Education and Training Inspectorate

Report of an Evaluation of

Provision for the Priority Skills Area of Mechanical and Manufacturing Engineering at Level 3

across the

Six Regional Colleges in Northern Ireland

November 2010

The Education and Training Inspectorate - Promoting Improvement

Providing Inspection Services for
Department of Education
Department for Employment and Learning
Department of Culture, Arts and Leisure

CUSTOMER SERVICE EXCELLENCE

CONTENTS

PART ONE: INTRODUCTION

1. CONTEXT

1.1 This report summarises the findings of an evaluation of the further education provision at level 3 for the priority skill of mechanical and manufacturing engineering in the six area-based colleges of further education. The provision comprises full-time and part-time professional and technical courses to prepare students for employment in, and to up-skill existing employees within, the manufacturing sector of Northern Ireland's economy. The professional and technical courses include the specialist areas of computer-aided design (CAD), computer-aided manufacturing, fabrication and welding, and maintenance and operations engineering. At the time of the evaluation, there were two colleges with campuses designated as Centre of Excellence for manufacturing engineering.

1.2 Employees within this sector, with a level 3 professional and technical qualification, manufacture products primarily from metals and plastics, and maintain and develop the machinery for the production of a wide range of consumer goods. They are employed in a range of industries including those manufacturing aircraft parts, buses and forklifts, farm and quarrying machinery, heating and ventilation systems, injected-moulded plastic products, architectural and structural steelwork, computer hardware components, and drilling equipment for the oil and gas industry. They are also employed in the manufacturing industries of consumer goods, such as food and beverages, tyres, textiles and clothing, tobacco products, pharmaceuticals and chemical products, and printed paper products, as maintenance and system development engineers.

1.3 The manufacturing sector in Northern Ireland is responsible for 12%[1] of the total direct employment; 27% of the total economic activity; and 24% of the Gross Value Added (GVA)[2]. Just less than 30% of the sector's GVA is accounted for in the manufacture of food products, beverages, and tobacco products. The remaining significant industries within this sector include the manufacture of transportation equipment (9.1%), fabricated metal products (8.5%), machinery and equipment (7.4%), rubber and plastic products (7.1%), electrical equipment (6.5%), non-metallic mineral products (5.3%), chemicals and chemical products (4.8%), and computer, electronic and optical products (4.8%).

1.4 Across Northern Ireland, around 40,000 people are employed in engineering roles. The demand for new employees with engineering qualifications, according to the Sector Skills Council, Science Engineering Manufacturing and Technology Alliance (SEMTA)[3] forecasts, is about 1,350 per annum with the greatest proportion (34%) of these with level 3 qualifications. Science Engineering Manufacturing and Technology Alliance also report that there is a potential up-skilling requirement for more than 14,000 existing employees across management and technical occupations, with the greatest need for employees to up-skill to level 2 (60%) and to level 3 (25%).

1.5 The STEM Report[4] highlights the increasing need for a greater supply of employees with higher qualifications in engineering and technology to support sustained growth in the economy. The report, which draws on the Oxford Economics report, 'Forecasting Future Skills Needs in Northern Ireland', underlines strongly the need to increase the supply of students completing science, technology, engineering and mathematics (STEM) related

[1] Department of Enterprise, Trade & Investment: Labour Force Survey Quarterly Supplement: January - March 2010 published 26th May 2010
[2] Department of Enterprise, Trade & Investment: Northern Ireland Annual Business Inquiry (NIABI)2008, published by 31 March 2010
[3] SEMTA: Engineering Skills Balance Sheet - Northern Ireland: An analysis of Supply and Demand issues, June 2008
4 Report of STEM Review, Science Technology, Engineering and Mathematics: Department of Education and Department for Employment and Learning September 2009

qualifications. These include engineering and technology qualifications for the manufacturing sector in Northern Ireland, particularly at levels 4 to 5, where Northern Ireland levels are significantly below the UK average. The report also records a slight decline in enrolments to further education courses in engineering and technology across levels 2 to 4, over the period 2002-2007. The report's recommendations include improving the supply of students with engineering and technology qualifications, and improving the students' investigative and enquiry-based learning.

1.6 Over recent years, the employability skills required for the mechanical and manufacturing engineering industry at level 3 have changed significantly. There is a greater emphasis on computer-aided design and manufacturing techniques; a broader range of electro-mechanical skills and knowledge; wider range information communication and technology (ICT) skills; improved communication and team working skills; and a focus on efficiency within manufacturing. Key drivers for these changes include the rapidly increasing global competitiveness from low-cost manufacturing countries, Northern Ireland's productivity-gap at 80% of the UK average, and the continual need to reduce society's carbon footprint. The first two Public Service Agreements (PSA) of Northern Ireland's Executive Programme for Government 2008-2011 reflect these changes and drivers, and are:

- PSA 1: Productivity Growth:- Improve Northern Ireland's manufacturing and private services productivity; and

- PSA 2: Skills for Prosperity:- Ensure our people have the right skills to deliver economic prosperity now and in the future and increase skills and career choices in STEM subjects.

1.7 There is, therefore, an increasing need for the further education sector to equip a greater number of potential and existing employees with higher level STEM related skills and knowledge to increase the value added in manufacturing, and with the capabilities to do it more efficiently.

2. SUMMARY OF MAIN FINDINGS

2.1 The overall effectiveness of the provision across the sector varies from very good to inadequate. In one college it is very good; in two it is good; in two it is satisfactory; and in one it is inadequate. It is of particular concern that in half of the colleges, which serve significant geographical regions of Northern Ireland, the overall effectiveness ranges from satisfactory to inadequate.

2.2 Enrolment levels for full-time students vary significantly across the colleges, and are too low in two of the colleges. Part-time day release student enrolments are unacceptably low in five of the colleges, and almost all of the enrolments on evening programmes are restricted Computer-aided Design (CAD).

2.3 There is a significant gender imbalance in student enrolment; almost all of the students across the full-time and part-time programmes are male.

2.4 A significant minority of the full-time students do not hold the most appropriate qualification level in English and mathematics on entry to their programme. Across the sector, approximately one-third do not hold a General Certificate in Secondary Education (GCSE) at grade C or above in English, or equivalent, and in five of the colleges just over 20% do not hold a GCSE at grade C or above in mathematics, or equivalent.

2.5 There is well-balanced curriculum of mechanical and manufacturing engineering specialist units provided for full-time and part-time day release students in five of the colleges. In the remaining college, the curriculum is inadequate; it is not matched well to needs of the students or local employers. Across the sector, the range of evening programmes for part-time students is too narrow.

2.6 The timetabled time provided for full-time students to complete a good range of practical tasks and investigations, particularly to design and manufacture projects in an engineering workshop, is inadequate in five of the colleges.

2.7 The overall quality of the leadership and management ranges from outstanding to good in half of the colleges. In the remaining half it is satisfactory to inadequate; in one college it is inadequate.

2.8 The strategic planning across the sector is variable. In one college there is robust curriculum planning to develop a sustainable and coherent provision, which is economically focused for a wide range of students. In the remaining colleges there are gaps in the provision, particularly in the range and nature of the part-time programmes offered for students in employment.

2.9 The levels of economic engagement with local employers are good or better in five colleges. In three of these colleges, the links and partnerships with local and international companies are excellent and that have led to tailored programmes to support economic and workforce development. In the remaining college, the links with employers are under-exploited.

2.10 The quality and range of workshops and specialist equipment available to students in four of the colleges are outstanding to very good. In the remaining two colleges the deployment of workshops and specialist resources is inadequate; there is a lack of planning to provide students with access to specialist equipment and workshops, particularly for project work.

2.11 The collaboration arrangements within and across the colleges to share good practice and support continual curriculum development are underdeveloped.

2.12 There is effective deployment of well-qualified and experienced lecturing staff within five of the colleges, including ongoing staff development in modern manufacturing engineering technology. In the remaining college, there are limited opportunities for the lecturers to develop further their expertise in manufacturing engineering technologies.

2.13 The quality of the teaching and learning was good or better in the majority of the lessons observed; in 27% it was outstanding to very good, and in 34% it was good. In the remainder of the lessons, 36% of them were satisfactory, and 3% were inadequate.

2.14 The quality of the work-related learning provision is good in two colleges. In the remainder, it is satisfactory. In these colleges, there are insufficient work-related learning opportunities to support students in completing their design projects and in their career planning.

2.15 The standards of the students' work are good or better in four colleges. For the two remaining colleges, the standards are mostly satisfactory. The students have limited ability to apply and use mathematics and engineering principles to solve practical engineering problems.

2.16 Full-time student retention rates vary from good to poor across the sector, and for the majority of the colleges they are modest or better. Full-time student success rates are excellent to good. Part-time student retention rates vary from excellent to satisfactory and for most colleges they are excellent to good. Success rates are excellent to good.

PART TWO: MAIN FINDINGS

3. PROVISION

3.1 The full-time provision across all of the colleges is a two year programme leading to a Edexcel BTEC National Diploma in Engineering, which is equivalent to three General Certificates in Education (GCE), Advanced Level. In three of the colleges, the programme includes a well-balanced range of both electrical and mechanical units, particularly during the first year of the programme. In second year, students can choose to specialise in mechanical and manufacturing engineering. In the other three colleges, the design of the engineering curriculum provides the students with the opportunity to specialise in mechanical and manufacturing engineering throughout their programme.

3.2 The total number of full-time students enrolling on year one of the National Diploma in Engineering with mechanical and manufacturing units across the six colleges increased significantly in 2009-2010 by almost a 50%. At the time of the evaluation, a total of 360 students were enrolled; 229 in year 1 and 131 in year 2. The spread of recruitment varies significantly across the colleges, from 15 students to 132, with an overall average of 60 full-time students enrolled in each college. In two colleges, the National Diploma in Engineering with mechanical and manufacturing units has only been offered over the last two years and recruitment is low.

3.3 Most of the part-time provision is apprenticeships; significant numbers of apprentices attend day release programmes through ApprenticeshipsNI to complete a vocationally related qualification (VRQ) at level 3. Only a small number of part-time further education students infill into these VRQs. The main VRQs are City and Guilds Certificate in Engineering for craft engineers and Edexcel BTEC National Certificate Mechanical and Manufacturing Engineering for technician engineers. At the time of the evaluation there were 56 part-time further education students completing a City and Guilds Certificate in Engineering, and 41 part-time further education students completing a Edexcel BTEC National Certificate in Mechanical and Manufacturing Engineering. There has been a steady decline in part-time day release students, and most of the colleges have been unsuccessful in addressing this decline or providing alternative modes of attendance. As a result, the supply of level 3 craft engineers and technician engineers from further education is too low[5].

3.4 The part-time evening provision is very limited; it comprises only CAD and welding courses. At the time of the inspection there were around 70[6] students enrolled on CAD courses and only four on a welding course.

3.5 Across the sector a significant minority of the full-time students were enrolled without the most appropriate qualification level in English and mathematics. In five of the colleges, approximately 23% of the students were enrolled without at least a grade C in GCSE mathematics, or equivalent. Across all of the colleges, approximately one third of the students were enrolled without at least a GCSE grade C in English, or equivalent. This enrolment profile is due to a number of interrelated factors, and include poorly developed and implemented recruitment polices and procedures, a declining interest in STEM related subjects by school leavers, and the colleges' increasing financial pressures to achieve more economical class sizes. The students who enrol on the Edexcel BTEC National Diploma in Engineering without a level 2 qualification in mathematics demonstrate a lack of ability and

[5] This does not include the ApprenticeshipsNI provision.
[6] These course may also include students from the construction and built environment sector

confidence in the transposition of formulae and the manipulation of data, which are key prerequisite skills for studying engineering principles. Similarity, the students enrolled without a level 2 qualification in English, have limited communication skills to compose and structure written reports clearly and concisely using their own vocabulary, which inhibits significantly their ability to produce good quality written assignments.

3.6 Almost all of the students enrolled are male, resulting in a significant gender imbalance across the mechanical and manufacturing engineering provision.

4. OVERALL EFFECTIVENESS OF THE PROVISION

4.1 The overall effectiveness of the provision across the sector varies from very good to inadequate; in one college it is very good; in two it is good; in two it is satisfactory; and in one it is inadequate. It is of concern that in half of the colleges, which serve significant geographical regions of Northern Ireland, the overall effectiveness of the mechanical and manufacturing engineering provision at level 3 ranges from satisfactory to inadequate.

4.2 In the one college where the overall effectiveness is very good, the leadership and management are outstanding. There is a strong commitment to excellence, which is demonstrated in the excellent economic engagement with industry; ongoing investment in high quality specialist learning resources; the excellent staff development; and a good start made on intercampus collaborative working. The standards of most of the students' work are very good to excellent, and are matched well to current industry practice. The provision for learning is very good; there are very good opportunities for the students to gain a wide range of appropriate skills and knowledge, particularly in advanced manufacturing. Increased practical workshop time is required for full-time students.

4.3 In the two colleges where the overall effectiveness is good, there are important strengths in most areas of the provision. These include effective leadership and management to bring about improvement; very good quality specialist teaching facilities; good standards of work achieved by most of the students; and there is a broad range of teaching strategies deployed in the majority of the lessons. The main areas for improvement include the insufficient workshop time to complete practical engineering projects and the limited work-based learning experiences, for full-time students; the satisfactory quality of the teaching in a minority of the lessons; and the under-developed provision for part-time students.

4.4 In the two colleges where the overall effectiveness is satisfactory. The strengths outweigh areas for improvement in the provision, and include the good quality of the specialist teaching resources; the good standards of work achieved by most of the students; and the good or better teaching in the majority of the lessons. The main areas for improvement include the limited opportunities for practical project work and work-related learning for full-time students; the satisfactory quality of the teaching in a significant minority of the lessons; and the under-developed provision for part-time students.

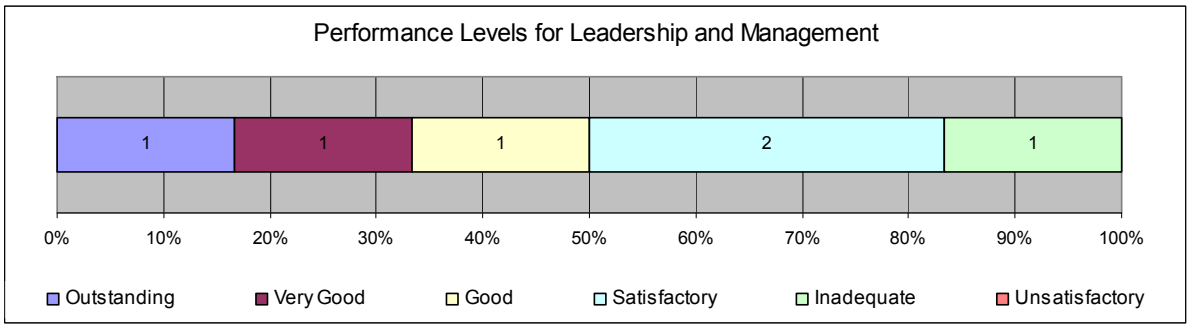
4.5 In the one college where the overall effectiveness is inadequate, the areas for improvement outweigh the strengths in the provision. The significant areas for improvement include the inadequate curriculum to meet effectively the needs of the students and employers; the narrow range of skills and knowledge developed by the students; and the satisfactory quality of the teaching and learning in half of the lessons.

5. LEADERSHIP AND MANAGEMENT

STRATEGIC LEADERSHIP

5.1 The quality of the leadership and management is variable across the sector, as shown in figure 1. In three colleges, the quality of leadership and management ranges from good to outstanding, in two it is satisfactory, and in one it is inadequate. This satisfactory to inadequate quality of the leadership and management across half of the colleges has a significant adverse impact on the overall effectiveness of the provision.

Figure 1: Performance Levels for Leadership and management



5.2 Strategic planning across the sector is variable; it is good or better in three colleges, and satisfactory to inadequate in the remainder. In only one college is there robust curriculum planning to ensure there is a sustainable and coherent provision for a wide range of students, across a broad range of specialist areas. Across the remaining colleges, there are gaps in the provision, particularly in the range and nature of the part-time further education courses offered. As a result, there are limited opportunities for part-time students, particularly for those in full-time employment who may wish to broaden or upgrade their qualifications in specialist areas. These areas include computer numerical control (CNC) programming, pneumatics and hydraulics, robotics, and programmable logic controllers (PLC) programming.

5.3 In the one college, where strategic leadership and planning are outstanding; there is an excellent understanding of the educational and training needs of the mechanical and manufacturing industry. There is effective economic engagement with local and regional employers, including the Sector Skills Council and the local Workforce Development Forum. This has provided the college with a clear understanding of the curricular needs of a wide range of students and employers. As a result, the curriculum managers have made successful bids for additional European funding to purchase key industry standard equipment; have developed partnerships with employers to design and provide bespoke training and to inform curriculum development; have put in-place effective knowledge transfer arrangements with industry and other educational providers; and developed a modern curriculum for both full-time and part-time students that reflects the contemporary needs of industry.

5.4 In the two colleges where the strategic leadership and planning, links with employers are very good to good. There is evidence of ongoing curriculum development to ensure the provision is adapted to meet the changing needs of a range of students and of local employers. Through Department funding, there has been very good investment in industry standard equipment and facilities which reflect the technology of modern mechanical and manufacturing engineering companies. There is good progress in engaging with employers to support economic growth through up-skill training or through product design and development support services.

5.5 In the remaining colleges, the strategic leadership and planning are satisfactory for two colleges and inadequate for one. The provision is fragmented, and is mainly the legacy provision from the constituent colleges within the new regional college. In two of these colleges, the provision has been allowed to contract significantly over the last three years, and is now offered only in one campus of each college. While there is economic engagement with local employers and access to a good range of specialist equipment, there is a lack of effective strategic planning to exploit fully these industry links and to utilise fully the available specialist resources. This inhibits the development of a coherent provision that reflects and meets the needs of full-time students, part-time students and local employers. As a result, enrolment, particularly in two colleges, is unduly low; the potential within the existing or future links with employers are not exploited fully to support economic development; and the deployment and effective use of specialist equipment and facilities are inadequate.

ACTION TO PROMOTE IMPROVEMENT

5.6 The quality of the self-evaluation and development planning carried out by course teams varies from very good to inadequate. In four of the colleges it is good or better. There is a collegial approach to self-evaluation, where strengths and areas for improvement are identified accurately by course teams and are articulated clearly to the college management team. There is good integration and monitoring of the curriculum development plans within the whole college development plans. In the two remaining colleges, the development planning process is overly bureaucratic and fails to use specific targets adequately to measure and track improvements in the quality of the provision for students and in standards achieved by the students.

5.7 Collaboration and sharing of good practice across the six colleges is mainly underdeveloped. Although, the Learning Skills and Development Agency, Northern Ireland facilitate a STEM forum where relevant members of staff can exchange ideas on how to promote and increase the number of students studying engineering and technology, there is no evidence of colleges collaborating to plan how to meet better the needs of students and employers across Northern Ireland. Collaboration and sharing of good practice across campuses within the colleges are also mainly underdeveloped. Although a small number of staff, with specialist skills and knowledge, travel between college campuses to meet timetabling requirements and for specialist equipment training, there are limited opportunities for course teams to share good practice and develop the curriculum across the college. As a result, the benefits from the formation of the regional colleges are not yet realised fully, either locally or regionally.

Best Practice Example of Sharing Good Practice:

In one college, an internal staff development programme allows lecturers from across the regional college to work-shadow colleagues with specialist skills in advanced manufacturing to upgrade their skills and knowledge in Computer-aided design and manufacturing.

STAFFING

5.8 The range of lecturers with specialist skills and knowledge is good or better in five of the colleges. The lecturers have a very good range of skills and expertise to provide the specialist education and training programmes required by industry. This is particularly true for one of these colleges where there is excellent planning for developing staff with specialist skills and knowledge. The lecturers through placements in industry, employer partnerships,

or specialist training courses continually upgrade their skills and expertise in line with employers' technology and training needs. In the remaining college, there is insufficient priority given to developing lecturers' industry standard skills across a broad range of manufacturing technologies. As a result, the curriculum offer is too narrow and there is limited practical work within the students' learning experiences.

PHYSICAL RESOURCES

5.9 The quality of the facilities and specialist equipment vary from outstanding to satisfactory. In one college the quality of the workshops and the range of specialist advanced manufacturing systems are outstanding. There has been significant investment, through a variety of funding streams, in industry standard modern computer-aided design and manufacturing equipment to ensure that educational and training programmes are aligned to ongoing technological developments and to support economic development. In three of the colleges, the facilities and specialist equipment are very good. Through Department funding, particularly through funding for new estate, there has been significant investment in a very good range of equipment and workshops. In the remaining two colleges, although the quality of workshops and equipment is satisfactory, the planning for ongoing investment in, and the effective deployment of, specialist equipment and facilities is inadequate at all levels. As a result, the students have inadequate access to workshops and manufacturing equipment to complete practical projects.

Best Practice Example of Development of Facilities and Equipment:

In one college, the curriculum management team, over the last ten years, has been successful in securing additional European funding in partnerships with further education colleges in Republic of Ireland and in Scotland. This funding has enabled the college to develop an advanced manufacturing centre that includes industry standard computer aided design, manufacturing and automation equipment.

5.10 The collaborative arrangements across and within the colleges to improve student access to specialist equipment are under-developed. In only one college, has the sharing of specialist resources across its campuses begun; full-time students from one campus travel to another campus one day each week to access the advanced manufacturing equipment. As a result, some of the highly expensive advanced manufacturing equipment is under-utilised. There is undue variance across Northern Ireland in student access to modern workshops and advanced manufacturing engineering equipment; students attending some campuses are unable to use the advanced equipment available in other campuses or colleges.

5.11 With the recent introduction of the Entitlement Framework within the post-primary sector and its increasing focus on STEM, there is a growing demand for colleges to supply a range of engineering and technology courses for post-primary school pupils. Over the last three years, this provision has increased significantly and curriculum managers have struggled to resource all curricular demands, and have mostly prioritised links with the schools. As a result, on occasions, the best resources are skewed towards the school links, and are at the expense of growing the part-time provision or developing the most appropriate curriculum for full-time students.

ECONOMIC ENGAGEMENT

5.12 Economic engagement across the sector is variable. It is very good to excellent in the two colleges which have a campus designated as a Centre of Excellence in manufacturing engineering. In these colleges there are well-established links and partnerships with local, regional and international employers and other educational providers. This has led to a range of programmes to promote and support knowledge transfer and support economic development through the supply of technical expertise and workforce development.

Best Practice Examples of Economic Engagement with Employers:

This college provides an international engineering manufacturing company with a bespoke a Design for Manufacture programme, which is integrated into the company's systems worldwide. Also at this college, a local manufacturing company has co-located its engineering training facility within the college's engineering department, which is for the benefit of all of the college's engineering students. There are also two lecturers who are funded by local engineering companies to spend 50% of their time improving the company's manufacturing techniques.

5.13 In three of the colleges, economic engagement is good overall; there has been very good progress in aspects of economic engagement, particularly in supporting innovation through the technical skills and expertise of staff. In these colleges, this work, however, has had limited impact on the overall effectiveness of the full-time provision. The economic engagement in the remaining college is satisfactory; there is a focused strategy to establish links with local employers, but these links have yet to be exploited to support innovation and economic development.

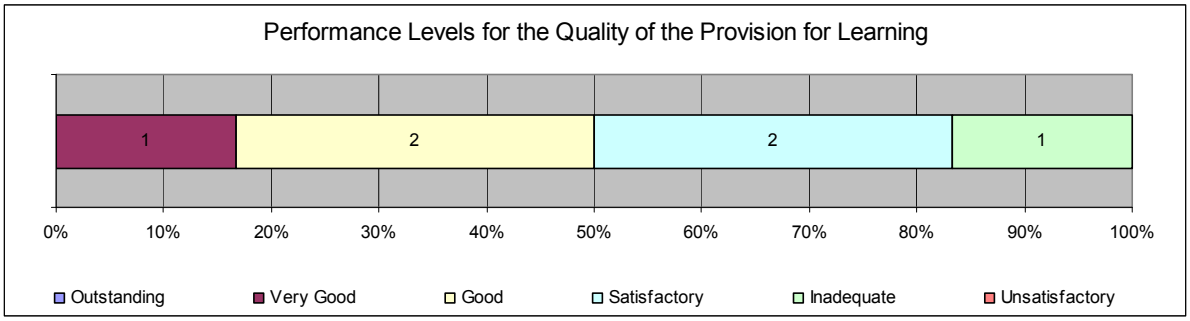
Best Practice Examples of Supporting Innovation and Economic Development:

One of these colleges has secured significant funding from the Department to develop an innovation and technology centre, which employs a range of engineers with various specialisms to support local employers in research and design to improve their competitiveness and productivity.

6. QUALITY OF THE PROVISION FOR LEARNING

6.1 The overall quality of the provision for learning varies from very good to inadequate across the sector, as illustrated in figure 2. In three of the colleges it is good or better. In the remaining three colleges, it is satisfactory for two and inadequate for one.

Figure 2: Performance Levels for Quality of the Learning Provision



QUALITY AND EFFECTIVENESS OF THE CURRICULUM

6.2 The curriculum design in four of the colleges is at least good; in three it is good and in one it is very good. The students on full-time Edexcel BTEC National Diplomas are provided with a broad and balanced programme of units that prepares them well for progression to work as a technician engineer in industry or to progress to higher education. The programme includes mathematics, engineering principles, engineering communication, welding technology, computer-aided design and manufacture, pneumatics and hydraulics, programme logic control, and design project. In the college where the curriculum design is very good, there is also an excellent range of craft and technician programmes for part-time students. Part-time craft students can complete a City and Guilds Certificate in Engineering, specialising in maintenance engineering, manufacturing engineering or fabrication and welding, that is matched well to industry's needs. Part-time technician engineering students complete an Edexcel BTEC National Certificate in Mechanical and Manufacturing Engineering, specialising either in maintenance engineering or manufacturing engineering. These programmes equip part-time students with an appropriate range of industry standard technical skills to enable them to work as technician engineers within industry or to progress to higher education.

Best Practice Example of Curriculum Design:

In one college, the ranges of option pathways for full-time students include Motor Sport, which is aligned to the students' personal interests and provides an engaging context for teaching a range of mechanical engineering principles.

6.3 The curriculum design in the remaining two colleges is satisfactory to inadequate. In the college where it is satisfactory, the programme of units provided for full-time students is not balanced or sequenced appropriately, and as a result the students do not make appropriate progression in their learning. In the college where the curriculum design is inadequate, the learning programme for full-time students is too narrow; it focuses unduly on theoretical units and does not provide the students with sufficient breadth of learning experiences, particularly to develop practical mechanical and manufacturing engineering skills. The provision for part-time students is also inadequate; it similarly focuses on theoretical principles and fails to provide the craft engineering students with sufficient opportunities to develop relevant practical skills.

6.4 Across five of the colleges, the timetabled teaching hours allocated to full-time students on Edexcel BTEC National Diploma students does not provide them sufficient time for practical work, particularly in engineering workshops. On average, the students are provided with 16 hours timetabled teaching time each week, which limits significantly the opportunities for the students to apply and consolidate their learning through practical projects. In particular, there is insufficient time for the students to design and manufacture engineering projects. The timetabled time provided for tutorials is at least adequate; it ranges 45 minutes to two hours each week, and is mostly between one and two hours. There is adequate additional time provided for full-time students entering the programme inappropriately without level 2 qualifications in mathematics, English or ICT, to allow them to achieve a level 2 qualification in these areas.

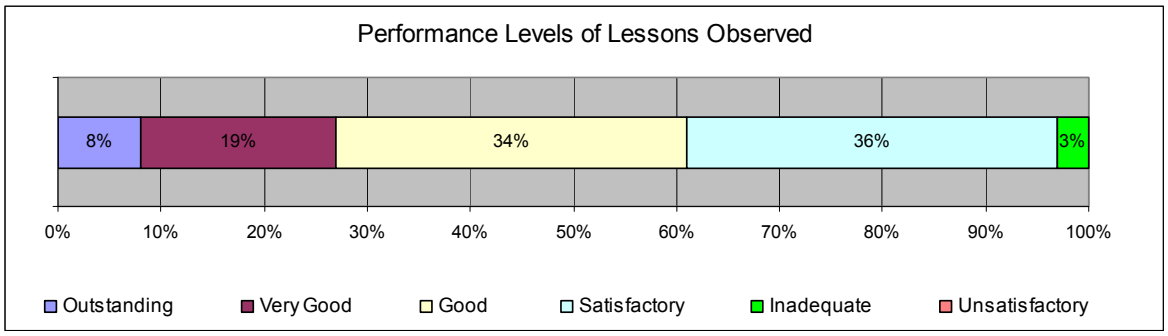
Best Practice Example of Curriculum Design:

In one college, full-time students are provided with practical engineering workshop time, which affords them the opportunity to develop a range of practical engineering skills. This ensures that full-time students acquire important employability skills for the engineering industry.

THE QUALITY OF THE TEACHING AND LEARNING

6.5 The quality of the teaching and learning varies from outstanding to inadequate across the colleges. In three colleges it is mainly good to very good, and in the remainder it is mainly satisfactory. Across the sector, just under two-thirds (61%) of the total lessons observed were evaluated as good or better, and just over a third (36%) were satisfactory, as illustrated in figure 3. Only a few (3%) were judged to be inadequate.

Figure 3: Performance Levels of Lessons Observed



6.6 In the good or better lessons, the teaching is well-planned and the learning outcomes are understood clearly by the students. The students are provided with a range of learning tasks which are stimulating and suitably challenging. They have good opportunities to use modern technology and have structured practical activities to support the development of their understanding of fundamental principles and how they are applied in industry. The pace of work is appropriate and the students respond well to a good range of skilful questioning that promotes and reinforces their learning. The lecturers make good use of simulation software, digital presentations, websites and the college's virtually learning environment (VLE) to support and enhance the students' learning experiences. In particular, the VLE is a critical resource in providing all students with a comprehensive repository of lesson notes, web links, tutorial questions and assignment briefs.

Best Practice Example of Teaching and Learning:

In a mechanical principles lesson, the students developed their understanding and application of the gas laws through the lecturer's skilful use of web-based animations, questioning, group tutorial work, and practical investigations of the turbo-charger of a diesel engine. The lesson's learning material was placed on the college's VLE to facilitate the students' further independent learning.

6.7 In the satisfactory lessons, there is a narrow range of teaching approaches, insufficient challenge in the learning tasks, and a slow pace of work. The dominating learning strategy is theoretical exposition of engineering principles by the lecturer, and note taking by the students. There is ineffective use of information learning technology and insufficient practical learning activities to enhance and support the students' learning. As a result, a significant minority of the students are not sufficiently motivated in their learning, do not attend lessons regularly, and are making inadequate progress in completing their assignments and achieving appropriately high grades.

ASSESSMENT

6.8 Assessment arrangements are satisfactory to very good, and are mainly satisfactory across most of the colleges. Assignments briefs are clear, and students are provided with good support and feedback on how to improve their work. Assignments are, however, not integrated across the students' units, and as a result the number of assignments for full-time students is mostly too excessive. In most colleges, the assessment arrangements for mathematical subjects are inadequate. Neither the design of the assignments nor the assessment arrangements are sufficiently rigorous to ensure that the students complete their assessment work autonomously.

CAREERS EDUCATION, INFORMATION, ADVICE AND GUIDANCE (CEIAG)

6.9 The quality of the work-related learning provision ranges from good to satisfactory, and is mainly satisfactory. In two colleges, the students have good opportunities to develop an understanding of the world of work through industry visits, guest speakers, industry related practical tasks, and exposure to modern manufacturing technology within the college. In the remainder, there are insufficient opportunities for the full-time students to develop their knowledge and understanding of career pathways in mechanical and manufacturing engineering. Overall, across all colleges, full-time Edexcel BTEC National Diploma students are not provided with structured work experience to support the development of their understanding of the role of a technician engineer in industry.

6.10 The provision to develop the full-time students' design and project skills is mainly satisfactory across all the colleges. There is insufficient time for engineering workshop practice, limited integration of units, and lack of workplace experiences, which inhibit significantly the opportunities for the students to develop and apply the necessary practical manufacturing, communication, problem-solving, and team working skills to design and manufacture engineering projects effectively.

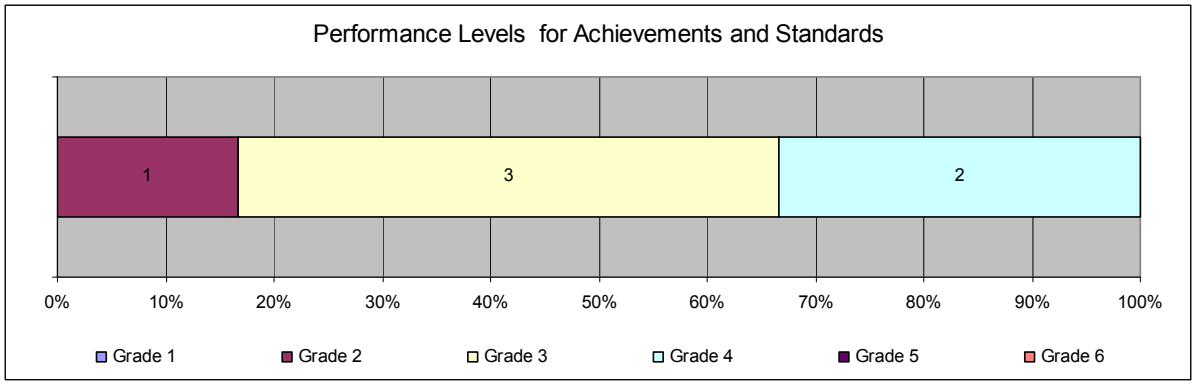
STUDENT SUPPORT

6.11 The tutorial support provided for full-time students is satisfactory to good across all of the colleges. Course tutors use the tutorial time effectively to review and monitor the students' progress and achievements. This is particularly beneficial for students who planning to progress to University, as it enables the students to set appropriate targets, and receive career advice and guidance for selecting courses.

7. ACHIEVEMENTS AND STANDARDS

7.1 Achievements and standards overall range from very good to satisfactory across the sector. In four colleges they are good to very good, and in the remainder they are satisfactory, as illustrated in figure 4.

Figure 4: Performance Levels for Achievements and Standards



7.2 The standards of work achieved by the students range from excellent to satisfactory. In one college they are mostly very good to excellent; in three colleges they are mostly good; and in two colleges they are mostly satisfactory. In the colleges where the standards of the students' work are mostly good or better, the students develop a good understanding of engineering principles, systems, and technology. They are able to use advanced engineering technology competently to perform design and manufacturing tasks. These include, generating computer two-dimensional drawings and three-dimensional models competently, using manual and computer controlled engineering manufacturing processes to produce components accurately, and programming computer automation systems with minimal assistance. In particular, part-time engineering craft students are able produce engineering artefacts, using industry standard machines and techniques, consistently to industry standards.

Best Practice Example of Standards Achieved:

In one college, most of the part-time and full-time students achieve very good to excellent standards of industry relevant skills and knowledge. They are able to use proprietary engineering design software, write CNC programmes for industry standard machining centres, use coordinate measurement machines, set up robotic systems, design and set up pneumatic and hydraulic systems, and use manual lathes, mills, welders, folders and measurement equipment to produce artefacts to industry standards.

7.3 In the two colleges where the standards of the students' work are mostly satisfactory, the students have low motivation and their attendance is variable. A significant minority of the students develop a narrow range of mathematical skills and a minimal understanding of engineering principles and technology in order to achieve a pass grade in their assignments. The graphical communication and practical engineering skills of the majority of the students are underdeveloped. As a result, they have limited ability to design and manufacture engineering products or systems to a good or better standard. The projects demonstrate weaknesses in product research, sketching and design development, the production of detailed drawings, incorporation of moving parts or control mechanisms, and poor quality of accuracy and finish in construction.

7.4 Overall, the majority of the students make good progress in their learning. They develop a good range of personal capabilities. These include proficient ICT skills, satisfactory communication skills, good numeracy skills, good self-management and problem-solving skills. A minority of students are, however, making inadequate progress in addressing the weaknesses in their numeracy and communication skills. As a result, these students have insufficient mathematical and written communication skills to make good progress in their learning or achieve beyond the minimum.

7.5 The average student retention rates on the full-time programmes[7] vary across the sector from good to poor. In one college average retention is good at just over 80%; in two it is satisfactory at around 75%, in one it is modest at just over 65%; and in remainder it is poor at just under 50%. Success rates on these programmes range from excellent to good; in two colleges they are good at around 87%, and in the remainder they are excellent at over 90%. As a result, the achievement rates in three of the colleges are between 65% and 70%, and in the two remaining colleges they are 40% and 80% respectively. An achievement is not yet available in one college.

[7] Based on available data provided by the colleges at the time of the evaluation.

7.6 The average student retention rates on the part-time programmes vary across the colleges from excellent to satisfactory. In two colleges it is excellent at over 90%; in one it is good at around 85%; and in one it is satisfactory at just over 70%. Success rates on these programmes range from excellent to good; in three colleges it is excellent at over 90%; and in one college it is good at just over 80%. As a result, the achievement rate in one college is 100%; in two it is just over 80%; and in the remaining college it is just over 70%.

7.7 Progression rates to employment or to higher education are generally good; the majority of the full-time students who complete successfully their course progress to higher education programmes.

PART THREE: CONCLUSIONS AND KEY PRIOITIES FOR DEVELOPMENT

8. CONCLUSION

8.1 The overall effectiveness of the education provision for the priority skills of mechanical and manufacturing engineering is good or better in half of the colleges. In one college the provision is very good, it is good in two colleges, it is satisfactory in one college and it is inadequate in one college.

9. KEY PRIORITIES FOR DEVELOPMENT

9.1 While this report highlights strengths in the provision of mechanical and manufacturing engineering programmes across the colleges, it has identified a number of key issues. In order to improve the quality of the provision in the professional and technical area of mechanical and manufacturing engineering, the colleges and the Department need to:

- improve the breadth of the curriculum offer and the modes of attendance to increase the number of part-time employed students studying qualifications or part qualifications in mechanical and manufacturing engineering;

- develop a coherent strategy to increase significantly the number of females studying mechanical and manufacturing engineering;

- ensure all full-time students have attained appropriate level 2 mathematical skills on entry to their programme;

- in consultation with employers and students, set and agree a minimum entitlement for full-time students to acquire an appropriate range of practical mechanical and manufacturing skills, particularly for design and manufacture project work;

- increase the opportunities for full-time students' to undertake work-based learning with mechanical and manufacturing employers to improve their project skills and their understanding of career pathways with the engineering, technology and manufacturing industry;

- establish formal inter-college collaborative arrangements to facilitate ongoing curriculum development; share specialist resources; and to realise fully the sector's collective capacity to support innovation and economic development within Northern Ireland's mechanical manufacturing sector; and

- provide support for curriculum managers to build their capacity to bring about effective improvements in curriculum design, in the quality of the students' learning experiences, and in the standards achieved by the students.

Copies of this report are available on the ETI website: www.etini.gov.uk