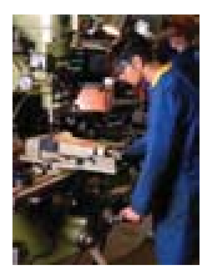
ENGINEERING IN SCOTLAND'S COLLEGES

A report by HM Inspectors for the Scottish Funding Council

October 2007







Contents

1. Introduction

Engineering has played an important role in Scotland's industrial history. Over the years, the skills requirements of industry have changed as the technology has progressed and the industrial base of the country has developed. Over the past decade, there have been substantial changes in the employment opportunities for people with engineering skills as some areas of employment have grown while others have diminished. These changes have often been the result of worldwide industrial dynamics and competition. For example, global changes in semiconductor and electronic product manufacturing reduced the scale of these industries in Scotland and this had an impact on large multinational and small, locally-based companies. Other industries, including oil and gas exploration and production, continue to provide many long-term career opportunities for people with engineering skills. Clearly, engineering and manufacturing industries employ fewer people than in the past and projections in a recent report[1] by Futureskills Scotland indicate that the downward trend in total employment in these sectors will continue. However, the same report indicates that replacement demand in these sectors will result in continued demand for employees over the next decade. Recent reports by Scottish Engineering[2] have indicated growth in manufacturing orders, employment and investment over the past few years. People with engineering skills also have important contributions to make in other sectors of the economy, including transport, telecommunications and business services. Overall, engineering skills continue to be very important for the Scottish economy.

The Scottish Government's recently published skills strategy document, *Skills for Scotland, A Lifelong Skills Strategy*[3], stresses the importance of a skilled population to the economy of Scotland and its society. The strategy document recognises the significance to colleges to the development of skills and refers to their "pivotal position in the skills community". In engineering, Scotland's colleges have played a key role in contributing to the education and training needs of learners and the skills needs of employers, at both further education (FE) and higher education (HE) levels. Colleges have also played their part in preparing learners for work or for progression to higher education institutions. Recent Futureskills Scotland reports[4,5] showed that 20% of engineering sector employers in Scotland and 21% of automotive sector employers recruited staff directly from colleges.

---

[1] *Futureskills Scotland 2007, Labour Market Projections 2007 to 2017,* *http://www.futureskillsscotland.org.uk/web/site/home/Reports/SkillsForTheFuture/Report_Labour_Market_Projections_2007_to_2017.asp*
[2] *Scottish Engineering Quarterly Review, http://www.scottishengineering.org.uk*
[3] *Skills for Scotland, A Lifelong Skills Strategy, Scottish Government Publications, 2007, http://www.scotland.gov.uk/Resource/Doc/197204/0052752.pdf*
[4] *Futureskills Scotland 2005, Science, Engineering and Manufacturing Technologies, Scottish Sector Profile*
http://www.futureskillsscotland.org.uk/web/site/home/Reports/IndustrySector/Report_Scottish_Sector_Profile_2005_Science,_Engineering_and_Manufacturing_.asp
[5] *Futureskills Scotland 2005, Automotive, Scottish Sector Profile*
http://www.futureskillsscotland.org.uk/web/site/home/Reports/IndustrySector/Report_Scottish_Sector_Profile_2005_Automotive.asp

The Leitch Review[6], which reported in 2006, examined the long-term skills needs of the United Kingdom. The report, *Prosperity for all in the global economy – world class skills*, stressed the influence of the global economy on the UK and the importance of a strong skills base, while pointing out that the UK had lower levels of technical and vocational skills than France and Germany.

This report seeks to examine the role of Scotland's colleges in the provision of education and training in engineering, the quality of that provision and the factors that influence it. The term *engineering* is used in this report to include subjects as diverse as aeronautical engineering, automotive engineering, electrical installation, electronic engineering, fabrication and mechanical engineering. Civil engineering is not included. Many of the statistics in the report are drawn from the Scottish Further and Higher Education Funding Council's (SFC) database. For consistency, the engineering superclass[7] of subjects is used as the basis for comparisons of SFC statistical data.

[6] *Prosperity for all in the global economy – world class skills*, 2006, HMSO
http://www.hm-treasury.gov.uk/media/523/43/leitch_finalreport051206.pdf
[7] Superclass: a group of related subjects used to define subject areas. Listed in Appendix 1

2. Summary of findings

Engineering continues to be a large part of the provision in the majority of Scotland's colleges. In 2005-06, more than a third of colleges derived at least 10% of their teaching activity from engineering programmes. Colleges had to have a strong, strategic, long-term commitment to maintain the skill levels of their staff, and competitive standards of accommodation and equipment.

Factors affecting strategic decisions on future provision of engineering included learner demand, the employment situation, college staffing, accommodation and equipment needs and performance indicator (PI) data. A few employers or industries had a particularly strong influence on college provision. Colleges had to respond well to changing industry conditions if they were to continue to offer learners an effective up-to-date learning experience and meet skills needs.

Some colleges had found it too challenging to recruit sufficient number of learners into engineering and had responded by using their resources to offer programmes in areas related, for example, to music or media. In a few cases, colleges had stopped offering engineering or had focused their attention on one or two specific subject areas. Elsewhere, colleges often offered a wide range of provision with many options for learners. Provision was generally well adapted to local demand. Some colleges had a very extensive portfolio of engineering programmes at all levels and covering many engineering disciplines. In smaller engineering departments, the choice for learners was generally narrower.

While the total engineering provision across the college sector had declined over the past few years, it had grown in a few colleges. Specific subject areas like electronic engineering had declined in many colleges but other subjects such as motor vehicle engineering had remained strong or were growing. There had been a large fall in the numbers of learners taking Higher National (HN) engineering programmes in the past four years. There had been steady growth in the number of Modern Apprenticeships (MA) over the same period. Only a small percentage of Modern Apprentices were aged 25 or over. There were very few female learners in engineering programmes.

A number of factors influenced learners' decisions to study engineering in colleges. Family experiences were important, as were employment opportunities and learner interest in the subject area. Few learners felt that the information and advice they received at school had been very helpful in relation to colleges or Modern Apprenticeships, or had been an important influence.

A wide range of external stakeholders made contributions to the development of engineering provision in colleges, including the awarding bodies, the sector skills councils and employers. Colleges worked well with sector skills councils and relevant training organisations. There were many examples of very effective engagement between employers and colleges. Many colleges were working with companies or industries that operated worldwide or across the UK. As a result, a college could be in competition with training providers elsewhere in the UK. In some industries and localities, employers were small and locally based. These employers' varied training requirements for very small numbers of people challenged the flexibility of colleges to respond.

A few colleges had invested heavily in engineering resources. However, it was a significant challenge for all the colleges that offered engineering in their curriculum to establish and maintain an experienced and well-qualified staff team, a high standard of accommodation, and a suitable range of high-quality, industry-standard equipment. In a few colleges, outdated equipment detracted from the learner experience. Professional networks such as those linked with awarding bodies or sector skills councils provided staff with opportunities to share good practice and contribute to the development of engineering in colleges. Staff engagement with employers helped some to maintain their awareness of current practice in industry, but few staff had undertaken recent secondments with employers.

Professional organisations such as the Institution of Engineering and Technology[8] (IET) had a relatively low profile in colleges.

Most learners benefited from a good learning experience in their college. Most were well motivated, particularly by the practical elements in their programmes. Learners enjoyed good relationships with teaching staff. Teaching was generally of a high standard and learners benefited from the wide experience of staff, as well as their knowledge and skills. Learners usually developed a range of relevant vocational skills including the use of specialised ICT hardware and software such as computer-aided-design tools. However, in many cases learners and staff did not make sufficiently effective use of the opportunities that ICT offered as a learning and teaching medium. More than a few teaching staff did not plan the development of core skills well enough.

There were examples of high attainment rates for all levels and modes of attendance in engineering programmes. The highest rates of attainment were generally in programmes for employed learners, in particular, those programmes designed for Modern Apprentices. However, retention and attainment rates were issues of concern for most engineering departments, particularly in relation to programmes for full-time, non-employed learners.

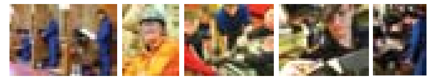
[8] Institution of Engineering and Technology: http://www.theiet.org/

3. Methodology

HMIE carried out this review during 2006-07. The review team analysed the outcomes of HMIE reviews of engineering that were published in the period 2005-07 to provide information about the *learning and teaching process*, *learner progress and outcomes* and other significant factors. There were 20 reports on engineering subjects during this period, ranging in scope from reviews of single subject areas such as automotive engineering to broader multidisciplinary engineering reviews. The team also drew evidence from a range of documents relating to engineering in Scotland and elsewhere.

HMIE visited six colleges with substantial provision in engineering, located in different areas of the country. The colleges had interests in different, but overlapping, areas of engineering and worked with a range of employers and other partners. During these visits, the review team met senior managers, staff and learners to discuss a wide range of issues relating to engineering provision. They also looked at important aspects of the colleges' facilities and received a wide range of documentary evidence. These documents included college plans, lists of programmes and employers, promotional material and evaluations. Discussions with learners concentrated on their motivation for studying engineering and their experience in their college. The SFC, Scottish Qualifications Authority (SQA) and individual colleges provided data on enrolments and attainment.

HMIE consulted a range of stakeholders including an employers' organisation and sector skills councils. Colleges were invited to send staff to two focus group meetings. These were attended by 24 teaching staff and managers. Where requested, special arrangements were made to take account of the views held by college staff who were not able to attend either of the focus groups. The focus group questions are provided in Appendix 5.



4. The provision of engineering programmes

4.1 Policy and planning

Historically, the direction of education and training in European countries has been influenced by different factors in each country. A paper given at a CEDEFOP[9] conference on vocational education and training held in 2002 described three models for vocational training in Europe. These can be summarised as:

> "1. *The economy takes priority from a cultural perspective. Training is primarily by market forces. The functional needs of the company or the actual job are the leading didactic principles.*
>
> 2. *Politics take priority from a cultural perspective. Training is primarily regulated by bureaucratic control. The academic principle is the main didactic tenet.*
>
> 3. *Society takes priority from a cultural perspective. Training is primarily regulated by dual control ie a combination of market and bureaucracy. The vocational principle is the determining didactic orientation."*

While the paper recognised changes in systems in Europe in the past 20 years, it identified model 1 as applying in the UK, model 2 in France and model 3 in Germany. These models are simplifications but they indicate that the UK model is strongly affected by market forces while the "*dual*" model[10] in Germany is based more strongly on partnership with employers. The UK model has moved towards the German with the advent of Modern Apprenticeships, but remains significantly different in terms of the proportions of people qualified at different levels and the funding and ownership of training[11].

In Scotland's colleges, a very wide range of factors has influenced decisions at a strategic level about provision. These have included learner demand, funding arrangements, college staffing, and accommodation and equipment requirements. Learner attainment shown in performance indicator data was also a factor. External influences included liaison with schools, other colleges and public bodies. Colleges also took account of the needs of employers and their skills requirements through liaison with industry and training bodies, and by reference to national and local labour market information. For more than a few colleges, particular employers or industries had a very strong influence on the curriculum. For example, the oil and

---

[9] *Towards a history of vocational education and training (VET) in Europe in a comparative perspective*, CEDEFOP, Proceedings of the first international conference, Florence, 2002, http://www.trainingvillage.gr/etv/Information_resources/Bookshop/publication_download.asp?pub_id=373&dl_id=1111&pub_lang=en

[10] *Vocational Education and Training in Germany*, CEDEFOP, 2007 http://www.trainingvillage.gr/etv/Upload/Information_resources/Bookshop/465/5173_en.pdf

[11] *Catching up with the Continent, Final report on EU and UK manufacturing productivity*, EEF, 2005 http://www.eef.org.uk/NR/rdonlyres/1EB68CF0-D0A2-420D-A43E-1A04E77D0C79/1339/catchingup.pdf

associated industries had a major influence on the provision in colleges in the north-east and elsewhere in Scotland.

Employers were often competing in a global marketplace and required high and competitive skills levels in their employees. For a few colleges, major contracts with local, national or international employers to provide education and training had offered the prospect of continuity of demand in engineering and enabled them to plan and invest with more confidence. This continuity also provided a base from which colleges could offer training courses to smaller engineering companies who themselves would not have provided sufficient numbers of learners to justify the overall provision or investment. For others, it had been helpful for colleges to work with industry sectors that were stable and had predictable employment trends. Changes in the fortunes of specific industry sectors had resulted in colleges having to adapt to new circumstances. For example, there had been a well-publicised decline in production and employment in sections of the electronics industry and semiconductor fabrication industry. The Scottish *Index of Manufactured Exports 2007 Q1*[12] commented that:

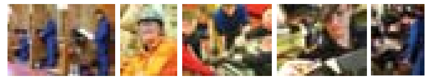
"At its peak, in 2000, the electrical and instrument engineering sector accounted for 58 per cent of Scotland's manufactured exports. This industry remains Scotland's largest exporting sector and accounted for 34 per cent of Scotland's total manufactured exports in 2006."

This decline in production had affected radically the demand for electronics and mechatronics programmes in some colleges. In a few cases, lack of demand for places on engineering programmes had resulted in colleges withdrawing from areas of engineering provision. Some colleges had also shifted the emphasis of their activity to subject areas related, for example, to music or media. However, links with more buoyant areas of the economy had enabled a few colleges to plan for growth in specific areas of engineering, such as those areas servicing the petrochemical industry.

Decisions made in colleges to move into or withdraw from some areas of engineering provision required a long lead time and could not be reversed easily. As a result, successful, well-resourced engineering provision depended on strategic decisions made by college Boards of Management and senior managers to support this area of activity in line with those colleges' strategic plans.

A majority of colleges in Scotland offered some engineering provision. SFC data showed that 28 colleges had 5% or more of their provision (measured in unweighted SUMs) in the engineering superclass group of subjects in 2005-06. Chart 1 shows the relative significance of engineering across the 43 colleges. The average for all colleges was 8%.

[12] *Index of Manufactured Exports 2007 Q1, Scottish Government Publications,* *http://www.scotland.gov.uk/Publications/2007/07/IME07Q1*



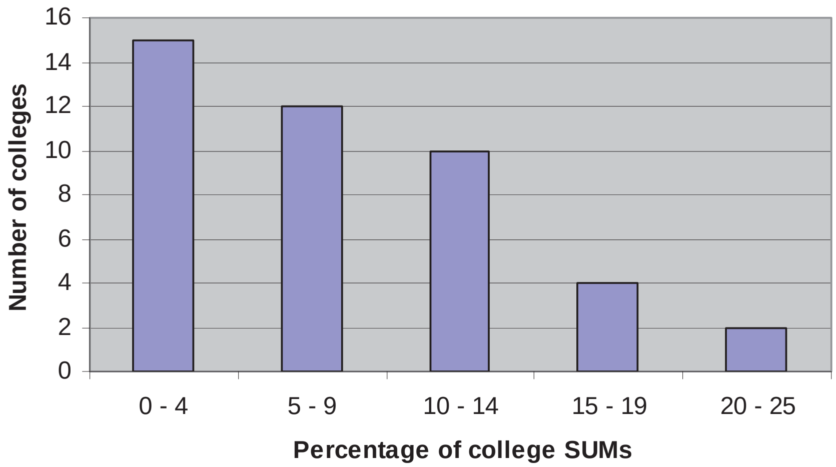


Chart 1: Percentage of college SUMs derived from the engineering superclass group

For a majority of colleges, engineering had formed an important element of the curriculum for many years, reflecting the needs of the local economy and community. Engineering in some form was offered across the country from Shetland to the Borders, although the pattern of provision had changed as colleges had responded to learner and employer demand.

Colleges required staff with a wide range of skills and experience, including industrial experience, in order to plan and deliver their engineering programmes. Engineering was a relatively costly area of provision to establish and maintain, particularly in those subject areas that required extensive capital equipment such as milling and turning machines and electrical plant. It was also costly for colleges to maintain the industrial relevance of their resources and staff expertise in areas where the technology developed rapidly, and equipment or software became obsolescent after a few years. In many cases the accommodation required was highly specialised. For example, electrical installation and motor vehicle programmes required specially designed workshops that could not readily be used for other purposes. Some types of engineering plant required large amounts of space, some needed industrial power supplies and much of the machinery installed could not be moved readily. The nature of the resources, including staff skills, capital equipment and accommodation, required to support engineering meant that the provision of engineering was necessarily a relatively long-term commitment by colleges.

4.2 Range of engineering programmes

Colleges worked with a number of awarding bodies to offer a very wide range of qualifications. Most learners were working towards SQA qualifications, but many learners on motor vehicle programmes were working towards City & Guilds[13] or Institute of Motor Industry[14] (IMI) qualifications. Engineering SVQs were awarded by

[13] City and Guilds: http://www.city-and-guilds.co.uk
[14] IMI: http://www.motor.org.uk/

several awarding bodies including SQA and EMTA Awards Ltd (EAL)[15]. Influences on a college's choice of awarding body included the range of qualifications available, progression opportunities, relevance to employment needs, recognition by employers and sometimes the availability of high-quality support materials.

Colleges had established programmes and units at levels up to SCQF level 9, although most provision was at SCQF levels 4 to 8. They included programmes leading to National Certificates (NC) and National Qualifications (NQ) at Intermediate level, Higher National Certificates and Diplomas (HNC and HND), degrees, Scottish Vocational Qualifications (SVQ), Modern Apprenticeships, Vocationally Related Qualifications (VRQ), Scottish Progression Awards (SPA), Professional Development Awards (PDA), school-link programmes, and taster courses for school pupils and others. Colleges offered modes of attendance that included full-time, part-time, evening class, block release, day release and flexible learning. Subject coverage across Scotland included aeronautical engineering, automotive engineering, electrical installation, electrical engineering, electronic engineering, engineering practice, fabrication and welding and mechanical engineering.

Colleges were generally responsive to local demand in developing their engineering provision. Appendix 3 illustrates the diversity of engineering provision in colleges by listing some of the range of programmes that were running in 2006-07 in two colleges that had wide-ranging engineering provision. Small engineering departments with a narrow range of resources were unable to provide learners with a wide subject choice at entry or for progression. The range of programmes and subjects available to potential learners also depended on their location. While mechanical and electrical engineering were widely available, a few subjects such as aeronautical engineering and marine engineering were available in only a few colleges. Other highly specialised subjects were only available in one or two colleges because they were designed to support a particular, local industry. At FE level, programmes were often locally devised to meet specific local needs or to provide progression opportunities.

Programmes for school pupils represented a growing aspect of engineering provision that was becoming more soundly based and better promoted. For example, one college had a well-presented prospectus specifically for schools that set out clearly details of the engineering programmes available to pupils and the progression opportunities in the college. While a few teaching staff expressed concerns about the low level of motivation shown by learners on school-college programmes, others reported good learner motivation when their college was directly involved in recruitment. Many colleges co-operated very well with schools to offer short programmes or taster events.

Most college engineering departments offered programmes on a commercial basis. These programmes were often short courses of study focused clearly on skills updating, for example, wiring regulations, the use of specific types of equipment or software or conversion courses to broaden the skills of staff working in engineering. A few colleges marketed their commercial training courses very effectively using high

[15] EAL: http://www.eal.org.uk

quality brochures or websites to provide businesses with details. Other colleges adopted a less systematic approach. A few colleges also had successful engineering programmes for international learners that operated on a commercial basis.

Progression routes within colleges were well established and offered most learners an opportunity to progress to HN level, if appropriate. Colleges with extensive engineering provision were unsurprisingly better placed to offer a range of progression paths.

> Aberdeen College had adopted progression arrangements for part of the engineering course portfolio that allowed learners to progress either through a practical route, from SVQ to HNC Engineering Practice, or through a more academic route from NC Engineering to HNC and HND in Engineering in each of the disciplines. This clarified the options and priorities for learners and staff. The college also had strong articulation links to university programmes that facilitated progression from HN to degree programmes.

In a few colleges, the narrow range of programmes and levels available resulted in learners having to travel to another college if they wished to progress to further study. Most colleges had articulation links with higher education institutions (HEI) that aided progression for learners who sought entry to a degree course. More than a few colleges, including UHI Millennium Institute (UHI) partner colleges, also provided opportunities for learners to study at SCQF level 9 on a small number of engineering degree programmes. Working with HEI and college partners, the Scottish Advisory Committee on Credit and Access (SACCA) had developed a website[16] that provided learners and college staff with helpful information about progression routes and the links between HEI and college qualifications.

Staff generally sought to ensure that learning and teaching activities provided a suitable balance of skills and knowledge to ensure that learners were motivated by their activities and prepared for employment or progression to higher levels of study where this was appropriate.

A few colleges worked together effectively to find suitable places for potential learners, to support learner progression, to share or make use of specific resources or to meet employers' training needs. However, in general the nature of engineering provision available to learners and employers in particular subject areas or geographical locations was the result of strategic decisions made by individual colleges.

[16] SACCA mapping project: https://mapping.qaa.ac.uk

4.3 Current engineering provision, participation and major recent changes

Two recent SFC reports *The Pattern of Subject Provision in Scotland's Colleges and Higher Education Institutions*[17] and *Scotland's Colleges: A Baseline Report*[18] have provided detailed information about activity levels in different subject areas in colleges, including engineering. Both reports concluded that there had been a pattern of decreasing activity in engineering overall[19].

The SFC data showed an overall drop in the recorded level of college activity in engineering subjects in recent years, from 176kSUMs in 2002-03 to 161.1kSUMs in 2005-06[20]. This is shown in Chart 2. There was also a small decline as a proportion of total college activity from 9% of SUMs in 2002-03 to 8% in 2005-06.

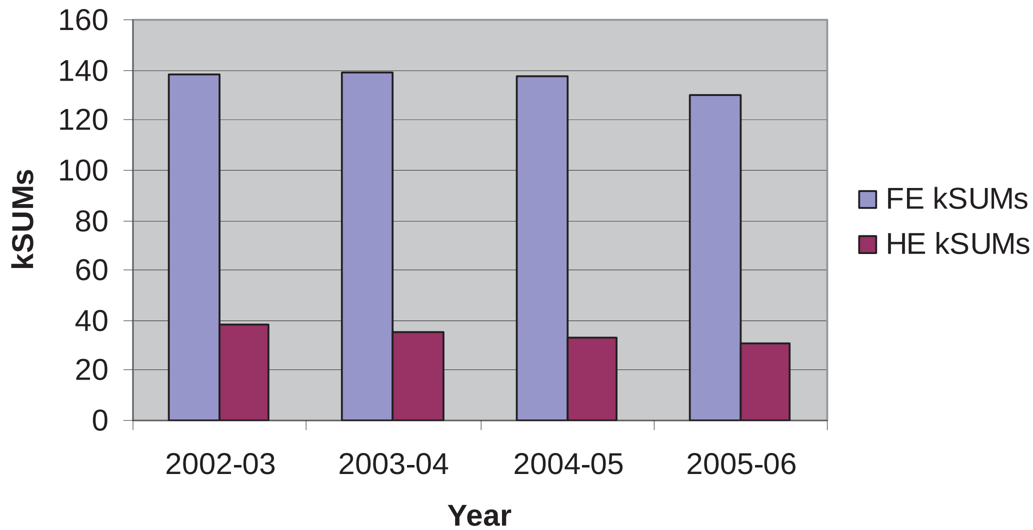


Chart 2: SUMs at FE and HE levels for the engineering superclass group, SFC Infact database

Chart 3 gives the headcount for the same period for the engineering superclass group of subjects. This shows that, counter to the decline in the overall SUMs count for engineering subjects and the decline in the number of HE learners, there was an

[17] *The Pattern of Subject Provision in Scotland's Colleges and Higher Education Institutions*, Scottish Funding Council, 2007
http://www.sfc.ac.uk/publications/Pattern%20of%20Provision.pdf
[18] Scotland's Colleges: A Baseline Report, Scottish Funding Council, 2007
http://www.sfc.ac.uk/publications/FE_baseline_Mar07.pdf
[19] There have been several changes in the basis for the calculation of the data over the years. For example, Bell College and UHIMI were included in the college data prior to 2002-03 and there were changes to the method of calculation of SUMs values. Also, it was noted that engineering might be over-reported in the programme data compared with the unit data because of the structure of the programmes and the allocation of programmes to superclasses. These factors make interpretation of the figures over the longer term quite complex.
[20] SFC changed the SUMs value for FE FT programmes from 21 to 20 for 2005-06. This applied to all subject areas and depresses the 2005-06 numbers slightly at FE level. Unweighted SUMs are used throughout this report unless otherwise indicated.

overall increase in the number of learners enrolling for courses. As a proportion of total learners in colleges, this represented a small increase for engineering as a proportion of the total from 6% to 7%.

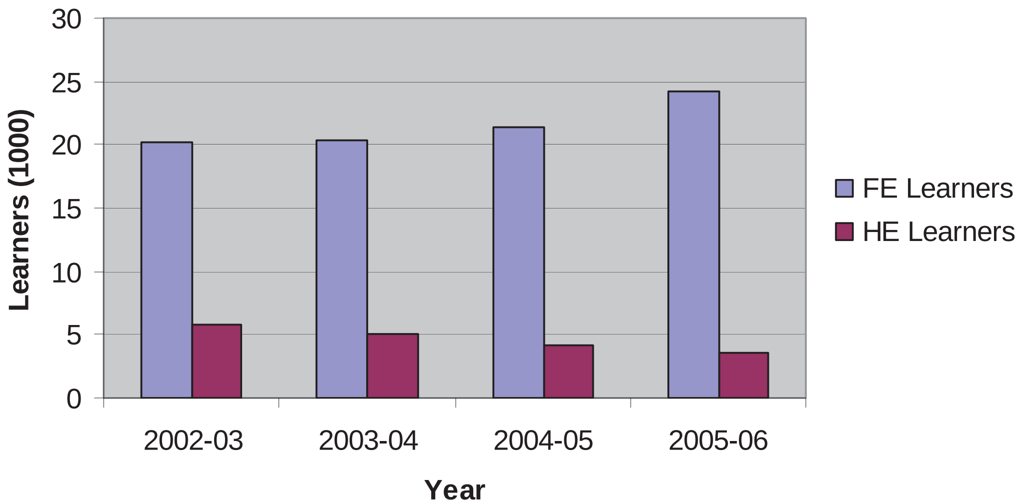


Chart 3: Headcount at FE and HE levels for the engineering superclass group, SFC Infact database

Comparison of the data in Charts 2 and 3 suggests an increase in the proportion of part-time learners, consistent with data below.

Within these overall trends, there were significant variations between colleges. There were nine colleges where the proportion of SUMs in the engineering superclass group of subjects as a proportion of all subjects fell by two percentage points or more and six colleges where it rose by two percentage points or more.

There were also wide variations in the trends for the different engineering subjects considered for this report. Table 1 below gives examples of the activity levels for specific subjects, again using unweighted SUMs as the basis for measuring activity.

Superclass	2002-03	2003-04	2004-05	2005-06
Electrical engineering	33.2	32.3	31.1	30.6
Electronic engineering	29.5	25.7	24.8	19.2
Electrical / electronic servicing	7.4	9.5	9.6	8.6
Engineering / technology (general)	28.8	23.7	23.9	30.2
Mechanical engineering	21.7	21.7	21.5	12.7
Vehicle maintenance / repair	28.9	35.5	32.7	32.0
Welding / joining	10.3	9.4	8.9	12.2

Table 1: Activity levels in selected subjects in kSUMs, SFC Infact database

Subject to the caveats about the relationship of 2005-06 SUMs calculations to those of earlier years, this table shows a decline in some of the major areas of activity such as electronic engineering and mechanical engineering during the period covered. However, other areas such as vehicle maintenance and repair and electrical engineering showed greater stability, and there was growth in welding and joining. Table 2 shows the percentage of unweighted SUMs in engineering for HE and FE respectively. Taken together with Charts 2 and 3, these data show a slight shift in college activity from HE to FE.

Level of study	% SUMs 2002-03	% SUMs 2003-04	% SUMs 2004-05	% SUMs 2005-06
FE	78.4	79.7	80.8	80.9
HE	21.6	20.3	19.2	19.1

Table 2: Trends in FE vs HE provision, SFC Infact database

Table 3 below shows the number of HNC entries in Scotland for the same period for a range of engineering programmes[21]. Consistent with Table 1, the data shows a rapid decline in entries for electronics, with mechatronics also showing a very large fall in entries. This decline in specific subjects is also in line with comments by college staff that the relatively greater fall in employment in the electronics sector has impacted strongly on entries to HNC programmes, including employed learners upgrading their qualifications.

Qualification aim	2002-03	2003-04	2004-05	2005-06
Engineering: Electrical	327	315	385	308
Engineering: Electronics	401	308	227	203
Engineering: Fab,Weld,NDT	125	68	97	104
Engineering: Mechanical	348	332	396	312
Engineering: Mechatronics	289	101	110	119
Engineering: Aeronautical	97	99	98	65
Engineering: Practice	87	130	87	63

Table 3: Trends in entries for HNC in selected engineering subjects, SQA data

Looking at modes of attendance, SFC data shows a major fall in the number of learners undertaking distance learning (from 1453 in 2002-03 to 377 in 2005-06). This fall in numbers has happened despite the opportunities offered by ICT to widen participation. Evening class numbers also fell (from 3095 to 2628). Day release numbers dropped and then recovered during this period (from 5294 to 5306), and there was an increase in the number of block release learners (from 1380 to 1688). There was a substantial increase in enrolments in other part-time day programmes (from 8518 to 11290).

[21] The impact of the new SQA HN frameworks does not show in these figures. The small number of learners enrolled for HNC Electronics under the new HN framework in 2005-06 are not included.

4.4 Factors influencing participation

While demand for programmes to meet the needs of apprentices or other employed learners was strongly influenced by employers and the labour market, demand for places on full-time programmes (for non-employed learners) was much more dependent on individual learner demand. While learner demand was clearly influenced by factors such as the apparent success or employment prospects in specific industry sectors, there was a wide range of other factors that influenced learners to take an engineering programme in colleges or to seek an apprenticeship.

Parents, other relatives and friends had a strong influence on learners, particularly younger learners who knew someone with knowledge and experience of engineering. For example, one learner was influenced by his parent's job and "*decided to study electrical engineering because my father is an electrician.*" Another said he had taken engineering "*because my uncle is an engineer*". A few learners had taken engineering because they liked science or technology at school. For example, one learner said "*I decided to study engineering when doing standard grade physics, and I enjoyed doing the practical work and written parts of electrical*". Learners on automotive engineering programmes were more likely to express an interest in the subject itself than other learners. They commonly described a strong interest in cars as leading them to take the subject. For example, one learner commented that he had "*always had a great interest in cars and repairing them*." Another said that "*My father has always been interested in motorcycles and passed that interest on to me*".

While few learners thought that advice received in school had had a strong or explicit influence on them, one learner commented that "*I decided on a career in engineering because of my school teacher. I was told of the opportunities offered by companies such as BP and Shell and decided this was my best route*". A common view was that school guidance staff had not told them much about Modern Apprenticeships, although some learners had received general advice to "*get a trade*". Learners often felt that they received more information in school about the qualifications needed for university entrance than about vocational opportunities in colleges. A few learners found school-arranged visits to college or to an employer's premises helpful.

> Banff and Buchan College had launched the *Next Step* initiative. This initiative involved direct interaction with schools to equip teachers with information about entry points into engineering. The initiative targeted S2 pupils, and was designed to raise the profile and the image of engineering. The college aim was to provide basic skills in disciplines such as hydraulics, pneumatics, machining, CNC, welding and fabrication leading to a Scottish Progression Award (SPA). Five companies had contributed to a joint campaign. A high quality brochure containing a CD presentation and information on the companies involved was commissioned and launched at an Engineering Showcase event in November 2006.

The local employment situation was a very important factor. There were clear links between the demand for places in colleges and the strength of local industries. For example, the influence of oil and related industries was very strong in the north-east of Scotland and many learners coming into areas of engineering such as mechanical and electrical engineering had done so to get employment in these industries. A few colleges had worked very effectively with schools and companies to provide information and guidance to school pupils.

Young engineers' clubs could provide an interesting and challenging experience for young learners and introduce them to some of the technologies that they might meet in college programmes. The Scottish Council for Development and Industry (SCDI) had organised a network of clubs in Scotland, sponsored by a number of major companies. SCDI had set up a website[22] to support the network and listed 11 clubs based in colleges, each of which would draw learners from several schools. The success and continuity of these clubs and other, similar initiatives in colleges were very dependent on the enthusiasm and commitment of a few college staff who were keen to promote engineering. Colleges had not measured the impact of their clubs on recruitment to engineering programmes.

Female learners made up only a small proportion of learners in engineering subjects. Data from SFC for 2005-06 showed that, for engineering subjects, only 16% of learners at FE level and 4% at HE level were female. The higher percentage at FE level included a large number of younger female learners involved in short programmes, for example through school-college links. In terms of SUMs, only about 5% of activity at FE and at HE level derived from female learners. Overall, this represented a slight decline in the proportion of SUMs since 2002-03. This was consistent with recent statistics from SQA which showed that only 6% of learners undertaking HN units in engineering were female. However, in some subject areas and programmes the proportion of female learners was much lower than average. A very small proportion of Modern Apprentices were female.

Over the years, a number of initiatives by colleges and industry bodies have been set up to encourage more female learners into engineering and related subjects. These have included work by individual colleges, HEIs, Scottish Engineering, the Women's Engineering Society, and the Scottish Resource Centre for Women in Science, Engineering and Technology among others. However, overall numbers have remained low at all levels across the engineering disciplines.

These persistently low proportions of female learners in engineering subject areas meant that relatively few women were then able to progress into related areas of employment that often pay higher than average salaries. Reports by Futureskills Scotland in 2005 showed that only 20% of employees were women in what were described as engineering sector workplaces compared to an average across all employment sectors of 52%. The equivalent figure for automotive sector workplaces was 24%.

In the UK, the term *engineer* has traditionally been used to cover a great many jobs that have some involvement with technical equipment, whether the worker is qualified at any level in engineering or not. This is partly a cultural issue that is reinforced in the media and is so embedded in our language that it is not likely to

[22] http://www.yecscotland.co.uk/

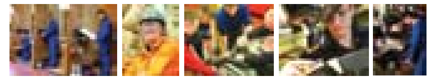
change in the near future. However, staff in Scotland's colleges maintained that this use of the word had an unhelpful effect on the attitudes of learners and their parents to a career in engineering. The term was often linked with perceptions of low status[23], low skills level, poor working conditions and modest income levels that often did not reflect reality. In Germany, the term *ingenieur* is protected in law for graduate engineers. In France, where to be an engineer means to have a profession that requires a good level of technical expertise, the use of the term *ingénieur diplômé* is reserved for graduate engineers. At technician level in France, the term *technicien supérieur* is used for someone who has completed a two-year advanced technical programme called a *Brevet de technicien supérieur*. This use of language is consistent with the higher status of professional engineers in France and Germany, compared with similarly qualified people in the United Kingdom. Efforts over many years by the Engineering Council (UK), the Institution of Engineering and Technology and other engineering institutions to improve the recognition and status of qualified engineers and technicians by promoting registration for Incorporated Engineers or Engineering Technicians have not had a strong influence in Scotland, particularly at technician level. As a result, these terms are not widely used by people outside the institutions and a very few areas of employment. Importantly, employers do not commonly demand professional accreditation. However, a few colleges had worked with a small number of major engineering employers to develop apprenticeship programmes that were approved by the IET as routes to Eng Tech registration. This contributed to developing the status and profile of engineering as a recognised and accredited career path.

4.5 Links with sector skills councils, training organisations and employers

Modern Apprenticeships were an important element of the provision in many colleges. Colleges that offered MAs worked closely with the relevant sector skills councils and training organisations. These organisations included the Science, Engineering, Manufacturing Technologies Alliance (SEMTA), the Oil and Petroleum Industry Training Organisation (OPITO), the Engineering Construction Industry Training Board (ECITB), Automotive Skills and the Scottish Electrical Charitable Training Trust (SECTT).

Among the engineering subjects, Modern Apprenticeships in engineering, electrotechnical (electrical installation) and motor vehicle had the highest uptake across the country as a whole. Table 4 below shows the numbers of apprentices funded through Skillseekers who were in training at the end of 2006 in the Scottish Enterprise and Highlands and Islands Enterprise areas for the four engineering Modern Apprenticeships with the largest uptake.

[23] *The Engineering Profession*, Hamilton, Engineering Council, 2000
http://www.engc.org.uk/documents/Hamilton.pdf



Modern Apprenticeships	Scottish Enterprise area	Highlands and Islands Enterprise area
Engineering	2579	226
Electrotechnical	2433	232
Motor vehicle	2331	65
Vehicle maintenance and repair	411	208

Table 4: Numbers of modern apprentices in training for four MAs, December 2006, data from the Sector Skills Alliance Scotland[24]

Data from Scottish Enterprise and Highlands and Islands Enterprise showed that there had been steady growth in apprenticeships over that past few years. The data also showed that almost all apprentices in the engineering subjects were male and almost all were aged under 25. These data are consistent with concerns expressed by college staff about the continuing low levels of recruitment of female learners and the impact of funding and other factors on the take-up of Modern Apprenticeships by people aged 25 and over.

The arrangements for MAs involved a number of agencies in their planning and delivery. The programme for electrician apprentices can be used as an example.

SECTT managed the Scottish Joint Industry Board (SJIB) apprenticeship scheme. This scheme was designed with Scottish employers to meet their training needs while adhering to the standards set by the relevant sector skills council, SummitSkills. Twenty-two centres, almost all of which were colleges, provided the off-the-job element of the apprenticeship. SECTT provided guidelines on the facilities required and the expected experience and qualifications of staff in the 22 centres. Its staff visited colleges regularly to liaise with staff and monitor the progress of learners. At the start of the programme 87% of apprentices were in the 16-19 age group. However, SECTT also had schemes that enabled a smaller number of older learners to qualify through accreditation of prior learning or through an adult training scheme. On average, learners took four years and two months to complete the MA working for their employer and attending college by block release, day release and at evening class during different stages. Successful apprentices became electricians and could progress to the status of "approved electrician". All the colleges involved provided essentially the same training and had apprentices who were employees of different companies, many of which were small employers. The network of organisations involved in this training arrangement provided all stakeholders with some opportunity to influence the training arrangements. These stakeholders were SECTT, the colleges, individual employers, the employers' organisation, SELECT, the trade union, AMICUS, the sector skills council and the joint awarding body, SQA/SJIB.

In other industries, employers often worked directly with a college to develop a training programme to meet their skills needs and the needs of their employees,

---

[24] http://www.ssascot.org.uk

while meeting the criteria for the MA. In some cases, the recruitment and training of modern apprentices was linked directly to very specific local skills needs. For example, Forth Valley College had long standing arrangements with the petro-chemical industry to train apprentices and, more recently, had worked with and a local coach manufacturer to provide a training programme in coach building.

All college engineering departments had some engagement with industry. Many successful partnerships between colleges and companies had resulted in the development of effective training for employees or prospective employees. A few colleges had been particularly successful in engaging with employers or representative organisations to establish appropriate training arrangements.

> Anniesland College had worked with two major engineering companies to develop apprenticeships for a large and growing number of learners. The companies had worked closely with college staff to ensure that the training was tailored to meet the employers' needs while meeting the standards of the modern apprenticeship. The college had invested heavily in specialised engineering equipment that matched that used by the industry, so helping to ensure that the training was relevant.

> The North Highland College worked closely with engineering companies linked to the Dounreay nuclear site to train a large number of professional and skilled people to work on the decommissioning. The HMIE report on the college commented that:
>
> *The college had been successful in gaining approval for plans to develop the Scottish wing of the National Nuclear Skills Academy. This development was supported by a range of partners who worked closely with the college.*

> Banff and Buchan College had established the *Goldeneye* project with a number of companies involved in oil exploration and production. This project had enabled the college to introduce new engineering programmes with progression opportunities for learners and to improve its engineering resources. The HMIE report on the college stated that:
>
> *An innovative training programme sponsored by major multinational companies and other key partners, provided an effective blend of HN and SVQ subject content. Work experience placements within sponsoring companies, provided trainees with very good preparation for employment in the oil and gas industry.*

While staff recognised the value of work experience for full-time learners, such experience was very uncommon at either FE or HE level in colleges.

Colleges and others reported a growing need by employers for upskilling and short courses to meet specific skills development. This required colleges to be flexible and use qualifications frameworks that supported short courses. However, employer demand and learner demand are not the same. One consequence of this is that employers may identify a lack of training opportunities in a particular engineering discipline such as manufacturing in one part of the country while colleges find it difficult to recruit into programmes in this discipline. The challenge for colleges is to address both employer needs and learner needs, taking into account the wider agenda on access, inclusion and equalities and all the other influences on their provision. A Learning and Skills Development Agency (LSDA) report[25] on apprentice training in England questioned whether small and medium-sized enterprises with little capacity or desire to offer long-term training places could be encouraged to do so. This last point has some implications for Scotland. In industries where many of the employment opportunities are in small and medium sized enterprises (SME) and there are fewer major engineering employers with established training arrangements, it is more challenging for colleges to engage directly with employers. Training arrangements with broad stakeholder involvement, such as those for electrical installation, have helped enable a systematic approach to training for SMEs in their industry sectors.

[25] *Apprenticeships: a review of recent policy and practice*, Learning and Skills Network, 2006
http://www.lsneducation.org.uk/pubs/Pages/062481.aspx

5. Capacity of colleges to deliver engineering provision

Colleges generally had the engineering accommodation and equipment that they required to deliver the programmes they offered. HMIE reviews identified strengths in ICT resources and high quality equipment in a number of specialist workshops, including some in automotive engineering, mechanical engineering and machining. These strengths resulted from significant commitment by the colleges concerned and, in some cases, support from industry.

> The HMIE review of Anniesland College found that for engineering:
>
> *The very high standards of new modern machine-shop plant matched the needs of the curriculum very well, and motivated learners*.

> The HMIE report on Barony College noted the benefits of close collaboration with companies:
>
> *Very strong and productive collaboration with major dealerships and manufacturers in both forestry engineering and agricultural engineering ensured the vocational relevance of programmes. Staff had access to a wide range of expensive modern equipment on loan as well as high quality manufacturers' product information and training materials. This significantly enhanced the quality and relevance of learners' experiences.*

Weaknesses were found in colleges that had equipment which was usable but outdated and not fully consistent with industrial practice and standards. College staff were often concerned that, while they were able to service the programmes they currently offered, they would not be able to meet future demands or to provide learners with experience of high quality, industry-standard equipment and so help secure the future competitiveness of industry. Colleges usually responded well to education and training needs as they arose, for example, in relation to the oil and gas industry and shipbuilding industries. A few colleges were also taking the initiative in developing new provision in areas such as renewable energy technologies. However, it was not clear how colleges generally would be able to respond appropriately to major longer-term developments in industry or technology that might require different approaches or major investments in technology. Examples of technology areas that might challenge the resources and skills in most colleges included major new developments in renewable energy or nuclear power, advances in telecommunications and computer technologies and the continuing integration of complex electronics and sensors in motor vehicles.

For a few industries, colleges saw UK-wide training arrangements as particularly important because of the need for recognition by employers working across the UK as a whole.

Motherwell College had become a member of the UK Motor Industry Skills Consortium (MISC). MISC was a partnership of 14 of the UK's colleges that had significant involvement in automotive engineering training. The partners within the consortium had been chosen on a geographical basis to provide training for the automotive industry throughout all regions of the UK. College staff were members of the MISC management group and development groups. Learners benefited from the access to the very high quality learning materials and links with industry. The college had attracted significant amounts of equipment and training aids from manufacturers. The HMIE review also noted that:

The college's close collaboration with major (car) manufacturing companies had led to its approval to deliver key elements of these companies' Modern Apprenticeships programmes, ensuring that the college provided up-to-date programmes with high quality learning.

The members of the MISC in England were drawn from established centres of vocational excellence (CoVE). CoVEs and National Skills Academies (NSA) in England are seen as key elements in the Learning and Skills Council's strategy[26]:

> *The CoVE programme and NSAs are central to the Learning and Skills Council's aim to improve and develop skills for employers that are needed to underpin business success and economic competitiveness. These programmes are focused on delivering vocational skills that meet particular sector and industry needs through the development and delivery of high quality, specialist training across a range of sectors.*

An evaluation report[27] commissioned by the Learning and Skills Council was broadly positive about the success of CoVEs in meeting the programme aims, including the expansion of industry-standard equipment, the widening of access and better employer engagement.

Some college staff in Scotland supported the general concept of centres of excellence in Scotland with a view that it would help to draw investment and expertise into a smaller number of better resourced centres. However, they also expressed concern about the impact of any such initiative on other colleges, access to training for learners in some geographical areas and learner choice.

Colleges generally had sufficient, qualified staff to deliver their current levels of provision. However, a few colleges had experienced difficulties in recruiting new staff in specialist subjects where there were good employment opportunities in industry. Teaching staff engaged in continuing professional development (CPD) to enhance their professional skills relating to quality improvement, learning and

[26] http://www.lsc.gov.uk
[27] *Impact of the Centres of Vocational Excellence programme: attitude and engagement of employers and key stakeholders*, Learning and Skills Council, 2007 http://cove.lsc.gov.uk/programme-evaluation/Impact-of-the-Centres-of-Vocational-Excellence-CoVE-Programme-Attitude-and-Engagement-of-Employers-a.htm

teaching and other themes. The knowledge, skills and experience of staff contributed to their credibility with learners, and learners were generally very positive about the knowledge and skills of the teaching staff they worked with. While most college teaching staff had opportunities to engage in networks of interest or engage with employers, few had recently spent any time on secondment to industry to maintain their awareness of current practice. This was due, in part, to staffing pressures in colleges and to the difficulty in persuading employers to be involved.

Staff in most engineering departments in colleges were involved in various networks that contributed to their knowledge of the subject, their ability to influence developments in their subject area and their own CPD. For example, staff at one college engineering department were involved with the Institute of Motor Industry National Advisory Panel, a City & Guilds network, the Automotive Skills Standards Steering Group and Quality Improvement Group, and the SQA HN Framework Development Group. Staff in other colleges referred to their work with industry and sector skills councils as providing opportunities to network with colleagues from other organisations.

> The HMIE report on Anniesland College identified the benefit of industry links for staff CPD:
>
> *Teaching staff had successfully capitalised on the school's strong employer links and had received specialist employer-based continuing professional development. In doing so, teaching staff ensured that the skills they taught matched the requirements of the workplace.*

Some training organisations and awarding bodies held subject-specific events to deal with qualifications issues or provide broader CPD at annual conferences or consortium meetings. Many staff had benefited from working with staff from other colleges on SQA developments and were able to influence the development of qualifications.

The Scottish Association for Engineering Education (SAFEE) organised an annual conference which provided teaching staff in colleges with a useful opportunity to share views on a range of issues of interest in engineering departments including, for example, the use of ICT in learning and teaching and learner attainment. The SAFEE executive committee included both college staff and representatives from organisations such as SQA, but did not include any employer representatives. SAFEE had not recently had a widespread influence on developments in colleges but was developing its website to improve its engagement with teaching staff and to provide online access to learning materials. The SQA Sector Panel for Engineering, Science and Mathematics provided useful networking opportunities for representatives of organisations that included colleges, schools, sector skills councils, Scottish Engineering, HMIE, SQA, IET and SAFEE.

Most college staff did not routinely use online forums or similar means for informal discussion or sharing of good practice. The Scottish Further Education Unit (SFEU) was in the process of developing an engineering subject network. SFEU had appointed a part-time subject mentor to provide support to teaching staff in colleges. This development was at an early stage and had yet to have an impact.

6. Learning and teaching and learner progress and outcomes

HMIE carried out 20 engineering subject reviews in the first three years of the current cycle of reviews that started in 2005. In order to reflect the provision of each college, the scope of these reviews ranged from more subject specific reviews covering, for example, only automotive engineering to broader reviews that covered all the engineering subjects in the college. Two quality elements were graded in each review. *Learning and teaching process* was graded as *very good* in 40% of HMIE engineering subject reviews and *good* in 60%. There were no *fair* or *unsatisfactory* grades. *Learner progress and outcomes* was graded as v*ery good* in 25% of HMIE engineering subject reviews and *good* in 65%. It was graded as *fair* in 10% of reviews. There were no *unsatisfactory* grades.

6.1 Learning and teaching process

Most learners were well motivated and fully engaged in their learning, particularly during practical activities. Learners were motivated most effectively by practical activities that they could relate to vocational skills. Most programme teams took account of that, and in some colleges practical units were scheduled early in the academic session in order to build on that motivation. Staff in several colleges commented that the least motivated learners were full-time learners on introductory level programmes. In one college, staff reported that an improvement in learner motivation was due in part to better selection and initial guidance, clearer expectations from both staff and learners of what the programmes entailed, an increased use of virtual learning environment (VLE) delivery and a greater emphasis on interactive learning. Staff and learners also considered that good prospects of employment on completion helped to provide motivation for full-time learners. Most part-time learners were already in employment and the additional influences of their employment helped them maintain interest and attend regularly. Effective teaching practice and better planning could improve motivation.

Three quotations from HMIE reports illustrate the evaluations related to motivation:

> *In most lessons, learners were well motivated and attentive, and took part positively in learning, demonstrating a readiness to express views and question teaching staff on relevant matters.*
>
> *Most learners were well motivated and actively engaged with the learning process.*
>
> *More than a few learners were not attentive unless directly engaged in practical workshop activity.*

Learners generally made good use of college resources, especially workshop tools and equipment. Most learners were developing skills in using the ICT resources that were appropriate to their subject area. These uses included:

- computer-aided-design software for mechanical engineering;
- monitoring and diagnostic ICT in automotive engineering;
- electronic simulation packages; and
- software for computer numerically controlled (CNC) lathes.

Learners' use of these dedicated and specialised resources helped to develop their general skills and ICT skills. Quotations from two HMIE reports illustrate these evaluations:

> *Most learners made good use of equipment and simulation facilities in laboratories to reinforce theory and develop relevant vocational skills.*

> *Most learners made good use of hand tools and modern automotive engineering equipment and progressed well in developing vocational skills.*

Learners in engineering departments generally had good access to ICT, but many did not make enough use of ICT as a tool for independent learning. This finding was consistent with the findings of a recent HMIE report on ICT in learning and teaching[28]. The report indicated that few learners made sufficient use of college VLEs to access learning materials or email facilities for communication.

In engineering, learners in fewer than half of colleges demonstrated an independent approach to learning or reflected well on the progress they were making. One HMIE report observed that:

> *Only a few learners made effective use of the library and other centrally-provided learning facilities for independent learning.*

Almost all teaching staff used their technical and industrial knowledge to good effect in lessons. They used their expertise well to contextualise learning during lessons and to demonstrate practical skills in workshop and laboratory activities. This helped to relate theoretical and practical work in college to the vocational area. It also contributed to learner confidence in staff knowledge and skills. For one college, the HMIE report noted that:

> *Almost all teaching staff used their extensive links with industry to good effect in applying up-to-date industrial practices within learning activities.*

The teaching approaches in both practical and classroom activities were in general of a high standard. Strengths identified in review reports included good questioning techniques, appropriate demonstrations, facilitation of classroom discussion and generally effective interaction with learners. Teaching staff mostly used resources well and there were a few good examples of staff using ICT as a major element of the learning and teaching process, for example, in automotive engineering where there were readily available teaching packs. In one college that had a good range of

[28] Improving Scottish Education, ICT in Learning and Teaching
www.hmie.gov.uk/documents/publication/iseictilat.pdf

VLE materials for engineering and a high standard of ICT resources, a small group of senior lecturers had responsibility for helping colleagues develop their use of the VLE. Staff recognised the value of interactive learning in helping learners to take some ownership of their own learning and a few staff promoted it well. However, there were too few instances overall where staff used ICT effectively as a teaching medium and this was identified as a weakness in almost half of HMIE reviews. In one college, the HMIE report observed that:

> *Teaching staff made insufficient use of ICT, visual aids and simulation to enrich the learning and teaching process for theoretical subjects.*

A strong focus on learners and promotion of achievement were identified as strengths in the subject reviews of only a few colleges. However, one college made good use of its website to encourage learners in the college and in local schools to take part in national and local competitions and to celebrate the achievements of those who were successful.

On more than a few occasions, ineffective questioning techniques, a perception by learners of lack of relevance of the topic or a lack of activities at the correct level for groups or individuals, reduced the effectiveness of the teaching process and diminished learner engagement.

Good staff-learner relationships helped learners to engage with staff effectively. Most learners felt that the relationships they had with staff help them to engage in their studies and fostered mutual respect. Teaching staff generally ensured that learners experienced a suitable mix of theoretical lessons and practical activities.

The standards set by staff were appropriate for the level of the programme and learners knew the standard of work that was expected of them. Staff generally made clear the standard expected from learners regarding behaviour, attendance and punctuality. This helped to develop learners' employability skills and contributed to an effective learning environment. Almost all learners thought that their programme matched the expectations they had before starting.

Only a few reports identified strengths relating to the planning for core skills delivery or the incorporation of core skills development in learning and teaching. In more than a few colleges, the planning for delivery of core skills, employability and citizenship skills was not well enough developed. Too many college programme teams and staff relied on the core skills units in the programmes they offered and did not ensure that all teaching staff contributed effectively to the development of core skills, citizenship skills and employability skills as integral parts of the learning and teaching process. The HMIE report for one college noted that:

> *Teaching staff did not incorporate sufficiently into their teaching plans opportunities for learners' core skills development.*

In a few colleges, teaching staff did not plan the use of learning resources well enough, which led to an ineffective use of learners' time in workshops and laboratories.

6.2 Learner progress and outcomes

Most learners were making good progress from their starting point. They produced coursework of an appropriate standard and were developing their vocational skills well. These skills included the use of tools, equipment and software. This progress in skills development was in line with the preference shown by most learners for practical lessons, the good staff-learner relationships and the skills and experience of teaching staff in their own vocational areas. Two HMIE reports noted that:

> *In welding workshops, most learners produced work of a high standard.*

> *Learners on full-time programmes developed vocational skills that prepared them very well for employment.*

In the majority of colleges, learners also made good progress in the development of their core skills and other employability skills. However, in more than a few colleges learners' progress in core, citizenship or employability skills was insufficient or was not monitored well enough. HMIE reports for two colleges observed that:

> *Most learners did not develop skills in citizenship.*

> *There was little formal recognition of learners' development of core skills*.

In a few cases, the deficiency in core skills or citizenship skills achievement or poor recording of these skills was due to programme teams failing to take full account of wider college initiatives.

A detailed comparative analysis of attainment in engineering programmes across the sector is beyond the scope of this report. There are a number of awarding bodies, levels of programmes and attendance modes. Some programmes are certificated after one year, others on completion of two or more years. At FE level especially, there are many college-devised programmes for employers in addition to the group awards developed by the awarding bodies. SQA data showed that for the year 2005-06, 66% of those who registered for a named NC award in an engineering subject attained the qualification. For HNC, the equivalent figure was 75%. However, these numbers only formed part of the overall picture for SQA awards. For example, there were a large number of college-devised programmes at FE level and some learners undertook just a few units at either FE or HN level. Also, learners who left college after a very short time may not have been entered as candidates and so would not contribute to the overall attainment rates.

Across the sector there were instances of high attainment rates for all levels and modes of attendance, and more than a few HMIE reports recorded examples of full-time programmes with high or very high levels of attainment. However, the highest levels of attainment were generally in programmes for employed learners, in particular, Modern Apprenticeships. HMIE reports for two colleges illustrate this:

Learner attainment levels in all employer-based full-time courses were very high.

Attainment rates were very high in part-time FE and part-time HE programmes.

Modern Apprentice programmes often had retention and attainment rates of greater than 90%. A common view of engineering teaching staff was that apprentices were better motivated to attend and apply themselves, and that the clear link between college activities and their employment provided an additional factor that encouraged learners to succeed.

Retention and attainment was an issue of concern for colleges. Most HMIE engineering reviews identified low retention and attainment as a weakness in at least one programme. These weaknesses most commonly related to full-time programmes, usually at FE level. For example, HMIE reports for two colleges stated that:

Learner retention levels and programme attainment levels were low on full-time FE programmes.

Learner attainment rates on FE full-time programmes were low overall.

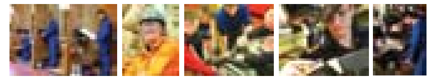
In a few cases, low attainment was recorded as a weakness in school-link programmes. For example, in one college:

The learner attainment rate for the large number of school pupils who attended non-advanced provision in college was very low, often as a result of poor attendance.

Teaching staff often identified progression to employment as a reason for learners leaving before completion of their programme. This was a successful outcome for some learners whose main short-term goal was progression into employment rather than the attainment of a qualification. Such learners often returned to part-time programmes.

Most learners who completed their programmes were able to progress into employment or further study. Learners on HN programmes often aimed to study for a degree on completion of their programme but, overall, only a small proportion of learners in engineering went on to study for a degree. More than a few colleges did not have accurate data on their learners' progress on leaving college.

In a few colleges, learners attained specific employer qualifications that provided a basis for further career development within the relevant industry.



7. Recommendations

The Scottish Funding Council should:

1. consider how to influence and support Scotland's colleges in establishing and maintaining leading edge engineering provision, preparing to meet future challenges and ensuring that people have the skills to compete in a global economy; and

2. work with colleges and partners to increase the proportion of female learners;

Colleges should:

3. fully analyse the trends in HN enrolments and work with partners to ensure that the current provision is meeting learner and employer needs;

4. work in partnership with schools to improve the quality of information and advice about engineering available to potential learners, including advice about opportunities for female learners;

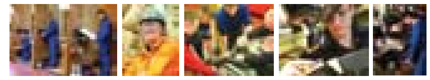
5. ensure that their engineering resources provide learners with an appropriate experience in relation to current industry-standard technologies and practice;

6. ensure that teaching staff take full advantage of ICT in learning and teaching;

7. work with employers to enable college staff to benefit from relevant industrial experience;

8. ensure that the development of core skills is a well-planned, integral part of the learning experience for all learners in engineering; and

9. take steps to improve retention and attainment rates, particularly in respect of full-time, non-employed learners.



Appendix 1

Extract from the SFC list of subject superclass codes

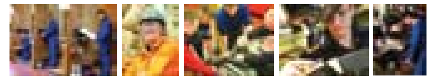
X: Engineering

XA	Engineering/Technology (general)
XD	Metals Working/Finishing
XE	Welding/Joining
XF	Tools/Machining
XH	Mechanical Engineering
XJ	Electrical Engineering
XK	Power/Energy Engineering
XL	Electronic Engineering
XM	Telecommunications
XN	Electrical/Electronic Servicing
XP	Aerospace/Defence Engineering
XQ	Ship and Boat Building/Marine/Offshore Engineering
XR	Road Vehicle Engineering
XS	Vehicle Maintenance/Repair
XT	Rail Vehicle Engineering

Appendix 2

The Scottish Credit and Qualifications Framework

SCQF Levels	SQA National Units, courses and group awards	Higher Education (HE) qualifications	SVQs	SCQF levels
12		Doctorate		12
11		Masters	SVQ 5	11
10		Honours degree		10
9		Ordinary degree		9
8		HND Diploma of HE	SVQ 4	8
7	Advanced Higher	HNC Certificate of HE		7
6	Higher		SVQ 3	6
5	Intermediate 2/Credit S Grade		SVQ 2	5
4	Intermediate 1/General S Grade		SVQ 1	4
3	Access 3/Foundation S Grade			3
2	Access 2			2
1	Access 1			1



Appendix 3

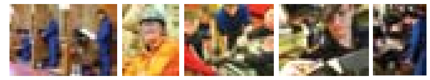
Examples from the range of programmes offered by two colleges. These lists are illustrative rather than complete lists of provision.

College 1

Introduction to Service Engineering
Introduction to Vehicle Body Repair and Refinishing
Introduction to Service and Repair of Road Vehicles
NC Electronic Engineering
NC Electrical Engineering
NC Engineering Practice
NC Engineering
SVQ Mechanical Engineering
SVQ Body Repair and Refinishing
SVQ Service Engineering: Agricultural Machinery
SVQ Performing Engineering Operations
SVQ Service Engineering
HNC Process Control
HNC Engineering Practice
HNC/D Electrical Engineering
HNC/D Engineering: Mechanical
HNC/D Electronics
Range of short courses and commercial courses
Schools programmes

College 2

Introduction to Electronic Engineering
Introduction to Measurement and Control
NC Electronic Engineering
NC Engineering
NC Engineering Practice
NC Fabrication and Welding Engineering
SVQ Electrical Installation
SVQ General Engineering Maintenance
SVQ Motor Vehicle
SVQ Performing Engineering Operations
HNC Electrical Engineering
HNC Engineering
HNC Engineering Practice
HNC/D Electronics
HNC/D Engineering: Mechatronics
Range of short courses and commercial courses
School programmes



Appendix 4

Bibliography

Aberdeen City and Shire: The Energy Sector, Aberdeen City and Shire Economic Forum, 2006

Apprenticeships: a review of recent policy and practice, Learning and Skills Network, 2006
http://www.lsneducation.org.uk/pubs/Pages/062481.aspx

Assessing the Needs of Further Education Colleges in the Management of Intermediate and Higher Level Engineering and Technology Programmes, New Engineering Foundation, 2006
http://www.neweng.org.uk/uploads/reports/Understanding-the-Needs-of-FE-Colleges06.pdf

Catching up with the Continent, Final report on EU and UK manufacturing productivity, EEF, 2005
http://www.eef.org.uk/NR/rdonlyres/1EB68CF0-D0A2-420D-A43E-1A04E77D0C79/1339/catchingup.pdf

Engineering UK 2005, Engineering and Technology Board, 2005
http://www.engc.org.uk/documents/Engineering%20UK2005.pdf

Futureskills Scotland 2005, Automotive, Scottish Sector Profile
http://www.futureskillsscotland.org.uk/web/site/home/Reports/IndustrySector/Report_Scottish_Sector_Profile_2005_Automotive.asp

Futureskills Scotland 2005, Science, Engineering and Manufacturing Technologies, Scottish Sector Profile
http://www.futureskillsscotland.org.uk/web/site/home/Reports/IndustrySector/Report_Scottish_Sector_Profile_2005_Science,_Engineering_and_Manufacturing_.asp

Futureskills Scotland 2007, Labour Market Projections 2007 to 2017
http://www.futureskillsscotland.org.uk/web/site/home/Reports/SkillsForTheFuture/Report_Labour_Market_Projections_2007_to_2017.asp

Impact of the Centres of Vocational Excellence programme: attitude and engagement of employers and key stakeholders, Learning and Skills Council, 2007
http://cove.lsc.gov.uk/programme-evaluation/Impact-of-the-Centres-of-Vocational-Excellence-CoVE-Programme-Attitude-and-Engagement-of-Employers-a.htm

Improving Scottish Education: ICT in Learning and Teaching, HMIE 2007
http://www.hmie.gov.uk/documents/publication/iseictilat.pdf

Index of Manufactured Exports 2007 Q1, Scottish Government Publications,
http://www.scotland.gov.uk/Publications/2007/07/IME07Q1

Modern Apprentices: Improving Completion Rates, Jim Gallacher et al, for Scottish Executive, 2004
http://www.scotland.gov.uk/Publications/2004/03/19059/34269

Prosperity for all in the global economy – world class skills, 2006, HMSO
http://www.hm-treasury.gov.uk/media/523/43/leitch_finalreport051206.pdf

Realising the Potential – A review of the future role of further education, Foster, Department for Education and Skills, 2005
http://www.dfes.gov.uk/furthereducation/index.cfm?fuseaction=content.view&CategoryID=20&ContentID=18

Scotland's Colleges: A Baseline Report, Scottish Funding Council, 2007
http://www.sfc.ac.uk/publications/FE_baseline_Mar07.pdf

Skills for Scotland, A Lifelong Skills Strategy, Scottish Government Publications, 2007, http://www.scotland.gov.uk/Resource/Doc/197204/0052752.pdf

Spotlight on VET Germany, CEDEFOP, 2007
http://www.trainingvillage.gr/etv/Upload/Information_resources/Bookshop/466/8021_en.pdf

The Engineering Profession, Hamilton, Engineering Council, 2000
http://www.engc.org.uk/documents/Hamilton.pdf

The French Vocational Education and Training (VET) System, CEDEFOP
http://www.refernet.de/documents/a13_refernet_thematic-overview_frankreich.pdf

The Pattern of Subject Provision in Scotland's Colleges and Higher Education Institutions, Scottish Funding Council, 2007
http://www.sfc.ac.uk/publications/Pattern%20of%20Provision.pdf

The Supply and Demand for Science, Technology, Engineering and Mathematical Skills in the UK Economy, Department for Education and Skills, 2006
http://www.dfes.gov.uk/research/programmeofresearch/projectinformation.cfm?projectid=14945&resultspage=1

Towards a history of vocational education and training (VET) in Europe in a comparative perspective, CEDEFOP, Proceedings of the first international conference, Florence, 2002,
http://www.trainingvillage.gr/etv/Information_resources/Bookshop/publication_download.asp?pub_id=373&dl_id=1111&pub_lang=en

UK Standard for Professional Engineering Competence: Engineering Technician Standard, Engineering Council UK, 2005
http://www.engc.org.uk/documents/Engineering%20Technician%20Standard.pdf

Vocational Education and Training in France, CEDEFOP, 2000
http://www2.trainingvillage.gr/etv/publication/download/monograf/7002en/7002en.html

Vocational Education and Training in Germany, CEDEFOP, 2007
http://www.trainingvillage.gr/etv/Upload/Information_resources/Bookshop/465/5173_en.pdf

Appendix 5

Focus group questions

1. What are the main strengths and weaknesses of engineering education and training in Scotland as provided by the FE college sector? To what extent does provision meet the current needs of employers (including UK and Global enterprises), communities, learners and prospective learners?

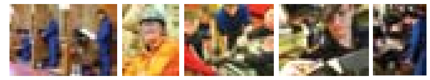
2. What main changes have taken place in engineering education and training in Scotland as a whole over the last five years? What has been the impact of industry sector growth and contraction?

3. How well placed is engineering education and training in Scotland as a whole to meet the projected needs of employers (including UK and Global enterprises), communities, learners, prospective learners and the economy for the next five years?

For example -

- In a resource intensive discipline such as engineering, how well suited are current arrangements to ensuring that engineering learners in Scotland have sufficient opportunities to receive education and training from the most highly qualified specialist staff?
- To what extent do your existing workshops and laboratories provide a top class learning environment equipped with sufficient quantities of the most up-to-date and relevant equipment?
- To what extent do you and your engineering staff/colleagues receive regular and sufficient specialist updating to ensure that you keep abreast of the latest most modern equipment, processes, systems and products and leading edge industrial practice?
- How effective are succession planning arrangements in your dept/college? What risks are there that key specialist skills needed for the future will be lost?
- How extensive and effective are your relationships, with employers, employers' organisations and other key bodies (eg SSCs) in relation to engineering education and training? What evidence do you have that the other parties share your view regarding the effectiveness of the relationship?
- In your locality, are there examples of Modern Apprentices or other trainees/learners having to travel long distances in order to obtain training of the quality and level of specialisation needed by their employers? Are their opportunities for providers locally, perhaps working in partnership to offer such provision to the standards required? If not what are the factors that influence employers' decisions?
- What experiences or activities motivate learners most? least? How do you know? What do/can you do to improve learner motivation?

4. To what extent are you familiar with the expertise, facilities and training provision offered by your local private training providers?



5. What impact, if any, are strategic developments in education and training elsewhere in the UK having on the opportunities available to learners and potential learners in Scotland?

6. How relevant to Scottish engineering education and training is the centre of excellence model? Would it be an improvement on existing arrangements? How might it operate in Scotland? What improvements might it bring? What weaknesses if any would be likely to accompany it? What role would colleges play who were not centres of excellence?

7. Which awarding bodies do employers require to be used and for which programmes? What are the reasons for these choices? What if any role does the college have in the choices made? What reasons influence the college's choices?

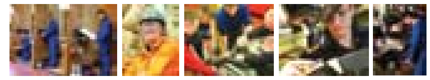
8. To what extent are adults given equal opportunities with younger learners eg in relation to accessing training or Modern Apprenticeships in engineering? If not, what are the reasons for any inequalities?

9. Why does the gender imbalance persist?

10. What is your view of the quality of advice or preparation that learners get in schools about engineering? What are you doing about it?

11. Work placement for FT learners. Do you offer them? If not, why? Would they be helpful?

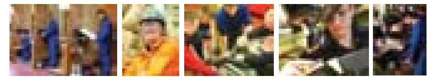
12. What changes would you like to see in engineering education and training in Scotland that would have the greatest impact on the quality and relevance of the experiences provided, and the skills and knowledge of the learners?



Appendix 6

Glossary

CNC	Computer Numerically Controlled
CPD	Continuing Professional Development
CoVE	Centre of Vocational Excellence
EAL	EMTA Awards Ltd
ECITB	Engineering Construction Industry Training Board
FE	Further Education
HE	Higher Education
HN	Higher National
HNC	Higher National Certificate
HND	Higher National Diploma
HEI	Higher Education Institution
ICT	Information and Communication Technology
IET	Institution of Engineering and Technology
IMI	Institute of Motor Industry
LSDA	Learning and Skills Development Agency
MA	Modern Apprenticeship
MISC	Motor Industry Skills Consortium
NC	National Certificate
NQ	National Qualification
NSA	National Skills Academy
OPITO	Oil and Petroleum Industry Training Organisation
PI	Performance Indicator
SACCA	Scottish Advisory Committee on Credit and Access
SAFEE	Scottish Association for Engineering Education
SECTT	Scottish Electrical Charitable Training Trust
SEMTA	Science, Engineering, Manufacturing Technologies Alliance
SFC	Scottish Funding Council
SCQF	Scottish Credit and Qualification Framework
SQA	Scottish Qualifications Authority
SECTT	Scottish Electrical Charitable Training Trust
SFEU	Scottish Further Education Unit
SME	Small and medium sized enterprise
SPA	Scottish Progression Award
SUM	Student Unit of Measure
SVQ	Scottish Vocational Qualification
UHI	UHI Millennium Institute
VLE	Virtual Learning Environment



Appendix 7

Acknowledgements for assistance in the preparation for this report

Aberdeen College
Anniesland College
Automotive Skills
Ayr College
Banff and Buchan College
Cardonald College
Clydebank College
Cumbernauld College
Dumfries and Galloway College
Dundee College
Forth Valley College
Glasgow College of Nautical Studies
Highlands and Islands Enterprise
Institution of Engineering and Technology
Inverness College
James Watt College
Langside College
Lews Castle College
Moray College
Motherwell College
Reid Kerr College
Science, Engineering, Manufacturing Technologies Alliance
Scottish Association for Engineering Education
Scottish Electrical Charitable Training Trust
Scottish Engineering
Scottish Enterprise
Scottish Funding Council
Scottish Qualifications Authority
Shetland College
Stow College
The Adam Smith College

Photographs were kindly provided by Anniesland College, Banff and Buchan College, James Watt College and Motherwell College