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## Country Report

### Great Britain

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## 1. Introduction

Previously, the *Engineered Systems* pathway<sup>1</sup> qualification was mapped to the Competence Matrix “Mechatronics” provided by 3s. This UK National Vocational Qualification (NVQ) contains elements of Mechatronics but is not labelled in this way and the focus is different to Mechatronics qualifications in other countries. In other words, a Mechatronics VET qualification is not offered in the UK in the NVQ System at Levels 4 or below.<sup>2</sup>

The aim of the previous report was to map the learning outcomes of the UK qualification to the matrix provided to identify common areas of competence development and suggest new ones. In the process of this comparison it was noted that since the Engineered Systems pathway qualification is a Level 3/4 vocational qualification, some areas of competence development that were contained in the matrix provided by 3s were not covered. For example, the ‘Mechatronics’ matrix goes beyond *using* engineering drawing and documents and involves designing, adapting and building mechatronic systems and putting them in operation; these areas are not included in the UK qualification.

The UK Level 3/4 qualification mentioned above was chosen because being a National Vocational qualification (NVQ) means it is competence-based and aims to reflect what individuals are able to do in the work environment. Moreover, its learning units are based on National Occupations Standards (NOS) which are “statements of effective performance which have been agreed by a representative sample of employers and other key stakeholders and approved by the UK NOS Panel” (NOS, 2012). Consequently, the learning units that constitute NVQs such as the Engineered Systems Pathway are defined based on what workers must know, be able to do and understand to perform a given job role or function within the work environment.

The present report turns its attention to Mechatronics qualifications in the UK which are offered as such at Level 5 and above in the form of Foundation Degrees. Although Mechatronics is also offered in the UK as a Higher Education (HE) degree, this report will focus on Foundation Degrees since they fall within the VET system. UCAS, the organisation responsible for providing information about higher education courses in the UK and of managing applications to HE, provides the following description of Foundation degrees:

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<sup>1</sup> From the Engineering Maintenance Suite 3 NVQ qualification structure.

<sup>2</sup> It is interesting to note, however, that Siemens have introduced from August 2013 a ‘European apprenticeship’ based in England whereby recruits can take part in an apprenticeship in either Mechatronics or Electrical/Electronic Engineering. The European Apprenticeship Scheme runs for 3.5 years, includes an extended placement in Berlin, and German lessons. However, the special European orientation of this programme is emphasised in that UK recruits to the programme can also spend 11-29 weeks per annum, in plants in Berlin and just 4 weeks in the UK. In this case the students work towards an IHK (Chamber of commerce) exam in German. Assignment after education will be follow-on employment in the UK. The ideal applicant will have a basic knowledge of German, but could be a school leaver (18 years +), a university student or a college graduate. Hence everything about this scheme shows it has a German genesis and is exceptional rather than representative of the UK system.

- Foundation degrees are designed and delivered in partnership with employers to equip people with the relevant knowledge and skills for business.
- They are offered by universities in partnership with higher education colleges and further education colleges. The study methods can be very flexible, which means that they are available to people already in work, those wishing to embark on a career change and to those who have recently completed level 3 qualifications (e.g. A levels, Advanced Apprenticeships or NVQ3).<sup>3</sup>
- A foundation degree is the equivalent of the first two years of an Honours degree, may be studied full- or part-time, and consist of academic study integrated with relevant work-based learning undertaken with an employer. It may be studied as a stand-alone qualification or upon completion you may progress to the final year of an Honours degree.<sup>4</sup>

As this description suggests, Foundation Degrees allow flexibility in relation to how they can be studied and in terms of progression routes. They also designed in partnership with employers and include employer-based training. Nonetheless, there seem to be fewer options for studying a Foundation degree in Mechatronics than for studying Mechatronics as a Bachelor's or Master's degree. A UCAS home/EU search for Foundation degrees in Mechatronics yielded two results<sup>5</sup>, whereas a search for 'Mechatronics on its own as a single subject' yielded nine courses at six different universities<sup>6</sup>.

Other courses can be found in colleges or universities web pages, but on a closer inspection or after contacting these institutions, it became clear that the degrees are no longer available. It seems that dynamic nature of Foundation Degrees helps to make them relevant to students and employees but at the same time this makes them difficult to sustain over time. The two courses currently available through UCAS are:

- FdSc, Engineering (Mechatronics), City of Bristol College, 3 years part-time (validated by Plymouth University)
- FdA, Mechatronic Engineering, Coleg Morgannwg, 2 years part-time (validated by the University of South Wales and the University of Wales)

The next section looks at the learning outcomes approach in the UK VET system. It then explores learning outcomes in Mechatronics by focusing on the courses listed above as exemplars.

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<sup>3</sup> [www.ucas.ac.uk/students/choosingcourses/choosingcourse/foundationdegree](http://www.ucas.ac.uk/students/choosingcourses/choosingcourse/foundationdegree)

<sup>4</sup> [ucas.faq-help.com/?search=Type%20your%20question%20here...#](http://ucas.faq-help.com/?search=Type%20your%20question%20here...#), See [www.qaa.ac.uk/Publications/InformationAndGuidance/Documents/FHEQ08.pdf](http://www.qaa.ac.uk/Publications/InformationAndGuidance/Documents/FHEQ08.pdf) for a description of The framework for higher education qualifications in England, Wales and Northern Ireland.

<sup>5</sup> [fd.ucas.com/CourseSearch/Default.aspx#results\\_new](http://fd.ucas.com/CourseSearch/Default.aspx#results_new) (accessed 27.05.2013)

<sup>6</sup> [search.ucas.com/cgi-bin/hsrun/search/search/StateId/EHAsQ7t9A1UGM7Kma7e-5Ou7DpRq\\_-VBOOn/HAHTpage/search.HsKeywordSuggestion.whereNext?query=425&word=MECHATRONICS&single=Y](http://search.ucas.com/cgi-bin/hsrun/search/search/StateId/EHAsQ7t9A1UGM7Kma7e-5Ou7DpRq_-VBOOn/HAHTpage/search.HsKeywordSuggestion.whereNext?query=425&word=MECHATRONICS&single=Y) (accessed 27.05.2013)

## 2. The learning outcomes approach

Learning outcomes have been used throughout the UK since the early 1990s in relation to higher education (cf. Adams, 2004). It may be said that, in relation to VET, their adoption can be traced back to the 1980s, as NVQ qualifications in the UK VET system are based on what experts in setting occupational standards consider individuals need to know to perform a given job in the labour market, i.e., on the desired learning outcomes defined by employers and relevant organisations. In order to be recognised as NVQs the standard setting process had to follow tightly prescribed procedures.

Back in the early stages of the implementation of this approach in the UK, Jack et al. (1993, p. 1) defined “learning outcomes” as “what learners are able to do as a result of learning”. The authors stressed the importance of making learning outcomes explicit as well as the importance of linking them to the requirements of employment and/or progression in terms of education. From this approach stemmed a concern for ensuring that assessment concentrated on evaluating the extent to which individuals’ capabilities matched the specified learning outcomes.

Learning outcomes are currently used in the UK education system at all levels but their adoption and impact on teachers and learners is not without critique. Some suggest that establishing learning outcomes can narrow rather than extend the teaching and learning process to those aspects that can be measured and assessed (cf. Furedi 2012). They suggest that developing learning outcomes is, at best, an activity that is accepted as a task of the profession with little or no impact on practice. In spite of this criticism, it is recognised that learning outcomes provide a tool for planning how to help students progress and for measuring where students should be at a given level of development.

However, recent reforms to strengthen vocational education provide evidence of an imminent drift away from an over-reliance on competence-based units towards valuing more holistic qualifications, suggesting that learning outcomes will occupy a less central role in the proposed ‘high value vocational qualifications’. The next section discusses the critique of the learning outcomes approach in the UK as well as some of the proposed changes for Level 3 Vocational Qualifications for 16-19 Year Olds. It then looks at some exemplary descriptions of Mechatronics courses and learning outcomes in this area.

## Critique of the learning outcomes approach in the UK VET system

CEDEFOP (2012) classifies the UK as an early developer of learning outcomes in Europe together Belgium (Flanders), Finland, France, Hungary, Ireland, Lithuania, the Netherlands, Norway, Poland, Romania, Slovenia and Sweden. These countries started to develop their outcome-oriented curriculum before the 1990s. In contrast to these, central and eastern European countries as well as Mediterranean countries are classified as more recent developers as the introduction of learning outcomes dates from 2005 onwards. Recent adopters include: Austria, Belgium (Walloon), Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Germany, Greece, Iceland, Latvia, Liechtenstein, Malta, Portugal, Slovakia, Spain and Turkey.

In spite of this classification which shows widespread adoption of a learning outcomes approach across Europe, CEDEFOP (2012) reports difficulties in establishing to what extent it has been implemented, particularly in relation to VET. Among the difficulties, the report highlights that the learning outcomes approach can be a meaningful exercise that ultimately supports the teaching and learning process but it can also be seen as a 'paper exercise' with limited implications on the curriculum.

In addition to this, the adoption and implementation of the learning outcomes approach and associated implications vary from one country to another and more detailed comparisons reveal differences even among systems that may seem comparable. For this reason, classifying VET systems is a challenging task and different classifications necessarily focus on specific dimensions but obscure others.

In her literature review on divergences in VET in Europe, Michaela Brockmann (2007) adopts a typology which classifies VET systems according to their focus as learning outcomes developed. This typology suggests that VET systems may fall into two groups: those which "focus on education of the person for an occupation" on the one hand, and "those aimed at employability of individuals" (p. 2) on the other. This approach allows her to compare the VET systems of Germany, the Netherlands, France and England.

According to the author, VET in Germany, the Netherlands and France is moving toward putting more emphasis on employability, whilst retaining defining principles such as providing a holistic education embracing the notion of citizenship. This is reflected in VET systems that focus increasingly on occupational mobility and less delineated (rather than more specialised) occupations "in line with requirements of the knowledge economy" (p. 3). On the other hand, the author suggests that England is moving in the opposite direction by narrowing learning outcomes to specific skills as a result of a strong emphasis on fostering the skills demanded by employers. It is argued that these skills, nonetheless, do not provide the general education and culture essential for future education and training (cf. Green, 1998) or for lifelong personal development.

Of main relevance here is the conclusion that Brockmann (2007) draws in relation to how learning outcomes are negotiated in the countries being compared. Whereas in France, Germany and the Netherlands a range of institutions (the state, employers, unions, teaching institutions) are involved in the process of defining learning outcomes, in England employers' skills needs take centre stage. This leads to a VET system based on a holistic concept of education for the former group of countries, and a system based on the development of those skills required by employers in the case of England.

Brockmann (2007) concludes by saying that the English VET system presents a major challenge in relation to upgrading the UK skills base in order to achieve economic competitiveness. The role that the author portrays for learning outcomes is of restricting the development of a broader set of skills as well as aspirations. Although there is a debate regarding the role of learning outcomes in education in the UK, there is also the view that learning outcomes represent a useful tool for planning teaching and learning. As the following quote suggests, there is a place for learning outcomes in supporting teaching, although the question of who develops learning outcomes and who should be involved remains.

We expect every single learner to be completely engaged and participating; they're enjoying their lessons, they're excited about it and that their learning is rigorously assessed. In very simple terms, that's what we want to see but for every learner to travel some distance in a lesson there needs to be very clear learning outcomes set for them. The teacher really needs to know very well where those learners are at and in order to really contextualise the learning, make it relevant and interesting for them, know what they're interested in, what their aspirations are, and develop aspirations in them. Where do they want to work in the future? What are their strengths, how do they prefer to learn? So all of that background information is really important in order to plan learning (quoted in Faraday et al., 2011).

While it is difficult to argue against a process of planning pupils learning pathways and expectations and making these explicit through outlining learning outcomes, the limitation of the role of written specifications has also been recognised. As it was mentioned in The Wolf Report<sup>7</sup> "written specification plays only a small part in determining what is actually taught, let alone the standard and quality of the assessment" (Wolf 2011, p. 176).

Furthermore, The Wolf Report audited current provision and concluded that a requirement to comply with National Occupational Standards (NOS) creates a number of problems for VET for young people. NOS reflect practice at a particular point in time in a specific occupation.<sup>8</sup> Although this may be a suitable approach to specific qualifications for adults who are

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<sup>7</sup> The Review of Vocational Education, also known as The Wolf Report) was published in 2011. It was commissioned by the UK government to review the state of vocational education for 14-19 year olds in England and to provide recommendations as to how it could be improved.

<sup>8</sup> Overall, the challenge in supporting the development of personal capabilities of those taking substantive work-based qualifications is reconciling the development of particular sets of skills, knowledge, understanding and

already in employment, “it is entirely inappropriate for young people who are likely to change jobs, and who are entering decades of employment in a rapidly changing economy” (Wolf 2011, p. 75). The report also suggests that for apprenticeship frameworks, England presents an ‘unusual’ case for the amount of responsibility for design of awards given to employer organisations.

As a result of the recommendations of The Wolf Report, the government carried out a public “Consultation on the Reform of Level 3 Vocational Qualifications for 16-19 years old” which led to a Government Response (Department for Education, 2013a) and a Technical Guidance for Awarding Organisations (Department for Education, 2013b). The latter document highlights the following characteristics that Level 3 vocational qualifications must demonstrate, namely: declared purpose, size, recognition, synoptic assessment, external assessment, grading, employer involvement, progression and proven track record.

The declared purpose states that qualifications “must declare the purpose of a qualification in terms that will be meaningful and relevant to students, parents, employers, post-16 providers and higher education institutions” (Department for Education, 2013b, p. 10). The size specifies the number of expected Guided Learning Hours and it is stated that relevant qualifications “should be publicly recognised by employers, recognised professional or trade bodies and/or higher education institutions (HEIs) as fit for purpose” (idem, p. 12). The document continues specifying each of the seven characteristics but there is no mention of learning outcomes. In all, there seems to be a move in the short term future from small learning units to more meaningful and holistic qualifications.

#### Exemplary description: ‘FdEng Foundation Degree in Mechatronics’

After a discussion of learning outcomes in the UK VET system, this section considers learning outcomes in Mechatronics. Mechatronics degrees are available in the UK as Foundation Degrees as well as at Bachelor’s and Master’s degree level. The focus here will be in the former given that Foundation Degrees are considered as part of the VET system, although they are offered by higher education institutions and colleges offering higher education degrees. Above all, these degrees can be seen as offering permeability between VET and higher education.

The table below shows the structure of the courses currently being offered as Foundation Degrees and accessible through UCAS (see Section1). Both courses are offered as 2-year full-

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ways of thinking, being and doing, with developing dispositions which go beyond these particular developments in responding to new challenges: curiosity, resourcefulness (including learning from others), resilience, ability to support the learning of others, taking responsibility for self-development and reflexivity. Vocational Qualifications above all need to support expansive forms of learning and development – it is important to move people to more challenging forms of work – higher skill utilisation etc. as the percentage of learning intensive skilled jobs in the UK is much lower than in other countries in Northern Europe.

time degrees, or 3 years part-time. However, further descriptions of these courses are not available online. In the case of the FdA in Mechatronic Engineering at Coleg Morgannwg, the information provided states that assessment methods include: “written assignments, laboratory experiential learning, an examination and research reports related to industrial workplace”<sup>9</sup>. In the light of the lack of information available other courses delivered in the recent past, but not currently available, will be considered.

FdSc, Engineering (Mechatronics), City of Bristol College*		FdA, Mechatronic Engineering, Coleg Morgannwg**	
Stage 1	Stage 2	Year 1	Year 2
Engineering Design Mathematics for Engineers 1	Industrial Project Design for Manufacture	Engineering Mathematics	Introduction to quality
Materials Engineering	Engineering Science 2	Electrical Technology	Electrical Principles Method & Simulation
Engineering Science 1	Control Systems	Programmable Logic Controllers	Mechatronic Systems an Individual Project
Business Management for Engineers	Programmable Logic Controllers	Introduction to C Programming & Embedded Systems	Design of Electrical Installations
Mechatronic System Principles	Instrumentation and Control Principles		Work Based Learning

\*Offered in partnership with the University of Plymouth

\*\*Validated by the University of South Wales and the University of Wales

Table 1: Foundation Degrees in Mechatronics currently accessible in the UK

The following description belongs to the FdEng Foundation Degree in Mechatronics offered by Farnborough College of Technology. The course is not available through UCAS and it was not possible to confirm with the College whether the course was on offer the next academic year or not. However, the description of the course provides further information about Mechatronics Foundation Degrees. As can be noted from the description, the course seeks to help students develop both practical and academic knowledge. The second paragraph places emphasis on vocational and practical skills required in the Mechatronic sector.

- The course structure is designed to offer students a well-balanced, broad range of subjects relevant to today’s engineers. The programme of study will develop the student’s practical engineering skills through projects and enrichment activities, as well as the academic knowledge required within a degree programme.
- The combination of academic and vocational skills is designed to provide a holistic approach to engineering and to ensure that students are “work-ready” at the end of

<sup>9</sup> www.morgannwg.ac.uk (accessed 24.10.2013)

their programme. It is intended to produce high quality graduates, who are industrially focussed with vocational and practical skills, related to the Mechatronic sector of Engineering at an advanced practitioner level. Thus, success on this programme will place graduates in an ideal position to compete for positions within this flourishing area of the sector.<sup>10</sup>

The above descriptions do not provide a description of the learning outcomes involved in relation to these courses. This information is not available online although this does not mean that learning outcomes have not been documented. In contrast to this, however, undergraduate and postgraduate degree courses seem to make their learning outcomes more readily available. For instance, the University of Ulster provides a list of the learning outcomes associated to the following Mechatronic engineering degrees:

- MEng Mechatronic Engineering with DPP (6691)
- MEng Mechatronic Engineering + German Master's Degree with DPP (6692)
- BEng(Hons) Mechatronic Engineering with DPP (Exit Award)
- AB Mechatronic Engineering with or without DPP (Exit Award)
- CertHE (Exit Award)'s part-time degree in Mechatronic Engineering

Table 21 provides the learning outcomes for the above Mechatronic engineering degrees. These are divided into i) knowledge and understanding; ii) intellectual qualities; iii) professional/practical skills; and iv) transferable skills. (Teaching, learning and assessing methods are also specified for each of these categories in the next section). As can be seen, the language used in the description of the learning outcomes are clear statements of what candidates should be able to do to be awarded the relevant qualification. They are statements of what can be achieved and/or assessed in a specific timeframe and are written in a language accessible to students as well.

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<sup>10</sup> [www.farn-ct.ac.uk/subjects/engineering/fdeng-foundation-degree-in-mechatronics%20-%20H](http://www.farn-ct.ac.uk/subjects/engineering/fdeng-foundation-degree-in-mechatronics%20-%20H) (accessed 24.10.2013)

	Learning outcomes
Knowledge and understanding	<p>K1 Demonstrate a comprehensive understanding of the scientific principles of mechatronic engineering and the related disciplines of electronic, mechanical and software engineering.</p> <p>K2 Demonstrate a comprehensive knowledge and understanding of mathematical principles necessary to underpin their education in mechatronic engineering and to enable them to apply mathematical methods, tools and notations proficiently in the analysis and solution of engineering problems.</p> <p>K3 Demonstrate a comprehensive understanding of concepts from electronic mechanical and software engineering, as well as business and management studies and apply them effectively in engineering projects.</p> <p>K4 Demonstrate extensive knowledge and understanding of management and business practices, and their limitations, and how these may be applied appropriately.</p> <p>K5 Demonstrate an awareness of developing technologies related to mechatronic engineering.</p> <p>K6 Demonstrate a comprehensive knowledge and understanding of mathematical and computer models relevant to mechatronic engineering, and an appreciation of their limitations.</p>
Intellectual qualities	<p>Demonstrate understanding of engineering principles and apply them to analyse key mechatronic engineering processes.</p> <p>I2 Identify, classify and describe the performance of mechatronic systems and components through the use of analytical methods and modelling techniques.</p> <p>I3 Apply mathematical and computer-based models for solving problems in mechatronic engineering, and the ability to assess the limitations of particular cases</p> <p>I4 Demonstrate understanding of and ability to apply a systems approach to solving mechatronic engineering problems.</p> <p>I5 Demonstrate a wide knowledge and comprehensive understanding of engineering design processes and methodologies and the ability to apply and adapt them in unfamiliar situations. School of Engineering 4</p> <p>I6 Generate innovative designs for mechatronic products, systems, components or processes to fulfil new needs, and, where appropriate, make general evaluations of commercial risks through some understanding of the basis of such risks.</p>

	I7 Use fundamental knowledge to investigate new and emerging technologies
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	Learning outcomes
Professional practical skills	<p>Demonstrate extensive knowledge and understanding of a wide range of engineering materials and components.</p> <p>P2 Plan and conduct laboratory and workshop tasks using a variety of equipment.</p> <p>P3 Demonstrate understanding of contexts in which engineering knowledge can be applied (e.g. operations and management, technology development, etc.).</p> <p>P4 Source, integrate and use effectively technical literature and other engineering information and data.</p> <p>P5 Demonstrate an awareness of the nature of intellectual property and contractual issues, appropriate codes of practice and industry standards, and quality issues.</p> <p>P6 Work with technical uncertainty.</p> <p>P7 Demonstrate a thorough understanding of current practice and its limitations, and some appreciation of likely new developments.</p>
Transferable/key skills	<p>Make effective and appropriate use of Information and Communications Technology (ICT) skills.</p> <p>T2 Communicate effectively, both orally and in written form.</p> <p>T3 Able to function effectively as a member of a team and use management skills to plan, organise and provide leadership in work groups and projects.</p> <p>T4 Exercise planning, organisational, problem-solving, and time-management skills and effectively use available resources.</p>

Table 2: Learning outcomes and examination procedures of exemplary course\*

\*Mechatronic engineering courses at the University of Ulster (source: [seng.ulster.ac.uk/uploads/documents/mengmechatronicengineeringprogrammespec.pdf](http://seng.ulster.ac.uk/uploads/documents/mengmechatronicengineeringprogrammespec.pdf))

The next section looks closer at the examination procedure and assessment in relation to learning outcomes in the UK.

### 3. Examination procedures

According to Jack et al. (1993), the outcome-based assessment model implies that the specified learning outcomes provide a basis against which candidates 'competencies' are directly compared and evaluated. To do this, evidence can be gathered from a wider range of

sources than is the case for the 'traditional' model of assessment. Given that in the outcome-based approach individuals' capabilities are at the heart of the evaluation, evidence of performance or development can include prior experience, observations, and portfolio evidence as well as evidence from more traditional forms of assessment such as oral or written examinations.

As the authors suggest, it is likely that the assessment process will require evidence from more than one source depending on the type of competencies being evaluated. In the case of assessment of knowledge, for example, performance evidence although useful may not be sufficient to establish that the candidate's performance is at the required level and that it can be maintained consistently. Therefore, this evidence will need to be complemented with evidence from other sources such as written tests or oral questioning (Jack et al., 1993). This is more so at higher levels where "correct actions' are less easily prescribed and new unforeseen contingencies are more likely to arise" (p. 2).

Table 22 presents the examination procedures for the Mechatronic engineering courses at the University of Ulster discussed in the previous section. By comparing these with the learning outcomes listed in Table 21, it is possible to observe a relationship. However, the descriptions below are general and these differences cannot be observed in detail. All categories include coursework assignments and other sources of assessment methods that allow students to accumulate evidence of their progress. Professional and practical skills are also assessed through visits, reports and an oral presentation but these methods are also included in other areas.

	Examination procedure
Knowledge and understanding	<p>Teaching and Learning Methods</p> <p>Subject related qualities are acquired mainly through lectures, seminars, directed reading, videos, IT based resources, case studies and experiential learning. Exposure to the engineering environment is an important aspect of the teaching and learning methods, as are projects.</p> <p>Assessment Methods</p> <p>Testing of the knowledge base is principally through examinations, coursework assignments, laboratory reports, project dissertation and oral presentations.</p>
Intellectual qualities	<p>Teaching and Learning Methods</p> <p>Intellectual qualities are developed mainly through coursework assignments, experimental work and projects.</p> <p>Assessment Methods</p> <p>Assessment focuses on the coursework assignments, experimental write-ups and project reports. Some of these skills are also assessed in the formal examinations.</p>

	Examination procedure
Professional practical skills	<p>Teaching and Learning Methods</p> <p>The teaching and learning methods place emphasis on engineering workshop practice, visits to local engineering companies and the supervised industrial placement year. Experimental work, team projects and design assignments also contribute.</p> <p>Assessment Methods</p> <p>The supervised work experience is assessed with visits, reports and an oral presentation. Coursework assignments, workshop exercises, laboratory reports, project dissertations and student peer assessment also contribute to the assessment methods.</p>
Transferable/key skills	<p>Teaching and Learning Methods</p> <p>Transferable and key skills are delivered throughout the programme, i.e. lectures, coursework assignments, laboratory work, industrial placement year and project dissertations. The IT skills are taught within the programme structure.</p> <p>Assessment Methods</p> <p>Assessment is principally through coursework assignments, laboratory reports and project dissertations. Assessment of teamwork is through submission of teamwork tasks, student peer and self-assessment, and oral presentations.</p>

Table 3: Examination procedures of exemplary course\*

\*Mechatronic engineering courses at the University of Ulster (source: [seng.ulster.ac.uk/uploads/documents/mengmechatronicengineeringprogrammespec.pdf](http://seng.ulster.ac.uk/uploads/documents/mengmechatronicengineeringprogrammespec.pdf))

## 4. Conclusion

The UK is among the early adopters of the outcome-based approach in Europe. Like in all countries adopting this approach, its implementation and operationalization depend on each country's historical context. In the UK, the NVQ system introduced in the 1980s provided the basis for a system based on outputs (what candidates should be able to do) rather than inputs (the training that candidates should be offered). In this case, employer-defined National Occupational Standards (NOS) provide statements of outputs which are then translated into learning outcomes. The UK system differs to those of for example Germany, France and the Netherlands in the predominant role that employers are offered. Supporters of this view suggest that this leads to a "strongly demand-led system" which "ensures the production of a narrow set of skills suited to a low-skilled labour market" (Brockmann 2007, p. 3).

In spite of this critique, the learning outcomes approach is a tool which supports the integration of different actors in the education and training system, including employers, students,

teachers and qualification awarding institutions. The defining of learning outcomes is a process which can potentially integrate the interests of these groups. Moreover, it provides a map of the progress that candidates are expected to have made to be awarded a specific qualification. This provides useful information for those concerned. For example, to employers it details what individuals holding a specific qualification should be able to do and know. For teachers and learners it provides a description of what the latter should be able to demonstrate during examination procedures to be awarded the qualification.

Foundation degrees in Mechatronics are effectively the only VET courses offered in Mechatronics. As said above, however, they can also be seen as being on the frontier between VET and higher education, facilitating permeability between the two systems. One of the difficulties of running foundation degrees courses is ensuring continuity in terms of resources, students and partnerships with employers. Although foundation degrees are a model that is in principle efficient and effective from a learning development perspective, in practice the administration side of these programmes becomes a barrier to their sustainability. This is likely to impinge on the development of learning outcomes and on ensuring that these become relevant for all involved, including employers, education institutions and learners.

The most important aspect to recognise about the English VET system is the rediscovery of the importance of teaching and learning processes and the recognition that adoption of a 'hard' learning outcomes approach resulted in a significant narrowing of what was learned in VET. Now attention is focused upon both learning outcomes and processes in an attempt to deliver broader and more balanced curricula. Given that the development of National Qualifications Frameworks based on learning outcomes is still popular it is perhaps instructive to look at the reasons for the policy failure of an NQF based exclusively on learning outcomes in England. The major lesson to be learned is that a focus on competence, mapping qualifications, levels, and outcomes can become a distraction from the much more challenging goal of improving the quality of teaching and learning. Shifting attention to a developmental approach to the development of expertise may prove to be more effective by highlighting the importance of the processes of learning and the need to support the development of expansive learning environments in education, training, and employment (cf. Brown 2011). Recognising that the development of an NQF has a limited part to play in this process, and that a "rough guide" to equivalence will often be sufficient in mapping potential progression pathways, may be a useful starting point for this shift.

#### [Brief exposition of reasons for the policy failure of an NQF based exclusively on learning outcomes in England](#)

The starting point for any analysis of English policy in the area of vocational qualifications was the almost complete failure of the attempted reformation of VET through the introduction of outcomes-based National Vocational Qualifications (NVQs) in the decade following 1986 (Williams 1999). The standards of occupational competence upon which the NVQs were based were too narrow; employers were reluctant to use the new qualifications; and the in-

roduction of NVQs exacerbated, rather than mitigated, the “jungle” of vocational qualifications. In the mid-1990s unsuccessful attempts were made to restructure NVQs following a series of highly critical reports (cf. Beaumont 1996; Dearing 1996; Hyland 1998), but the National Council for Vocational Qualifications (NCVQ) and associated agencies continued to market the system overseas, without acknowledging the failings of NVQs and the competence-based education and training outcomes-driven system. Hyland (1998) highlighted how this was a strange case of exporting policy failure. The model was held up as promising reform even though it had not worked in practice in England.

Since then NVQs have been further reformed, a wider range of vocational qualifications have been encouraged and NCVQ was abolished and replaced by the Qualifications and Curriculum Development Authority (QCDA), which had responsibility for the development of a National Qualifications Framework. However, the whole area of qualifications reform remained a policy failure and the decision was taken to replace the NQF as the driver of reform with a Qualifications and Credit Framework (QCF) and to close the QCDA.

The reason for the move away from an exclusive focus on NQF outcomes, levels and qualifications was that these were too prescriptive – they excluded too many valuable qualifications, the system was too inflexible, did not support progression very well and 'level' was not a very good discriminator of the value of a qualification. The QCF now uses volume as well as level so that the system of credits can operate across units as well as whole qualifications. The credit based system recognises qualification size and represents a pragmatic and modest attempt at qualifications reform, and that the NQF development was the culmination of a major policy failure is now universally acknowledged.

The most obvious lesson is not to treat particular qualification design features as in some way inherently better than others and seek to apply them universally. The ‘pure’ English outcomes-based NQF was inflexible and unhelpful in practice, and although the new QCF system aligns less well with the recommendations for qualification framework development associated with the EQF, it was still possible to reference the QCF against the EQF. The key point about the QCF is that it is a pragmatic attempt to improve learner mobility, transferability and progression. The introduction of the QCF has been low key, recognising that earlier grand schemes based around a major reformation of vocational qualifications through NVQs and the NQF have been failures. Underpinning this change is the belated recognition that it is the quality of teaching, learning and skill development associated with qualifications that is key to whether they help individuals in processes of upskilling, reskilling and progression, not the imagined benefits of having qualifications of a particular type.

There is now recognition that qualifications are an inadequate proxy for skill development and that qualifications reform plays a much smaller role in improving the quality of VET than more direct measures to improve the quality of teaching, learning and skill development and that for much of the past 25 years qualifications reform has actually been drawing resources away from improving the quality of the teaching, learning and the inter-

relationship between the two (Nash et al. 2008). There is also an implicit recognition that the pragmatic evolution of the Scottish VET system over the last twenty five years, whereby each development built incrementally on a previous reform, has been much more successful in practice than the more radical attempts at reform of processes of qualifications design that have failed in England (cf. Raffe 2011). As a consequence the Scottish Credit and Qualifications Framework, a national credit transfer system for all levels of qualifications in Scotland, has gained widespread acceptance in practice.

In the QCF qualifications consist of a number of designated units, each of which has an approved credit value. These credit values represent the number of credits a learner will be awarded for successfully completing the unit. *One credit is awarded for those learning outcomes notionally achievable in 10 hours of learning time.* These changes were introduced to overcome the problems of having very different types of qualifications appear at the same level within a qualifications framework. An alternative approach may be just to exclude certain small qualifications from a NQF and keep the NQF just as a means of mapping the most important qualifications of a country in a way which could encourage progression within or across different pathways.

Developing an NQF which maps the broad pathways and major qualifications in a country, however they are described, and offers a 'loose coupling' to the EQF is probably sufficient to support the role of the EQF as a translation device to make relationships between qualifications and different national systems clearer. In that respect the lesson from the demise of a pure outcomes-based NQF in England is unequivocal: the drive for comprehensiveness and standardization in a qualifications framework consumed vast amounts of resources, was unworkable in practice and produced a whole array of qualifications which were not fit for purpose and were inferior to the qualifications they replaced when judged against the criterion of whether they supported continuing learning and development. In the field of NQFs less is more! It is a common trap to think that a more highly qualified workforce equates to a more highly skilled and more knowledgeable workforce. Indeed the focus on levels, qualifications and learning outcomes can be comforting because it gives the illusion of progress, but a much more sophisticated model of skill development and expertise is required to underpin a more meaningful movement towards a knowledge society (cf. Brown 2011).

## 5. Post-Script

Partly because of the weaknesses outlined in this report there is yet another review of direction of vocational qualifications and it is likely that vocational qualifications will now be expected to describe the abilities to be developed and the pathways where they might lead. This is in part because the national occupational standards on which many vocational qualifications are based tend to be too long and detailed, having been developed to be used directly in assessment.

While national occupational standards are usually restated in terms of the QCF units that

make up most regulated vocational qualifications, the formats of the standards and the units are often similar, with the units also including detailed criteria to be used directly by assessors. Neither the national occupational standards nor the QCF units provide a summary of the qualification's content.

The Richard Review of Apprenticeships made a similar point:

“We have overly detailed specifications for each qualification, extraordinarily detailed occupational standards ... We must turn the system on its head and set a few clear standards: preferably one per occupation, which delineates to employers what it means to be fully competent in that occupation” (Richard 2012, p. 40).

There is a need for a summary statement of the abilities that the qualification will represent. The statement needs to be expressed with sufficient detail to inform curriculum and assessment design, but it should not be made longer by the inclusion of additional detail such as the criteria for assessors. It should be more akin to a subject benchmark statement for a vocational degree than to a combination of national occupational standards or of QCF units.

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