actors, including large and small companies. The size and diversity of FP7 means that it represents an opportunity for East Midlands organisations to use it as a source of R&D funding. FP7 funding mechanisms of interest to the East Midlands include:

Frontier research

Advanced Investigator Grants - to be managed by the European Research Council and awarded by competitive process. The grants will support 'frontier research', a new term introduced for FP7 that is defined as 'the pursuit of questions at or beyond the frontiers of knowledge', characterised by an absence of disciplinary boundaries. Proposals will be invited from leading established researchers across Member States and associated countries and are open to academics and companies (http://erc.europa.eu);

Joint Technology Initiatives (JTIs) – JTIs are a new structure to support long-term industrial R&D by large public-private partnerships. They are intended to accelerate the development of key technologies, moving them closer to market. Under FP7, six JTIs are planned. Once up and running, JTIs will issue calls for proposals in areas corresponding to their Strategic Research Agenda. The following JTIs have been approved, or are close to approval at the time of writing:

- Clean Sky - environmentally friendly technologies for aerospace, (recently launched and worth €1.6bn)
- Embedded computing systems
- Innovative Medicine Initiative – focus on biopharmaceuticals
- Nano-electronics – focus on functionality, integration and miniaturisation of devices

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- Hydrogen & Fuel Cells – for transport and stationary applications
- Global Monitoring for Environment and Security

Significant advances beyond state of the art

Collaborative projects – these involve:
- Research and Technological Development aimed at significant advance beyond state of the art; Demonstration activities to prove viability of new technologies
- Size and scope of projects to vary, from medium-scale focused research to large-scale integrating projects.
- Minimum of 3 organisations from 3 member states; Duration 2-5 years

Developments within the state of the art

Research for SMEs
- Research and Technological Development; SMEs' focus on specifications, testing and validation. Focus on developments within state of the art.
- Typical consortium: 5-10 participants; Total budget to be €0.5m-€1.5m
- Minimum of 3 SMEs organisations from 3 member states and 2 RTD performers; Duration 1-2 years

Research for SME Associations - Rules similar to 'Research for SMEs', but:
- Typical consortium 10-15 participants; Total budget €1.5-€4m
- Project duration 2-3 years

The main research themes are set out at table 9 overleaf.

Table 9. Technology-based research themes within FP7 Thematic Areas

Thematic Area	Areas	Activities
Nanosciences, Nanotechnologies, Materials and New Production Technologies	Nanosciences and nanotechnologies	Materials and systems with predefined properties and behaviour
	Materials	Focus on multifunctional surfaces and materials
	New production	New knowledge and its application for sustainable production and consumption patterns
	Integration of technologies for industrial applications	Focus on new applications and novel solutions responding to major challenges
Energy		Hydrogen and fuel cells Renewable electricity generation Renewable fuel production Renewables for heating and cooling Co2 capture and storage technologies for zero emission power generation Clean coal technologies Smart energy networks Energy efficiency and savings Knowledge for energy and policy making
Environment (including Climate Change)	Climate change, pollution and risks	Pressures on environment and climate Environment and health Natural hazards
	Sustainable management of resources	Conservation and sustainable management of natural and man-made resources and biodiversity Management of marine environment
	Environmental technologies	Environmental technologies for observation, simulation, prevention, mitigation, adaptation, remediation and restoration of the natural and mad-made environment Protection, conservation and enhancement of cultural heritage Technology assessment verification and testing
	Earth observation and assessment tools	Earth and ocean observation systems, monitoring methods for the environment and sustainable development Forecasting methods and assessment tools for sustainable development
Health	Biotechnology, generic tools and medical technologies for human health	High-throughput research Detection, diagnosis and monitoring Prediction of suitability, safety and efficacy of therapies Innovative therapeutic approaches and intervention
	Translating research for human health	Integration of biological data and processes Research on the brain and related diseases Translational research into infectious diseases Translational research in major diseases: cancer
	Optimising the delivery of healthcare to European citizens	Translation of clinical outcome into clinical practice Quality efficiency and solidarity of health care systems incl. transitional healthcare systems and home care strategies Enhanced disease prevention and better use of medicines Appropriate use of new health therapies and technologies
Food, Agriculture and Biotechnology		Sustainable production and management of biological resources; Tools to implement relevant strategies, policies and legislation supporting European k'based bio-economy Integrity and control of the food chain Life sciences and biotechnology for sustainable non-food products and processes
Transport	Aeronautics and air transport	Reduction of emissions; work on engines and alternative fuels Air traffic management; safety aspects of air transport Environmentally efficient aviation
	Sustainable surface transport	Development of clean and efficient engines and power trains, reducing the impact of transport on climate change, inter-modal regional and national transport, clean and safe vehicles, infrastructure construction and maintenance, integrative architectures
	European global satellite navigation system	Galileo and EGNOS Navigation and timing services; efficient use of satellite navigation
Space	Space-based applications	Satellite observation systems and GMES services
	Exploration of space	Support for collaborative initiatives between ESA or national space agencies
	RTD to strengthen Space foundations	Research in response to long-term needs e.g. space transportation, bio-medicine, life and physical sciences in space
Security		Security of citizens; Security of infrastructures and utilities; Intelligent surveillance and border security; Restoring security and safety following crisis; Security systems integration Security and society; Security research co-ordination and structuring

Source: "FP7: Tomorrow's Answers Start Today" brochure published by the European Commission

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3.1.2 The UK Technology Programme

The purpose of the Technology Strategy Board is to drive forward the Government's Technology Strategy. The objectives for the Strategy over the next five to ten years are to encourage and enable:

- The continued restructuring of the UK economy in favour of high value, knowledge-based design, manufacturing and services;

- Significant activity relative to international competitors in chosen 'Key Technology Areas[12]';

- High levels of domestic and inward investment relative to competitors in the Key Technology Areas;

- Strategic procurement by Government which stimulates innovation in business and improves the quality and cost effectiveness of public services by encouraging pull-through of innovative products and services.

In helping to achieve these objectives, the Technology Strategy Board will set its priorities and direct funding under its control to:

- Help the UK's leading sectors and businesses maintain their position in the face of global competition;

- Stimulate those sectors and businesses with the capacity to be among the best in the world to fulfil their potential;

- Ensure that the emerging technologies of today become the growth sectors of tomorrow;

- Combine all these elements in such a way that the UK becomes a centre for investment by world-leading companies.

There is a strong focus on technologies where the UK has the capability and capacity to compete on a global stage, where the biggest benefit for UK business can be achieved and most difference can be made to UK capabilities. The strength of the research base and the creativity and diversity of the workforce are regarded as key assets.

The Technology Programme has various mechanisms to stimulate cross-disciplinary networking and collaboration, between and across industry and research. The scale of these mean that they all have potential to influence the environment in which the Regional Technology Framework operates:

Innovation Platforms are intended to integrate players (industry; research) and funders (government departments), aligning policy, regulation and public procurement in pursuit of innovative solutions. For example, Innovation Platforms have a role in influencing the subject areas covered by the ongoing calls for Collaborative R&D projects.

There are currently two innovation platforms in existence and a further three planned:

Underway
- Intelligent Transport Systems and Services
- Network Security

Planned
- Low Carbon Vehicle
- Low Impact Buildings
- Assisted Living

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[12] Advanced Materials; Design Engineering and Manufacturing; Bioscience and Healthcare; Sustainable Production and Consumption; Emerging Energy Technologies; Information and Communication Technologies; Electronics and Photonics

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Innovation platforms can launch their own calls for collaborative projects and therefore can bring significant additional government funding from across departments to bear on particular issues.

Knowledge Transfer Networks (KTNs) were developed in response to the DTI's Innovation Review[13], which identified access to networks and sources of new knowledge as two of the most important determinants of business innovation performance. Innovation is a complex process, and success relies on the coming together of a variety of players, such as suppliers, customers, other firms, universities, research and technology organisations and other intermediaries. The Review found that many businesses do not make the most of their potential for innovation this is often attributable to a lack of awareness and access to the latest technological knowledge and breakthroughs.

In response to the Review, 22 KTNs have been established since 2003. KTNs are national networks and exist to make the necessary connections between the various players, helping industry to access knowledge and information central to innovation growth.

KTNs are currently developing 'roadmaps' to identify the technology areas and industrial needs covered by their topic areas, and also to identify links with the work of other KTNs. They also act as important fora to inform government about future technology needs, and awareness of issues that inhibit business innovation. KTNs also provide feedback to the Technology Strategy board on subject areas that should be covered by the periodic Collaborative R&D calls.

The 22 KTNs are:

- Aerospace and Defence
- bioProcessUK
- Bioscience for Business
- Chemistry Innovation
- Cyber Security
- Electronics
- Electronics Enabled Products
- Food Processing
- Grid Computing Now!
- Health Technologies
- Industrial Mathematics

- Intelligent Transport Systems
- Integrated Pollution Management
- Low Carbon & Fuel Cell Technologies
- Location and Timing
- Materials
- Micro and Nanotechnology
- Modern Built Environment
- Photonics
- Resource Efficiency
- Sensors
- UK Displays and Lighting

The main funding programmes supported by the Technology Programme are Collaborative R&D projects and Knowledge Transfer Partnerships (KTPs). Further information on these can be found in section 2.4, pages 22-29.

3.1.3 The Energy White Paper 2007[14]

The Energy White Paper has been included as an 'external driver' of the Regional Technology Framework because of its implications for automotive, aerospace, and construction, as well as sustainable production and consumption more generally. The UK Biomass Strategy[15] and the Low Carbon Transport Innovation Strategy (LCTIS)[16] were published alongside the White Paper and pick up on its objectives in more detail. The main

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[13] 'Competing in the Global Economy: The Innovation Challenge' Department for Trade and Industry, December 2003

[14] 'Meeting the Energy Challenge: A White Paper on Energy', Department for Trade and Industry, May 2007

[15] 'UK Biomass Strategy, Department for Trade and Industry, Department for Transport, Department for Food and Rural Affairs, May 2007

[16] 'Low Carbon Transport Innovation Strategy' Department for Transport, May 2007

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technology support action highlighted by the White Paper, and reiterated by the Biomass and LCTIS strategies, is the establishment of an **Energy Technologies Institute**.

Energy Technologies Institute

The remit of the Energy Technologies Institute will be to accelerate the development of secure, reliable and cost-effective low-carbon energy technologies towards commercial deployment. The Institute will play a major role in technology developments internationally in support of the UK's climate change goals. The government will provide up to £500m in match-funding for the Institute over 10 years, but the full amount will depend on the contributions of the final industry partnership. The government is seeking 10 core industry sponsors, each able to commit £5m per year.

The objectives of the Institute are to connect and manage networks of best scientists and engineers, support R&D that facilitates rapid deployment of cost-effective low carbon energy technologies, and to provide improved strategic focus for commercially applicable energy related R&D in the UK. Its research programme will cover:

- **Large scale energy supply technologies** (efficient power generation; reduced emissions from fossil fuels)
- **Small scale energy supply technologies** (develop distributed energy supply options using locally available energy sources)
- Energy **security of supply** (develop mix of energy technologies)
- **End-use efficiency/demand management** (increase efficiency of energy use on demand side)
- **Transport** (sustainable transport fuels and transport management technologies)
- **Support infrastructures** (sustainable energy infrastructure)
- **Alleviating energy poverty** (break link between environmental harm and economic and social development for world's poorest)

A 'Midland Consortium' headed by the University of Nottingham with Loughborough and Birmingham has been selected to host the Energy Technologies Institute.

3.2 Sector-specific external drivers

This section examines drivers of technology development with potential to influence the research, development and exploitation of technology by specific industrial sectors. The focus of research has been on identifying technology strategies and programmes with potential to influence two broad areas:

First, those of clear relevance to the RES **priority sectors** of:

Transport Technologies	Healthcare
Food and Drink	Sustainable Construction

This section will consider any specific drivers that exert at an international or national influence on technology developments in these sectors, taking each sector in turn.

3.2.1 Transport technologies

International drivers

7th Framework Programme

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The Framework Programme 2007-2013 can potentially fund up to €4bn of transport research; approximately 50% of this is available for aeronautics and air transport. Among the Joint Technology Initiatives are two that offer research funding opportunities that are unique to transport sector:

- "Clean Sky" JTI for aerospace (potential value €1.6bn, 50% to be provided from the Framework Programme);

- JTI on hydrogen and fuel cells (focus on stationary and transport applications) of interest to the automotive sector.

For a more detailed outline of Framework Programme funding mechanisms, which offer wide opportunities for organisations with an interest in transport technologies, see section 3.1.1, page 30.

The Clean Sky JTI has been influenced by the activities of the Europe-wide Advisory Council for Aeronautics Research, which has its own Strategic Research Agenda, containing ambitious targets to for a 50% reduction in CO^2 emissions, and an 80% reduction in NO_x emissions per passenger km travelled by 2020.

National drivers

Energy White Paper - Meeting the Energy Challenge (May 2007)

The Energy White Paper sets out the UK Government commitment to strengthen the policy and regulatory frameworks governing energy markets. In addition to specific commitments to research and development, set out in the Low Carbon Transport Innovation Strategy and the UK Biomass Strategy, the Government:

- Supports desire of the European Commission to revise voluntary emissions targets agreed with automotive manufacturers (proposed new target: 130g CO^2 per km by 2012), and eventually make targets mandatory;

- Will introduce the Renewable Transport Fuels Obligation (RTFO). The RTFO comes into force April 2008 and states that by 2010 5% of all fuel sold on UK forecourts must come from a renewable source. The RTFO also includes a trading scheme: companies will be able to trade their RTFO certificates of compliance, and any firms not able to comply can buy themselves out of their obligation.

Low Carbon Transport Innovation Strategy (LCTIS)

The LCTIS identifies what R&D actions are required in the transport sector to support UK Government commitment to reduce carbon emissions. The LCTIS has been published by the Department for Transport and is linked to the establishment of a Low Carbon Vehicles Innovation Platform under the auspices of the Technology Strategy Board. Activities to be supported by the LCTIS include:

- R&D and demonstration projects that take advantage of public procurement requirements

- Review to identify vehicle and fuel technologies that have potential to help 'decarbonise' road transport within 25-year time frame

- Establishment of the Energy Technologies Institute (see section 3.1.3, page 35)

In September 2007, the first Technology Competition for the new **Low Carbon Vehicles Innovation Platform** was launched, making up to £20m available to support low carbon vehicle research, development & demonstration projects. The initiative is accompanied by other measures, to be taken by the Department for Transport and DBERR, to use public procurement requirements intended to make opportunities more visible to the marketplace – in this case by supporting a series of projects to demonstrate fleet-scale use of low-carbon

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vehicles (likely to be brokered by the Centre of Excellence in Low Carbon and Fuel Cell Technologies (Cenex), which is based at Loughborough University[17]).

For the future, the Technology Strategy Board notes that the Low Carbon Vehicles Innovation Platform should also act as a mechanism for leveraging investment from other sources, for example by linking capital-rich RDA investments with national R&D programme activity (i.e. the Technology Programme), or by opening up demonstration activities to trans-national collaboration, thereby leveraging both public and private overseas investment into the UK[18].

In the area of rail, the LCTIS notes that energy efficiency will be most important for cost reasons (rail contributes just 1% of total carbon emissions). Areas of technology to be supported will be developments in:

- Optimising rail network for energy efficiency
- Hybrid trains
- Technologies for reducing train mass
- Hydrogen fuel cells

White Paper 'Delivering a Sustainable Railway'

The Department for Transport has recently published the White Paper 'Delivering a Sustainable Railway'[19], which sets out the needs of the network over a 30-year time frame. A Rail Technical Strategy[20] was published alongside the White Paper, that considered how the industry should go about meeting the requirements of the White Paper for reduced environmental impacts, greater safety, reliability, information, and customer comfort. The process of considering the technical requirements of the railway in these terms identified a number of research and innovation gaps that need to be filled in order to achieve the 30-year vision for the railway, and therefore the Department for Transport intends to work with the industry on drawing up a Rail Industry Research Strategy (to be completed).

Within the Rail Technical Strategy six themes for future research have already been identified, and a summary of these is set out at table 10.

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[17] Source: Cenex web-site (www.cenex.co.uk)

[18] Source: 'Proposals for new Innovation Platforms' presented to the 10th meeting of the Technology Strategy Board, 19 February 2007.

[19] White Paper 'Delivering a Sustainable Railway' (CM 7176), Department for Transport, July 2007

[20] 'Rail Technical Strategy', Department for Transport, July 2007

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Table 10. Research themes identified by the Rail Technical Strategy (2007)

Research theme	
Enhancing reliable capacity	High-reliability infrastructure High-reliability trains Effect of European Traffic Management System on capacity Advisory speeds Effect of cab signalling on route knowledge requirements Line-of-sight working Freight (and other train) planning Cost-benefit analysis of train lengthening versus double-decker trains
Reducing specific cost of reliable infrastructure	Intelligent condition monitoring Systems to monitor infrastructure/rail integrity as a safety measure Applications to support 'graceful degradation' Implications of 'graceful degradation' at design level, on operations standards and procedures Implications of 35-tonne axle loads for infrastructure provision and maintenance Technologies to support whole-life, whole-system costing Reducing risk and impact of trespassers onto rail infrastructure Differentiated railway concepts
Encouraging reduction in vehicle mass	Lightweight rolling stock Reductions in mass of equipment
Environmental case for rail	Baselining current environmental performance and setting targets for improvements Use of biofuels Air quality (traction packages compliant with European regulation Non-Road Mobile Machinery IIIB) Hybrid traction packages Energy metering New forms of energy (e.g. fuel cell)[21] Noise reduction Effect of climate change on the railway
Improving the passenger experience	Communication with passengers by personal media Integration of passenger data and information systems
Reducing cost and improving availability	Rational family of trains Reductions in life-cycle cost and improving availability Community rail

Source: Rail Technical Strategy, Department for Transport, 2007

Although the themes reflect UK priorities, they also echo priorities identified for rail in FP7 which are[22]:

- Development of clean and efficient engines and power trains

- Reducing the impact of transport on climate change

- Inter-modal regional and national transport,

- Clean and safe vehicles,

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[21] Rail Safety and Standards Board (RSSB) is engaged developing a project for possible inclusion in the Joint Technology Initiative on Hydrogen and Fuel Cells, supported under FP7

[22] Source: 'FP7 – Tomorrow's answers start today', European Commission brochure

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- Infrastructure construction and maintenance
- Integrative architectures

National Aerospace Technology Strategy

The National Aerospace Technology Strategy (NATS) is now funded by the UK Technology Programme. It is led by the Aerospace Innovation and Growth Leadership Council which drives the NATS and articulates needs of industry to Technology Strategy Board (e.g. it can influence topics supported by the Collaborative R&D calls and other Technology Programme mechanisms).

The March 2007 review[23] of the NATS calculated that aerospace has won approximately 25% of the funding available under the Technology Programme 2004-2006, noting that public funding for research by this sector now stands at £45m per year.

Many of the activities set up when NATS was funded as a separate programme continue to exist, influencing the technology development environment for aerospace companies. The most notable activities are:

12 Aerospace Innovation Networks, which have a similar role to the Innovation Platforms supported by the Technology Programme, but that will in future seek to forge closer links with related Knowledge Transfer Networks

Aerospace Technology Validation Programmes – opportunities identified by the Innovation Networks can be supported by Aerospace Technology Validation Programmes, and six of these are currently underway. Since they involve industry, they can have a regional focus, and indeed since 2004 the English RDAs have committed £43m of funds to support the programmes. The Department for Trade and Industry (now DBERR) has contributed £110m since 2004[24]

UK Technology Programme

The objectives and principal delivery mechanisms of the UK Technology Programme are set out in section 3.1.2, page 33.

Two **Innovation Platforms** are of particular relevance for transport technologies, particularly automotive:
- The recently-launched Low Carbon Vehicles Innovation Platform, which will help to deliver priorities in the LCTIS (see page 36), and
- The Intelligent Transport Systems and Services Innovation Platform

Like other Innovation Platforms, the Intelligent Transport Systems and Services Innovation Platform provides a framework to bring together Government policy makers, business representatives, academia and other organisations to better understand the challenge, the future direction of Government and the solutions that business may be able to provide or should be working towards. The Platform vision is for Britain to become a "world-leader in innovation in intelligent transport systems and services".

Numerous activities have been launched via the platform to date, including:
- The Future Intelligent Transport Systems (FITS) initiative, funded by EPRSRC, DTI and DfT, and aimed at nurturing 'next generation' transport technology over a research time frame of 7-10 years

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[23] 'Report on Progress with the National Aerospace Technology Strategy', Department for Trade and Industry, March 2007

[24] Source as previous footnote

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- £7m of funding from the DTI via the Technology Programme intended to support UK businesses in development of telematics services and innovative services for road-users. This call coincided with DfT demonstrations project to explore the systems and technology that could enable Time, Distance and Place (TDP) road pricing.

3.2.2 Healthcare

International drivers

FP7

See information on FP7 on pages 30-32. Note the "Innovative Medicines Initiative", which has recently been established as a Joint Technologies Initiative and will focus on frontier research in biopharmaceuticals.

National drivers

Health research strategy 'Best Research for Best Health'

The NHS health research strategy 'Best Research for Best Health'[25] intends to drive more integrated research activity across the NHS, leading to greater efficiency and effectiveness., and helping to achieve the Government goal of raising R&D investment to 2.5% of GDP by 2014. Key features of the strategy are:

- Shift away from letting single R&D contracts.

- NHS Trusts to make proposals for portfolios of research to be undertaken by partnerships of research organisations.

- NHS Trusts will also bid to act as local co-ordinating centres for wider clinical research networks (there are a variety of topic-specific networks operating across the UK; the local centres will have an R&D management role and support local researchers).

  This focus on clinical research networks could be an opportunity for the East Midlands given its strengths in clinical research (Universities of Leicester and Nottingham both achieved grade 4 ratings for hospital-based clinical subjects in the RAE 2001). Life and Health Technology Strategic Delivery Plan

White Paper 'Our Health, Our Care, Our Say'

The January 2006 Department of Health (DH) White Paper, 'Our Health, Our Care, Our Say' outlined plans to develop large-scale demonstration pilots of assistive and monitoring technologies to address this market failure[26].

The White Paper **Whole System Long Term Condition Demonstrators** (WSD) will be on a scale significantly greater than anything undertaken in the UK to date will consist of three, 2 year pilots covering a population of 1 million people with circa 7,500 users of Telehealth/Telecare in total.   The "call" was issued on 21 December 2006, with demonstrators due to commence during 2007.

The Department of Health confirmed in their WSD communications that in parallel with the demonstrators, there will be a technology development work stream involving DH, DBERR and NHS, working closely with industry to establish open technical standards that will enable inter-operability between the assistive technology devices and the supporting back-end systems. Lessons learned from the demonstrators will inform this work.

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[25] Department of Health, January 2006

[26] Announced in the DH White Paper ''Whole System Long Term Conditions Demonstrators', December 2006

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The proposed **Assisted Living Innovation Platform** will be the mechanism to support this working, bringing together relevant players who would otherwise be unlikely to work together in such a structured and sustained way. If the WSDs are successful, the Innovation Platform will continue to support their national roll-out over a 3-5-year time scale. As demand for more sophisticated solutions develops, the intention is that the Innovation Platform play a role in facilitating technology collaborations, ensuring linkages between relevant KTNs[27] and bringing together research funding from a variety of sources (e.g. the Technology programme, FP7, the Ambient Assisted Living programme[28], the Research Councils, etc.).

Assisted living will require a range of enabling technologies, including **sensor, data technology** (including human interface) and **communications**. More defined areas of focus will be defined as the WSDs progresses. These enabling technologies are also applicable to **Intelligent Transport**

3.2.3 Food & Drink

International drivers

FP7

See the overview of the for an overview of support mechanisms, and for an overview of the main research themes.

National drivers

Legislation

Legislation is an important driver of technological developments that are eventually adopted by industry, including the food and drink industry. An overview is provided here because of the importance of food and drink within East Midlands manufacturing, and for regional employment.

Several mechanisms currently provide an incentive to firms to reduce their energy consumption and minimise waste.

Climate Change Levy and Climate Change Agreements

The Climate Change Levy is a tax on the use of energy in industry, public sector and commerce. Companies can enter into a Climate Change Agreement with government by which they get an 80% discount on the Climate Change Levy in return for meeting energy efficiency or carbon saving targets. In order to facilitate this process, the Department for Food and Rural Affairs (Defra) also supports firms adopting energy efficiency schemes or renewable sources of energy. Climate Change Agreements can be traded in the UK and Europe.

Landfill Tax

The landfill tax provides an incentive for companies to increase recycling and to develop other means of dealing with waste as an alternative to landfill. The tax will increase progressively over coming years, with the standard rate rising from £24 per tonne in the 2007/08 tax year by £8 per tonne each year from April 2008 until at least 2010/11.

Defra supports several programmes aimed at helping businesses reduce waste, including the Business Resource Efficiency and Waste programme (BREW) which itself operates several nationwide programmes including the Carbon Trust (advice on the adoption of low

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[27] Notably the KTNs for Sensors, Grid Computing, Cyber Security, and Location and Timing

[28] The Ambient Assisted Living Programme was established in 2007. It is an international programme that is the responsibility of Member States but receives support from the European Commission. The legal basis for the Commission's involvement is Article 169 of the European Treaty.

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carbon technologies) and Envirowise (energy efficiency and resource minimisation). BREW is currently approaching the end of its funding period (2007), but further three-year funding is expected and the forward strategy is under development.

Support for technology development

Defra-funded R&D programmes

Defra provides approx. £5m of its £134m science budget to support research and development in farming and food via a series of LINK programmes (see table below).

Table 11. Research themes under Defra Food and Farming LINK programmes

Food LINK	
Advanced Food Manufacture	- Principles and tools for design of processes (design for manufacture) - Improved process capabilities (efficiency, mass-customisation) - Higher operational efficiency through diagnostics and control
Food Quality and Innovation	- Quality of raw materials - Food ingredients, food safety, materials science - Delivery of improved nutritional quality - Sensory quality and customer perception

Horticulture LINK

- Efficient use of resources (especially energy, water and growing media)
- Novel and more efficient production and harvesting systems
- Efficient, environmentally acceptable and sustainable pest and disease control, contributing to integrated crop protection management (ICMS)
- Technologies to ensure the availability of quality UK produce at times required by the market
- Crops targeted to provide novel or improved food products (including proven protective and beneficial components of diet)
- Reduction and management of waste in production and processing
- Exploiting genomics for improving horticultural crop quality and productivity

Renewable Materials LINK

- New opportunities for non-food uses of crops
- Develop products from renewable materials with novel or improved functionality
- Optimisation of supply chains for sustainable development
- Research to support informed decision making on the environmental sustainability of products derived from renewable materials
- Improved understanding of primary production and the associated impacts of land use

Sustainable Arable LINK

- Novel methods of pest, disease and weed control
- Diagnostics and monitoring systems to identify pests or pathogens present at a 'pre-observable' level and to monitor plant status to improve targeting and efficiency of agrochemical use.
- Strategies for controlled resistance to pests
- Biotechnology, breeding and agronomy for specific end-uses
- Novel strategies for applying nutrients and reducing their loss to the environment
- Sustainable soil management systems
- Decision support systems
- Precision farming, for example exploiting advances in remote sensing to gain greater temporal and spatial precision in the use of non-renewable resources, such as fossil fuels, agrochemicals and fertilisers

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Sustainable Livestock Production LINK
▪ Genetic approaches to improving efficiency and quality of UK livestock production.
▪ Improvement of animal health and welfare in sustainable systems.
▪ Improving the sustainability of livestock production through optimal nutrition.
▪ Integration of livestock production with crop enterprises, including organic agriculture and integrated farm management systems
▪ Development and improvement of livestock husbandry systems.
▪ Improving environmental management of livestock systems.
▪ Optimising carcass processing efficiency at the abattoir.
▪ Social science aspects of sustainable livestock production
Opportunities for funding research into organic production
Covers the main LINK programmes outlined above

Activities under the Technology Programme

Food and drink companies can benefit from the Technology Programme by participating in Knowledge Transfer Partnerships, Collaborative R&D projects, and a variety of KTNs. For information on take-up of the Technology Programme in the East Midlands, see section 2.4, pages 22-29. For general information on the Technology Programme, see section 3.1.2, pages 33-34.

The **Food Processing KTN** is run by the Food Processing Faraday Partnership, which is based in the East Midlands region. In September 2006, the KTN published an outline research strategy that made the following points:

- ▪ Research should continue to be funded, despite poor industry record in applying existing results. Increasing competitive pressures require the UK food and drink industry to shift even more towards offering added value products and services

- ▪ Emphasis of any research supported should be on 'technology translation to generate application'

The strategy identifies the following research themes and areas of activity as priorities:

Areas of research activity	Research themes		
	Water, Waste, Energy	**Safety, Cleaning, Hygienic production**	**Human factors** (medical safety, health & safety, reduction of errors)
Processes new to the food industry	X	X	X
Process intensification	X	X	X
Sensors for control of quality	X	X	X
Intelligent mechatronics	X	X	X

The KTN will keep a watching brief on 4 areas of research activities that are also being funded by DTI and Defra:

- ▪ Processing ingredients into food

- ▪ Supply chain logistics and ingredient traceability

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- Nanotechnology (improvement of food processing equipment; application of molecular-scale food structuring processes)
- Legislation

3.2.4 Sustainable Construction

International drivers

FP7

For an overview of FP7, see pages 30-32. Key FP7 Thematic Areas for sustainable construction are Nanosciences, Nanotechnologies, Materials, and New Production Technologies, and Energy.

European Research Area

ERABUILD, is the European Research Area network for sustainable building, which formulates the strategic research agenda for European construction industry. The network aims to create synergies between national and European programmes and has issued a number of calls for pilot or research projects. The current funding for ERABUILD is coming to an end, and a successor programme of activity is under discussion, likely to focus on renovation for sustainable buildings and improved use of Information and Communications Technology in better value-driven construction processes. DBERR represents the UK on ERABUILD. The work of the UK's National Technology Platform for the Built Environment, which sets the research agenda for the UK construction industry, also informs ERABUILD.

Interreg Programme

Some stakeholders in the East Midlands believe that the Interreg IVB North Sea Programme is likely to be a more significant source of European funds than FP7 for the East Midlands because the main priority for the construction sector in the region is to achieve greater take-up of existing technologies.

National drivers

Sustainable Construction Strategy

Two strategies provide the framework for activity in the area of sustainable construction. The first is the Sustainable Development Strategy "Securing the Future", published in March 2005[29], and the second is the Sustainable Construction Strategy (draft 2007), which at the time of writing is out for consultation.

The draft Sustainable Construction Strategy[30] echoes the priority areas identified by the Sustainable Development Strategy[31] and sets out a series of immediate actions needed to support innovation in the sector to the end of 2008. They include:
- Greater engagement by Government with the relevant KTNs (identified as Modern Built Environment; Materials; Resource Efficiency; Integrated Pollution Management, and Sensors)

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[29] 'UK Government Sustainable Development Strategy', Defra, March 2005

[30] 'Draft Strategy for Sustainable Construction: A Consultation Paper', DBERR, DCLG, DCMS, Defra, Strategic Forum for Construction, July 2007

[31] These priority areas are: Sustainable production and consumption; Climate change and energy; Natural resources and enhanced environment; Creation of sustainable communities

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- Development of the Innovation Platform on Low Impact Buildings. The immediate priorities are to support:

  - Robust validation and demonstration of affordable insulation technologies for solid-walled homes, and
  - Technologies to for new housing to meet the energy and water efficiency targets set out in the Code for Sustainable Homes)

- Commitment by the Technology Strategy Board to build on the findings of the forthcoming Offices of Science and Innovation Foresight report on "Sustainable Energy Management and the Built Environment"

- Continued UK participation in ERABUILD and any successor, with a view to ensuring that UK learns from and co-develops:

  - New technologies for retro-fitting insulation/cladding; low carbon energy integration; water conservation systems, and for
  - "breathable" buildings and components

UK Technology Programme

A proposal for the Technology Strategy Board to support an **Innovation Platform for Low Impact Buildings** is under preparation by DCLG, Defra and BERR, intended to reduce the carbon footprint left by new and existing housing. Stakeholders have already identified 11 technology challenges on the way to low impact buildings:

- Delivering a healthy, low energy, indoor environment

- Making older buildings thermally efficient

- Changing user behaviour to improve energy efficiency

- Intelligent energy generating and using buildings

- Designing out waste in construction

- Better understanding and acceptance of new materials

- Sustainable deconstruction of buildings

- Sustainable refurbishment of buildings

- Smart water networks to reduce loss and improve efficiency

- Unbundled water services that provide differentiated water quality appropriate for use

- Low water consumption appliances and homes

Based on stakeholder discussions, the government departments engaged in proposing the platform have recommended that it focus on supporting activities that

- Enable UK industry to deliver new homes meeting level 6 of the Code for Sustainable Homes in energy and water consumption, materials and waste

- Deliver a step-change in the energy efficiency of existing housing through improved insulation, integration of renewable energy sources and smart energy management.

The budget for the Innovation Platform may be as much as £4m in its first year of operation and £10m per year in subsequent years. Of this, proposers suggest that up to 30% of its budget be spent on validation and demonstration activities.

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4. Internal drivers of the Regional Technology Framework

4.1 Cross-cutting internal drivers

4.1.1 Competitiveness & Employment Regional Operational Programme for the East Midlands

At the time of writing the East Midlands 2007-13 ERDF Competitiveness and Employment Operational Programme is still in draft form. It is expected that first funding will come on-stream in early 2008. The draft Operational Programme has two priorities, and Priority one is directly relevant to the Regional Innovation Strategy, including actions 10-12 of the strategy.

The draft Operational Programme aims to boost the productivity and sustainability of East Midlands businesses and to help its most disadvantaged communities realise their economic potential by:

- Supporting fewer, but larger and more strategic, investments than previous ERDF programmes

- Being more targeted than past programmes – both spatially and sectorally

- Ensuring that actions 'accelerate delivery' of the Regional Innovation Strategy

- There are two priorities for the programme, the first of which is directly relevant to the Regional Technology Framework:

- Increase productivity through innovation and sustainable business practice

- Increase sustainable and economic enterprise activity in disadvantaged communities

Priority 1:
Increase productivity through innovation and sustainable business practice

In the current draft, the Programme states that the European funds will contribute 40% towards the cost of activities under this priority, up to €115.4m (£78.5m), and therefore the maximum value of the Programme overall will be €288.5m (£196.1m).

There are two objectives for Priority 1: to increase business investment in innovation, and to reduce waste and promote resource efficiency. The activities foreseen in the Programme draws closely on the 'Innovation Strategy and Action Plan for the East Midlands 2007-2010'. Thus the Programme states that it will support activities that:

- Promote Knowledge exchange (iNets)

- Provide innovation support for business

- Create the environment for innovation

- Foster emerging and enabling technologies, and

- Promote sustainable consumption and production

More explicitly, the Technology Strategy Board is recognised as a driver of the Programme:

> 'where Structural Fund interventions aim to promote innovation and knowledge transfer, they will seek to achieve alignment with national priorities and maximise the benefits from collaborating with TSB-supported programmes',

The outcomes expected from the programme also echo the goals of the Regional Innovation Strategy. The draft states that the Programme will:

- Increase the number of businesses investing in innovation

- Increase overall levels of business investment in innovation

- Improve the effectiveness of the commercialisation process

- Recognise and build on regional strengths and take steps to secure sustainable competitive advantage

- Increase frequency of business-university interactions

In its draft form the Programme also provides further details of actions that correspond to the 'future' theme of the Regional Innovation Strategy[32], though it does not offer any definition of what is meant by 'emerging and enabling technologies'. For example, the draft Programme states that it will support actions to:

- Identify and support development of emerging and enabling technologies through university-business collaborations

- Build research capability and capacity of SMEs so that able to 'engage in R&D for emerging and enabling technologies'

- Promote benefits of enabling technologies and processes to SMEs, and provide support for SMEs to assess the implications of new technologies and processes

Suggested activities for these action areas include:

- Identifying and prioritising investments related to future prosperity of region

- Supporting pilot projects to promote commercialisation of regional expertise in enabling technologies and deployment of RE technologies

4.1.2 East Midlands Advanced Materials Strategy (October 2006)

The strategy has been developed by the Materials East Midlands Network, and seeks to build on East Midlands capacity and expertise in composites, minerals and aggregates. The strategy emphasises that although materials are relevant to most industrial sectors, materials production tends to be organised around the needs of certain types of industry. In order to move materials up the value chain, there is a need to build better interfaces and undertake activities that shift thinking away from materials as commodities to 'goods that enhance performance and life-cycle cost'.

The strategy has funding of £1.6m for the period 2006-2009, £300k of which is for technology development in the form of 'innovative projects' that support the strategy theme 'Commercialising scientific excellence through facilitated business collaboration'.

In addition the strategy has a £25k (budgeted for 2006-07) to map publicly-funded assets and equipment in universities and other organisations.

4.1.3 Regional Energy Strategy

A Regional Energy Strategy and Action Plan for the East Midlands has been developed in response to the UK government mandate that regions consider how to achieve goals set out in national energy strategy. A 'Framework for Action' was published in March 2007[33]; this prioritises actions to stimulate deployment of existing know-how and technology and to improve energy efficiency among users. Whilst the Framework does not include direct support for technology development, the actions are likely to foster markets for new technologies when these are ready to be commercialised.

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[32] That is, actions 10-12 of the RIS Action Plan, which are to be addressed by the Regional Technology Framework.

[33] 'East Midlands Regional Energy Strategy (Part 2): Framework for Action', *emda,* EERA, GO-EM, March 2007

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4.2 Sector-specific internal drivers

4.2.1 Transport technologies

The East Midlands Regional Economic Strategy recognises the strategic importance of the aerospace, automotive, motorsport and rail sectors, which are major employers in the region and generate high levels of GVA[34]. In recognition of this, the RES has set a target of achieving a 30% increase in transport equipment sector GVA over 2004-14.

emda co-funds several of the organisations that represent transport equipment industries in the region:

Midlands Aerospace Alliance   Motorsport Development UK

Midlands Marine Alliance   Silverstone Innovation Centre

The Agency also plans to support the proposed UK Rail Centre in Derby.

Transport Sector Implementation Plan

emda's Transport Sector Implementation Plan[35] is concerned with identifying business support measures for the sector generally, and innovation and technology is just one theme within it. The Plan notes that the structure of transport sector industries varies widely, with consequences for innovation support, For example:

- Most industries in the sector are organised in supply chains and therefore 1-to-1 support for individual companies has little overall impact

- In some industries (e.g. aerospace) SMEs are not relevant focus for strategic intervention – it has to be much broader

- For aerospace and rail, development and manufacturing programmes are measured in decades (very different from time-scales in the food and drink sector, for example)

- There are technological links between power generation and transport equipment, particularly with the aerospace industry, and therefore, though there are few companies in the region working in power generation, there is scope for companies serving aerospace to diversify into the energy sector, particularly as new energy markets develop.

Under the theme 'Innovation and Technology' the Plan proposes that interventions should concentrate on ensuring that:

- Knowledge of future developments diffuses into and down supply chains

- Supply chains have access to technology centres in the region

- There is greater involvement of supply chains in technology programmes

- Investment from National and European programmes is supported by key investments in the region (e.g. into technology centres). The aim is to achieve 'maximum regional gearing from national programmes with significant activity in the region'

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[34] Data from Transport Equipment Sector Strategy (draft):

Aerospace accounts for 60% of transport equipment employment in the region; there are 250 companies based in the region that serve the rail sector, providing 7,000 jobs and including several globally significant rail consultancies; some 8,000 jobs are connected with the automotive industry (5,000 of these with Toyota); 625 companies serving the marine sector are based in the region, employing 2,300 people; 2 of the UK's 7 Formula 1 teams are based in the East Midlands.

[35] 'East Midlands Transport Equipment Sector Strategy– draft' *emda,* March 2007

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- Sector support planned in the East Midlands is aligned with activity in the West Midlands

East Midlands Advanced Materials Strategy

The East Midlands Advanced Materials Strategy recognises the importance of materials to transport sector industries, particularly lightweight composites and technical textiles, in which the region has strong materials capability. Key users of materials technology include Rolls-Royce, Bombardier, Goodrich, Smiths Aerospace, EPM Technologies, Advanced Composites Group and M Wright and Co.

Other regional strategies

Aerospace

Midlands Aerospace Alliance Five-Year Strategy 2006-2011

The Midlands Aerospace Alliance (MAA) was established in 2003 to represent the aerospace industry across the Midlands region. MAA currently has 200 members, embracing industry, university researchers, private consultants, trade unions, local government and skills and training agencies. In 2006, the MAA published its five-year strategy which sets out the vision of the MAA to continue to strengthen its role as a driver of aerospace in the Midlands, working to improve the performance of companies and other organisations in the sector. The strategy has three strands:

- Share knowledge (information and networking opportunities);
- Deliver specialised support programmes for innovation and technology development;
- Lead and co-ordinate a shared strategy focused on influencing the business and policy environment

Motorsport

Based at Silverstone Innovation Centre, Motorsport Development UK (MDUK) was established in 2003 as a private/public sector partnership responsible for spearheading and implementing a five-year, £11.5m investment programme in UK motorsport (due to complete March 2009). MDUK is supported financially by *emda*, SEEDA, EEDA, AWM and DBERR. The Motorsport Industry Association (MIA) was active in calling for its creation.

MDUK has five areas of activity[36], three of which are concerned with education, training and widening participation in the sport. The remaining two are concerned with technology development:

- 'Business Development' focuses on pursuing opportunities for motorsport companies to trade internationally and to diversify, e.g into aerospace markets
- Energy Efficient Motorsport (EEMS) aims to highlight motorsport as an effective development environment for road car applications. Investment under this strand has been focused on facilitating the use of alternative energy sources while developing the means to regulate fuel flow under race conditions and hence create true energy-efficient racing, where those cars that make best use of fuel consumed have a competitive advantage.

Marine

Midlands Marine Alliance was launched in February 2007 and at time of writing no strategy was available for inclusion in the evidence pack.

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[36] 'Annual Report 2005', Motorsport Development UK

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Rail

UK Rail Centre in Derby is due to open in 2008, when it will act as an export showcase for the industry.

4.2.2 Healthcare

Life and Health Technology (LHT) Sector Strategic Delivery Plan

The consultation paper for the 'Life and Health Technology (LHT) Sector Strategic Delivery Plan 2007-2012 (December 2006) sets out actions required to accelerate the development and growth of this sector in the East Midlands. The plan contains a number of 'tactical interventions' that are concerned with building up the critical mass of the cluster by supporting technology development and exploitation. They include:

- Increasing the number and quality of new businesses (via BioCity's Germinator, and the Biobater, based at Leicester University)

- Developing facilities and accommodation (Plan calls for organisation to co-ordinate supply of this for LHT sector)

- Development of 'a major research centre'

- Skills improvement (both managerial and technical, deemed very important to build critical mass because task will not be possible if skilled people move away to take up opportunities in other regions)

- Increase breadth and depth of HEI-business interactions via brokered knowledge exchanges

- Improving access to and take-up of national and European R&D funding

The LHT Plan calls for regional service to support preparation of FP7 proposals – it suggests a combination of Medilink plus a specialised sub-contractor. (Similar schemes were run for FP6 in both the West Midlands and the North East)

The LHT plan notes that HEIs are strong in 'fundamental science' (forensics, pharmacology, clinical research, new materials, nanotechnology, post-genomic technologies, biosciences, chemistry, drug discovery, drug development), whilst the region's strengths in application of technology lie in stroke, cardiovascular disease, neurology, and oncology.

4.2.3 Food and Drink

East Midlands Food and Drink Sector Strategy

The draft East Midlands Food and Drink Sector Strategy[37] notes that industry trends in the East Midlands mirror those of the wider sector in the UK. For example:

- Skills are a major issue. IMPROVE, the Food and Drink Sector Skills Council, has predicted that employment requiring elementary skills (lower than level 2) will fall by 50% over the next 15 years, whilst 50% more managers will be required[38].

- Small companies tend to be bought up by international companies if successful

- Equipment not produced in UK

- Production tends to be outsourced, with companies moving towards assembly of finished products on site

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[37] 'East Midlands Food and Drink Sector Strategy', Draft no. 3, March 2007, Food and Drink Forum
[38] Quoted from the East Midlands Food and Drink Sector Strategy

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- Companies need to invest to tap into growth segments of the market, but finance hard to get

- Competitive pressures make it hard to plan long-term

The East Midlands Food and Drink Sector Strategy calls for a supply chain approach in order to move the whole industry up the value chain. In the area of innovation and technology therefore, the aim is to ensure that knowledge about innovation and technology opportunities diffuses into the whole supply chain. Activities that support this part of the strategy include:

- Ensure region's food academic centres provide a seamless service focusing on innovation, technology and food science. Extend this along the supply chain to engineering, logistics, biotechnologies, pharmaceuticals and food specific business support services

- Utilise the strong industry threats of increased energy & waste removal costs to drive manufacturing efficiencies and technology transfer

- Provide R&D planning and project management support

- Extend the provision of food-grade premises and associated services to enable more companies to grow

- Develop supply chain initiatives to encourage collaborative working, local sourcing of equipment, products and services and joint ventures into technology transfer

Food and Drink regional assets

Two East Midland HEIs achieved ratings in the RAE 2001 for food science and technology:
- University of Nottingham School of Biosciences (5) and
- The University of Lincoln (3b)

The region is home to the Food Processing KTN, and has a membership-based Food and Drink Forum for the industry in the region. There are also two food parks:
- Southglade Food Park (accommodation and business support centre)
- University of Lincoln Holbeach Campus (specialist food technology and food manufacturing centre)

4.2.4 Sustainable Construction

East Midlands Advanced Materials Strategy

This Advanced Materials Strategy is highly relevant to construction sector activity since it is concerned in part with aggregates and minerals, where the East Midlands has considerable industrial capacity. The strategy proposes actions to move materials up the value chain, via better industry and other interfaces, and by undertaking activities that shift thinking away from materials as commodities to 'goods that enhance performance and life-cycle cost'.

East Midlands Construction Sector Implementation Plan

The draft East Midlands Construction Sector Implementation Plan[39] does not prioritise specific technologies for support, but instead will fund:

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[39] 'East Midlands Construction Sector Implementation Plan 2007-2011, v.8.0' East Midlands Centre for Constructing the Built Environment (EMCBE)

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- Establishment of an Innovation Network (iNet) to 'raise the number and quality of interactions between innovation stakeholders and to increase levels of innovation' and

- Activities that increase profitability by improving efficiency, or by exploiting 'new and emerging technologies'

East Midlands Construction Sector Implementation Plan recognises the region's strong research base in construction-related areas, but also acknowledges weaknesses in the company base, particularly and limited take-up of digital technologies and efficient construction processes, together with limited engagement between firms with the research base. The Plan calls for activities to address these weaknesses, including support for greater industry-academic collaboration, and support for take-up of technology to improve productivity (e.g. lean construction methods) and business processes (e.g. e-commerce). Such plans find an echo in Government commitments to use procurement and regulation to create a construction market for low-carbon technologies, products and services.

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Annexes

I.: Collaborative R&D projects involving organisations based in the East Midlands[40]

Design Engineering and Advanced Manufacturing

Funding (£m)		No. projects involving East Midlands organisations	
Public	18.8	Technologies to support Environmentally Friendly Transport: Aerospace	6
Private	20.3	Design, Simulation and Modelling	9
Total	**39.1**	Advanced Manufacturing - Direct Writing	4
		Management of complex fluid flow conditions	3
		Validation of Complex Systems	1
		Total	**23**

Activity Breakdown – 4 HEIs

	Partner	Lead partner
University of Nottingham	5	
De Montfort University	2	
Loughborough University	2	
Nottingham Trent University	1	
Project involvement	**10**	**0**

Activity breakdown – 25 Companies

	Partner	Lead partner
Advanced Composites Group	1	
Aggregate Industries		1
Beta R&D	1	
Bombardier Trans Holdings		1
British Precast Concrete Federation	1	
Caterpillar UK	1	1
Dana Automotive Ltd	1	
Delmia	1	
Golarath	1	
Langford Lodge	1	
Meridian Technology	1	
Moyola	1	
Newage International	1	
Pera Innovation	1	
Printed Electronics	1	
Project Design Engineers	1	
Rolls Royce		7
Ross Ceramics Ltd	1	
Serantel Ltd	1	
Sermatech	1	
Strahl Ltd	1	
Thales	1	
Unimatic Engineers Ltd		1
Wrightbus	1	
Zytek Electric Vehicles	1	1
Project involvement	**21**	**12**

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[40] Evidence collected from Technology Programme database during June 2007

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Electronics and photonics

Overview

Funding (£m)		No. projects involving East Midlands organisations	
Public	9.2	Sensor and Sensor Systems for Environmental Applications	4
Private	9.0	Optoelectronics and Disruptive Electronic Technologies	4
Total	**18.2**	Novel Technologies for Low-Cost, High Efficiency Electronics & Lighting Systems	3
		Next Generation Lasers in Manufacturing, Health and Security	1
		Imaging Technologies	2
		Power Electronics and Electrical Power Control Systems	2
		Total	**16**

Activity Breakdown – 4 HEIs

	Partner	Lead partner
University of Nottingham	3	
University of Lincoln	1	
Loughborough University	1	
Nottingham Trent University	1	
Project involvement	**6**	**0**

Activity breakdown – 8 Companies

	Partner	Lead partner
AML	1	
AstraZeneca	1	
Bookham Technology	1	1
E.On UK Power Technology	2	
Loughborough SA	1	
Rolls Royce		3
Semelab		1
Uvasol Ltd		1
Project involvement	**7**	**6**

Sustainable Production and Consumption

Overview

Funding (£m)		No. projects involving East Midlands organisations	
Public	5.7	Waste Management and Minimisation	4
Private	6.2	Design and Manufacture of Sustainable Products	3
Total	**11.9**	Meeting the Challenge of Zero Emission Enterprise: Feasibility Studies	3
		Energy Efficient Technologies	2
		Contaminated Land Remediation Technologies	1
		Total	**13**

Activity Breakdown – 4 HEIs

	Partner	Lead partner
De Montfort University	2	
Loughborough University	2	
University of Leicester	2	
University of Nottingham	3	
Project involvement	**9**	**0**

Activity breakdown – 19 Organisations

	Partner	Lead partner
Advantica Ltd		1
Bodycote H.I.P Ltd	1	
British Precast Concrete Federation	1	
Charnwood Borough Council	1	
Digital Living Ltd	1	
East Midlands Housing	1	
Efflotreat		1
H J Enthoven & Sons		1
Ibstock Brick	1	
Modular and Portable Building Association,	1	
Monarch Knitting Machinery	1	
NetComposites	1	
Packaging and Industrial Films Association	1	
Parker Plant Limited	1	
Pera Innovation	2	
Rolls Royce	1	1
Sure Technology	1	
The Boots Company	1	
Wood Panel Industry Federation	1	
Project involvement	**17**	**4**

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Advanced materials

Overview

Funding (£m)		No. projects involving East Midlands organisations	
Public	5.9	Advanced Composite Materials and Structures	4
Private	7.4	High performance in Extremely Hostile Environments	2
Total	**13.3**	Materials Modelling	2
		Materials for Extended First Use and Re-use	2
		Smart Materials and Related Structures	1
		Total projects	**11**

Activity Breakdown – 2 HEIs

	Partner	Lead Partner
University of Nottingham	2	1
Loughborough University	1	0
Project involvement	**3**	**1**

Activity breakdown – 11 Companies

	Partner	Lead Partner
Advanced Composites Group	2	
E.ON UK plc		1
EPM	1	
Euro Projects	1	1
Fibre Technology Ltd	1	
Formax	1	
NDT Solutions	1	
Pera Innovation	1	1
Rolls Royce	1	
Scott Bader	1	
Uvasol	1	
Project involvement	**11**	**2**

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Bioscience and Healthcare

Overview

Funding (£m)		No. projects involving East Midlands organisations	
Public	5.1	Bioprocessing	6
Private	7.9	Bio-Based Industrial Products And Processes	1
Total	**13.0**	Regenerative Medicine Technologies	1
		Total	**8**

Activity Breakdown – 4 HEIs

	Partner	Lead partner
University of Nottingham	2	1
University of Leicester	1	
Loughborough University	1	
Project involvement	**4**	**1**

Activity breakdown – 5 Companies

	Partner	Lead partner
Hyperlast	1	
Micron Design	1	
Pera Innovation	1	
RegenTec	2	
The Boots Company	1	1
Project involvement	**6**	**1**

Emerging Energy Technologies

Overview

Funding (£m)		No. projects involving East Midlands organisations	
Public	1.7	Oil and Gas Technologies	2
Private	2.6	Low Carbon Energy Technologies	2
Total	**4.3**	New and Renewable Energy	1
		Total projects	**5**

Activity Breakdown – 0 HEIs

Activity breakdown – 5 Companies

	Partner	Lead Partner
BAE Systems		1
Beta R&D	1	
Econnect Ventures Ltd		1
Pera Innovation		1
Technical Fibre Products	1	
Project involvement	**2**	**3**

ICT DTI funded collaborative R&D projects

Overview

Funding (£m)		No. projects involving East Midlands organisations	
Public	4.2	Inter-enterprise Computing	2
Private	6.1	Data & Content Storage, Management, Retrieval & Analysis: Software	1
Total	**10.3**	Data, Scientific & Medical Visualisation for Innovative Products & Services	1
		Pervasive Computing, including Networks & Sensors	1
		Total	**5**

Activity Breakdown – 4 HEIs

	Partner	Lead partner
University of Nottingham	1	
Loughborough University	1	
Project involvement	**2**	**0**

Activity breakdown – 5 Companies

	Partner	Lead partner
Advanced Composites Group Ltd	1	
Rolls Royce		2
Epistemics	1	
Link Integrated Security		1
Pera Innovation	1	
Project involvement	**3**	**3**

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Table 12. Involvement in Collaborative R&D projects across the East Midlands HEIs

	UoN	Lboro	DMU	Leic	NTU	Linc	Total per Tech Area
Key Technology Area							
Design engineering & advanced manufacturing	5	2	2		1		**10**
Electronics and photonics	3	1			1	1	**6**
Sustainable production and consumption	3	2	2	2			**9**
Advanced materials	3	1					**4**
Bioscience and healthcare	2	1		1			**4**
ICT	1	1					**2**
Total per HEI	**17**	**8**	**4**	**3**	**2**	**1**	**35**

Source: Technology Programme project database[41]

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[41] http://www.technologyprogramme.org.uk/site/publicRpts/default.cfm?subcat=publicRpt1

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Table 13.   Company and other organisations' involvement in Collaborative R&D projects

Company name	No. Projects Lead	No. Projects Member
Rolls Royce	13	2
Pera Innovation	2	6
Advanced Composites Group Ltd		4
E.ON UK plc	1	2
The Boots Company	1	2
Bookham Technology	1	1
Caterpillar UK	1	1
Euro Projects	1	1
Uvasol Ltd	1	1
Zytek Electric Vehicles	1	1
Beta R&D		2
British Precast Concrete Federation		2
RegenTec		2
Advantica Ltd	1	
Aggregate Industries	1	
BAE Systems	1	
Bombardier Trans Holdings	1	
Econnect Ventures Ltd	1	
Efflotreat	1	
H J Enthoven & Sons	1	
Semelab	1	
Unimatic Engineers Ltd	1	
AML		1
Astra Zeneca		1
Bodycote H.I.P Ltd		1
Charnwood Borough Council		1
Dana Automotive Ltd		1
Delmia		1
Digital Living Ltd		1
East Midlands Housing		1
Epistemics		1
EPM		1
Fibre Technology Ltd		1
Formax		1
Golarath		1
Hyperlast		1
Ibstock Brick		1
Langford Lodge		1
Link Integrated Security		1
Loughborough SA		1
Meridian Technology		1
Micron Design		1
Modular and Portable Building Association		1
Monarch Knitting Machinery		1
Moyola		1
NDT Solutions		1
NetComposites		1
Newage International		1

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Table 14 (cont)

Company Name	No. Projects	
	Lead	Member
Packaging and Industrial Films Association		1
Parker Plant Limited		1
Printed Electronics		1
Project Design Engineers		1
Ross Ceramics Ltd		1
Scott Bader		1
Serantel Ltd		1
Sermatech		1
Strahl Ltd		1
Sure Technology		1
Technical Fibre Products Ltd		1
Thales		1
Wood Panel Industry Federation		1
Wrightbus		1
Totals	**31**	**67**

Source: Technology Programme project database[42]

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[42] http://www.technologyprogramme.org.uk/site/publicRpts/default.cfm?subcat=publicRpt1

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II. Knowledge Transfer Partnerships involving organisations based in the East Midlands[43]

Table 14. Take-up of KTPs by companies in the East Midlands

	Elec & Mech Eng	Mfng Eng	Proc Eng	Food Pro	E-comm	Design	Computing	Mktg	Mats	Adv IT	Sci	Civ Eng	Clean Tech	Qual	Biotech	Multi-media	Agric	Mgt Sci	Other
2BP Ltd																		1	
Access Hydraulics									2										
ACS Systems								1											
Aida Bliss (Europe) Ltd	1																		
Alan Shelton Ltd																			1
Albert Browne Ltd															1				
Alltech (UK) Ltd															1				
AM Labels								1											
Ariel Industries plc	1																		
Armillatox Ltd						1							1						
Arnott Conveyors						1													
Arrow Technical Services	2																		
ASG (Accessories) Ltd						1													
Ashton Court Group										1									
Autobraid Ltd								1											
Autochair Ltd						1													
Axis Software Systems							1												
B&H (Leics) Ltd									1			1							
Bambino Mio									1										
Belvoir Fruit Farms				1															
Belwood Foods		1																	
Bennett Windows						1													
Bergmann Direct Ltd	1																		
Bevans Holdings (Leicester)	1																		
BFS Group				1											1				
Bluesky International Ltd										1									
Bmi British Midland plc																		1	

[43] Evidence collected from Technology Programme database during June 2007

	Elec & Mech Eng	Mfng Eng	Proc Eng	Food Pro	E-comm	Design	Computing	Mktg	Mats	Adv IT	Sci	Civ Eng	Clean Tech	Qual	Biotech	Multi-media	Agric	Mgt Sci	Other
Bostik Ltd	1																		
Bottom of Form										3									
Bowater Containers		1												1					
Branall Ltd					1		1												
Branston Ltd			1																
British Gas plc	1																		
Brush Transformers Ltd		1																	
Business Link Nottinghamshire																		1	
C W Sellors (Gold & Silversmiths)						1													
Caledonian Mining Co.		1																	
Cambridge Carbonates Ltd											1								
Campbell Scientific Ltd	1										2								
Cannon Engineers and Associates																			1
Castillion Precision Engineering		1																	
Caunton Engineering			1																
Charles Lawrence Surfaces plc						1													
Chilprufe Ltd																		1	
Clayton Equipment	1																		
Clerical Gas						1													
Coba Plastics						1													
Cobra Design Centre (Seats)											1								
Collis Engineering																		1	
Common Time Ltd								1											
Concrete Products (Lincoln) 1980								1											
Cooper Parry LLP																		1	
Cooper Research Technology Ltd							1												
Corporate Ideas (UK)										1									
CRC Corporation																			1
Creative Tops Ltd						1													

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	Elec & Mech Eng	Mfng Eng	Proc Eng	Food Pro	E-comm	Design	Computing	Mktg	Mats	Adv IT	Sci	Civ Eng	Clean Tech	Qual	Biotech	Multi-media	Agric	Mgt Sci	Other
CSW Coldform Ltd	1		1																
Cursor Controls	1																		
D & H Engineering																			1
Dartex Coatings									1										
Davy Morris																			1
Deaf-Alerter plc										1									
Deanestor plc																		1	
Design Rule						1													
Dexion						1													
Dormer Tools									1									1	
Driver Technology						1													
Dunlop Cox	1																		
Dynex Semiconductor Ltd	1																		
e2v Technologies	1		1			1													
Easi-Bind International	1						1												
East Midlands Electricity plc												1							1
East Midlands Quality Centre								1											
EEV																			1
Elite Thermal Systems Limited									1										
Emics							1												
Eminox Ltd							1												
Engineering Systems (Nottingham)						1													
Environmental Engineering Group Ltd															1				
ERF Electrical Wholesalers																		1	
Esit										2									
Esprit Automation Limited											1								
Ethical Techhology Ltd										1									
Evets Communications						1													
Express Lift Co. Ltd	1																		
F Ball & Co									1										
Fairfield Control Systems	1							1											

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	Elec & Mech Eng	Mfng Eng	Proc Eng	Food Pro	E-comm	Design	Computing	Mktg	Mats	Adv IT	Sci	Civ Eng	Clean Tech	Qual	Biotech	Multi-media	Agric	Mgt Sci	Other
Falcon International Bags Ltd					1														
Fast React Systems																		1	
Femcare						1													
Fesa Ltd							1												
Finedon Mill				1															
Flexpress																		1	
Flowserve Pumps		1																	
Fluorocarbon Bakeware Systems																		1	
Force Engineering Ltd			1			1													
Ford Group of Nottingham								1											
Formax (UK) Limited									1										
Fosse Ltd								1											
Freshcut Foods						1													
Fusion Provida Ltd							1												
Gas Container Services		1																	
GCS Engineering (Derby)	1																		
GEC Alsthom Eng Systems Ltd							1							1					
GEC Power Inst & Control Ltd							1												
Gent Ltd							1												
Geoquip Ltd	1																		
Golder Associates (UK) Ltd												1							
Grantham Motor Company								1		1									
Guidance Monitoring																			1
Guttridge Services																		1	
H J Tinsely & Co							1												
H R Adcock Ltd						1				1									
H5 Ltd																		1	
Haley Sharpe Associates		1																	
Hambleside Danelaw						1													
Hamilton House Mailings								1											
Hepworth Refractories														1					

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	Elec & Mech Eng	Mfng Eng	Proc Eng	Food Pro	E-comm	Design	Computing	Mktg	Mats	Adv IT	Sci	Civ Eng	Clean Tech	Qual	Biotech	Multi-media	Agric	Mgt Sci	Other
Hill Holt Wood Ltd						1													
Hodges & Drake Design						2													
Househam Sprayers						1		1											
I Holland Ltd		1																	
Infranor		1			1														
Infrared Integrated Systems									1										
Insitution of Gas Engineers and Managers																		1	
Interfleet Technology		1																	
Ivor Shaw Ltd																		1	
J C Kellet (Developers)																		1	
Jack Masters Ltd																		1	
Jackson & Keay Ltd					1														
JCB Service	1	2	1									1							
JCM Seating Solutions						1													
Jetpress Sales		1						2											
Jones & Shipman	1																		
Kato Precision (UK) Limited									1										
Kettering Textiles					1	1													
Keystone Software Development							1												
Kimbell Construction Ltd							1												
Kingsfield Computer Products								1											
Krohne Ltd	2													1					
Krystals																		1	
Kybotech						1													
L Gent Ltd	1																		
Laser Rail Ltd						1													
Leicester City West Primary Care Trust																1			1
Lewis and Hickey								1											
Lifeforce Alliance Ltd																			1
Linear Drives Ltd	1																		

	Elec & Mech Eng	Mfng Eng	Proc Eng	Food Pro	E-comm	Design	Computing	Mktg	Mats	Adv IT	Sci	Civ Eng	Clean Tech	Qual	Biotech	Multi-media	Agric	Mgt Sci	Other
Lionmede Ltd			1																
Long-Airdox	1																		
Lucy Locket Ltd								1											
Lumitech Ltd											1								
Luxfer Group	1								5										
M Wright & Sons Ltd		1																	
Macarthy Hughes International							1	2											
Mantenance Ltd								1											
Marconi Command and Control System							1												
Marlec Engineering						1							1						
Matrix Marketing										1									
McDonald Engineering		1																	
Meads Ltd																		1	
Metallifacture																			1
MGN Electronics							1												
Micrographic & Imaging Technology								1											
Microlise		1																	
Micrometric Techniques									1										
Midland Software																			1
MMT Ltd																1			
Molecular Profiles			1																
Morrisflex	1																		1
Motorola Computer Products Group	1																		
Moulded Circuits	1																		
MSA Engineering Systems	1																		
Nei International Combustion		1																	1
Newton Derby Ltd						1													
Northampton Machinery Company						1													
Nylacast Oilon Ltd											1								
Optima Graphic Design								1											

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	Elec & Mech Eng	Mfng Eng	Proc Eng	Food Pro	E-comm	Design	Computing	Mktg	Mats	Adv IT	Sci	Civ Eng	Clean Tech	Qual	Biotech	Multi-media	Agric	Mgt Sci	Other
Opus Metrology Ltd	1																		
Orchid (UK)																		1	
OTR Tyres Ltd		1																	
Pacer Systems		1																	
Pafec Ltd		2																	
Pal International plc						1													
Particle Technology Limited											1								
Pci Systems										1									
Pegson Ltd	1																		
Pennine Healthcare						1													
Penny Hydraulics Ltd							1												
Planet Fabrications						1													
Powdertech (Corby) Ltd																		1	
Pozzani Pure Water plc											2		1						
Premier Grocery Products				1															
Primetake	1																		
Quantum Clothing Group								1											
Raddcliffe Rehabilitation Services						1													
Ramesys (business Services) Ltd												1							
Ramtech Electronics	1					1													
Ransomwood Estates																			
Readifoods								1											
Rearsby Automotive Ltd	1							1											
Reed Plastic Containers	1																		
Regent Heat Transfer	1																		
Rhp Bearings (newark) Ltd														1					
Richard Kimbell Ltd		1																	
Rim-Cast Ltd								1											
Robotec		1																	
Rolls Royce						1		1	2										1
Romax Technology Ltd	2	1						1											

	Elec & Mech Eng	Mfng Eng	Proc Eng	Food Pro	E-comm	Design	Computing	Mktg	Mats	Adv IT	Sci	Civ Eng	Clean Tech	Qual	Biotech	Multi-media	Agric	Mgt Sci	Other
Rototek Ltd			1			1													
S & A Foods				1															
S & P Coil Products Ltd																			1
Safe Technology Ltd	1																		
Samco-strong Ltd							1												
Sarantel Group						1													
Save It Nottingham								1											
Scott Wilson Pavement Engineering												1							
Semelab										1									
Shawtrack Services Ltd		1																	
Silicone Altimex Ltd	1																		
Simon Clyde Materials Handling		1																	
Smartscan Ltd		1								1									
Smith of Derby																		1	
Solutions Group (UK) plc					1		1												
Southfields Coachworks		1																	
Soutron										1									
Stanton plc																			1
Streets Heaver Computer System Ltd										1									
Strong and Fisher Ltd									1										
Sue Ryder Care Direct								1											
Supply Point Systems Ltd		1																1	
Sustainable Ecological Architecture			1																
T W Kempton (Corporate Clothing) Ltd			1																
T.H Clements & Son								1									1		
Tecquipment Ltd		1																	
Tector																			1
The Tile Studio									1										
Thomas Turton									1										
Timber Technology Ltd									1										

	Elec & Mech Eng	Mfng Eng	Proc Eng	Food Pro	E-comm	Design	Computing	Mktg	Mats	Adv IT	Sci	Civ Eng	Clean Tech	Qual	Biotech	Multi-media	Agric	Mgt Sci	Other	
Tingdene Homes Ltd		1																	1	
Tool and Steel Products		1																		
Transmitton Ltd	1																			
Transvac Systems						1														
Trent Concrete												1								
Tritex (International) Ltd		1																		
Triton Technology Limited											1									
Tungstone Batteries	1																			
Unicorn Products Ltd						1														
Uniq Prepared Foods													1							
University Hospitals of Leicester NHS Trust							1													
Uponor Limited									1											
Utopia UK			1																	
Vega Skillchange							1													
Victor and Young Ltd					1															
W J Furse & Co	1																		1	
Walker & Son (Leicester)		1																		
Wayzgoose Plc														1						
Worthington Software Systems							1													
Totals	**46**	**35**	**11**	**6**	**7**	**44**	**26**	**28**	**24**	**17**	**11**	**6**	**6**	**5**	**3**	**2**	**1**	**24**	**20**	**322**

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III. Workshop participants

Table 15. Participants at workshop on Transport Technologies, 26 June 2007

Organisation	Title	First name	Surname	Job Title
CENEX	Mr	Paul	Bromby	SMMT Foresight Vehicle Cenex Low Carbon and Fuel Cell Technologies KTN
East Midlands Universities Association (EMUA)	Ms	Jenny	Kenning	Director of Operations
emda	Ms	Catherine	Allford	Investment Manager - Automotive
emda	Mr	Eric	Boultbee	sector Innovation Manager - energy, environment and rail
emda	Mr	Ray	Newell	Sector Innovation Manager - Aerospace
Greater Nottingham Partnership	Mr	Mark	Sisson	Strategic Partnerships Manager
Innovation East Midlands (InnEM)	Prof.	Phil	Ruffles	
Loughborough University	Dr	Robert	Harrison	Senior Lecturer
Loughborough University	Mr	John	Richardson	Director, Ergonomics and Safety Research Institute (ESRI)
Loughborough University	Prof.	Richard	Stobart	Ford Chair of Automotive Engineering
Loughborough University	Dr	Kathryn	Walsh	Director, Business Partnerships
Midlands Aerospace Alliance	Dr	Andrew	Mair	Chief Executive
Midlands Marine Alliance	Mr	Adrian	Waddams	
Rolls Royce	Mr	David	Barnes	Programme Manager - UK Programmes, Regional Interface
Society of Motor Manufacturers and Traders	Mr	David	Ruffell	Membership Development Manager
University of Nottingham	Prof.	Andrew	Long	Head of Polymer Composites Research Group Chair of EMUA Transport Technology Research Group

Apologies sent by:				
Sustainable Technology Solutions (STS) Ltd	Mr	Karl	Seare	Director
emda	Mr	Ben	Sumner	Investment Development Co ordinator
ETETE Ltd	Mr	George	Tansley	Consultant
Loughborough University	Dr	Vicky	Story	Lecturer in Marketing, Centre for Automotive Management
Motorsport Development UK	Mr	Howard	Partridge	Development Manager
University of Leicester	Dr	David	Ward	Director of Research and Business Development
	Mr	Mike	Evanson	Consultant

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Table 16. Participants at the workshop "Sustainable Construction", 26 June 2007

Organisation	Title	First name	Surname	Job Title
Bowmer & Kirkland	Mr	David	Walker	Director
East Midlands Universities Association (EMUA)	Ms	Jenny	Kenning	Director of Operations
emda	Mr	Eric	Boultbee	Sector Innovation Manager - energy, environment and rail
emda	Dr	Martin	French	Director, Innovation East Midlands
emda	Ms	Catherine	Simpson	International Investment Manager, New Technologies
emda	Mr	Chris	Ward-Brown	Sector Innovation Manager - Construction
Innovation East Midlands (InnEM)	Prof.	Phil	Ruffles	
University of Derby	Mr	Harold	Convey	Business Development Manager, Faculty of Arts, Design and Technology
University of Leicester	Dr	Tim	Brewer	Senior Lecturer, Applied Geology
University of Northampton	Dr	Frank	Burdett	Pro Vice-Chancellor Research and Business Development

Apologies

Organisation	Title	First name	Surname	Job Title
Loughborough University	Prof.	Andrew	Dainty	Director of Research, Department of Civil and Building Engineering
Leicester Shire Economic Partnership	Ms	Niloofar	Sarkari	Enterprise and Innovation Project Manager
BRE (Building Research Establishment)	Mr	Kevin	Scobell	Commercial Director
University of Northampton	Mr	Ian	Mansell	Research and Knowledge Transfer Manager
University of Nottingham	Mr	Keith	Baker	Director, Environment Technology Centre
The Resource Efficiency Knowledge Transfer Network	Mr	Arnold	Black	Network Director

Send copy of notes to:

Organisation	Title	First name	Surname	Job Title
University of Lincoln	Mr	Paul	Kitson	Head of Business Development
West Northamptonshire Development Corporation	Mr	Paul	Quinn	Regeneration Manager

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Table 17. Participants at workshop on "Healthcare", 27 June 2007

Title	First name	Surname	Job Title	Organisation
Dr	Christopher	Brock	Team Manager - Sector Innovation	emda
Dr	Darren	Clark	Chief Executive	Medilink East Midlands
Dr	Glenn	Crocker	Chief Executive	Biocity Nottingham
Dr	Carl	Edwards	Managing Director	NHS Innovations East Midlands
Dr	Chris	Jones	Biobator Manager, Research and Business Development Office (RBDO)	University of Leicester
Ms	Linda	Leehane	International Investment Manager, High Technologies	emda
Mr	Saneth	Wijayaratna	Business Manager	Telemedcare
Ms	Heather	Woolford	Sector Innovation Manager - Healthcare and Bioscience	emda

Apologies

Title	First name	Surname	Job Title	Organisation
Dr	Gordon	France	Vice President - Strategy Technology and Systems	AstraZeneca
Mr	Ken	Larkin	International Investment team Manager	emda
Ms	Niloofar	Sarkari	Enterprise and Innovation Project Manager	Leicester Shire Economic Partnership
Dr	Nichola	Seare	Director Prospect-IP	De Montfort University
Mr	David	Wallace	International and Innovation Director	emda
Prof.	David	Williams	Professor of Healthcare Engineering	Loughborough University

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Table 18. Participants at workshop on "Emerging and Enabling Technologies", 27 June 2007

Organisation	Title	First name	Surname	Job Title
De Montfort University	Prof.	Philip	Moore	Head of Research and Commercial Development, Faculty of Computing Sciences and Engineering
De Montfort University	Ms	Ann	Palmer	Research Fellow Textile Engineering And Materials (TEAM) Research Group
E.On UK, Power Technology	Mr	Mike	Colechin	R&D External Interface Manager
East Midlands Europe	Mr	Michael	Bryan	Policy Advisor
East Midlands Universities Association (EMUA)	Ms	Jenny	Kenning	Director of Operations
Econolyst	Dr	Phil	Reeves	Managing Director
emda	Mr	Christopher	Brock	Team Manager - Sector Innovation (plus sector manager for food and drink)
emda	Dr	Kelly	Morley	Economic Policy Manager
emda	Mr	Ray	Newell	Sector Innovation Manager - Aerospace
EMTEX	Mr	Jeff	Scrivener	Chief Executive
Greater Nottingham Partnership	Mr	Mark	Sisson	Strategic Partnerships Manager
Loughborough University	Prof.	Ronald	McCaffer	Professor of Construction Management
Loughborough University	Dr	Chris	Stokes	Technology Watch Analyst Electronics Enabled Products KTN
Nottingham Trent University	Mr	Frank	Abbott	Acting Programme Leader, Creative Collaborations MA
Nottingham Trent University	Prof.	Nasser	Sherkat	Professor of Intelligent Recognition
University of Leicester	Dr	David	Ward	Director of Research and Business Development
University of Nottingham	Prof.	Nabil	Gindy	Professor of Advanced Manufacturing Technology

To receive note of workshop

Alstom Power Turbo-Systems	Dr	Derek	Allen	Head of Test, Instrumentation and Materials
Derby and Derbyshire Economic Partnership (DDEP)	Ms	Sonja	Childs	Programme Manager Energising Business and Skills
emda	Mr	Amreesh	Mishra	Policy & Relationships - Innovation
emda	Mr	Paul	Singh-Bhatia	International Investment Manager
emda	Dr	Alan	Srbljanin	Economic Policy Advisor - ICT
emda	Mr	David	Wallace	International and Innovation Director
ETETE Ltd	Mr	George	Tansley	Consultant
Loughborough University	Mr	Paul	Palmer	Director, Electronics Enabled Products KTN
Sustainable Technology Solutions (STS) Ltd	Mr	Karl	Seare	Director
The Welland SSP	Ms	Libby	Kingsley	Strategic Development Manager
	Mr	Mike	Evanson	

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Table 19.   Participants at a workshop on "Food and Drink", 10 July 2007

Organisation	Title	First name	Surname	Job Title
Derby and Derbyshire Economic Partnership (DDEP)	Ms	Sonja	Childs	Programme Manager Energising Business and Skills
East Midlands Food and Drink Forum	Ms	Fiona	Anderson	Managing Director
East Midlands Food and Drink Forum	Ms	Briony	Cross	Innovation and Technology Manager
emda	Dr	Christopher	Brock	Construction Policy Advisor
emda	Ms	Nicola	Culliford	Innovation Strategy Manager
emda	Mrs	Hardeep	Sandhu	International Investment Executive - High Technologies
Food Processing Faraday Partnership	Mr	Peter	Moores	Regional Manager - South
Food Processing Faraday Partnership	Ms	Sue	Wigram	Operations Director
Nottingham Trent University	Mr	Gwent	Paylor	Business Manager College of Science and Technology
Richard Turner Consultants Ltd	Mr	Richard	Turner	
The Welland SSP	Ms	Libby	Kingsley	Strategic Development Manager
University of Lincoln	Mr	Paul	Kitson	Head of Business Development
University of Nottingham	Prof.	Michael	Steven	Professor of Environmental Remote Sensing

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IV. Workshop notes

IV.1 Notes from Transport Technologies workshop, 26 June 2007

Workshop Summary

Before considering the critical technologies for transport, the group began by noting that 'transport' comprises several industry/market sectors, the main ones being:

Aerospace	Motorsport
Rail	Non-Road Vehicles
Automotive	Powertrain (as a cross-cutting sector)
Marine	

Session 1: Technologies deemed critical for the transport sector

*Technologies deemed by participants to be critical in 5-10 years' time highlighted in **bold**.*

Areas deemed to be linked to, or sub-sets of a larger area technology are denoted by O

Lightweight Materials
- o Metals
- o Composites

High-temperature materials

Advanced Materials

Geospatial

Satellite

Signals

Intelligent Transport & External Controls

Condition Monitoring

Fuel, combustion
- o Reduced Emissions
- o Greater Economies

Low Carbon Technologies

Electronic Controls

Hybrid drives
- o **Energy storage**

Computing
- o Simulation, modelling

Networks
- o Systems integration

Alternative energy sources
- o **Low carbon alternatives**
- o Infrastructure

Manufacturing process and virtual engineering
- o Robotic assembly, etc. rapid prototyping / manufacture
- o Modelling of engineering designs, facilities, manufacturing processes, etc.
- o Lean enterprise process improvement[44]

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[44] This bullet added by Motorsport Development UK (MDUK.) as an underpinning technology that drives competitiveness and application of new technology. High-end examples of lean enterprise process improvement

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Points arising from session 1

Lightweight materials and high-temperature materials are a branch of Advanced Materials; requirement for greater energy efficiency is the driver behind research here.

Technologies for transport sector are not solely concentrated on the vehicle; infrastructure advances are important too. The group decided therefore to include Intelligent Transport Technologies and Condition Monitoring on their list. The latter was deemed to be well-developed in aerospace, and developing in motorsport and marine industries.

Computing Technologies (high-power computing; simulation; modelling); Networks, and Systems Integration were 'underpinning', i.e. relevant to all sectors and supporting advances in these.

Aerodynamics and Computational Fluid Dynamics (CFD) (added post-workshop by MDUK, see footnote for comments)[45]
Low Carbon Technologies and Alternative Fuel Technologies also deemed to be important now, and important in a 5-10-year timeframe, particularly as by then the first wave of biofuels will have come onto the market[46].

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are the Rolls-Royce 40-day engine programme and the constant product development applied in Formula 1. Mid-range exemplars will be Toyota and its supply chain. Delivery mechanisms are tried and tested – Manufacturing Advisory Service and through industry bodies such as MAA (Lift Off) SMMT (Industry Forum) and SBAC (UKLAI).

[45] This is area crosses over with computing but has additional elements, e.g. wind tunnels, rooted in physical science. It is applied to the design of all vehicles (trains, boats, planes), supports fuel combustion research and can lead to improved efficiency by improving cooling and underbonnet airflow in cars. Within the region the greatest single effort in this field is occurring at Honda F1. However these efforts are focussed on F1 performance and direct technological benefits limited. Indirect benefits are different matter. Williams F1 (Oxfordshire) are collaborating with Rolls-Royce and Airbus among others to develop a world leading next generation CFD capability. This is supported by a substantial grant from the DTI technology programme. Other world-class capability sits just outside the region at Aircraft Research Association (ARA) in Bedford, who work for most of the world's aircraft manufactures. MIRA (Motor Industry Research Association) are on the other side of the region in Nuneaton. Opportunity for region to supply the highly skilled staff that these R&D facilities require and work to seize the opportunity that they might afford, either directly or through spin-outs, to the regional economy.

[46] Points added by MDUK: This is an issue today, not for five yeas time. McDonalds has announced today that they will convert all their delivery vehicles to run on their own recycled cooking oil within the year. http://news.bbc.co.uk/1/hi/business/6259328.stm At the same time, govt. announced that it is removing the fuel tax of private users of this biodiesel to encourage its use. There is a mandate in place to increase the bio-proportion of forecourt fuel to 10% and Ford and Saab are already marketing vehicles that will run on E85. Now is the time to seize the high ground in this field!

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Session 2: Position of these technologies in East Midlands today

As a first step, participants divided into groups and considered where they would place the technologies identified in session 1 on a matrix that allowed them to rate the research strength of a technology against its level of exploitation by businesses in the region.

Following this, participants returned to a plenary session, placing their perspectives on one shared matrix:[47][48].
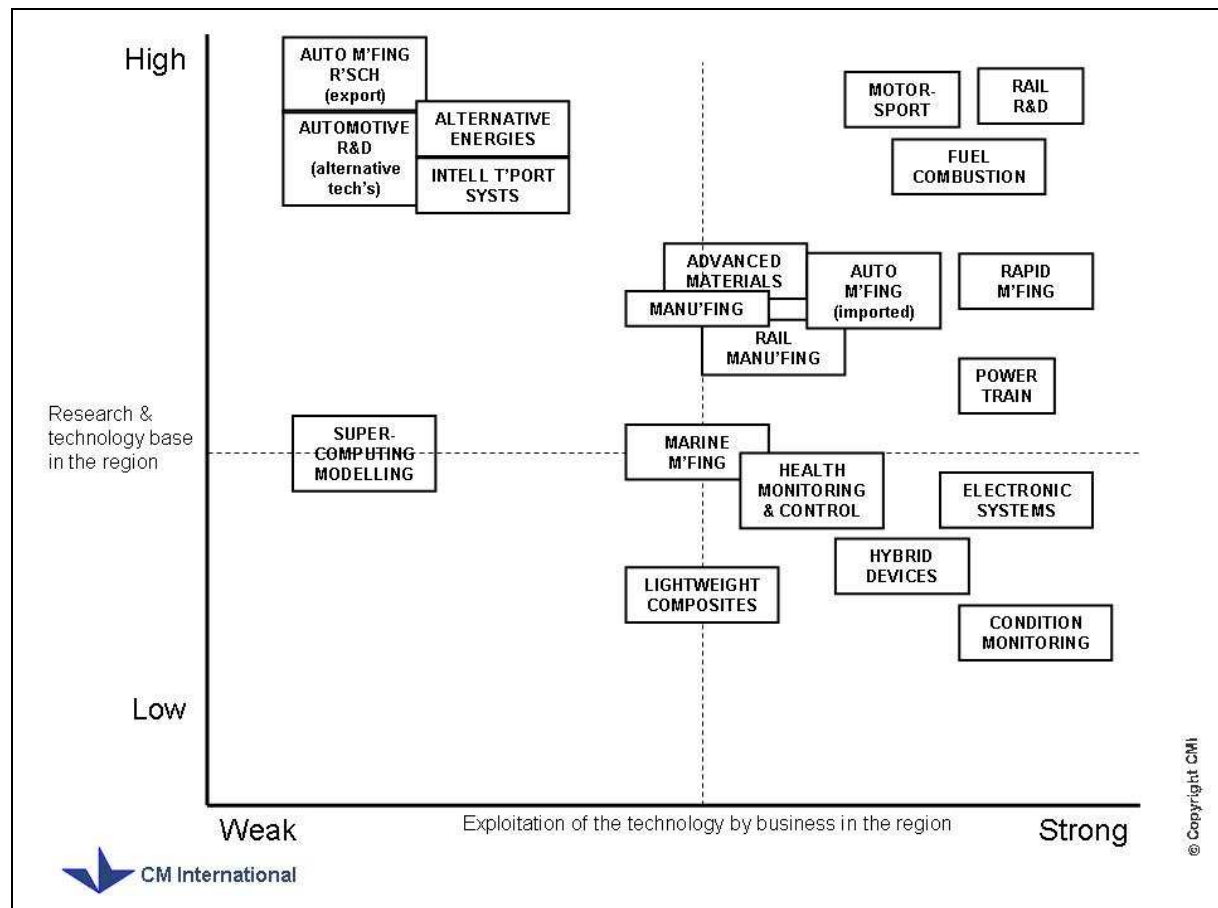
A discussion followed this, and some of the main points made are recorded here. (The group considered the matrix quadrant by quadrant, moving clockwise from top left):

Quadrant 1: High research base, Weak business exploitation

Automotive research, Alternative Energy, Intelligent Transport Systems
All deemed by participants to be emerging technologies. Exploitation currently by larger companies.

A lot of demonstrators come from this region, but we need the skills to deploy them.

Corporate anchor – is there any large company that could be an anchor for exemplar and demonstration activities?

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[47] Note post-meeting by *emda* participant: important to note that people's perception of the technology priorities was quite subjective due to their own areas of interest and also that there was a lack of industry representation in the discussions

[48] Point added by MDUK: Consider whether alternative fuels sit within fuel combustion or if they are separate item that sits further to the left, closer to alternative energies. These three items might be joined as a spectrum

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Research into alternative energy sources is strong, but exploitation opportunities relate to companies outside the region and a technology strategy has to take this into account when proposing support activities.

One option could be to focus activities on achieving positive societal impacts, e.g. by supporting exemplar or demonstrator activities that would develop understanding of these technologies ready for when alternative energy markets emerge in region.

Fuel combustion
Good research and exploitation in the region. Key companies are Rolls Royce, Perkins and Bombardier[49]. .

Any support provided by *emda* has to generate outcomes for the *region.* Given the number of national programmes In this area, one option could be to take the carbon footprint of the region and use that as a framework for supporting different environmentally-oriented activities.

The Environmentally Friendly Engine programme is national, but the environmental benefits associated with it could provide 'hooks' enabling the region to support it with complementary activity[50].

Even if the £500m Energy Technologies Institute does not come to the region, the region will be seeking to draw down some of the funding attached to that initiative.

Quadrant 2: High research base, Strong business exploitation

Advanced Materials
emda has a role in facilitating greater linkages between R&D and exploitation across: materials; composites, and manufacturing processes (i.e. the technologies clustered around the right-hand side of the matrix, either side of the middle line).

Composites
Composites deemed a research strength, with potential for much greater exploitation because the market for these materials is growing. Also potential for much greater take-up by SMEs in the region. The challenge is how to improve the production process (quite manual at the moment), and therefore R&D in composites has links to advanced manufacturing technologies[51].

Quadrant 3: Low research base, Strong business exploitation

Condition Monitoring
Difficult to generalise; a research and exploitation strength in the rail sector, but not a regional strength when it comes to exploitation in other sectors. However exploitation does occur (e.g. by Rolls Royce), but the knowledge tends to come from elsewhere in the UK and overseas.

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[49] Point added by MDUK: These companies concerned with aerospace. For automotive, consider Cosworth, Mahle Powertrain, Ilmor Engineering, Mercedes Benz High Performance Engines (HPE), Honda F1, Zytek (Engine Technology Division) and Loughborough University in piston engine R&D. Mugen (Japanese engine development specialists) have recently chosen to invest in this cluster because of the facilities and expertise available.

[50] The supply chain opportunity should provide more substantial 'hooks'.

[51] Comment from MDUK: Note the practical design, development and application capability that exists in motorsport. More sustainable / recyclable / repairable / biodegradable composites are fields we should be looking to develop in the near future.

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Generally speaking, aerospace leads in development and use of Condition Monitoring technologies, but it refers to them in different terms (it is a strand in the National Aerospace Technology Strategy)[52].

Electronic systems

Many nodes of expertise in the region resulting from the break-up of large companies such as GEC, Marconi and Plessey, but little activity in the region to bring them together.

Sector is strong in intellectual property, not in manufacturing.

Hybrid Devices

Technology comes from outside the region. Situation is fluid (automotive sector only at 1st generation of hybrid vehicles). .

Potential for region to support practical exemplars and demonstrators here[53]. Attracting Cenex (Centre of Excellence for Low Carbon and Fuel Cell Technologies) a good start.

Session 3: What can the region do to strengthen these technologies in research and exploitation terms?

Essentially the discussion centred around what it might be feasible for the region to do in order to move towards, or maintain more technologies in, the upper right-hand quadrant (High research, Strong business exploitation).

The automotive and transport-related technologies in quadrant 1(high research; weak business exploitation) are a key strength and could be supported by demonstrator and exemplar activity, particularly where the potential for encouraging businesses to exploit to the technology is weak in the short term, but where the expectation is that new markets will develop that rely on these technologies. In this case there would be merit in ensuring that a wider range of companies understand the potential of these technologies now.

The 'manufacturing' technologies (i.e. the cluster of technologies at the lower end of quadrant 2 – high research, high business exploitation) was deemed very important for the region. Group agreed that composites also important for the region. Group felt that these technologies would benefit from via activities intended to maintain and build on region's strong manufacturing and development capacity.

For technologies in quadrant 3 (e.g. hybrid devices, electronic systems, condition monitoring, etc.), group felt they also had potential to be supported by exemplar or demonstrator activity, also with the aim of ensuring a wider base of companies understand the technologies and opportunities that the emerging markets present.[54]

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[52] Note from MDUK: Technology is increasingly applied in Formula 1 and other high-end motorsport. Therefore Honda F1, Spyker F1 and Mercedes Benz HPE have expertise in the application of this technology, though not necessarily its development.

[53] Note from MDUK: Zytek have considerable capability in this field, though their headquarters and Electric Vehicle division are in the West Midlands (Litchfield), their Engine Technology Division is in Repton – and hybrid vehicles need both! Zytek are working on projects from Electric Smart to a diesel-electric endurance racing car. They might offer significant supply chain opportunities and the potential for demonstrators mentioned above.

[54] Point made by *emda* participant was that it does not matter so much whether we are strong in a given area because the expertise can be brought in from elsewhere, but rather the focus should be on 'pulling' more technologies into the top-left quadrant (i.e. boosting their take-up and commercialisation).

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IV.2 Notes from the workshop on Sustainable Construction, 26 June, 2007

Workshop Summary

Before considering what technologies are critical for the sector, the group began by fixing on a flip-chart the activities that the term 'sustainable construction' can be deemed to cover:

Buildings   Lifecycle
Infrastructure   Built environment
Services   Processes
          Energy/Water/Waste   Communities
Materials
Decommissioning

Session 1: Technologies deemed critical for sustainable construction

*Technologies deemed by participants to be critical in 5-10 years' time highlighted in **bold**.*

Areas deemed to be linked to, or sub-sets of a larger area technology are denoted by O

Design
o   Urban design
o   Architecture
o   Transport systems

Characterisation of Materials

New Materials

Recycling of Materials

Manufacturing processes
o   Onsite
o   Offsite

Modelling (Computer)
o   Airflow
o   Heat loss
o   Etc.

Energy efficiency
o   Intelligent monitoring (smart buildings)
o   Insulation
o   Durability

Micro-generation/Distributed Networks
o   Combined Heat & Power (CHP)

Control systems
o   Energy
o   Water
o   Recycling

Energy Storage

Waste minimisation and management

Project/process management and systems

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Points arising from session 1

During discussions, the group agreed that they had not burrowed down to the technologies underpinning the various activities listed above. It transpired that there were several reasons for this, two highlighted in the workshop were the fact that:

In addition to being a very broad area of activity, the construction sector is made up principally of users, whereas most innovations come from the companies in the supply chain (e.g. providers of materials, equipment or services);

The technologies used for any given task (e.g. materials characterisation) will vary depending on the choice of materials and the context (e.g. what type of building; what level of performance is required).

Construction and Sustainable Construction are not two distinct sectors, rather the latter term reflects the need for the construction sector to change; on the one hand to meet rising environmental standards and requirements, and on the other to become more efficient. Several points were made relating to these two issues:

The Code for Sustainable Homes, which will require all new homes to achieve 'zero carbon' status after 2016, will be a key driver of innovation in the construction sector.

All participants agreed that policy and market environment need to change if construction to become more sustainable. There is a need to

- Get the technologies into the supply chain
- Get technologies into the market that are cost-effective; at the moment many are too expensive to be used for large-scale developments.

Construction is a sector that frequently uses technologies originally developed for other uses. There is potential to do much more of this.
One option is to use demonstrators to show to industry and customers what new materials and applications can do, but the problem to date is that demonstrators have had limited success in changing market expectations (Sherwood Energy Village was cited as an exemplar in the region[55]).

Suggestion that Technology Strategy should:
Concentrate in the short-term on ways to bring enabling technologies closer to market, and
In the longer term on identifying what the next wave of change is likely to be (arising from the mix of changing market demand and advances in technology).

Problem is not so much one of identifying and transferring new technologies, but thinking how to get the sector to take up existing technology. In this context, research into human behaviour (client and user acceptance of new applications and technologies) is important.

Possibly a role for the Technology Strategy in ensuring that knowledge and understanding about the way that construction markets operate gets into the public domain (i.e. how info is shared more broadly with buyers, users and contractors).

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[55] Sherwood Energy Village Ltd is a social enterprise based at Ollerton, Nottinghamshire. It pursues a holistic approach to social, environmental and economic regeneration (www.sev.org.uk)

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Session 2: Position of these technologies in East Midlands today

Participants considered where they would place the technologies identified in session 1 on a matrix that allowed them to rate the research strength of a technology against its level of exploitation by businesses in the region (see below)
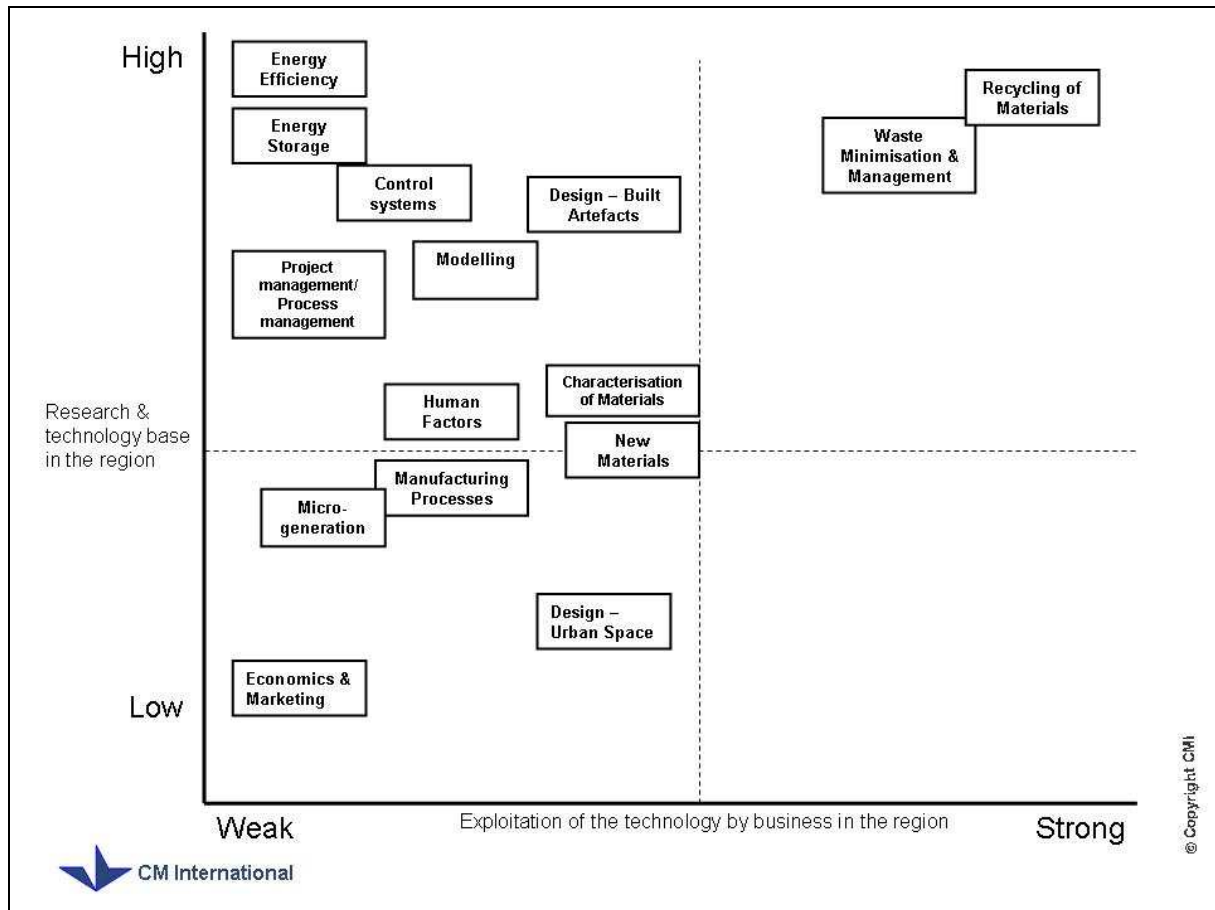
A discussion followed this, and some of the main points made by individual participants are recorded here. (The group considered the matrix quartile by quartile, moving clockwise from top left):

Quartile 1: High research base, Weak business exploitation

Energy efficiency
Strong, world-class research base on Energy Efficiency in the region (Research Councils are driving this area of research).

This prompted a comment on the contrast with sector activity in the region; Commission for Architecture and the Built Environment (CABE) research has recently rated over half of new housing developments in the East Midlands as 'poor'[56].

Energy storage
Very similar level of research to energy efficiency (fuel cell technology is very strong research-wise)

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[56] 'Housing Audit: Assessing the design quality of new housing in the East Midlands, West Midlands and the South West', CABE (2007) (www.cabe.org.uk)

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Characterisation of Materials

CERAM (a subsidiary of British Ceramic Research Ltd) is located in the West Midlands and offers testing, characterisation and consultancy facilities to UK industry. East Midlands would benefit from having a regional centre of its own, serving industry and fostering a more co-ordinated approach among East Midlands HEIs to research and service provision.

Design – Built Artefacts

Design was deemed important to sustainable construction as a whole, but the group split it into two areas of activity, judging the region to have significant research expertise in design as it relates to built artefacts (buildings, roads), but less in more holistic design for urban spaces (placed in quartile 4).

In the area of built artefacts, civil engineering (design of transport systems) deemed strong at University of Nottingham, and University of Lincoln strong in architecture.

However, the group felt the consensus on where to place design on the matrix would probably have been different had a representative from Loughborough University been present, since staff at this HEI likely to be very knowledgeable on industry requirements.

**

emda should have considerable scope for activity to improve exploitation of technology in the region, given its role as the lead RDA for construction (it will be responsible for reporting on sustainable construction to the Technology Strategy Board).

Quartile 2: High research base, Strong business exploitation

The SITA Centre for Sustainable Wastes Management at Northampton University deemed very strong.

Quartile 3: Low research base, Strong business exploitation

Empty

Quartile 4: Low research base, Weak business exploitation

The activity Economics & Marketing was included here by the group because although it is has neither a high research nor a high business profile, there is a need to develop new approaches to reducing the cost of technologies. (London School of Economics mentioned by one participant as having research strengths in this area).

Session 3: What can the region do to strengthen these technologies in research and exploitation terms?

The desire for the region would be to move activity in quartile 1 (High research, Weak business exploitation) across to quartile 2 by increasing take-up/application in the construction sector.

A point re-iterated here was that this challenge is not purely in the hands of the technologists; changes in the market are decisive in determining whether a new application becomes a success. One participant cited double-glazing, where improvements in manufacturing processes made it possible to design and fit inner windows *with minimum disruption* (1st generation double-glazing in 1970s). Once market acceptance of the concept in place, it was possible to make and sell further developments.

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What conclusions from this discussion for the Technology Strategy?

Distinguish between innovations for new build and retro-fitting; they will require different technologies and have different price points.

Waste minimisation and management are regional strengths, strategy should help keep them strong

Energy efficiency and micro-generation: region is lagging behind other parts of UK and other countries, but is an important sector if we believe big gains will come from continued development. Technology Strategy should address questions of how to: :

> Support it and build bridges to users
>
> Support sector so that it does not locate elsewhere
>
> Use resources and infrastructure already in region as a draw for inward investment

Characterisation of materials/New Materials

> Facilitator noted link between this and composites and advanced materials, both identified in the Transport Technologies workshop as an area the Technology Strategy should focus on. Transport conclusion was that these should move into quartile 2 (High research, Strong business exploitation).
>
> New materials and characterisation skills are important when it comes to developing specifications and standards.

Waste

> Noted that region could benefit from developing an index of waste material and its location. Knowing where waste materials are located is of potential value in the future, because they can be recovered should it later become possible to re-use them.

There are priorities that cannot be tackled directly by a *Regional Technology Framework* because they are subject to more powerful external influences, even though they will nevertheless affect people and organisations in the East Midlands (e.g the development of alternative technologies). However, there is a case for promoting demonstrators and exemplars (challenge is to encourage take-up, which many present stressed is currently hampered because technology not cost-effective on large scale).

East Midlands exports high volumes of aggregate to other parts of UK. Characterising this form could be useful source of information to feed into development of more energy efficient materials.

Regarding construction, the Regional Technology Framework needs to strike a balance between academic perspectives (emphasis on research and development) and business perspectives (emphasis on market). "Hidden Innovation" report by NESTA[57] recommended for its review of innovation in the construction industry.

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[57] "Hidden Innovation: How Innovation happens in six 'low innovation' sectors", NESTA, June 2007

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IV.3 Notes from workshop on Healthcare, 27 June 2007

Workshop Summary

Session 1: Technologies deemed critical for the healthcare sector

*Technologies deemed by participants to be critical in 5-10 years' time highlighted in **bold**.*

Areas deemed to be linked to, or sub-sets of a larger area technology are denoted by O

Assistive Technologies (technologies for supporting long-term conditions)
- o ICT-based
- o Mechanical
- o Bio-mechanical

Telehealth
- o Care
- o Medicine

Medical Devices

Imaging

Pharmacogenomics   *Personalised Medicine*

Diagnostics

Systems Biology

Vaccines

Regenerative Medicine
- o **Tissue Engineering**
- o Cell therapies
- o Gene Therapy

Drug Delivery Technologies

Drug Discovery and Development
- o Immunotechnologies

Proteomics

Gene Therapy

Bio-informatics

Materials
- o Scaffolds to support tissue engineering
- o Medical textiles

Points arising from session 1

A major driver of investment in research and in development is the ageing population, which means society will have to find ways of managing long-term conditions

Science underpinning the areas listed above is moving forward all the time.

Strictly speaking assistive technologies and medical devices are concerned with the application of technology, but so much going on in these areas that they were included as a technology area in the matrix overleaf.

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Session 2: Position of these technologies in East Midlands today

Participants considered where they would place the technologies identified in session 1 on a matrix that allowed them to rate the research strength of a technology against its level of exploitation by businesses in the region (see below)
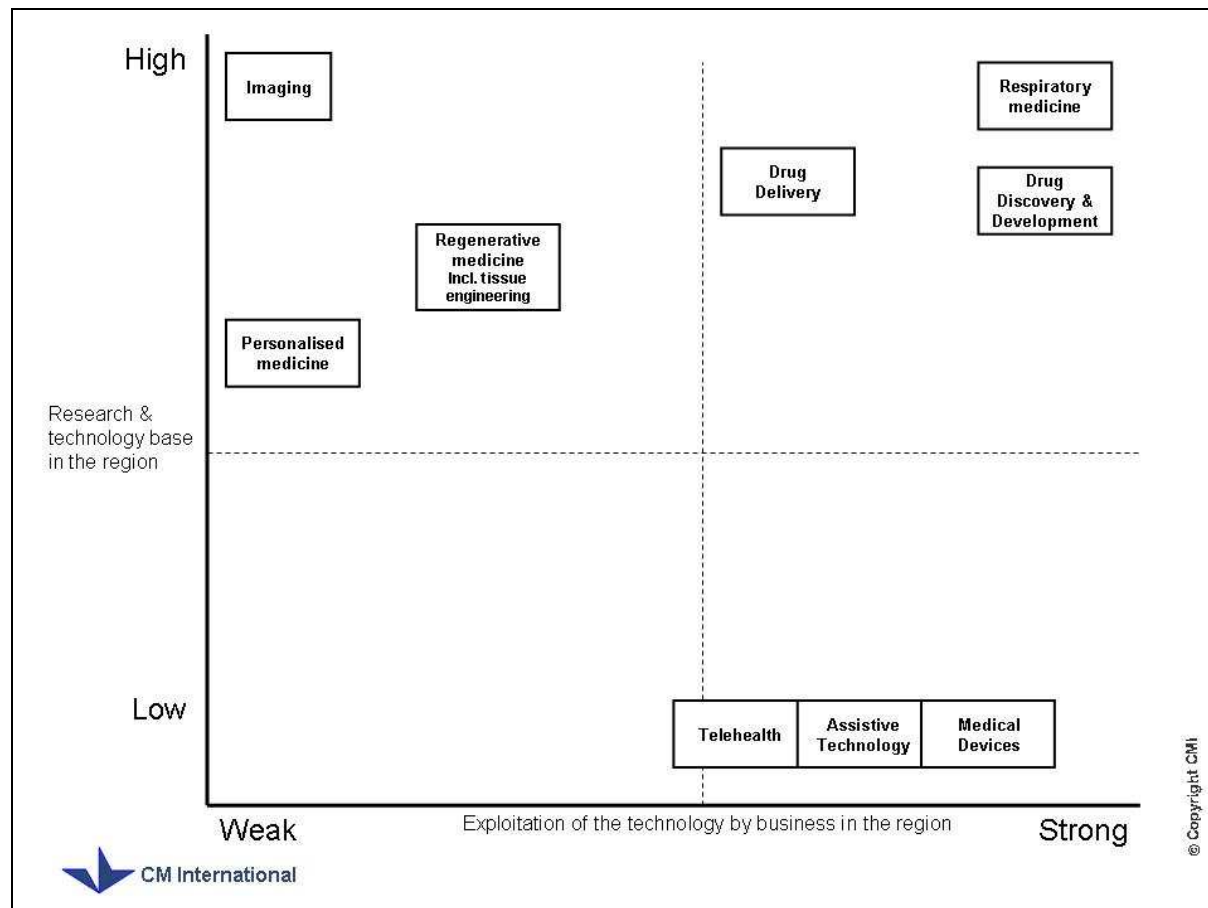
A discussion followed this, and some of the main points made are recorded here. (The group considered the matrix quartile by quartile, moving clockwise from top left):

Quartile 1: High research base, Weak business exploitation

Pharmacogenomics (part of "Personalised Medicine" on the matrix)
Pharmacogenomics a new technology area; there is not critical mass in the region yet (a lot of activity in and around Cambridge).

Quartile 2: High research base, Strong business exploitation

Respiratory medicine
The strength of this technology area deemed to be an example of the market players pulling in research to help solve the problems they encounter. Key players are AstraZeneca, 3M and Vectura.

Drug Discovery

Group felt that companies active in this area are likely to stay/can be persuaded to stay in the region. Some home-grown firms will be bought by multi-nationals and some may then move. The trick to keeping exploitation in the region will be to create the conditions for a steady stream of new start-up companies.

Quartile 3: Low research base, Strong business exploitation

Telehealth
Good research base in Nottingham and Derby, but HEIs in the West Midlands have more expertise.
A technology area with applications in sport.

Medical Devices
Not all that research-intensive; encompasses aids and disposables. Driven more by innovation (spotting opportunities and responding to them) than by technology.

Developments in this area tend not to be funded by the Research Councils.

Assistive Technology
Comments as for Medical Devices, above.

Session 3: What can the region do to improve strengthen these technologies in research and exploitation terms?

Matrix highlighted that region has significant research strengths (quartiles 1 & 2). Ideally, the technologies on the matrix should all be moving towards quartile 2.
One route to achieving this is to continually foster spin-out creation, but this is a challenge.

There is a need to make technology transfer processes between academia and industry more efficient, not only for spin-out creation, but for more general exploitation (e.g. this needed if Telehealth, Medical Devices and Assistive Technologies to make greater use of the research base)

Participants felt region needs to identify and back its Unique Selling Points (communication very important). The USPs need to be focused and credible, and could be very specific.

For example, in the area of Regenerative Medicine lots of companies are exploiting niche technologies – activities that can integrate the players and allow the region to tell a strong 'story' would be beneficial.

Likewise, activities encouraging companies and researchers to work across technology areas are required (e.g. Regenerative Medicine/Personalised Medicine/Drug Discovery).

One of the region's Unique Selling Points is its strength in **clinical sciences**[58]. The fact that it is possible to undertake large scale data collection and trial is a USP to draw in companies.

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[58] The population of the region, together with its healthcare infrastructure, means that there is a lot of patient throughput.

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IV.4 Notes from Workshop on Emerging and Enabling Technologies, 27 June 2007

Workshop Summary

Before tackling the questions listed above, workshop participants discussed how enabling and emerging technologies can be defined. The purpose here was to set the scope for subsequent discussions. Most of the discussion centred on enabling technologies; the chief distinction between emerging and enabling technologies was felt to be that enabling technologies have commercial exploitable value, whereas if a technology is 'emerging' it is deemed to early too determine whether it has this.

Enabling technology - definitions:

Enabling technologies may be:

- Transferable, or more-or-less ready to use (i.e. technology adoption such as ICT to boost productivity).

- Transforming in nature (the presence of a new technology opens up a whole new way of working/new markets/ new products/new services)

- Enabling in the sense that they make it possible for a company to use another new technology

They must have scale and applicability – should be applicable across a range of sectors

Whether a technology is 'enabling' or not depends on your perspective, i.e. what your position is within a supply chain, or a sector, or a market. For example, energy producers are waiting for technologies currently 'emerging' for use in biomass feedstock supply chain to develop further so that they can fully exploit biomass feedstock, already recognised by them as an 'enabling' technology

Time frames are one way to distinguish how 'enabling' or 'emerging' a technology is. If Regional Technology Framework looking at a 5-10-year time frame, then its focus should be on enabling technologies over emerging technologies. .

Emerging technologies - definitions

Require funding for their development (they are not yet deemed to have immediate commercially exploitable value). These are typically the technologies that the Research Councils fund.

Next, the group considered which key technologies fit under this 'emerging and enabling' umbrella.

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Session 1: Technologies deemed critical within Emerging and Enabling technologies

*Technologies deemed by participants to be critical in 5-10 years' time highlighted in **bold**.*

Areas deemed to be linked to, or sub-sets of a larger area technology are denoted by ⇨

Energy
- o Biomass/Agro-energy
  - o Fuel supply chain: equipment manufacturers (e.g. Alstom in region); suppliers

Sensors and Controls

Global Positioning and Earth Observation

Fermentation

ICT
- o Web 2.0
- o Production Technologies
- o RFID

Advanced Manufacturing Technology
- o Advanced Materials (incl's. both emerging and enabling tech's)
  - o Additive Manufacturing
  - o Nanotechnologies

Session 2: Position of these technologies in East Midlands today

In groups, participants considered where they would place the technologies identified in session 1 on a matrix that allowed them to rate the research strength of a technology against its level of exploitation by businesses in the region. They then came together in plenary to share their results (see the figure overleaf). There were some considerable differences in opinion as to where the research-exploitation strengths of particular technologies lay, and this is highlighted in the figure. Participants pointed out that it was difficult to get a consensual picture of these technologies because their knowledge of the various industries and research strengths varied. There was also the consideration that interpretations of 'strong' and 'weak' exploitation of a technology by companies is subjective, particularly given the number of sectors that emerging and enabling technologies may apply to.

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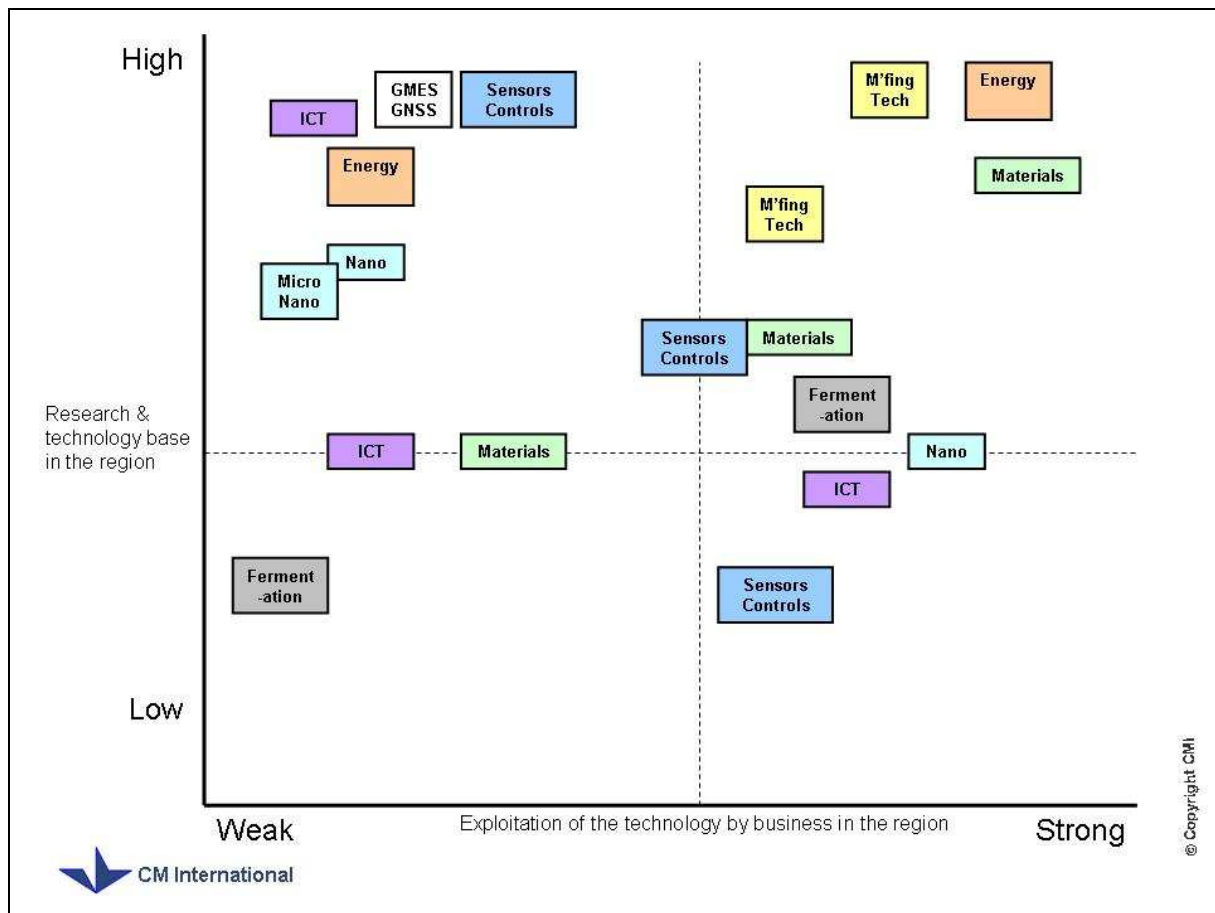
Not surprisingly, the results prompted further discussion. Key points made were:

Manufacturing Technology – region has research strengths across this broad technology area, and exploitation is also strong (i.e. presence of world-class companies).

Global Navigation Satellite Systems (GNSS) and Global Monitoring for Environment and Security (GMES) were recognised by all as a research strengths, which are now giving rise to commercial applications in the global market place, if not the East Midlands.

Energy deemed a strength in terms of research and exploitation, with the proviso that the prorportion of SMEs exploiting energy technology is low.

Participants agreed that the **ICT** research base was not as strong as Energy and GNSS/GMES, but again there was a difference in perceptions about exploitation. There was no consensus regarding the proportion of companies in the East Midlands that exploit ICTs, but one group noted that there are a small number of companies that are very successful at developing ICT methodologies.

The three groups each placed **Sensors and Controls** on a different part of the matrix; the general consensus was that the region is better at exploiting these technologies than at developing them, with the proviso that there is a strong pocket of sensors and control research and adoption in the Derby area.

There was also a discrepancy across the groups about the position of **Materials Technology** on the matrix.   This was in part due to the fact that groups had different views on 'exploitation', with one group considering the level as a proportion the overall company population, and the others thinking about the question of terms of levels of world-class activity.

90

Session 3: What can the region do to improve strengthen these technologies in research and exploitation terms?

Participants agreed that the region should be focusing on pulling technologies from the upper left- towards the upper right-hand-side of the matrix by encouraging technology adoption.

The Technology Strategy should not only contain activities for *emda* and InnEM, but point out where action is needed that can be taken by other stakeholders.

As a development agency, *emda* should focus its investments on the adoption of enabling and emerging technologies by the four priority sectors of the RES.

Whilst supporting technology adoption, participants agreed that *emda* and its partners in the region should also be influencing funding decisions made elsewhere, according to a rough split as per the figure below.

Where Research Council and Framework Programmes are concerned, *emda* should only support activities that will enable the region to lever in significant additional amounts of research, proof of concept or demonstrator funding.
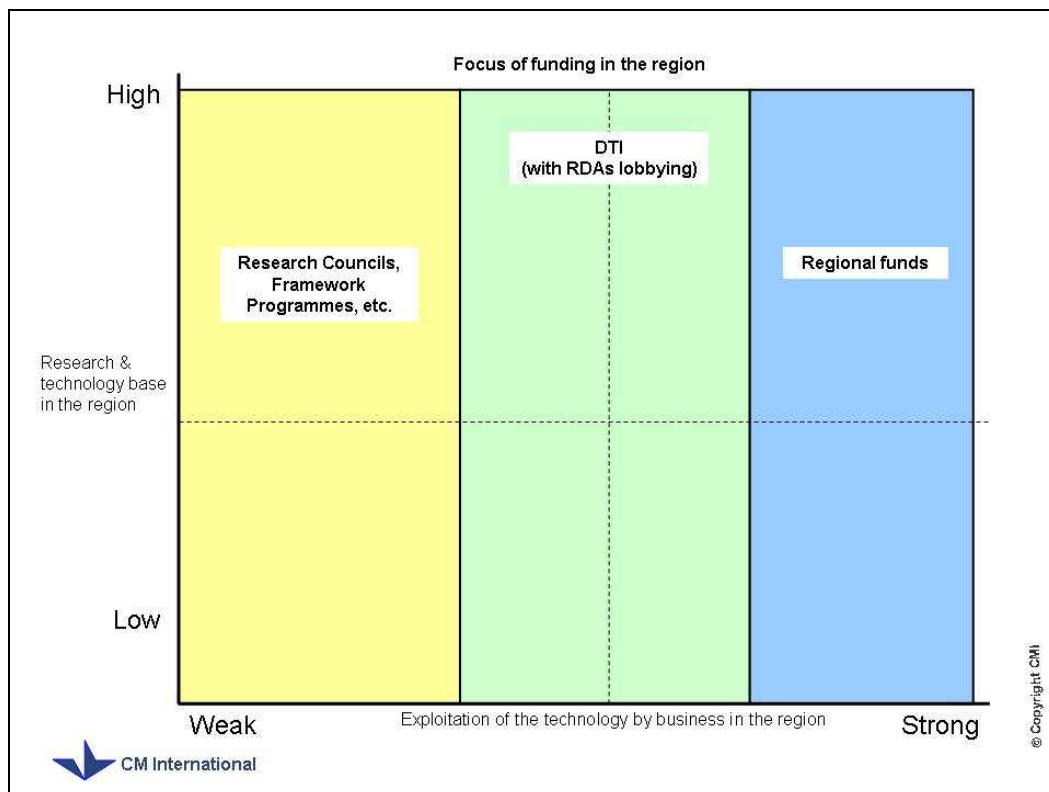
IV.5 Notes from a workshop on Food and Drink, 10 July 2007

Workshop Notes

Stage 1

Thinking beyond just East Midlands what are the key technologies for food and drink sectors?

AT/MS – How are we defining the Food and Drink sector?

What might this include in its entirety?

Food Supply Chain

- Farmers
- Processors
- Retailers
- Packaging
- Logistics

- Waste

- Suppliers (equipment)

- Compliance / regulations

- Importers
- Consumers
- Resources (cross cutting theme)
- Food service

Resource Utilisation

- Energy
- Environment

– relevant issues

LK - If we are just looking at strengths we may miss good opportunities if we do not also identify specific weaknesses.

CB – Through historical cluster approach we have been concerned with all of the above areas to a greater or lesser extent.

Today = Emphasis on food processing

Identified Existing Technologies

- Process engineering
- Microbiology and food safety
- ICT (process management)
- Packaging technology (materials, equipment and a controlled environment)
- Mixing, heating and cooling
- Track ability of ingredients and product (What is this?), ICT
- Counterfeiting (global problem), DNA profiling
- Genetic modification
- Soil engineering
- Hydrology / water technologies
- Rheology (science of materials)
- Food functionality
- Ingredient engineering
- Flavour science and technology
- Polymer science and technology
- Irradiation

- Logistic technologies and storage

What are the Critical Technologies to Gain Competitive Advantage to Regions

Criteria = crucial for next 5-10 years

Environmental technologies (waste reduction and management) have to be a key issue as such a hot topic.

PM – Customers now buy on basis of environmental friendliness of product not just cost.

Waste management = Covers lots of these issues

AT / MS – Compliance / regulatory ICT capabilities will become more important over the medium term.

CB – Process Engineering = Umbrella Technology

Includes:

- Robotics to reduce labour reliance
- Novel heating and cooling
- Non thermal processing / cleaning (reducing reactions etc), presentation
- Microwave technologies
- Process control and monitoring
- Intelligent manufacturing (part of process control)

Microbiology

- Functionality and fermentation enzyme production (yoghurts etc)
- Refrigeration (maintaining compliance under new regulations)

Need to separate 'issues' from the 'technologies' sitting behind them.

Traceability – consumers wanting to know where products have come from.

- Flavour science and technology
- Value adding technology (a little more long term)
- Nutraceuticals

Waste Management Technologies

Waste to energy (eg. potato skins)

Agricultural Science
Crops and growing
Biomass
Climate change
Genetic modification
Irradiation

Monopoly o a few large food purchasers dictate importance of food logistics and movement

- Process engineering
- Microbiology
- ICT
- Food safety
- Food functionality
- Agricultural Sciences
- Controlled environments

Summarised Key technology areas / issues

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- Logistics
- Resource / waste management
- Packaging

Stage 2

Position of East Midlands against identified technology areas.
- Understanding of current position
- High scores should represent world class strengths / capacity

Post Group Discussion (looking at chart positions)
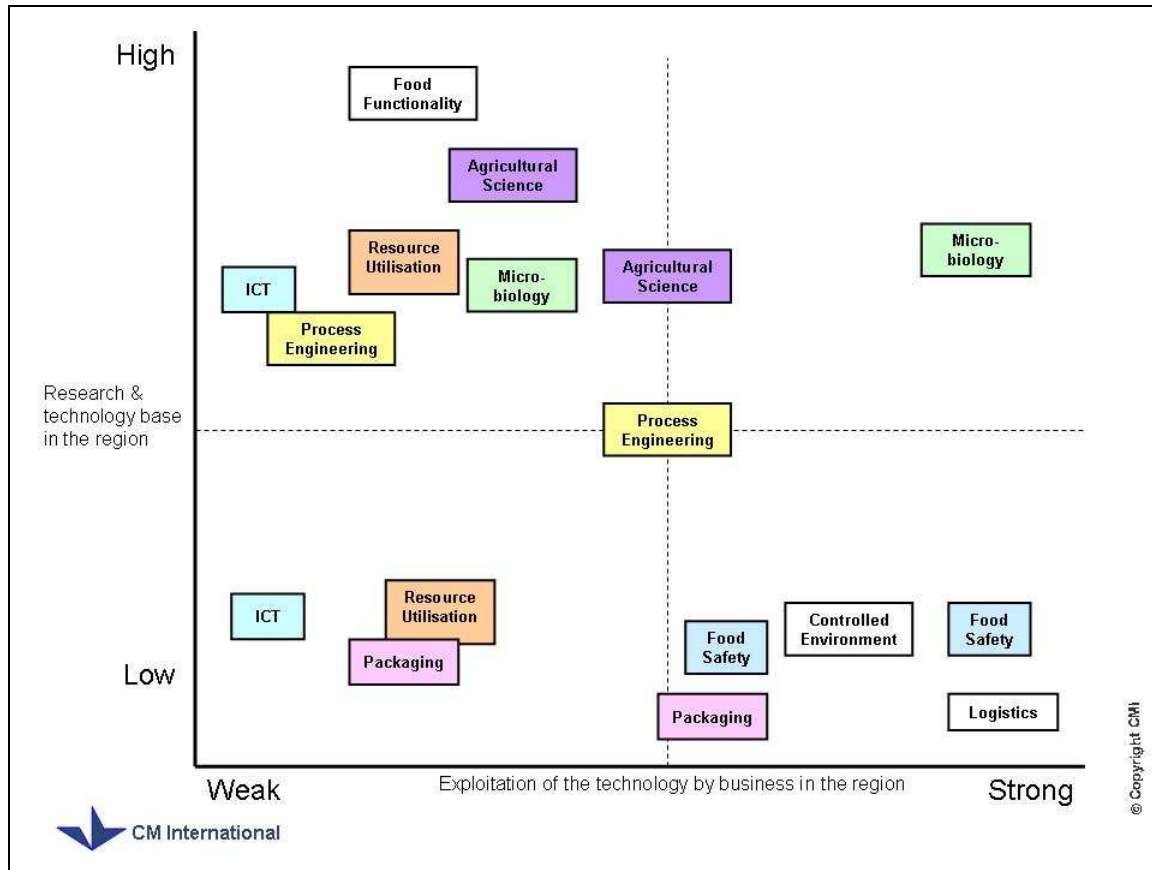
There was a difference of opinion between the groups as to the position of certain technologies, probably reflecting existence of pockets of expertise.

ICT

Agreement that research is present in the region but not being applied to the food sectors. (MS / AT)

GP – Has seen evidence of lots of technologies (embedded) that could be applied to the Food and Drink sector.

CB - Key is pushing R& D base and industry together to increase exploitation.

FP Faraday may be able to support this process with other faradays to pull together different industries.

PM – We will never compete with technology corridor around M4 so should we invest heavily in this or just focus in a specific area.

Resource Utilisation and Waste Management

LK – There is high collaborative strength in region but this is not being exploited.

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PM – There is a huge amount of waste being produced – yet we have world leading strengths in region which are not being taken up.

Microbiology

LK – This is not necessarily being exploited in the food and drink sector but we do have strengths in the region.

Food Functionality

DC – Need to get companies thinking about and understanding issues around this.

CB – Need to focus on added value side of this such as flavour technology.

Need to increase demand in this area from industry.

Demand in food industry often driven by large key buyers who focus on cost and safety.

CB – Consumers want more than this including environmentally friendly products so if we work on consumers they should drive purchase demand.

DC – Need to look at research translation to communicate with retailers.

Agricultural Sciences

Issue is getting new technologies out to end users.

CB – Where science is strong and end user is strong, HEI should come in with spin outs to support this.

Process Engineering

PM – Currently looking into building up supply chain in the East Midlands to build up technologies the food and drink industry will require in the future.

PM – Not being exploited in the food and drink industry although may be in other areas.

We have large food companies in the region with onsite food processing plants.

LK – Need to look separately at mapping skills gaps within food and drink sector as we will lose these over the next few years.

CB – iNet will address this issue rather than Technology Strategy.

Chart shows that the key issue in the food and drink sector is to link top right corner with bottom left to move things up to top right – engagement process.

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V. List of stakeholder interviewees (phase 1)

Title	First name	Surname	Job Title	Organisation	Contact type
Mr	Steve	Beasley	Chief Executive	BioKnex	iNet
Dr	Glenn	Crocker	Chief Executive	Biocity Nottingham	iNet
Dr	Gordon	France	Vice President - Strategy Technology and Systems	AstraZeneca	industry
Mr	Paul	Atkinson	Managing Director	Atkinson Design Associates	InnEM
Mr	Kevin	Scobell	Commercial Director	Building Research Establishment (BRE)	iNet
Prof.	Philip	Tasker	Vice-Chancellor	De Montfort University	InnEM
Dr	Christopher	Brock	Sector Innovation Manager - Construction	emda	emda
Mr	Mike	Carr	Executive Director Business Services	emda	emda
Mr	Dave	Shipley	Knowledge Transfer Manager	emda	emda
Mr	Peter	Strutton	Low Carbon Economy Advisor	emda	emda
Mr	David	Wallace	International and Innovation Director	emda	emda
Mr	Chris	Ward-Brown	Construction Policy Advisor	emda	emda
Ms	Heather	Woolford	Sector Innovation Manager - Healthcare and Bioscience	emda	emda
Mr	Tim	Miller	Managing Director	EMNet	industry
Prof.	Ronald	McCaffer	Professor of Construction Management, Member of InnEM Council	Loughborough University	InnEM
Dr	Darren	Clark	Chief Executive	Medilink East Midlands	iNet
Dr	Andrew	Mair	Chief Executive	Midlands Aerospace Alliance	iNet
Dr	Carl	Edwards	Managing Director	NHS Innovations East Midlands	InnEM
Dr	Frank	Burdett	Pro Vice-Chancellor Research and Business Development	University of Northampton	iNet
Prof.	Phil	Ruffles			InnEM

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VI. Industry Validation (Phase 2)

Introduction

During October and November 2007, a series of interviews with representatives from industry were undertaken in order to validate the technologies identified as priorities for the Regional Technology Framework. A total of 41 respondents took part in the validation exercise, from the four RES priority sectors of: healthcare and life sciences (11 respondents), construction (5 respondents), food and drink (9 respondents), and transport equipment industries (16 respondents).

Respondents were asked to give their opinion on 3 points:

- **Strength of a technology in the region** - whether the priority technology areas in figure 10 are 'core' to the region in terms of levels of activity in the research base and companies, or emerging – i.e. there is potential for the region's companies and research institutions to develop strength in the area. In fact, many respondents did not feel qualified to comment on this, but were able to highlight areas as having core or emerging importance for their industry. It should also be noted that not all respondents found all the technologies relevant to them, and also that some preferred to comment on a broad area (e.g. materials) rather than home in on particular sub-area (e.g. lightweight and composite materials).

- **Action required** – respondents were asked to consider what action *emda* should take to support development of a technology area they had identified as core or emerging. Respondents were able to select between:

  - Exploit – i.e. *emda* should concentrate on supporting commercialisation of the technology (respondents often had very specific recommendations here, tending to concentrate on suggestions to facilitate the process, either of developing a technology, or promoting its take-up on a wider scale than hitherto)

  - Strengthen – i.e. *emda* should support further technology development, either by the research base or by companies, or by both working in collaboration

  - Opportunity – this option was intended for technology areas that do not yet have market potential, but further developments are expected to lead to this in the medium-long term. In this case, the option open to respondents was for *emda* to monitor developments and support ongoing technology development where appropriate.

- **Comprehensiveness** – finally, respondents were invited to comment on whether all technology areas that they felt to be priorities for the region (or industry) had been covered.

Finally, respondents were asked to rate their level of knowledge on the technology areas they had chosen to comment on, selecting one of three levels:

- **Expert** – I regard myself as an expert in this technology area with strong research/exploitation experience

- **Average** – I regard myself as having an average degree of knowledge in this technology area with some experience or involvement in either research or exploitation

- **Minimal** - I have only a minimal, passing degree of knowledge

The technology priorities that respondents were asked to comment on can be found at figure 10, overleaf, and the following pages set out the results of the validation exercise. It should be noted that the exercise involved a relatively small number of participants, representing a wide range of commercial activity, and with varying degrees of technological knowledge, and

therefore the results should be taken as indicative of industry opinion only. Nevertheless, there was a degree of consensus on the key technology areas.

Figure 10. Table of technology Priorities sent to industry respondents for discussion
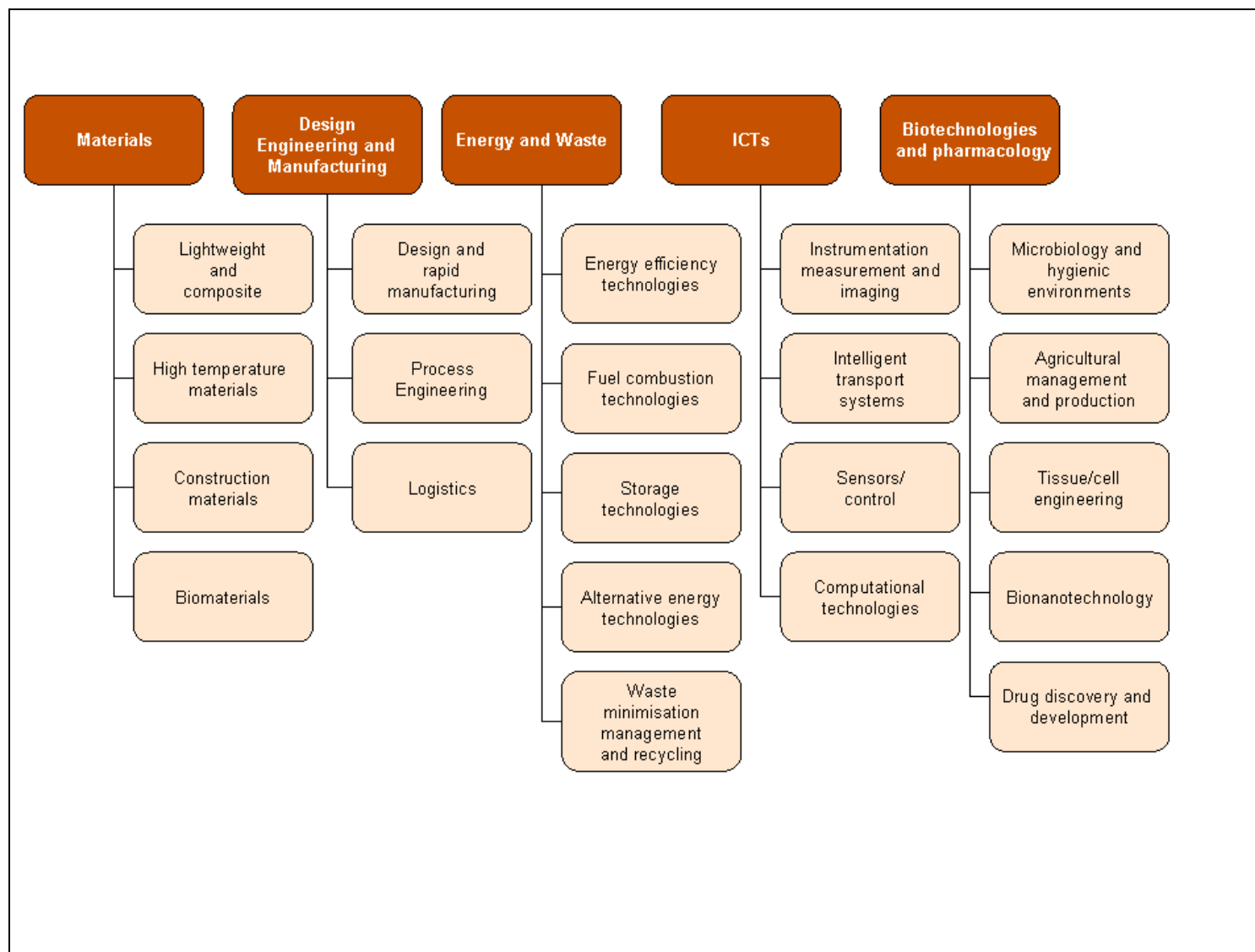
Materials technologies

The majority of respondents chose to comment on the technologies falling under the 'materials' priority. Figure 11 below shows that respondents felt they had varying degrees of development-based knowledge of the technologies, however many represented industries, such as motorsport, marine, and construction, where there is considerable scope to adapt existing technologies and materials to new uses.

Figure 11. How respondents rated their technology expertise
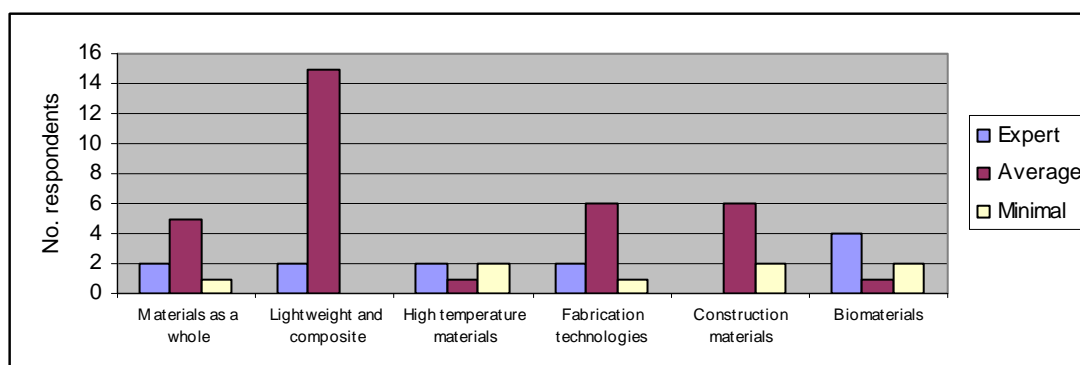
Respondents agreed that materials technologies area a priority area for the East Midlands. In particular the broad field of materials as a whole, and the sub-areas of construction materials and fabrication technologies were seen as core to the region, particularly in terms of greater take-up of existing technologies by industry. Respondents recognised strong technology development expertise (in both companies and universities) in the areas of lightweight and composite materials, high-temperature materials and biomaterials.

Figure 12. Industry feedback on status of the priority as area of 'core' or 'emerging' technologies
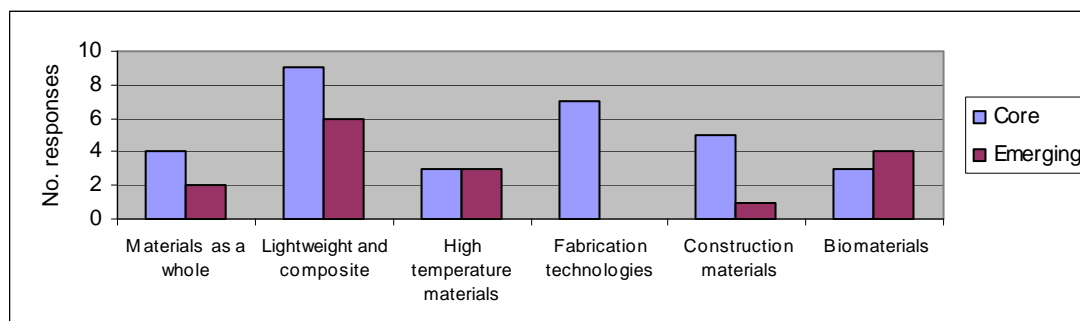
Feedback on action required was divided between recommendations to support exploitation (i.e. commercialisation) of existing technologies and activities to strengthen research and development. In the area of exploitation, many correspondents had suggestions on how to facilitate take-up of existing technologies (particularly in construction and food and drink sectors), whilst respondents from the healthcare sector made suggestions for actions to he facilitate the progress of new discoveries from proof of concept through development to commercialisation.

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Figure 13. Industry feedback on actions required

Figure 13. Industry feedback on actions required
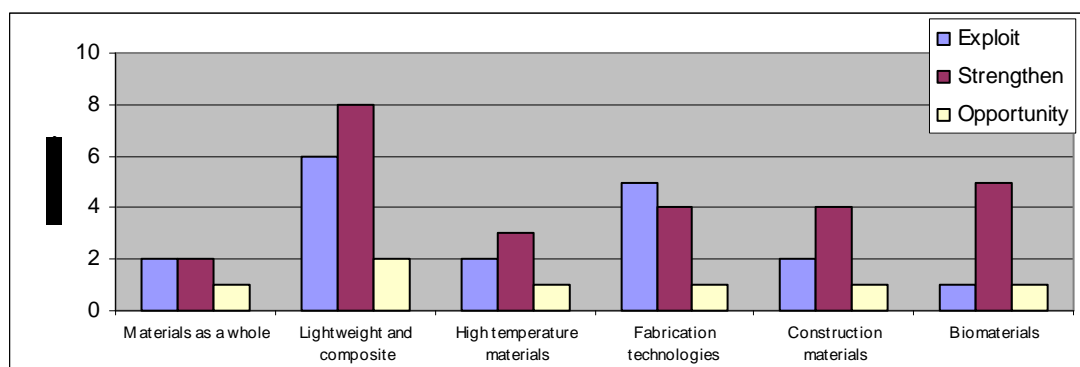
Design, engineering and manufacturing technologies

The majority of respondents who commented on this group of technologies confirmed they had some involvement in research and development (see figure 14).

*Figure 14. How respondents rated their technology expertise*
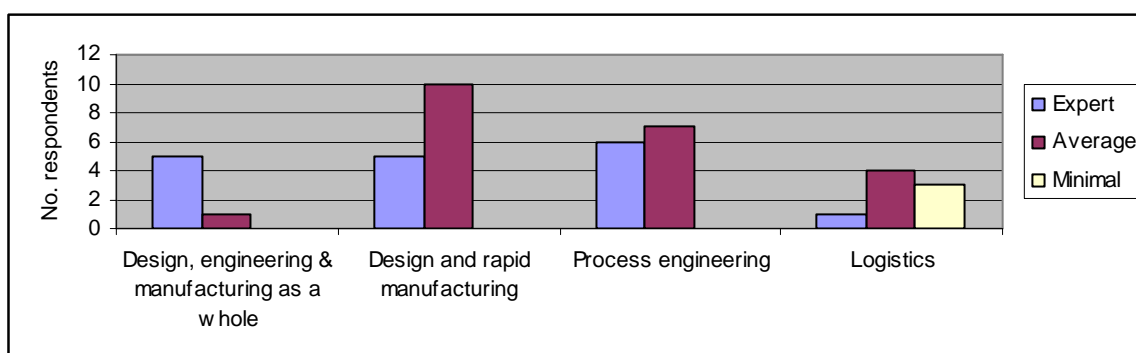
Respondents recognised this family of technologies as an area of commercial and research strength in the East Midlands, and one in which new technology developments are emerging (figure 15).

Figure 15. Industry feedback on status of the priority as area of 'core' or 'emerging' technologies
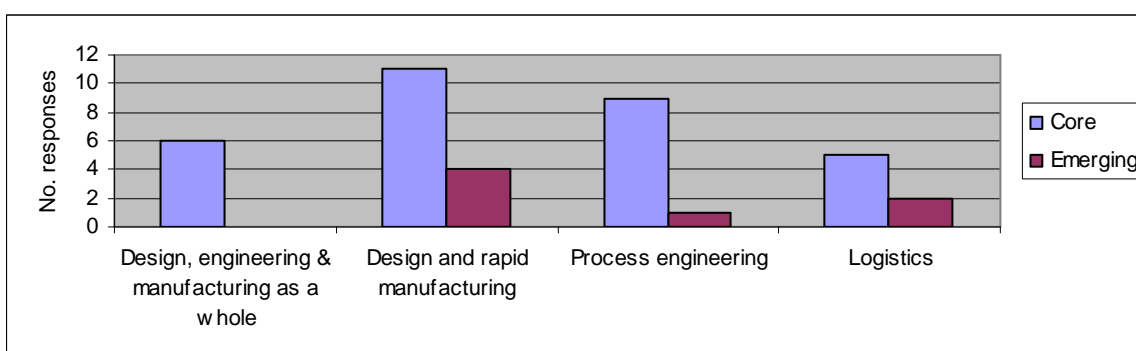
Recommendations for action were varied here too, but favoured support for technology exploitation and strengthening R&D in these areas (figure 16).

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Figure 16. Industry feedback on actions required
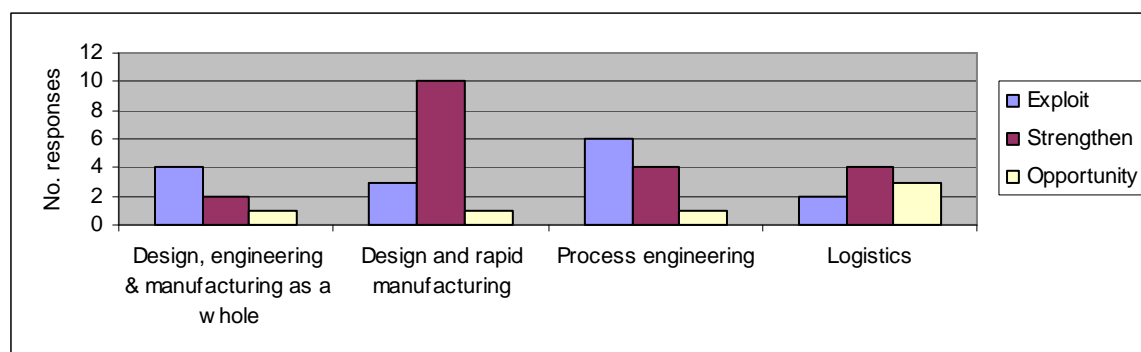
Energy and waste

Respondents who commented on energy and waste technologies came from a variety of industries, predominantly the transport equipment sector, and the food and drink sector. Respondents from the former group are more closely involved in research and development, whilst respondents from food and drink companies emphasised that their sector is predominantly a user, not a developer, of technology in this area. This split is also reflected in respondents' views of their technology knowledge, with high levels of 'average' knowledge recorded for energy efficiency, and waste management and minimisation, which are both areas where food and drink, and also construction companies, are seeking technology-based improvements to keep costs down and to comply with regulations on waste, landfill and energy use.

Figure 17. How respondents rated their technology expertise
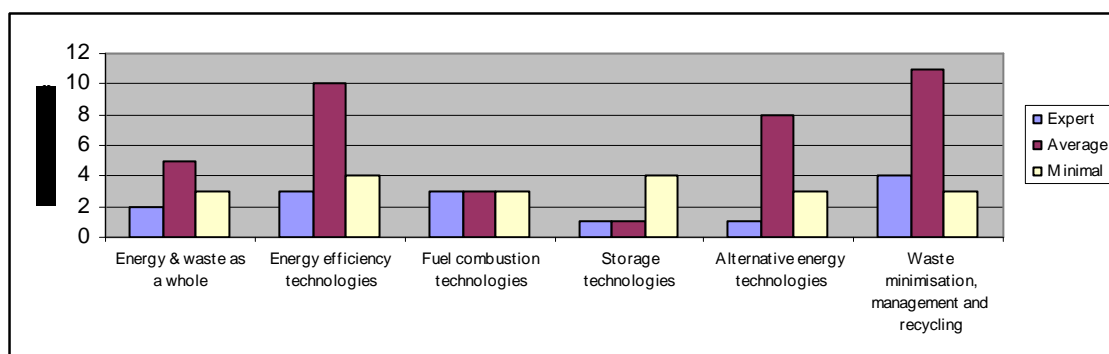
In the area of design, engineering and manufacturing, respondents tended to make comments on the status of the various technologies from the perspective of their industry, rather on the basis of the strengths present in the East Midlands. Several respondents felt certain technologies (e.g. fuel combustion technologies and energy efficiency technologies) were both 'core' and 'emerging' in the sense that strong industry and research players are based in the region (core), but further advances in knowledge are expected (the technologies continue to emerge).

Figure 18. Industry feedback on status of the priority as area of 'core' or 'emerging' technologies
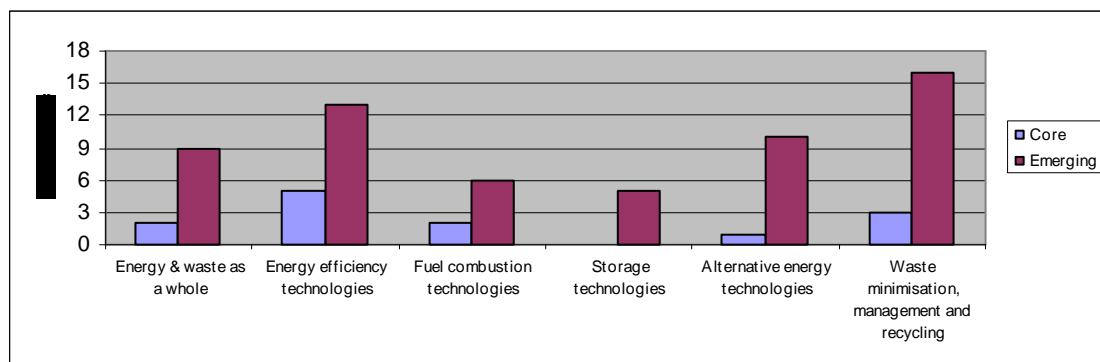
In terms of actions, opinion tended to support activities capable of supporting further technology development in the areas. However, a minority were in favour of exploitation, reflecting the fact that several technologies are either already have market applications or are very close to them.
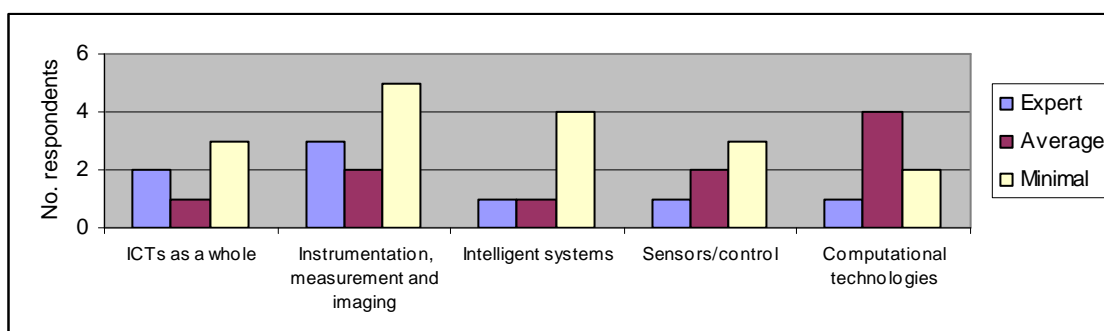
Figure 19. Industry feedback on actions required
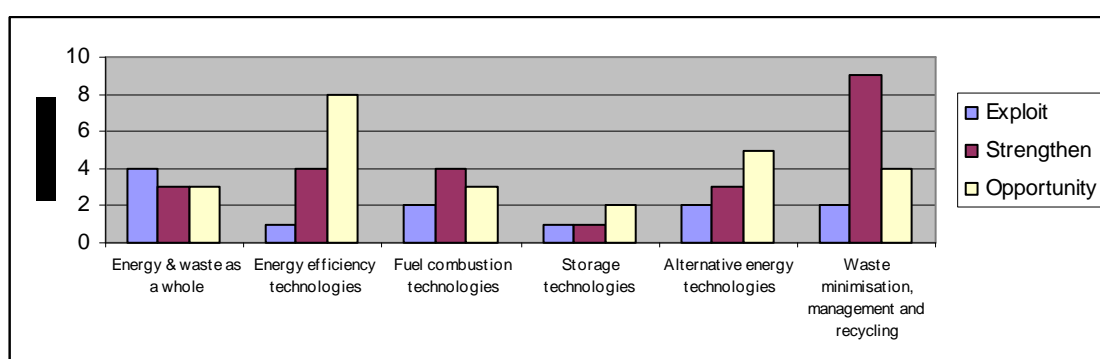
# Information and Communication Technologies (ICTs)

In this priority area, respondents had varying degrees of development-based knowledge, with the just over half (16) classing their level as 'minimal'.

Figure 20. How respondents rated their technology expertise

Many of these respondents were however familiar with using technologies in their activities, and several were seen as core to their industries. For example, food and drink respondents all recognised instrumentation and measurement as important, along with sensors and control technologies. Respondents from the transport equipment sectors also recognised these technologies as important, but also highlighted that significant developments are also underway in computational technologies and intelligent systems.

Figure 21. Industry feedback on status of the priority as area of 'core' or 'emerging' technologies
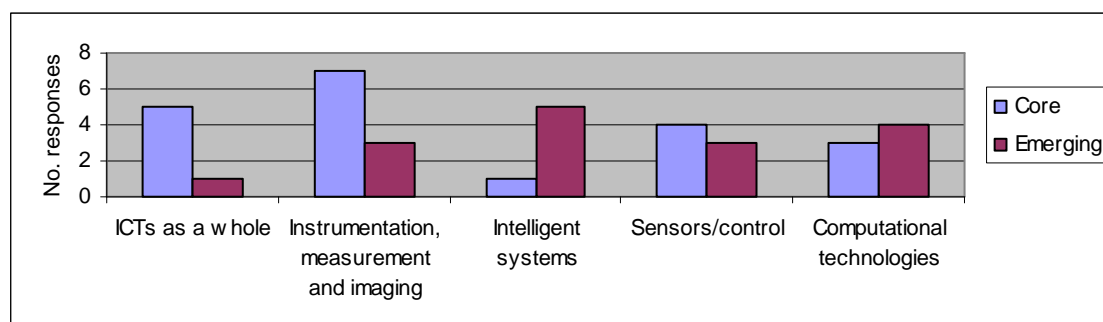
Respondents' suggestions on the actions required were also varied, but in general the priority area is seen as one where further developments are expected and that therefore there should be support for further technology development - strengthening industry-company collaborations in the short-to-medium term and supporting ground-breaking activity in the longer term.

Figure 22. Industry feedback on actions required
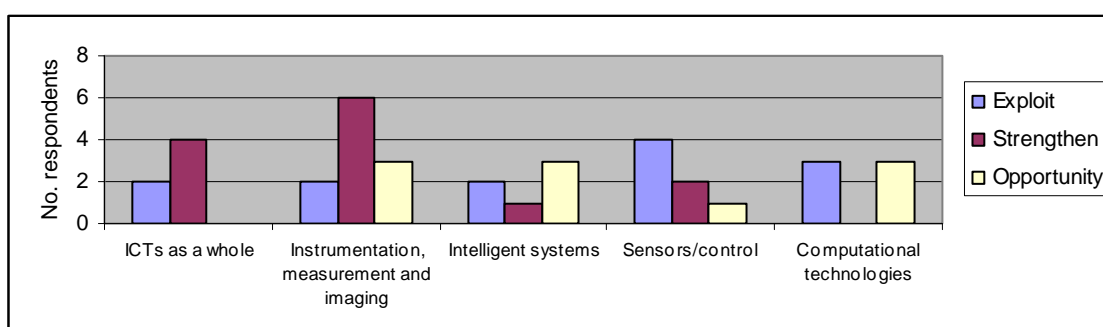


Biotechnologies and pharmacology

Respondents who commented on this technology area were predominantly from technology-based healthcare companies, and this is reflected in the respondents' perceived level of development-based expertise. Some respondents who regarded themselves as expert in other priority areas completed this section of the survey as well, which accounts for 9 returns from respondents who classed their development-based knowledge of the area as 'minimal'.

**Figure 23. How respondents rated their technology expertise**
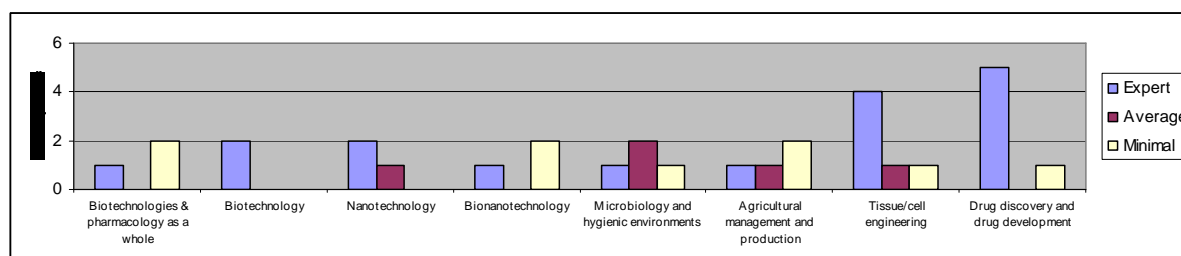
The consensus among respondents was that the East Midlands has key strengths in companies and research in this priority area, together with the infrastructure to develop clinical translation platforms. All respondents emphasised that the East Midlands has a record of world-class achievement in drug discovery and drug development, and that the legacy of this should be fostered. Other respondents were able to identify regional strengths in areas of emerging technology, particularly in tissue and cell engineering, and in drug discovery and drug development.

Figure 24. Industry feedback on status of the priority as area of 'core' or 'emerging' technologies
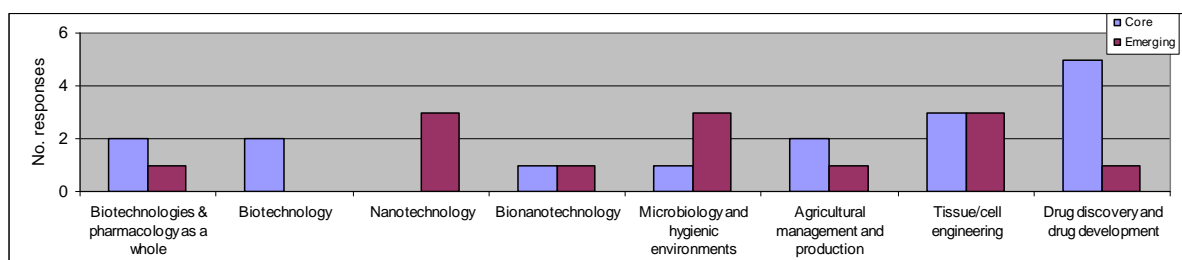
Given the region's strengths in key technology areas, respondents were strongly in favour of support to facilitate the process of bringing new drugs and therapies to market (support for exploitation), alongside support for further research and development, since this is the chief source of innovations in this area in the medium and long term.

Figure 25. Industry feedback on actions required

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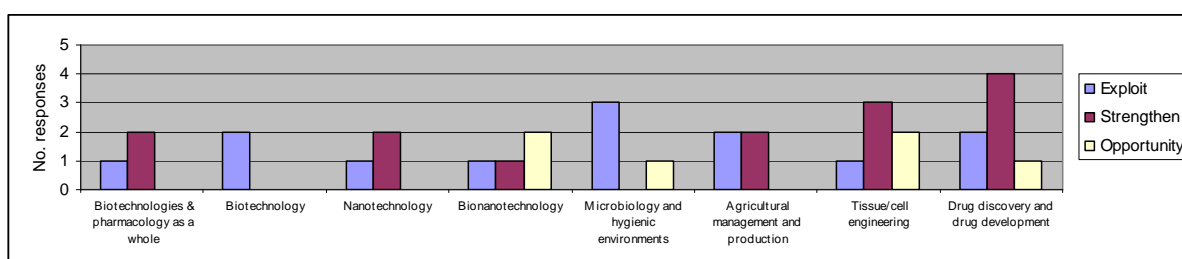
VII. HEI research groups and centres

VII.1 Centres relevant to materials, design engineering transport technologies

De Montfort University

Faculty/ Department	Research Centre/Group	Main Activity Area	More details
Computer Science and Engineering	Centre for Computational Intelligence	Fuzzy logic, fuzzy logic systems; reasoning agents and robots (emotion and perception-based reasoning; collaborative behavious and multi-agent systems); intelligent databases	
Computer Science and Engineering	Mechanical Engineering Research Centre (Combustion and Computational Fluid Dynamics Research Group).	Internal combustion engine performance, including emissions	Mathematical models capable of describing the processes involved in the burning of liquid fuel sprays. Experimental research into internal combustion engines, fuels additives, alternative fuels and alternative energy.
Computer Science and Engineering	Mechatronics Research Centre	Agile reconfigurable manufacturing machinery	Research within the integrated disciplines of mechanical, electronic and computing / software engineering. new approaches to the design and control of piezo-actuators/transducers; advanced methods in modelling and control of pneumatic servo-actuator technology; fundamentally new approaches to the integration of design and control of manufacturing machine and machine systems; digital manufacturing engineering; intelligent and integrated home environments; and new techniques and methods in realisation of life cycle products and systems.
Computer Science and Engineering	Centre for Manufacturing	Lean Engineering Research Group Principles by which manufacturing environments can become more responsive, flexible, productive, reliable and cost effective. Research themes: creation and understanding of system design, cost engineering and planning and control philosophies	
Computer Science and Engineering	Centre for Manufacturing	Rapid Prototyping and Manufacturing Group	

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Computer Science and Engineering	Electronic Controls and Drives Research Group		Modern electronic techniques applicable to power systems, electrical machines and their associated control, with a focus on induction machine vector control, power electronics and electrical machine integrated systems, power systems control and protection, renewable energy and power quality.
Computer Science and Engineering	Applied Electromagnetics Research Group	Application and development of measurements, theory and models, particularly to Electro-Magnetic Compatibility (the effect of electro-magnetics produced by one component on others around it) and communications infrastructure topics	
Computer Science and Engineering	Emerging Technologies Research Centre	Semiconductor Devices Hi-Voltage Microelectronics Reliability of semiconductors	
-	Insitute of Energy and Sustainable Development	Buildings Energy Performance	
Computer Science and Engineering	Centre for Interactive Media	Stereoscopic and autostereoscopic display systems (giving the illusion of being three-dimensional)	
Computer Science and Engineering	Wireless & Multimedia Communications & Signal Processing Group		Research includes Routing for Mobile Networks, Telecare for elderly patients, Video Compression, Software Radio and Spectrum Optimisation.
Computer Science and Engineering	Centre for Earth and Planetary Remote Sensing	Interdisciplinary. Analysis and interpretation of remote sensing data, with emphasis on radar instruments, particularly radar altimetry	
Computer Science and Engineering	Optimisation, Planning, Timetabling and Knowledge Discovery Research Group	Solutions to real world problems from modelling and knowledge discovery to planning, scheduling and optimisation of the solutions. .	Our approach is to combine optimisation techniques and techniques from artificial intelligence for creating adaptive systems for solving problems efficiently
Computer Science and Engineering	Software Technology Research Laboratory	Study, analysis and advance formal approaches to specification, design and (re-) engineering of computing systems with emphasis on those used in (distributed) real-time, safety critical and high-integrity applications.	Research themes: Software evolution; Service-Based Computing and Semantic Web; Critical systems; Computer security; Hardware/software co-design; aerospace systems (flight clearance); software architecture and design patterns; theoretical foundations

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Loughborough University

Faculty/ Department	Research Centre/Group	Main Activity Area	More details
Department of Design and Technology	Design Ergonomics Group		The design and evaluation of products e.g. car crash performance; vehicle ergonomics (e.g. the Fiat Punto & Bravo, European Cars of the Year 1995, 1996; Rolls-Royce Seraph, Bentley Arnage and concept car 'Bali'; Brussels Tram 2000; Lantau Line train for Hong Kong; Amsterdam train; Rotterdam train); 'Etan' cutlery for arthritic users, marketed worldwide; a powered drinking device for people with motor neuron disease; a 'palmtop'-based microcomputer to support people with severe intellectual impairments to perform complex work routines; driver's field of view from large vehicles.
Department of Aeronautical and Automotive Engineering	Acoustics and Vibration	Activities supporting design of safer and more environmentally-friendly vehicles	
Department of Aeronautical and Automotive Engineering	Aerodynamics	Use of experimental and numerical aerodynamic techniques to understand and exploit fluid mechanics in real aerospace applications.	Specialists in Experimental Aerodynamics and Computational Fluid Dynamics (CFD) together with an application focussed team forming the Rolls-Royce University Technology Centre (UTC) in Gas Turbine Combustor Aerodynamics
Department of Aeronautical and Automotive Engineering	Combustion and Energy Conversion	Fuel cells; auto propulsion; combusion; powertrains	
Department of Aeronautical and Automotive Engineering	Dynamics and Control	Vehicle dynamics and control	
Department of Aeronautical and Automotive Engineering	Materials and Structures	e.g. Simulation of stresses and deformation in an engine, depending on firing conditions	
Department of Aeronautical and Automotive Engineering	Systems, risk and reliability		
Department of Civil & Building Engineering	Acoustics and Noise Control		
Department of Electrical and Electronic Engineering	Control Systems Research Group	Research includes fault detection on systems, and the architecture and control of power networks. This research group is a member of the UK research grouping called Rail Research UK>	

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-	Research School of Systems Engineering	Systems Engineering is an inter-disciplinary approach to problem solving. It spans the whole system lifecycle from defining customer needs, capturing required functionality, undertaking design synthesis, system build and system validation while considering the complete problem domain. The aim is to produce a system that satisfies defined technical requirements within cost and timeframe constraints	
-	Systems Engineering Innovation Centre	Funded by *emda* and BAE, with L'boro Uni, SEIC focuses on systems engineering aspects that provide a framework for the integration of people, processes, tools and technology in order to improve management of risk, product configuration and technology insertion for development of innovative products	
Wolfson School of Mechanical and Manufacturing Engineering	Manufacturing Organisation		
Wolfson School of Mechanical and Manufacturing Engineering	Dynamics	Engineering dynamics is the fundamental area covering physics of motion of matter, machine, structures and processes under action of variable loads. Optimum design, i.e. maximising the speed, efficiency, controllability or accuracy of an operation, is based on the principles of dynamic analysis and synthesis.	Technological developments in smart structures, material processing, machine health monitoring and vibration control be achieved by harnessing new dynamic phenomena and by developing advanced control and measurement capabilities.
Wolfson School of Mechanical and Manufacturing Engineering	Manufacturing Processes	Research into all aspects of manufacturing organisation and management including the development and operational aspects of business.	Includes knowledge life-cycle management, designing organisations, and measuring performance

Wolfson School of Mechanical and Manufacturing Engineering	Manufacturing Systems Integration Research Institute	Leading edge expertise in areas of: systems engineering and change; business process modelling visualisation and analysis; human systems design and enactment; machine and software component design and implementation; workflow management; and internet-enabled distribution of design, engineering and monitoring services	
Wolfson School of Mechanical and Manufacturing Engineering	Manufacturing Technology	Systems technologies for component manufacturing, from CAD/CAM, casting, machining, dimensional metrology, stress analysis to systems technologies of production planning & control and environmental and sustainable manufacture	
Wolfson School of Mechanical and Manufacturing Engineering	Mechanics of Advanced Materials	Response of advanced engineering materials to various types of external loading and environmental conditions.	Analysis of deformation processes, damage evolution as well as failure initiation and development allows us to predict the properties, performance, reliability and structural integrity of modern materials
Wolfson School of Mechanical and Manufacturing Engineering	Mechatronics		Mechatronics is the synergistic integration of Mechanics, Electronics, Embedded Control and IT in the design and realisation of intelligent products, processes and systems. It has been described as Mechanical Engineering for the 21st Century.
Wolfson School of Mechanical and Manufacturing Engineering	Optical Engineering	Optical diagnostics in fluid mechanics; optical diagnostics in solid mechanics; high power laser processing; laser safety; image processing	Applications of modern optics and laser technology to engineering problems
Wolfson School of Mechanical and Manufacturing Engineering	Product Realisation Technologies	Research into next generation of manufacturing and computational technologies	
Wolfson School of Mechanical and Manufacturing Engineering	Thermofluids and Combustion	Broad range of research in thermodynamics, fluid dynamics, heat transfer and combustion, with a strong emphasis on the application of computational modelling and advanced optical diagnostic methods.	
Wolfson School of Mechanical and Manufacturing Engineering	Rapid Manufacturing		

Department of Computer Science	Intelligent and interactive systems	Includes artificial intelligence; fuzzy logic; safety-critical systems; machine learning; workflow systems.	
Department of Computer Science	Networks, Communication and Control Systems	Includes control of networks; accessibility and usability; semantic interoperability; wireless sensor networks, etc.	
Ergonomics and Safety Research Institute	Vehicle Safety Research Centre	Largest crash investigation research group in the world; major contributions to safety developments and to science of crash analysis	
Ergonomics and Safety Research Institute	Applied Ergonomics Centre	Works in mobile and telecoms, transport, design and safety	
-	Structural Integrity Research Group	Diagnostic tools for structural engineers, and improved understanding of the physical processes occurring during the failure of structures and materials	
Institute of Polymer Technology and Materials Engineering	Ceramics Research Group	Generation of scientific understanding and engineering solutions, e.g. for new or improved advanced ceramics, including nanostructured ceramics, glasses and ceramic matrix composites	
Institute of Polymer Technology and Materials Engineering	Loughborough Materials Characterisation Centre	A major area of research within LMCC is in adhesive bonding and pre-treatment of metals and alloys with particular application to the transport industry	
Institute of Polymer Technology and Materials Engineering	Metals Research Group	To understand, and direct, metallurgical behaviour through modelling microstructural evolution and to engineer surface coatings for enhanced performance	
Institute of Polymer Technology and Materials Engineering	Polymer Research Group	Established research areas include polyurethanes, PVC, rubber process engineering, filled thermoplastics (including flame retardants), rubber to metal bonding, polymer rheology, polymer composites, polymer blends.	
	Mechatronics Research Group	Lots of projects	

Nottingham Trent University

Faculty/ Department	Research Centre/Group	Main Activity Area	More details
School of Computing and Informatics	Intelligent Systems	Three strands: Intelligent machines (control of machines) Intelligent recognition (methods for acquisition, representation and learning of knowledge) Intelligent simulation and modelling (includes Transport Informatics - the application of mathematical models for traffic simulation and predicting traffic flow) Interactive systems (focus currently on social inclusion, so not immediately relevant)	
School of Computing and Informatics	Electronic Systems and Devices	Communications systems (high bandwith wireless communication) Imaging and Displays (3D, security applications)	
School of Computing and Informatics	Mathematics and Statistics	Applied Mathematics (projects cited do have auto/aero focus e.g. design of ball bearing; investigation of turbine blade cracking) Statistical Modelling	
Interdisciplinary	General Engineering and Applications Science Group	Areas of interest include displays devices, applied imaging (x-ray security, materials and medical imaging), surface acoustic wave (SAW) sensors, micro and nanoscale surfaces and devices, catalysis, biomedical engineering and biomaterials/biocompatibility.	

University of Derby

Faculty/ Department	Research Centre/Group	Main Activity Area	More details
Faculty of Arts, Technology and Design	Signal Processing Applications Research Group	Signal processing methods and real-time application design. Sensor design; embedded systems; data acquisition systems; condition monitoring	Can be used (for example) for noise-vibration control and telecommunications
Faculty of Business, Computing, and Law	Research Centre for Advanced Innovation and Management	Areas of research include: Manufacturing enterprise modelling Intenet and software engineering Knowledge engineering Artificial intelligence Virtual reality, 3D modelling, 3D visual system design, process controls, computer integrated manufacture.	

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University of Leicester

Faculty/ Department	Research Centre/Group	Main Activity Area	More details
Department of Engineering	Mechanics of Materials Research Group	Research in: Multiscale modelling; structure evolution and defect formation in casting; high temperature micromanipulation; surface Engineering and surface contact; structural integrity.	Expertise in: novel computational methods in mechanics and process modelling underpinned with experiments e.g. for microstructural evolution, powder processing and semi-solid processing.
Department of Engineering	Thermofluids and Environmental Engineering Research Group	Aerodynamics; Combustion; Computational Fluid Dynamics; Environmental Engineering; Turbomachinery	Any aspect of Engineering to do with fluid dynamics, aerodynamics, thermodynamics, combustion, and the environmental aspects of the supply of potable water and disposal of waste water
Department of Engineering	Radio Systems Research Group	Development of a better understanding of the effects of the atmospheric (principally the ionospheric) environment on the propagation characteristics of radio waves, and the development of techniques to account for these effects in radio system planning, development and operation.	
Department of Engineering	Control and Instrumentation Research Group	Nonlinear Analysis and Synthesis Techniques in Aircraft Control.Control Systems Group	Control Systems GroupPreferred Academic Capability Partner of BAE Systems in the area of Control; member of Rotorcraft Aeromechanics DARP (Defence and Aerospace Research Partnership) and the new MOD-funded (Defence Technology Centre) in Systems Engineering for Autonomous and Semi-Autonomous Vehicles. Most active UK university partner in the control-related action groups of GARTEUR (Group for Aeronautical Research and Technology in EURope)
Department of Engineering	Control and Instrumentation Research Group	Embedded Systems Laboratory Typical application areas include safety-critical automotive designs where low cost and high reliability are key design requirements	

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University of Lincoln

Faculty/ Department	Research Centre/Group	Main Activity Area	More details
Faculty of Media, Humanities and Technology	Centre for Visual Surveillance and Machine Perception	analysis of video data, including the detection of human subjects in video streams, and characterization of their behaviour. We often use artificial intelligence techniques (in particular, neural networks) to classify the detected behaviour. Good facilities thanks to new East Midlands Media Technology and Enterprise Centre (EMTEC). Strong focus on collaboration and commercialisation	Work is also being undertaken in satellite remote sensing, in particular covering advanced image classification and data fusion methods as well as integration of satellite data in geographical information systems. This work is aimed at improving environmental monitoring and smart farming with data provided by NASA and the European Space Agency.
Faculty of Media, Humanities and Technology	Centre for Research in Open Source Software	develops, deploys and evaluates tools and practices which assist in improving collaborative software development, for example between teams working in different countries	established in June 2006 in recognition of the unique position of the distributed software engineering research at Lincoln which has become the leading research centre within the UK on Open Source Software. The areas that we research are interconnected, with the common themes that we are interested in being the interactions between processes and products, the quality of software, and the organization of software development teams
Faculty of Media, Humanities and Technology	Lincoln Social Computing Research Centre	The primary concern of LiSC is the use of computing devices in society: Who uses them? How do they use them? How could they use them better? How could the devices be improved? The domain is highly applied, yet looks towards the future and towards emerging technologies.	

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University of Northampton

Faculty/ Department	Research Centre/Group	Main Activity Area	More details
School of Applied Sciences	Centre for Research on Leather and Materials Science	Aims to build up interdisciplinary research on surface modification/coating of materials and analysis of the efficacy of such modification/coating in providing protection. Focus isn't on metals	
School of Applied Sciences	Lift Technology and High Performance Engineering Group	Analytical, computational and experimental analysis of systems employing ropes, cables, and chains.	

University of Nottingham

Faculty/ Department	Research Centre/Group	Main Activity Area	More details
Interdisciplinary	Spencer Institute of Theoretical and Computational Mechanics	Mechanics of solids; mechanics of fluids; mechanics of multi-phase media. Applications in rail, aero, automotive, defence, construction.	Launched 2007. Brings to gether expertise in computational mechanics from across the University's schools
School of Mechanical, Materials and Manufacturing Engineering	Engine Research Group	Spark ignition and diesel engines for the automotive industry	The ERG interacts directly with Ford to advance powertrain development and introduce new technology, and pursues complementary lines of fundamental studies which support this. Areas of study include the performance and operation of engines during cold-start and warm-up, mixture preparation, cold-engine friction characteristics, emissions of hydrocarbons, CO, and NOx, and the control of these to within limits permitted by European and other International standards.
School of Mechanical, Materials and Manufacturing Engineering	Structural Ingegrity and Dynamics Research Group		Activities include development and application of advanced boundary element and non-linear finite element, including damage mechanics, software, stress analysis of composites; fatigue, creep and creep-fatigue of aeroengine and powerplant materials and structures; contact mechanics; crack propagation; micro-electro-mechanical sensors and actuators; modelling, balancing and control of machines, stochastic mechanics in structural dynamics and energy losses in heavy vehicle tyres and suspension; experimental and computational (FE and CFD) investigations of aeroengine shafts, support structures, bearings and oil systems

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School of Mechanical, Materials and Manufacturing Engineering	Thermofluids Research Group	Structures Dynamics Fluid Dynamics	Research extends from the fundamentals of turbulent flows and drag reduction, to studies of heat transfer to improve electric motor cooling. A large, internal combustion engines group works with Ford and Jaguar on experimental and theoretical developments. The CFD group is working on new numerical methods, and CFD applications such as gas turbine transmissions, and car interior climate control. The use of optical instrumentation techniques is being extended into new areas, and techniques are being advanced through research.
School of Mechanical, Materials and Manufacturing Engineering	Human Factors Research Group	Current research includes engineering management, concurrent enterprising, implementation of change, scheduling and planning, design of complex sociotechnical systems, virtual reality/virtual environments, product design, education and training programmes, human-computer interaction, work organisation, cognitive and physical ergonomics. Applications include air traffic control, the rail network, automotive and other design and manufacturing	development of innovative field research methods for use in settings and contexts as varied as air traffic control, railway signalling, GPs surgeries, distributed engineering projects, electronics assembly and bakery and textiles scheduling functions, and team and collaborative work generally
Predominantly in School of Chemical and Environmental Engineering	Nottingham Fuel & Energy Centre	Research into energy storage and generation - coal, gas, hydrogen. Focus mainly on generation and large infrastructures.	
Interdisciplinary	Centre for Structural Engineering and Construction	Material Science Fluids and Structures, but with a focus on built environment	
School of Mechanical, Materials and Manufacturing Engineering	Polymer Composites Research Group	Fundamental and applied research on manufacture and performance of advanced fibre reinforced composites. These are applied in a number of demanding sectors including automotive, aerospace, wind energy and medicine.	Experimental programmes include development of novel manufacturing processes, materials characterisation, end-of-life and recycling. Modelling studies relate to mechanical performance and process simulation, including numerical analyses using FEA and CFD

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Interdisciplinary	University of Nottingham Institute for Materials Technology (UNIMAT)	Interdisciplinary institute drawing on researchers from research groups in schools of Chemical and Environmental Engineering (SChEME); Mechanical, Materials and Manufacturing Engineering Management (3MEM), and Electrical and Electronic Engineering (EEE).	The areas of expertise pick up on those of research groups highlighted under the Schools, they include: Electronics and photonics Glasses and ceramics Light alloys (alloy processing and m'fure, effects of friction and wear, etc.) Materials analysis Modelling (composites modelling; have worked for Ford, Visteon, Jaguar) Surface Engineering (also a key focus of Advanced Materials Group) Particulates (clean technologies, fuel technology, process technology)
Interdisciplinary	Energy Technologies Research Institute	Clean energy Energy Performance Fuel Cells	
Interdisciplinary but linked to the School of Civil Engineering	Institute of Engineering Surveying and Space Geodesy	Remote/Integrated Sensors	
School of Mechanical, Materials and Manufacturing Engineering	Advanced Manufacturing Technology Group	Major research areas include: intelligent processing technology; advanced assembly methods; non-conventional processes; precision manufacture and assembly systems; robotics in non-automated industries; rapid product development; and design of responsive manufacturing systems incorporating new technologies	
School of Mechanical, Materials and Manufacturing Engineering	Advanced Materials Group	Key strength is study of wear resistant properties of engine materials	The principal activities within the group are: alloy development and processing; spray deposition of protective coatings; tribological assessment of surfaces; characterisation of functional and structural materials by electron microscopy; processing and characterisation of novel photonic glasses; development of biomaterials and biomedical devices and implants; bioactive and catalytic surface studies.
Interdisciplinary	Nottingham Innovative Manufacturing Research Centre	Research in three themes: Advanced Manufacturing Technology Lightweight Structures Manufacturing Responsive Manufacturing Enterprise (planning and scheduling control; strategic planning for technology products - in this area work a lot with aerospace)	Manufacture and design of polymer-composite structures; responsive manufacturing; mechanical performance of textile composites; planning, scheduling and control, precision machining; processing techniques; metalforming; and automated manufacture of compliant structures
School of Mechanical, Materials and Manufacturing Engineering	Rolls Royce University Technology Centre	UTC for Gas Turbine Emission Systems	Multi-disciplinary. Covers structures, dynamics, and fluid dynamics

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School of Mechanical, Materials and Manufacturing Engineering	Rolls Royce University Technology Centre	UTC for Manufacturing Technology	
School of Civil Engineering	Nottingham Transportation Engineering Centre (NTEC)	Research in pavement engineering commenced at the University of Nottingham in 1954 and has now been widened to embrace all a huge range of activities including roads, airfields, port and other specialist pavements, railways, performance and asset management, sustainable construction, environmental impact and transport systems	

VII.2 Centres and groups relevant to life sciences and healthcare

De Montfort University

Faculty/Department	Research Centre/Group	Main Activity Area
Faculty of Health and Life Sciences	School of Pharmacy	Concerned with applied biomedical science, encompassing the understanding of disease processes and the development of new drugs and strategies for treatment. Colleagues in the Faculty are developing a multidimensional approach to address specific issues in relation to cancer, neurodegenerative disease, psychiatric illness and renal and endocrine pathophysiology together with the investigation of novel drug delivery mechanisms. (Faculty scored 4 in RAE 2001 for its research on drug action)

Nottingham Trent University

Faculty/Department	Research Centre/Group	Main Activity Area
School of Biological and Natural Sciences	Biomedical Research Centre	Interdisciplinary Centre bringing together expertise from School of Biological and Natural Sciences and the School of Computing and Informatics
School of Biological and Natural Sciences	Biomolecular and Microbial Analysis	
School of Biological and Natural Sciences	Cell Biology and Pathology	
School of Biological and Natural Sciences	Environmental Quality and Management	
School of Biological and Natural Sciences	Neuroscience, Pharmacology and Toxicology	

University of Derby

Faculty/Department	Research Centre/Group	School involvement
School of Education, Health and Science	Biological Sciences Research Group	Current research includes: - Use of cryopreservation in plant conservation biotechnology - Biomedical research, particularly bone mineral composition and assessment of essential oils as therapeutic agents. - Interactions of toxic metals with biota, risk assessment of metals to human health. Facilities include microbiological containment and analytical chemical laboratories and an electron microscope facility.

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University of Leicester

Faculty/Department	Research Centre/Group	Main Activity Area
Faculty of Medical and Biological Sciences	School of Biological Sciences	The departments are: Biochemistry Protein structure and dynamics; gene expression; intracellular signalling; cell motility and cyto-skeleton; cell division; stem cell biology; cancer cell biology; cardiovascular and microbial-based diseases Biology Three research groups: Cellular and Molecular Biology; Biodiversity, Evolution and Ecology; Behavioural Biology Cell Physiology and Pharmacology Genetics Genetic variability, mutation and evolution; Microbial genetics; Pathogenicity and biotechnology; human and medical genetics; Behavioural and developmental genetics; Bioinformatics and genomics
Faculty of Medical and Biological Sciences	Leicester Medical School	5 departments: Cancer Studies and Molecular Medicine Chemoprevention and biomarkers; cellular interaction and cell signalling; radiation and oxidative stress; reproductive sciences; Childrens Cancer and Leukaemia Group, Forensic Pathology Group Cardiovascular Sciences Ageing and Stroke Medicine; Cardiac Surgery; Pharmacology and Therapeutics; Vascular Medicine; Vasular Surgery; Medical Physics Health Sciences Biostatistics and Genetic Epidemiology; Epidemiology and Chronic Conditions; Psychiatry and Social Care Education Infection, Immunity and Inflammation Medical and Social Care Education

University of Lincoln

Faculty/Department	Research Centre/Group	Main Activity Area
Department of Biological Sciences	Centre for Animal Welfare and Para-veterinary Science (CAWPS)	CAWPS builds on fundamental and applied research into biological processes relating to animal health, welfare and management.

University of Nottingham

Faculty/Department	Research Centre/Group	School involvement
Faculty of Medicine and Health Sciences	Centre for biochemistry and cell biology	School of Biomedical Sciences
Faculty of Medicine and Health Sciences	Institute of Cell Signalling	School of Biomedical Sciences School of Medical and Surgical Sciences
Faculty of Medicine and Health Sciences	Institute of Neuroscience	School of Biomedical Sciences School of Medical and Surgical Sciences
Faculty of Medicine and Health Sciences	Institute of Infection, Immunity and Inflammation	School of Molecular Medical Sciences (lead) School of Medical and Surgical Sciences
Faculty of Medicine and Health Sciences	Institute of Clinical Research	School of Medical and Surgical Sciences
Faculty of Medicine and Health Sciences	Institute of Pharmaceutical Sciences and Experimental Therapeutics	School of Medical and Surgical Sciences
Faculty of Medicine and Health Sciences	Centre for Biomolecular Sciences	School of Pharmacy
Faculty of Medicine and Health Sciences	Institute of Genetics	Led by the School of Biology
Interdisciplinary	Institute of Biophysics, Imaging and Optical Sciences	
Interdisciplinary	Centre for Postgenomic Technologies	
Interdisciplinary	Bioimaging Consortium	

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VII.3 Centres and groups relevant to sustainable construction

HEI	Centre/Group
De Montfort University	Institute of Energy and Sustainable Development
Loughborough University Department of Civil and Building Engineering	Innovative Manufacturing and Construction Research Centre Health and Care Infrastructure Research and Innovation Centre European Construction Institute Off-highway Plant and Equipment Research Centre Centre for Innovation and Collaborative Engineering Centre for Renewable Energy Systems Technology (CREST)
Nottingham Trent University	Applied Energy and Environmental Engineering Group Construction Procurement Group Advanced Design and Manufacturing Engineering Centre
University of Lincoln	Centre for Sustainable Architecture and Environments
University of Northampton	SITA Centre for Sustainable Wastes Management
University of Nottingham	Institute of Architecture Institute of Building Institute of Sustainable Energy Technology Institute of Urban Planning Multi-disciplinary centres include: Environmental Technologies Centre Energy Technologies Research Institute Developers' Forum University of Nottingham Institute of Materials Technology

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