Materials Education and Skills
A Wake-Up Call

Materials UK
Owned by the materials community

Education and Skills Working Group
Education and Skills Review 2008

Contents

The materials industry has an annual turnover of £200bn, contributing at least 15% of the United Kingdom's GDP.

Executive Summary

The materials industry has an annual turnover of £200bn, contributing at least 15% of the UK's GDP. It underpins every aspect of our economy, and many factors, such as responding to climate change and the need for new buildings, are increasing demands on the sector.

To meet these requirements, we must provide high-quality teaching in science, technology, engineering and mathematics (STEM), and better mechanisms for skills development at all levels in the materials supply chain. The Government target of 2.5% GDP spent on R&D (currently 1.9%) will drive the need for skills in materials at all levels.

There is strong evidence to suggest that the output of trained materials scientists, engineers and technicians is falling, while at the same time the loss of skilled professionals through 'baby boomer' retirements is accelerating.

Over 500 expert Chartered Engineers are leaving each year with fewer than 250 newly qualified potential replacements appearing from the HEI system annually. Clearly newly qualified staff must initially take positions below those filled by the CEng level experts. There is also concern over the quality of some of this intake.

A conservative estimate suggests that over three times the current level of materials graduates and postgraduates is required to provide a pool of sufficiently high quality.

Without such an increase, from both HEI output and in-work learning, this will seriously undermine Mat UK's vision of *'the UK continuing to be one of the foremost advanced technological societies in which world-class materials expertise underpins sustainable growth'.*

Solutions can be offered in the following key areas:

Provision of Higher Education

- Increasing student funding for materials engineering courses.
- Developing and promoting imaginative materials engineering courses.
- Encouraging overseas students to remain in the UK after undertaking postgraduate education and where industrial sponsorship is available.
- Increasing the provision of tailored materials postgraduate top-up courses at universities including the Open University (OU).

Work-based Training

- Influencing the Skills for Business Network (SfBN) to provide joined up cross sector support and keep the materials community informed of any new support available.
- Engaging further with the OU to develop concurrent distance learning and professional qualifications for materials engineering.
- Developing a single online database of materials engineering training provision.
- Bringing the needs of the materials community to the newly formed Commission for Employment and Skills, which has been set up to replace many functions of the Sector Skills Development Agency, as recommended by Leitch.

Schools and Image – In Conjunction with STEMNET

- Developing core Mat UK messages on the image of materials and the materials industry.
- Identifying existing schemes and initiatives through which Mat UK might deliver core messages, such as the IOM^3 Schools Affiliate Scheme.
- Production of basic promotional material for distribution at events, conferences and school activities.
- Reviewing individual schemes from institutes, livery companies and other bodies to create a multiplier in the national approach. A clear offering rather than a mass of unconnected initiatives is the objective.
- Building on the recognition of materials as a Key Stage 3, 4 and 5 subject.

The Evidence

The Demographic Problem

1.1

The Materials Innovation and Growth Team calculated that the materials industry has an annual turnover of around £200bn, contributing at least 15% of the GDP of the United Kingdom. The industry underpins every aspect of our economy and is central to meeting the increasing demand arising from:

- Climate change – more sustainable production and consumption methods, efficient energy generation, renewable energy, and energy conservation.
- The high demand for new buildings and engineered structures, both domestic and commercial, including the needs of the London Olympics in 2012.
- The UK's established presence in major industrial sectors; automotive, aerospace, oil and gas, chemical and marine.
- UK strengths in the pharmaceutical and biotech, food, ICT/multimedia, fashion, and design industries.

This comes at a time when a range of demographic factors is reducing supply.

1.2

The Royal Academy of Engineering established a working party to report on Educating Engineers for the 21st Century. The final report has noted,

'When our need for engineering talent is huge, we are failing to persuade that engineering careers are exciting, well-paid and worthwhile,' and 'We will face an increasing shortage of graduate engineers unless action is taken'.

1.3

Statistics available from the Universities and Colleges Admissions Service (UCAS) (see Fig 1) indicates that the number of students commencing higher education courses in engineering (both HND and degree) has been declining for a number of years. Furthermore, the proportion of these domiciled outside the United Kingdom has also increased.

Add to this to the *Business Week* report dated 10 July 2006, which stated that 25-40% of engineering graduates do not take jobs as engineers, then it can be seen that the situation is indeed serious.

1.4

The paucity of graduates in materials science and engineering is dramatically worse. The Higher Education Statistics Agency (HESA) figures, show that in 2006 there were just over 4,000 students (full- and part-time undergraduates and postgraduates) studying materials equating to less than 1,000 students studying in an average year (see Fig 2).

1.5

But a number of factors serve to reduce dramatically the number of these students entering the market.

- The figure drops to around 1,300 when only material science and metallurgy courses are considered (Appendix 1).
- The HESA figures contain a large number of students studying textiles and polymers who do not contribute to engineering materials knowledge.
- The National Subject Profile for Materials conducted by the UK Centre for Materials Education (UKCME), published in May 2008, sought data directly from Higher Education Institutions (HEIs). These give much lower figures for students of materials courses than the HESA estimate. The number of students graduating with BEng or integrated MEng were:

2004	2005	2006
450	389	364

- A survey conducted as part of this study revealed 43% of graduates were in full-time employment 6 months after graduation. Of these, at least 30% took jobs in finance, retail, health and social work where materials knowledge is not a requirement.
- One quarter of graduates continued in full-time education seeking a higher qualification.
- There is some evidence of a rise in postgraduates. HESA data show full-time postgraduate numbers growing from 930 in 2000 to 1,545 in 2006, but UKCME found that HEI returns gave graduate numbers from materials postgraduate taught courses as:

2004	2005	2006
309	332	311

Figure 1 UCAS data on students starting engineering courses in the UK

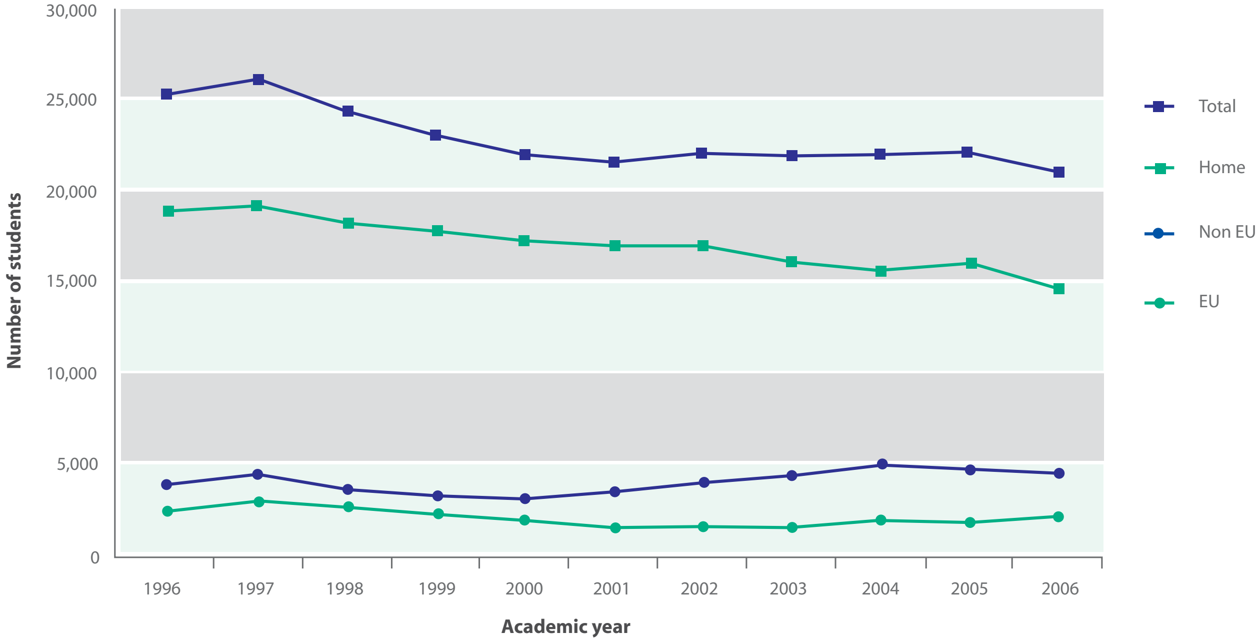
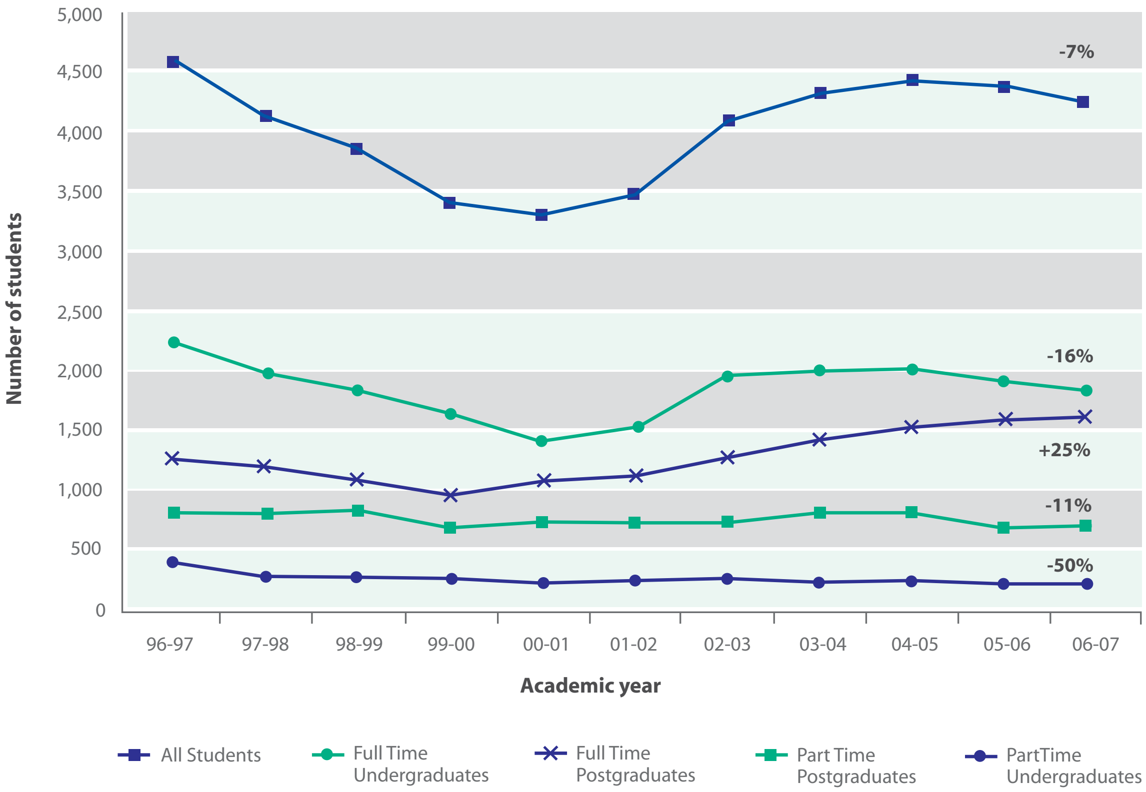


Figure 2 HESA data on the number of students studying materials in the UK



The Evidence

The Demographic Problem

1.5 (continued..)

- Add to this the proportion, almost 40%, not in full-time employment 6 months after completion of the course, plus those taking non-materials oriented jobs, and it may be estimated that as few as 60 entered the industry in 2006.
- A similar number of postgraduates gaining qualification through research may also be expected.
- Figures include foreign students, many of whom return to their homeland.

The overall effect of all these factors is that the numbers of qualified entrants to the market is frighteningly small ~100 graduates and 120 to 125 postgraduates.

Furthermore, this total of around 225 takes no account of quality. Mat UK has received comment from various organisations that many newly-employed graduates are below the standard that they desire.

1.6

At the same time, data from the Engineering Council UK have shown that between 1988 and 2005, the population of registered engineers aged significantly (see Fig 3).

While it may be argued that this seems to reflect on the ability of the affiliated institutions to attract young members, this is not the case for the Chartered Engineer (CEng) registration, which has increased. The data indicate a potential loss of about 4,000 Chartered Engineers per annum through retirement.

1.7

Of these 4,000, the number of materials engineers leaving the industry through retirement is considerably above 500 (as reported by IOM^3 and The Welding Institute), whereas fewer than 250 materials graduates and postgraduates are joining each year. Clearly, the situation is set to worsen.

1.8

There is a popular belief that, as in other areas, immigration offers a solution to shortages of materials skills. However, this may be short-lived. There is growing evidence that other countries are already experiencing their own shortages in these skills, so competition will increase:

- The 2005 USA Skills Gap Report by Deloitte, the National Association of Manufacturers and The National Manufacturing Institute found that 65% of respondents reported a disparity in supply and demand for skills in engineering and science. The ASM, in the USA, has long recognised this and in the 1950s established a Foundation to promote materials science in high schools.
- The New York Times reported in October 2007, *'As its technology companies soar to the outsourcing skies, India is bumping up against an improbable challenge. In a country once regarded as a bottomless well of low-cost, ready-to-work, English speaking engineers, shortages loom'.*
- In Korea, steel company POSCO is investing heavily in a new ferrous metals institute in order to ensure a supply of trained graduates.
- There are reports of companies in South Africa and China also failing to find the calibre of engineering staff necessary for business growth.

1.9

The UK Sector Skills Council for Science, Engineering & Manufacturing Technologies (SEMTA) conducted a market survey of its members in 2006, which showed 37% of companies with 300 to 499 employees and 40% of those with over 500 members of staff reported a skills gap (see Fig 4).

The majority of these stated that technical and engineering skills were the main problem areas.

1.10

Without skilled personnel with proven competence at CEng level or equivalent, the position of the UK as an innovation nation is threatened. The necessary leadership resources to underpin materials supply and usage will have to come from outside the UK. This will impact on the energy, aerospace, automotive, healthcare, electronics, defence and other sectors involved in advanced manufacturing products and engineering construction and infrastructure programmes.

Figure 3a
CEng Registration

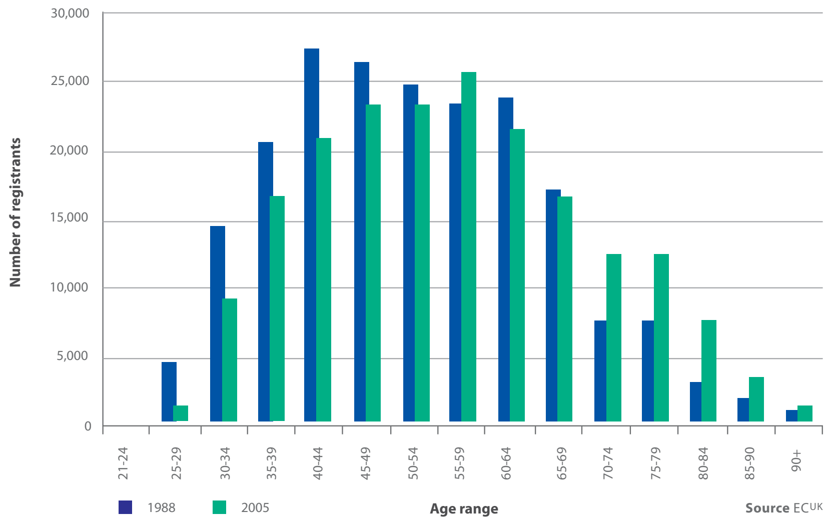


Figure 3b
IEng Registration

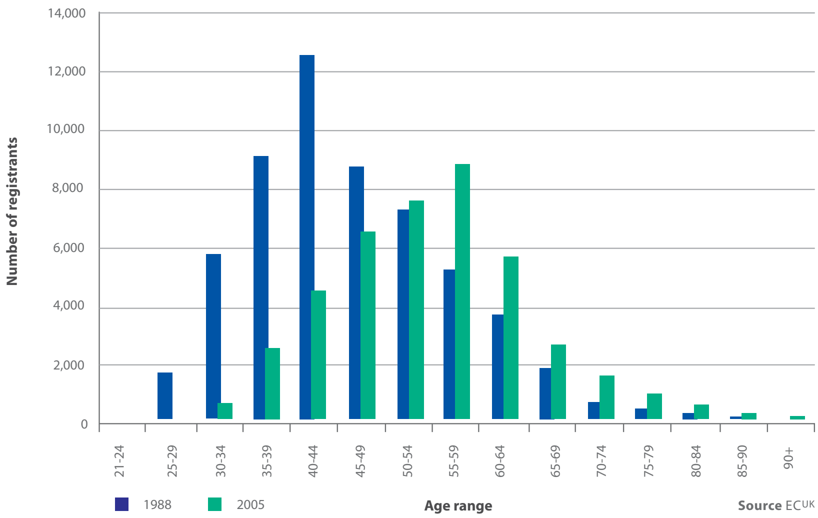
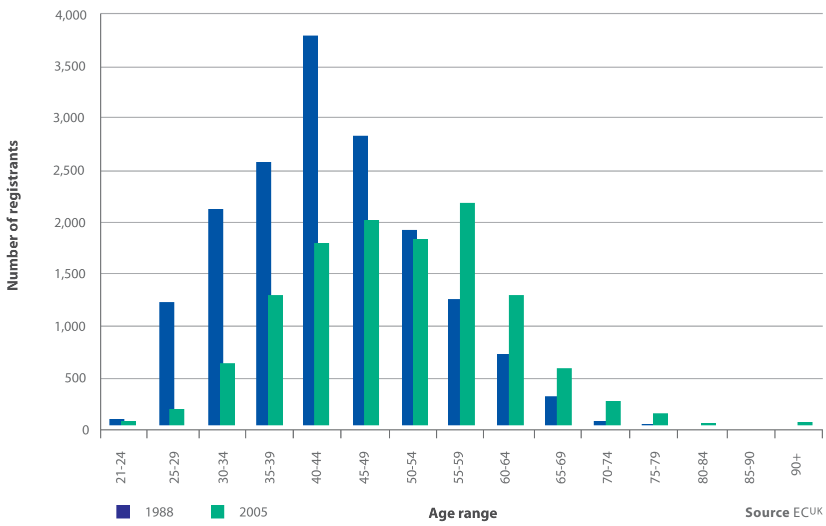


Figure 3c
EngTech Registration



Without skilled personnel, with proven competence at CEng level or equivalent, the position of the UK as an innovation nation is threatened.

Towards Solutions

Provision of Higher Education

2.1.1

The standard and reputation of UK materials courses come out well in international comparisons, though the challenge of maintaining standards will be impacted by the demographic squeeze affecting academic staff as in other materials areas. Even so, more needs to be done to enable students to see the variety of careers available and where the jobs are at the end of their courses.

Undergraduate courses with greater industrial content would assist, as it does at postgraduate level, where a significant proportion of projects are industry-sponsored. Promoting greater contact between students and practising materials scientists and organisations would also help.

2.1.2

Describing materials degrees as *'materials engineering for…'* would help to boost the image, especially given the trend elsewhere in higher education to sub-categorise courses. Some examples of this could be – materials engineering for sports; materials engineering for medicine; materials engineering for energy; and materials engineering for motorsport. However, this must not be at the expense of quality, and some employers have observed that the graduates of some such courses are not always well equipped for employment.

2.1.3

Government support for engineering undergraduates does not compare well with medicine and dentistry. The latter are in HEFCE Price Group A funded at £14,107 per head in 2007/8. Metallurgy and all engineering subjects are in Price Group B funded at only £5291 per head. These levels are based on historical trends, not future demand, and, as a consequence, less effort has been put into raising awareness of engineering-related courses.

2.1.4

Although postgraduate numbers in the field have grown slowly, this is largely due to the growth in overseas students, and, as indicated earlier, the effect of this on the UK skills pool is not as great as it could be and may be short-lived.

Nevertheless, we can build on the trend towards postgraduate study in general by taking undergraduates from other engineering disciplines and adding specific materials knowledge at the postgraduate level.

2.1.5

There is also a case for:

- Increasing student funding for materials engineering courses.
- More imaginative development and promotion of materials engineering courses.
- Encouraging the highest quality overseas students to remain in the UK after undertaking postgraduate education and where industrial sponsorship is available.
- Increased provision of tailored materials postgraduate top-up courses at universities including the Open University (OU).

Towards Solutions

Work Based Training

2.2.1

The Skills for Business Network (SfBN) was set up to identify and tackle skills gaps on a sector-by-sector basis. The network comprises 25 Sector Skills Councils (SSCs) which cover 85% of the UK workforce. The starting point for all SSCs is to define what the current skills gaps are and future requirements will be, and to ensure that state-funded provision of education and vocational training is focused on these priorities. National Skills Academies (NSAs) are being set up 'at the apex of the skills system'. Four (including manufacturing) are up and running, and a further eight are planned.

2.2.2

Prime Minister Gordon Brown, while Chancellor of the Exchequer, alongside then Secretary of State for Education and Skills, commissioned Lord Leitch to report on Prosperity for All in the Global Economy – World Class Skills. Leitch's report had some stark messages about the need for a more educated workforce and set targets that have been adopted by the Government.

2.2.3

While technical colleges are addressing the need to bring 90% of the workforce to Level 2, and initiatives to raise the profile of STEM are taking effect in schools, there is little evidence of attention to some of the other recommendations of the report made by Leitch, including:

- More than 70% of the 2020 working age population are already over the age of 16. Adults need to update their skills in the workplace.
- More than 40% of adults should be qualified to Level 4 and above.
- The skills system must meet the needs of individuals and employers.
- Employer investment in Level 3 and 4 qualifications in work needs to increase.

2.2.4

Relying on the current supply of new graduates attracted to university engineering courses straight from school will not address the issue until the medium term. This is further compounded in the short-term by evidence showing that the number of 18 year-olds is set for a marked downturn (see Fig 5). However, there is a current opportunity to increase the qualifications and skills of those already in the workforce.

2.2.4

According to Leitch, developing the skills of the existing workforce is hugely important given that over 70% of the 2020 workforce is already in employment. The report sets a target for more than 40% of the adult population to be qualified to Level 4 and above, which means 530,000 people per year as compared with around 250,000 today.

However, the education and skills system is largely focused on young people and is less well developed to meet the up-skilling needs of those already established in employment.

2.2.5

As shown by the SEMTA survey (see Fig 4), smaller companies often do not recognise the skills shortage as readily as larger ones. They may need special attention to get the message across. Assistance in making the business case for investment in skills will be particularly helpful.

2.2.6

One current initiative (Appendix 2) is aimed at increasing qualifications among engineering and materials science personnel currently in the workplace, directly in line with the needs identified above. The Welding Institute (TWI) has been liaising with the OU. Both see that technicians working in industry have much to offer and have demonstrated their innate ability and commitment to engineering. The proposal is to guide these employees to increase their qualifications to Foundation and Honours Degrees and potentially to postgraduate qualification. The Welding Institute and OU are each investing £1m in this effort. They have received support from Lloyd's Register Educational Trust with a £600k contribution to establish a Chair in Materials Fabrication and Engineering.

This will form an exemplar initiative involving centres of excellence around which to focus the effort and specific industrial networks who wish to add their own tailored requirements.

2.2.7

To put this initiative into perspective, the numbers of existing vocationally qualified personnel without degrees runs into tens of thousands. Many are more than capable of reaching CEng status, provided they are supported while they remain in work.

2.2.8

The key challenge for the materials community is to understand how the support structures work, ensure that its voice is heard and avoid fragmentation.

A specific strength that the UK can build on is the OU, which is world class in the provision of distance learning. The exemplar initiative with TWI is developing programmes for training in the workplace to raise the profile for both materials engineering and twin-tracking academic and vocational qualifications.

There is also a need to promote the training provision already available, much of which is currently invisible to industry.

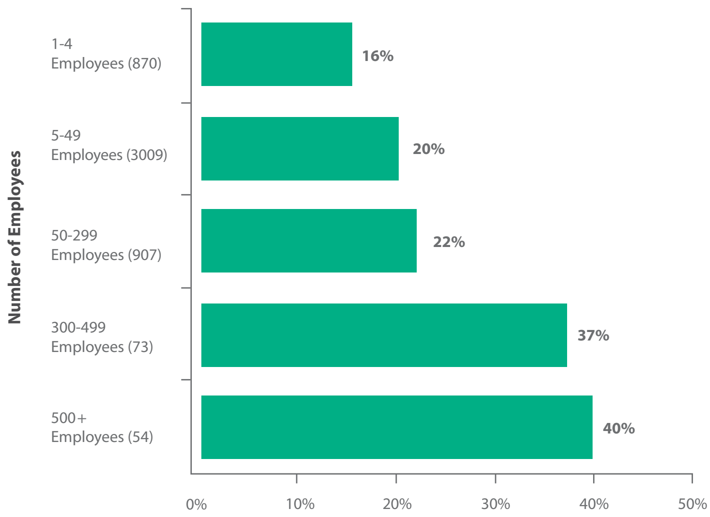
2.2.9

There is also a case for;

- Influencing SfBN to provide joined up, cross-sector support and keep the materials community informed of newly developed assistance available.
- Engaging further with the OU on the potential for concurrent distance learning & professional qualifications for materials engineering.
- Developing a single online database of existing materials engineering training provision.
- Bringing the needs of the materials community to the Commission for Employment and Skills.

Figure 4 Data from the Sector Skills Council for Science, Engineering and Manufacturing Technologies employers in 2006

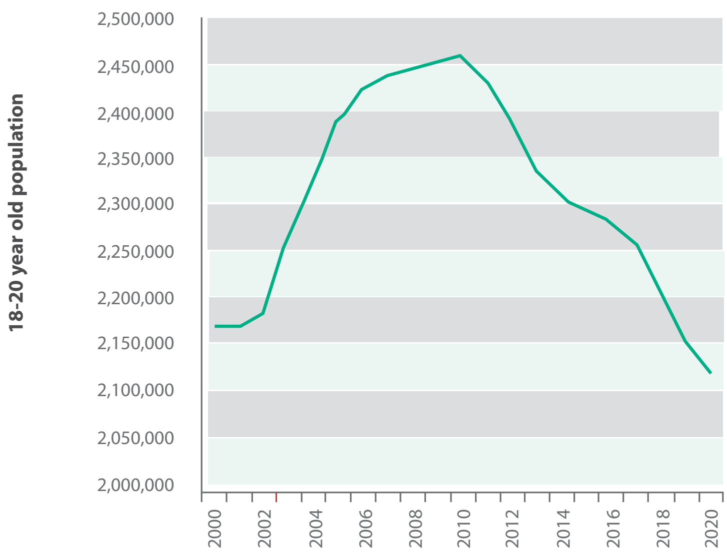
Proportion of organisations that have identified a skill gap, by organisational size (all respondents)



Figures in parentheses denote unweighted sample bases

Most organisations identifying skill gaps (70%) specify technical and engineering skills (at all levels within craft, operator, technician and professional engineering occupations).

Figure 5 Population estimates for 18-20 year olds in the UK



Source - Engineering and Technology Board Analysis of Office of National Statistics (ONS) and Government Actuaries Department Population Estimates 2006

Towards Solutions

Schools and Image

2.3.1

The root cause of many of these shortages is that not enough good students choose to study science and engineering. In common with other areas of manufacturing, both here in the UK and in other developed economies, materials faces difficulties in attracting young people.

2.3.2

The problem may even be more acute in the case of materials because, unlike defined sectors such as automotive or aerospace, materials lacks a distinct sector image. Certain sub-sectors like steel, glass and plastics do have visibility, but are generally not perceived by the general public as being part of a wider 'materials industry'.

2.3.3

This is a complex area, but there are two important underpinning contributory factors – a general decline in young people opting for science based study and a perception that manufacturing, in general, cannot provide exciting and fulfilling jobs which are well paid and have good prospects.

2.3.4

Mat UK produced a report aimed at young people entitled '*What's the Future Made Of?*' which represented a first attempt to address the 'image' problem. While this publication was received enthusiastically by those teachers and students who received it, Mat UK's limited resources meant that penetration was limited.

For the organisation to engage effectively with schools it will have to work closely with some of the many existing schemes and initiatives, both national and regional, promoting STEM subjects to young people.

2.3.5

In collaboration with the Science, Technology, Engineering and Mathematics Network (STEMNET), a Government funded organisation to encourage young people to enter science related careers, Mat UK aims to deliver, through existing programmes, clear positive messages about the materials industry to teachers, students and parents, including promoting contact with practising materials scientists. These activities should reveal the high-tech side of the industry and the range of career opportunities available.

Where possible, Mat UK will ensure that new initiatives include elements on materials and also the materials industry. STEMNET experience has already demonstrated that funding must be available to schools to pay for teacher training in offering these initiatives, such as engineering clubs. Otherwise efforts will be at best sporadic and/or short-lived.

2.3.6

Some progress, however, is being made. Materials is starting to be recognised as a Key Stage 3, 4 and 5 curriculum subject, and the IOM³ Schools Affiliate Scheme has involved over 8,000 pupils.

2.3.7

There is also a case for collaborating with STEMNET to:

- Develop core Mat UK messages on the materials industry.
- Identify existing schemes and initiatives through which Mat UK might deliver core messages, such as the IOM³ Schools Affiliate scheme.
- Agree on the production of basic promotional material for distribution at events, conferences and school activities.
- Review individual schemes from institutes, livery companies and bodies with a view to creating a multiplier in the national approach. A clear offering rather than a mass of unconnected initiatives is the objective.
- Build on the recognition of materials as a Key Stage 3, 4 and 5 subject.

Conclusion

The case presented in this report represents a wake-up call to industry, Government and education/training providers given the importance of materials to the UK's GDP.

A serious skills shortage will arise due to falling graduate numbers at a time of increasing retirement. This will directly affect our national ambition to be a world-recognised innovation nation.

While some of the shortage may be made up by immigration and people working beyond the age of 65, this will not provide the necessary resources to support the future growth predicted in advanced manufacturing in energy, aerospace, automotive, construction, medical devices, electronics and defence. Furthermore, engineering consultancy and project support will be needed to support the current and future UK materials infrastructure.

Mat UK wishes to bring its broader agenda and actions to the notice of policy makers in Government and industry to help effect the changes that are needed.

Appendix 1

Data Analysis of HESA and UK Centre for Materials Education Student Numbers

The data from HESA (www.hesa.ac.ku) suggest that student numbers on materials courses were increasing until 2005 as shown in the table opposite. The UK Centre for Materials Education (UKCME) comments that students are normally associated with Joint Academic Coding of Subjects (JACS) categories to generate these statistics, and that between 2002 and 2006, an average of 2,154 full person equivalents were recorded in the Textiles and Polymers category. The National Subject Profile* states 'the majority of students returned against the "Polymers and Textiles" materials JACS code are on textiles-related programmes that generally contain little or no significant materials content.'

The HESA figures are the total number of students registered in any one academic year. Students will be counted for each year of the course; for a full-time postgraduate this might be seven years. Thus the figures cannot be used to deduce the number of materials students leaving with qualification each year.

UKCME approached the issue of numbers of graduates by seeking returns directly from the HEIs. This is dependent on the categorisation in each institution but may be expected to be more accurate than the more general JACS categorisation.

The numbers of graduates from all materials programmes (with >40% materials content) as reported by HEIs in the National Subject Profile (NSP) by UKCME are:

2004		2005		2006	
BEng	MEng	BEng	MEng	BEng	MEng
280	170	257	132	251	113

The table above, published in the NSP, shows that there is a distinct trend to lower numbers through the period, with only 364 graduates in 2006.

Further analysis is presented on the type of programme and the number of students on each. Five categories are defined:

1. General Materials Science and Materials Engineering (including Metallurgy and Materials Science) programmes
2. Bio-Medical and Sport-Materials programmes
3. Aero/Auto/Marine/Design/ Mechanical/Environmental Materials programmes linked to industrial sectors (including Conservation and Restoration)
4. Metallurgy, Polymers, Composites and Natural Materials programmes related to specific types of materials
5. General MSE programmes and/ with Business/Management/ Language/Physics /Chemistry (including Mining and Minerals)

The tabulation by these categories, given in the NSP, omits category 5, presumably as 'Materials and/with…' programmes are considered unlikely to produce material scientists for the industry. The numbers of graduates from undergraduate materials programmes classified by these categories are:

	2004		2005		2006	
	BEng	MEng	BEng	MEng	BEng	MEng
Cat 1	118	84	106	68	89	59
Cat 2	84	15	74	20	79	19
Cat 3	38	26	40	14	52	11
Cat 4	30	0	18	1	16	0
Total	270	125	238	103	236	89

* http://www.materials.ac.uk/subject-profile/report.asp

Raw data from the HESA statistics on the student numbers at UK higher education institutions' materials courses 1996-2007

	Course	Total All	FTUGs	FTPGs	PTUGs	PTPGs
1996-1997	Materials science	687	339	77	194	77
	Metallurgy	979	240	493	2	244
	Other materials technology	2,896	1,624	662	159	451
	Total	**4,562**	**2,203**	**1232**	**355**	**722**
1998-1999	Materials science	423	280	54	34	55
	Metallurgy	831	226	383	2	220
	Other materials technology	2,616	1,297	623	187	509
	Total	**3,870**	**1,803**	**1,060**	**223**	**784**
2000-2001	Materials science	300	190	35	5	70
	Metallurgy	780	160	370	20	230
	Other materials technology	2,215	1,025	640	145	405
	Total	**3,295**	**1,375**	**1,045**	**170**	**705**
2002-2003	Materials science	435	225	155	20	35
	Metallurgy	650	110	390	0	155
	Other materials technology	2,990	1,590	710	195	500
	Total	**4,075**	**1,925**	**1,255**	**215**	**690**
2004-2005	Materials science	545	175	240	0	130
	Metallurgy	665	110	390	5	160
	Other materials technology	3,215	1,690	865	185	480
	Total	**4,425**	**1,975**	**1,495**	**190**	**770**
2006-2007	Materials science	650	230	260	0	155
	Metallurgy	670	100	405	0	165
	Other materials technology	2,935	1,525	870	175	365
	Total	**4,255**	**1,855**	**1,535**	**175**	**685**

This table shows the breakdown of students numbers in materials related courses in terms of their enrolment status.

Appendix 1

Data Analysis of HESA and UK Centre for Materials Education Student Numbers

An analysis was made in the NSP of the domicile of students on these courses and how this changed from 1996-2006. The strong growth in overseas students in all except category 2 is evident (See Fig 6).

UKCME took HESA information on first destinations of 985 domiciled graduates in the period 2003 to 2006 to compare materials with chemistry, mechanical engineering and physics. It found 43% of materials graduates were in full-time employment 6 months after graduation, and 25% were in further study. (See Fig 7a)

Thus, the estimated materials graduate entry into employment in 2006 was 43% of 325, that is, 140.

HESA also gives the Standard Industrial Classification (SIC) of employers of these UK domiciled graduates who have found work (See Fig 7b).

Materials scientists may be working in many sectors and contributing specialist knowledge to the benefit of the country but some will be working in completely non-materials related jobs. It is not possible to be definitive about the job functions in the SIC shown in the figure but it is likely that at least 30% of graduates are in non-materials oriented jobs. This estimate results in the conclusion that less than 100 graduates entered the materials field in 2006.

The NSP addresses postgraduates but restricts data to those studying taught courses, termed PGT (postgraduate taught). Postgraduate research (PGR) student numbers are difficult to find so, with reservations, the HESA data for full-time and part-time postgraduates are used as totals for PGT plus PGR in the following paragraphs.

The HEI survey reported in the NSP shows graduate numbers from all materials PGT Masters programmes as:

Year	2004	2005	2006
Grads	309	332	311

It is noted that about 45% of PGT students appear to be UK domiciled with just under 20% coming from non-UK EU countries and 35% coming from outside the EU. Thus around 140 UK domiciled Masters were produced in 2006.

The report notes that the proportion finding full-time employment, 60%, is higher for the PGT graduates than for BEng/MEng graduates. Assuming that a similar percentage to that determined above takes work in non-materials related jobs, less than 60 Masters entered the industry in 2006.

The HESA data show 1,545 full-time postgraduate students and 700 part-time. Estimating that the average study time is 3.5 years for a full-time student and 4 years for a part-time student, suggests the total number leaving in 2006 was 690. UKCME identified 311 of these to be PGT. It is not possible to determine the proportion of the remaining 379 that are PGT or PGR students in general programmes of the 'materials and/with…' type, but assuming a similar percentage, 12%, to that found in the HEI survey of undergraduates, the number of PGR materials students is around 330.

No data are available on the domicile or employment of PGR leavers so the figures given above for PGT have been used to estimate that 62 PhD holders also joined the industry in 2006.

These estimates show a total of around 220 materials qualified personnel finding employment in 2006. This has to be compared with more than 500 retirements (See 1.9 of main report).

Figure 6

Domicile of students on materials courses

(Categories defined on Pg 14)

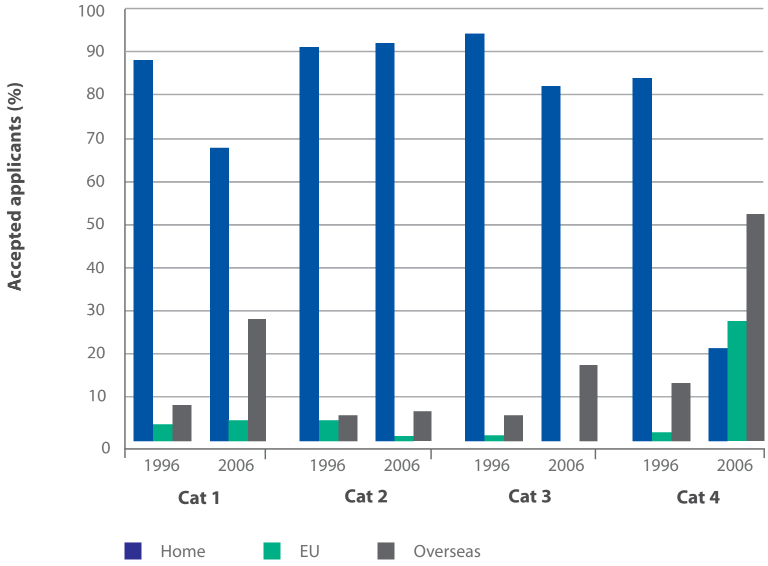


Figure 7a

Employment destination of UK domiciled graduates

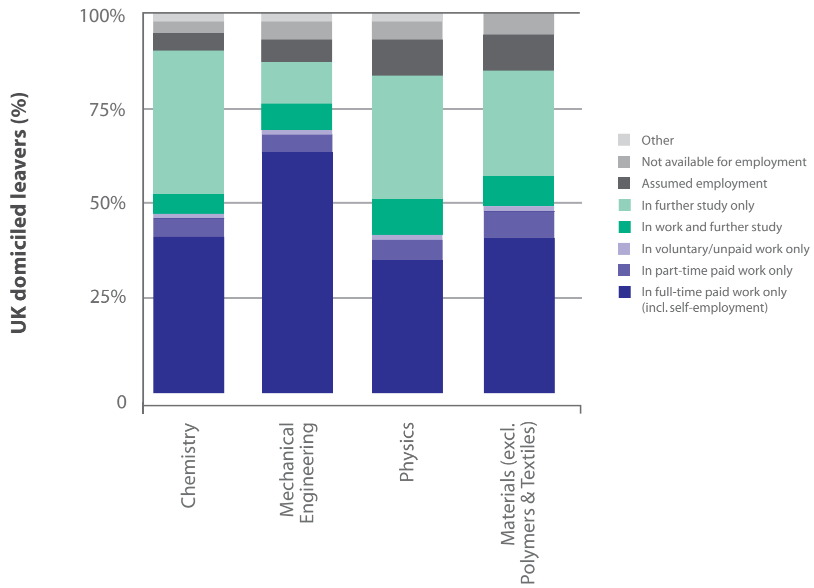
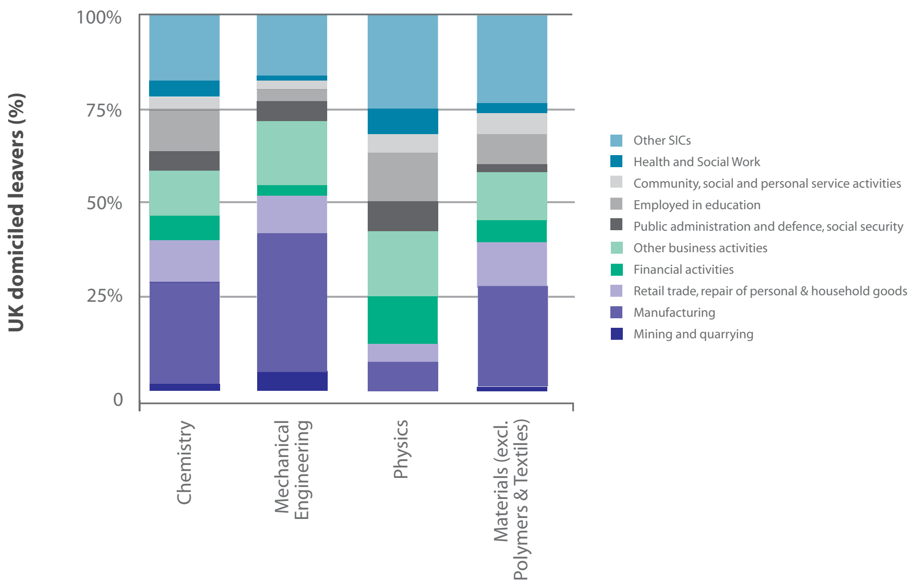


Figure 7b

Industrial classification of employers of UK domiciled graduates



Retirement is already considerably above 500 each year, whereas fewer than 250 materials graduates and postgraduates are joining each year.

Appendix 2

The Open University, The Welding Institute, and Lloyd's Register Educational Trust Model

The principle is to use the expertise of The Welding Institute (TWI) in materials fabrication and its connection to industry through Membership, combined with the teaching principles of the Open University (OU), to increase the number of graduates in a fundamental aspect of STEM. This scheme will be marketed, reflecting the sponsorship received, as in the case of the Lloyds Register Educational Trust.

The OU has built a strong reputation in the education of part-time students. It has the schemes and controls that are necessary to give integrity to the qualifications it awards. It is this that forms the basis of the project. The part-time, distance-learning approach of the OU is ideally suited to those students who need to remain in work while studying.

The scheme will be based on step-wise qualification development via a credit-based system, giving flexibility of timing and route chosen.

Although initially developed in the UK, a major aspect is that the scheme should be readily transportable to developing nations, giving access to, and acceptance of, British qualifications and technology know-how. As it is centred on distance-learning modules, the OU system is readily applied to students around the world.

The Welding Institute is a founder member of the scheme for welding engineering qualification operated by the International Institute of Welding (IIW). This scheme is recognised by more than 40 countries around the world as demonstrating knowledge in the theory of engineering fabrication.

No other instance is known in any profession of such widespread acceptance of a single qualification. The learning required for an IIW Diploma has been assessed by the OU and incorporated as modules counting towards an OU qualification.

The Engineering Council of the UK bestows professional qualifications upon suitably educated and experienced individuals. These qualifications, especially Chartered Engineer (CEng) and Incorporated Engineer (IEng), are recognised as significant achievements relating to education, work-based learning, job knowledge and the commitment to continuous professional development.

The Welding Institute is a licensed member of the Engineering Council of the UK and is authorised to assess qualifications for eligibility towards CEng and IEng. The modules available for this scheme will be selected for applicability to the Engineering Council requirements so that a student may gain these professional qualifications without further academic achievement.

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